# Professional Elective Courses -I

# PEC1ECE601E

# SOLID-STATE DEVICES

**UNIT I:**

Crystal Structure: Fundamental concepts, Closed packed structures, Crystal systems, Crystallographic planes and directions, Miller indices, Point defects. Free electron Theory, classification of solids into conductors, Semiconductors and insulators, Effective mass.

**UNIT II:**

Dielectric Properties: Dielectric materials, Polarization mechanisms, Dipole moment, Dielectric strength, Methods for producing polarization, Application of dielectric materials. Magnetic Properties: Basic concepts, Soft and hard magnetic materials, Ferrites Selection techniques for applications, Magnetic recording, Magnetic memories. Optical Properties: Index of refraction, Damping constant, characteristic penetration depth and absorbance, Reflectivity and transmissivity, Atomic theory of the optical properties, Optical storage devices.

**UNIT III:**

Device Materials: Materials for resistors, capacitors and inductors. Superconductivity: Properties of superconductors, Applications of superconductors. Semiconductor Materials: Intrinsic and extrinsic materials, Electron and hole concentration sate equilibrium, Temperature dependence of carrier concentrations, Conductivity and mobility.

**UNIT IV:**

Effect of temperature and doping on mobility, Direct and indirect recombination of electron and holes, Diffusion and drift of carriers, Diffusion length, Contact potential. Hall Effect and its Applications. Si, Ge, GaAs and other binary semiconductors.

**References**


1. HummelRE,“ElectronicPropertiesofMaterials”,NarosaPublishingHouse.
2. William D Callister, Jr “Materials Science and Engineering”, John Wiley and Sons, Inc.
3. Dekker A J “Solid State Physics”, Mac Milan, India Limited, Madras.
4. Pillai S O “Solid State Physics”, New Age International Publishers.
5. VanVlack L H “Elements of Material Science and Engineering”, Addison Wesley Publishers
6. Streetman BG and Banerjee S “Solid State Electron Devices”, Prentice Hall of India.

# PEC1ECE602E

# ADVANCED EMBEDDED SYSTEMS PROTOTYPING

**UNIT I**

Introduction to open source embedded systems: Components of embedded system. Advantages and applications of embedded systems. Examples of real time embedded systems and how they are manufactured industry ready. Different Microcontroller Architectures (CISC, RISC, ARISC). Internal Resources & Hardware Chips in Details. History of AVR Microcontrollers and Features. Memory Architectures (RAM/ROM).

**UNIT II**

Learning Arduino Platform: Introduction to ARDUINO, ARDUINO History and Family. ARDUINO flavours, ARDUINO Architecture, Basic ARDUINO KIT Circuits, Programming in Embedded-C, Concepts of C language. Installing the Integrated Development Environment (IDE)-Setting up the Arduino Board-Using the Integrated Development Environment (IDE) to prepare an Arduino Sketch-Uploading and Running the Blink Sketch.

**UNIT III**

Serial Communications: Introduction to Serial communications, Synchronous and asynchronous Serial communication, UART and Serial Teletypes and standards. Different types of protocol converter IC's used in serial communication interfaces. Anatomy of PC and microcontroller based Serial communications.

**UNIT IV**

Digital and Analog Input/Output: Introduction to digital inputs and outputs, Types of Digital Inputs and outputs, Introduction to Digital Sensors ,signal conditioning the outputs of sensors for digital input operation, Voltage and Current Specifications of Digital outputs, Signal conditioning of Digital outputs. Types of Switches and their interfacing with microcontrollers, Introduction to AD and DA converters, inbuilt AD, DA converters in microcontrollers. Introduction to PWM and inertial Loads.

**References**


1. Arduino Cookbook by Michael Margolis. Orielly Media Publications
2. Exploring Arduino: Tools & Techniques by Jeremy Blum. Wiley Publications

# PEC1ECE603E

# ADVANCED MICROPROCESSORS

**UNIT I**
Introduction to 8086 Microprocessor Architecture, features and signals.

**UNIT II**
80286- A Mircroprocessor with Memory Management & Protection. Salient features of 80286, Internal architecture of 80286, Signal descriptions of 80286, Real addressing mode, Protected virtual address mode, Privilege, Protection, Special operation, 80286 Bus interface, Basic Bus operation, Fetch cycles of 80286, 80286 Minimum system configuration, Interfacing memory and I/O devices with 80286, Priority of bus use by 80286, Bus Hold and HLDA sequence, Interrupt acknowledge sequence, Instruction set features.

**UNIT III**
80386, 80486 – THE 32 Bit Processor: Salient feature of 80386, Architecture and signal description of 80386, Register organization of 80386, Addressing modes, Coprocessor 80387.

**UNIT IV**
An Introduction to the Pentium Microprocessor.

**UNIT V**
Interfacing and Programmable Devices for 8086 Based systems, Interfacing of Co-Processor, Switches, LED's, Analog to Digital Converter, Digital To Analog Convertor, DC and Stepper Motor, Seven segment and LCD display with 8086.

**References**


1. A. K. Ray & K. M. Bhurchandi- Advanced Microprocessor and Peripherals- Tata Mcgraw Hill.
2. B. P. Singh – Advanced Microprocessor and Microcontrollers- New Age International.
3. Brey, Barry B – Intel Microprocessor.
4. D. V. Hall – Micro process Interfacing.
5. "An Introduction to the Intel Family of Microprocessor," by J. L. Antonacos.

# PEC1ECE604E

# POWER SYSTEMS

**UNIT I**

DC and AC Distribution System: Introduction to a power system (an overall view), distribution systems Feeder, distribution, service. Mains classification, connection schemes, various types of DC and AC distributors, voltage drop calculations.

**UNIT II**

Overhead AC Transmission lines: Line Parameters, Types of conductors. Aluminum Core Steel Reinforced (ACSR) etc. Stranding, bundling of conductors. Resistance calculations, skin effect, proximity effect, Inductance and capacitance and capacitance of single Phase, 3 phase, single circuit and double circuit lines.

**UNIT III**

Representations and performance of short medium and long lines, ABCD constants, Surge impedance, Feranti effect, Power flow through a transmission lines.

**UNIT IV**

Insulators for overhead lines: Materials for insulators, types of insulators, potential distribution over a string of suspension insulators, methods for equalizing the potential Interference of power lines with communication circuits.

**UNIT V**

Electrostatic and electromagnetic effect. Corona: Visual and critical disruptive voltage, conditions effecting corona, former loss due to corona, Practical consideration, Mechanical design of transmission lines. Sag and tension calculations.

**References**


1. Elements of Power System Analysis by W. D. Stevenson
2. Transmission & Distribution of Electrical Energy by H. Cotton & Barber
3. Power System Engg. by Nagrath & Kothari
4. Electrical Power Systems by C. L. Wadwa

# PEC1ECE605E

# SYSTEM DESIGN

**UNIT I**

**Introduction:** Understanding a system, Components of a system: inputs, internal processes, outputs, feedback, assessment and evaluation, learning, Ways of Thinking: Logical Thinking, Causal Thinking, Reductionist Thinking, Holistic Thinking.

**UNIT II**

**Interconnect:** The Wire, Interconnect Parameter: Capacitance, Resistance, and Inductance, Electrical Wire Models, SPICE Wire Models, Signal Integrity and High Speed Behavior Of Interconnects: Ringing, Cross Talk and Ground Bounce.

**UNIT III**

**System Hardware decomposition:** Data Path And Control Path, Register Transfer Level Description, Control Flow And Data Flow Pipelines with special reference to digital filters, Communication Between Subsystems, Dead Lock and Live Lock problems.

**UNIT IV**

**Subsystem design:** HDL based design flow for system design, Introduction to Verilog: various components of Verilog code, Design of combinational circuits, sequential circuits, barrel shifter register, multi-bit adders, multipliers.

**UNIT V**

**MPSoC as System Design Paradigm:** Introduction to MPSoC, Need for MPSoC Architectures, Interconnection requirements of sophisticated systems, Network-on-Chip as a interconnection solution, Problems of traditional interconnection techniques, Arbiter for NoC.

**References**


1) Rabaey Jan M., Chandrakasan Anantha and Borivoje Nikolic, "Digital Integrated Circuits (Design Perspective)", Prentice Hall of India, 2nd Ed., 2003.
2) Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen,"VLSI Test principles And Architectures Design For Testability", Morgan Kaufmann Publishers, 1st Ed., 2006.

# PEC1ECE606E

# MATHEMATICS FOR MACHINE LEARNING

**UNIT I**

**Linear Algebra:** Vectors**,** Modulus & inner product, Cosine & Dot product of vectors, Projection, Basis, changing basis, vector space, and linear independence of a set of vectors, Applications of changing basis, Linear dependency of a set of vectors, Matrices, vectors, and solving simultaneous equation problems, Types of matrix transformation, Composition or combination of matrix transformations, Gaussian elimination, Inverse matrix, Determinants and inverse, Identifying special matrices, eigenvalues and eigenvectors, Calculating eigenvectors, Visualising Matrices and Eigen

**UNIT II**

**Multivariate Calculus:** Functions, Definition of a derivative, Differentiation examples & special cases, Product rule, Chain rule, Matching functions visually, Matching the graph of a function to the graph of its derivative, Let's differentiate some functions, Practicing the product rule, Practicing the chain rule, Differentiate with respect to anything, The Jacobian, Jacobian applied, The Sandpit, The Hessian, Practicing partial differentiation, Calculating the Jacobian, Bigger Jacobians, Calculating Hessians, Multivariate chain rule, Simple neural networks, Training Neural Networks, Building approximate functions, Power series, Power series derivation, Power series details, Linearisation, Multivariate Taylor

**UNIT III**

**Statistics:** Exploring one-variable quantitative data: Displaying and describing, exploring one-variable quantitative data: Summary statistics, exploring one-variable quantitative data: Percentiles, z-scores, and the normal distribution, exploring two-variable quantitative data, collecting data

**UNIT IV**

**Probability:** Introduction to Probability, Conditional probability and independent events, Visualization of conditional probabilities and Independence, Bayes's rule, Probability distribution, Binomial distribution, Variance of random variable. Discrete random variables with infinite number of values, Geometric and Poisson distributions, Systems of random variables; properties of expectation and variance, covariance and correlation, Linear transformations of random variables, Probability density function (PDF), Cumulative distribution function (CDF), Properties of CDF, Linking PDF and CDF, Histogram as approximation to a graph of PDF.

**References**


1. Bayesian Statistics the Fun Way: Understanding Statistics and Probability by Will Kurt published by O'Reilly
2. Think Stats by Allen Downey published by O'Reilly
3. Think Bayes: Bayesian Statistics in Python by Allen Downey published by O'Reilly
4. *Mathematics for Machine Learning* by. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. published by Cambridge University Press
5. Linear Algebra and Learning from Data, by Gilbert Strang Wellesley Publishers
6. Highlights of Calculus, by Gilbert Strang Wellesley Publishers2nd Edition

# PEC1ECE607E

## OPERATIONS RESEARCH

**UNIT I**

Introduction to OR Modelling Approaches & various Real-life Situations, Linear Programming Problems (LPP), Basic L L P ’s Applications, Various Components of LPP formulation, Solving LPP.

**UNIT II**

Simultaneous Equations and Graphical Methods, Simplex Method, Duality Theory, Big-M Method, Transportation problems & Assignments Problems.

**UNIT III**

Network Analysis: Shortest Path, Dijkstra Algorithm, Floyd Algorithms, Maximal Flow Problem ((Ford-Fulkerson), PERT- CPM.

**UNIT IV**

Queuing Theory: Introduction, Basic Definitions & Notations, Axiomatic Derivation of the Arrival & Departure (Poisson Queue), Poisson Queue Models: M/M/1: ∞/FIFO, M/M/1: N/ FIFO.

**References**


1. H.A. Taha, “Operations Research”, Macmillan Publishing Company.
2. Hadley G., “Linear Programming”, Narosa Publishers.
3. Mital, “Optimization Methods”, New Age International.
4. Rao, “Engineering Optimization”, New Age International.

# Professional Elective Courses - II

# PEC2ECE701E

# INTRODUCTION TO MACHINE LEARNING

**UNIT I**

Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. Linear Regression, Multiple Variable Linear Regression, Logistic Regression, Naive Bayes Classifiers, k-NN Classification

**UNIT II**

Neurons and biological motivation. Linear threshold units. Perceptron's: representational limitation and gradient descent training. Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.

**UNIT III**

Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. Decision Trees, Random Forest, Using committees of multiple hypotheses. Bagging, boosting, and Active learning with ensembles.

**UNIT IV**

Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies. Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning.

**UNIT V**

Learning from unclassified data. Clustering. Hierarchical Clustering. k-means clustering. Dimensionality reduction (PCA), Expectation maximization algorithm (EM) for soft clustering. Semi-supervised learning with EM using labelled and unlabelled.

**UNIT VI**

Feature engineering Model selection and tuning Model performance measures K fold cross-validation, Regularising Linear models ML pipeline Bootstrap sampling Grid search Cross Validation,

**References**

**1.** Introduction to Machine Learning with Python by Andreas C. Muller & Sarah Guido O'Reilly

**2.** Hands on Machine Learning with Scikit-Learn and Tensor Flow by Aurélien Géron O'Reilly

**3.** Python Machine Learning for Beginners: Handbook for Machine Learning, Deep Learning and Neural Networks Using Python, Scikit-Learn and TensorFlow by Sanders, Finn

# PEC2ECE702E

# INTRODUCTION TO MACHINE LEARNING LAB

### List of Experiments

1. Basic concepts of object programming in Python A short journey from procedural to object approach Properties Methods Inheritance - one of object programming foundations Exceptions once again Generators and closures Processing files Working with real files

2. Introduction to Python Packages NumPy, Pandas, Matplotlib, Seaborn, ScikitLearn

3. Introduction to traditional Datasets used in Machine Learning

4.Introduction to Classification: Intuitive understanding of the Naïve Bayes Classification, Mathematical Formulation, Implementation of Naïve Bayes Classification using Python-ScikitLearn

5. Introduction to Regression: Intuitive understanding of the Linear Regression, visualizing linear regression, Machine learning applications of linear regression.

# PEC2ECE703E

# DIGITAL IMAGE PROCESSING

**UNIT I**
Introduction: imaging and imaging devices. Image sampling and quantization, relationship between pixels and imaging geometry

**UNIT II**
Image enhancement techniques: Frequency domain, spatial domain, and fuzzy logic based.

**UNIT III**
Image Segmentation: using edge detection and edge linking techniques, Image threshold and region-oriented segmentation.

**UNIT IV**
Image representation schemes: Chain codes, polygonal approximation, and signatures.

**UNIT V**
Shape descriptors: Fourier descriptors. Descriptor using moments. Descriptor using AR and CAR modeling.

**UNIT VI**
Texture: Introduction to texture, different techniques of texture analysis and their comparison

**References**


1. Digital Image Processing, R. C. Gonzalez and R. E. Woods
2. Fundamentals of Digital Image Processing by Anil. K. Jain
3. Two-Dimensional Signal and Image Processing by J S Lim

# PEC2ECE704E

# DIGITAL IMAGE PROCESSING LAB

### List of Experiments in MATLAB:

1. Image acquisition, digitization and display
2. Application of edge detection techniques on Images
3. Enhancement of images using histogram equalization, histogram modification, and fuzzy Logic
4. Segmentation of images using thresholding and region growing.

**Tools Required: MATLAB Software, Hardware support for DIP toolbox**

# PEC2ECE705E

# OPTICAL COMMUNICATION SYSTEMS

**UNIT I**

Structures, wave guiding and Fabrication: Nature of Light, Basic optical laws and definitions, Single mode fibers, Graded index fiber structure, Attenuation, Signal Dispersion in fibers. Optical Sources- LEDs, Laser Diodes, Line Coding.

**UNIT II**

Photo detector Noise, Detector Response Time, Avalanche Multiplication Noise. Optical Receiver Operation- Fundamental receiver operation, Digital receiver performance, Eye diagrams. WDM Concepts and Components- Passive optical Couplers, Isolators and Circulators

**UNIT III**

Point to point links, power penalties, error control, Coherent detection, Differential Quadrature Phase Shift Keying. Analog Links: Carrier to noise ratio, Multichannel Transmission Techniques, RF over Fiber, Radio over fiber links, Microwave Photonics.

**UNIT IV**

Network Concepts, Network Topologies, SONET/SDH, High speed lightwave links, Optical add/ Drop Multiplexing, Optical Switching, WDM Network, Passive Optical Networks, IP over DWDM, Optical Ethernet, Mitigation of Transmission Impairments

**UNIT V**

Measurement standards, Basic Test Equipment, Optical power measurement, Optical fiber characterization, Eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements.

**Recommended Books:**

1. Gerd Keiser, “Optical Fiber Communications”, 5th Edition, McGraw Hill.
2. Rajeev Ramaswamy and Kumar N Sivarajan, “Optical Networks: A Practical Perspective”, 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

**Reference Books:**

1. John. M. Senior, “Optical Fiber Communications: Principles and Practice”, 2nd Ed, 2000, PE.
2. Harold Kolimbris, “Fiber Optic Communication”, 2nd Ed, 2004, PEI

# PEC2ECE706E

# OPTICAL COMMUNICATION SYSTEMS LAB

**List of Experiments:**

1. Measurement of Numerical Aperture.

2. Measurement of Attenuation and Bending Loss.

3. Study of Analog Link and Digital Link.

4. Study of BER and Q-factor estimation in the optical system simulation.

5. EDFA design for DWDM link.

6. Study the Characteristics of a Communication channels AWGN BSC.

7. Analog and Digital Modulation Frequency Modulation and Demodulation QPSK Modulation and Demodulation.

8. Design Conventional Encoder and Decoder.

9. Construction of MUX and DEMUX for WDM systems.

10. Design of Fiber Optic WDM link.

11. Calculate and simulate the attenuation and signal degradation due to intermodal and intramodal distortion.

12. Calculate power coupling losses due to connectors, splices, source output pattern and fiber numerical aperture.

13. Understand, compute and simulate the modes in step index fiber and graded index fiber.

14. Design, implement and test WDM communication system using its basic components.

**Tools Required: Optiwave systems, OptSim, Optical Loss test set(OLTS), OTDR, VPIphotonics**

# PEC2ECE707E

# RF CIRCUIT DESIGN

**UNIT I:**

Importance of Radio Frequency Design, Frequency Spectrum, RF Behavior of Passive, Components, Chip Components and Circuit Board Considerations, RF Circuit Manufacturing Process, Transmission Line Analysis, Example of Transmission Lines, Equivalent Circuit, Representation, Theoretical Foundation, Circuit Parameters for a Parallel-Plate Transmission Line, Summary of Different Transmission Line Configurations, General Transmission Line Equations, Microstrip Transmission Lines, Terminated Lossless Transmission Line, Special Termination Conditions

**UNIT II:**

The Smith Chart (From Reflection Coefficient to Load Impedance, Impedance Transformation, Admittance Transformation, Parallel Series Connection)

**UNIT III:**

Single- and Multi-port Networks (Interconnecting networks, Network properties and Applications, Scattering Parameters), Impedance Matching and Tuning

**UNIT IV:**

Passive RF Components (Coupler Design, Power Combiner and Power Divider: analytical techniques; Multi-band Component Design Techniques), RF Filter Design, Multi-Frequency Design Techniques, Vector Network Analyzer and Simple Calibration Approach, Active RF Components (RF Field Effect Transistors, MOSFETs, HEMTs),

**UNIT IV:**

Power Amplifier (Biasing and Matching Networks Design Techniques; Stability Considerations, Constant Gain, Constant VSWR Circles, Power Amplifier Topologies, Power Amplifier Operation Modes, Multi-band Matching Techniques for Power Amplifiers)

**Recommended Books:**

1. RF Circuit Design Theory and Applications, 2nd edition – R. Ludwig and G. Bogdanov, Pearson Economy

**Reference Books**:

1. Microwave Engineering, 3rd Edition – D. M. Pozar, Wiley
2. Secrets of RF Circuit Design – Joseph Carr, McGraw Hill
3. RF Circuit Design – R. Bowick, Newnes
4. IEEE Xplore, and IEL

# PEC2ECE708E

# RF CIRCUIT DESIGN LAB

## List of Experiments:

**Section I:** Learning the CAD tool. Introduction to ADS, ADS Design Guides (Smith Chart and its applications)

**Section II:**

1. Design various transmission line configurations and study their performance and various termination conditions.
2. Design impedance matching networks for different types of load networks
3. Design and Analysis of multi-port networks
4. Design and implementation of a coupler
5. Design and implementation of Power Combiner and Divider
6. ·Design and implementation of different classes of Power Amplifiers.

**Tools Required**: Advanced Design System

# PEC2ECE709E

# COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

**UNIT I**

Review of Basic Computer Organization, Performance Evaluation Methods, Introduction to RISC Instruction Pipeline, Instruction Pipeline and Performance. Pipeline Hazards and Analysis, Branch Prediction, MIPS Pipeline for Multi-Cycle Operations.

**UNIT II**

Compiler Techniques to Explore Instruction Level Parallelism, Dynamic Scheduling with Tomasulo's Algorithm and Speculative Execution.

**UNIT III**

Advanced Pipelining and Superscalar Processors, Exploiting Data Level Parallelism: Vector and GPU Architectures, Architectural Simulation using gem5.

**UNIT IV**

Introduction to Cache Memory, Block Replacement Techniques and Write Strategy, Design Concepts in Cache Memory.

**UNIT V**

Basic and Advanced Optimization Techniques in Cache Memory, Cache Optimization using gem5, Introduction to DRAM System, DRAM Controllers, and Address Mapping, Secondary Storage Systems, Design Concepts in DRAM and Hard Disk.

**UNIT VI**

Tiled Chip Multicore Processors (TCMP), Routing Techniques in Network on Chip (NoC), NoC Router Microarchitecture, TCMP, and NoC: Design and Analysis, Future Trends in Computer Architecture Research.

**References**


1. Computer Architecture - A Quantitative Approach,5th edition, John L. Hennessy, David A. Patterson. 2.
2. Computer Systems Design and Architecture, 2nd Edition, Vincent P. Heuring 3.
3. Computer Organization and Architecture, 6th Edition, William Stallings 4.
4. Advanced Computer Architectures-A Design Space Approach, Dezsosima, Terence Fountain, Peter Kacsuk.

# PEC2ECE710E

# COMPUTER ARCHITECTURE AND PARALLEL PROCESSING LAB

**List of Experiments:**

1. Simulating the implementation of the pipeline.
2. Simulating the implementation of instruction level parallelism
3. Simulating the implementation of Vector Architecture
4. Simulating the implementation of GPU architecture
5. Simulating the implementation of super scalar architecture.

**Tools Required: GEM5 simulator, MATLAB and GEMS or SIMICS**

# PEC2ECE711E

# NETWORK SECURITY AND CRYPTOGRAPHY

**UNIT I**

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

**UNIT II**

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

**UNIT III**

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

**UNIT IV**

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

**UNIT V**

Authentication and System Security: IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer, Secure Electronic Transaction Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Trusted Systems.

**Recommended Books:**

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

**Reference Books:**

1. Christopher M. King, Ertem Osmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,
2. Stephen Northcutt, Leny Zeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, "Inside Network Perimeter Security", Pearson Education, 2nd Edition
3. Richard Bejtlich, "The Practice of Network Security Monitoring: Understanding Incident Detection and Response", William Pollock Publisher, 2013.

# PEC2ECE712E

# NETWORK SECURITY AND CRYPTOGRAPHY LAB

### List of Experiments:

1. Write a program to perform encryption and decryption using substitution and transposition cipher.

2. Write a program to implement DES algorithm logic

3. Write a program for evaluation of AES

4. Write a program for evaluation Triple DES

5. Write a program to implement Blowfish algorithm logic

6. Write a program to implement RSA algorithm logic

7. Implement Diffie-Hellman key exchange mechanism using html

8. Write a program to implement Euclid algorithm

9. Calculate the message digest of a text using SHA-1 algorithm

10. Implement the signature scheme digital signature standard

11. Implement electronic mail security

12. Case study on web security requirement

**Note:**

1. Perform above experiments using C/C++/JAVA/MATLAB/Python.
2. Minimum 10 experiments must be performed from the List.

# PEC2ECE713E

# MIXED SIGNAL DESIGN

**UNIT I**

Simple CMOS Current Mirror, Common-Source Amplifier, Source-Follower, Source Degenerated Current Mirrors, cascode Current Mirrors, MOS Differential Pair and Gain Stage Process and temperature independent compensation

**UNIT II**

Sampling Circuits Performance of Sample-and-Hold Circuits, Testing Sample and Holds, MOS Sample-and-Hold Basics, Examples of CMOS S/H Circuits, Bipolar and BiCMOS Sample-and-Holds. Sample-and-Hold Architectures- Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture, switched capacitor architecture.

**UNIT III**

D/A Converter Architectures Input/output characteristics of an ideal D/A converter, performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures

**UNIT IV**

A/D Converter Architectures Input/output characteristics and quantization error of an A/D converter, performance metrics, Performance Limitations, Resolution, Offset and Gain Error, Accuracy and Linearity, Successive approximation architectures, Flash architectures.

**UNIT V**

Integrator Based Filters Low Pass filters, active RC integrators, MOSFET-C integrators, transconductance-c integrator, discrete time integrators. Filtering topologies - bilinear transfer function and biquadratic transfer unction, phase-locked loop basics; PLL dynamics; frequency synthesis; all-digital PLLs.

**References**


1.Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.
2.Razavi, “Principles of data conversion system design”, Wiley IEEE Press, 1st Edition, 1994.
3.Jacob Baker, “CMOS Mixed-Signal circuit design”, IEEE Press, 2009.
4.Gregorian, Temes, “Analog MOS Integrated Circuit for signal processing”, John Wiley & Sons, 1986.
5.Baker, Li, Boyce, “CMOS: Circuit Design, layout and Simulation”, PHI, 2000.
6. P.E. Allen, Doug Holberg, “CMOS Analog Circuit Design”, Oxford University Press, 2011.

# PEC2ECE714E

# MIXED SIGNAL DESIGN LAB

**List of Experiments:**

**Section I:** ***Learning the CAD tool.***
Introduction to Cadence, Learning Cadence design framework and Virtuoso environment, Design with Virtuoso schematic editor, Layouts etc.

**Section II:** ***List of Experiments:***
1. Simulation and analysis of a basic Current mirror circuit.

2. Simulation and analysis of a bipolar current mirror circuit.

3. Design of Common Source Amplifier with different Loads

4. Simulation and design Differential Amplifier

5. Design, Simulation and analysis of an open loop track and hold using MOS technology.

6. Design, Simulation and analysis of Sample and Hold circuit with clock feedthrough circuitry.

7. Design and analysis of a voltage comparator circuit.

8. Design and analysis of ADC (e.g Flash)

9. Design, Simulation and analysis of first order RC filter circuit.

10. Design, Simulation and analysis of low Q and high Q bi-quad filters.

11. Design, Simulation and analysis of first order Gm-C filter circuit.

**Tools Required**: Cadence Virtuoso/ Advanced Design System/ any other industry grade CAD tool.

# PEC2ECE715E

# ANTENNA DESIGN

**UNIT I**

**Antenna Fundamentals and Types:** Radiation mechanism - over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Antenna Parameters.

**Antenna types:** Wires, Patches and Broadband, Dipole Antennas, Yagi - Uda Antennas, Micro strip Antenna, Travelling-wave Wire antennas, Helical antennas. Log - Periodic Antennas, spiral antennas, lens antennas etc

**UNIT II**

**Antenna Arrays**: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques.

**UNIT III**

**Aperture/Reflector Antennas:** Radiation from Aperture and Huygen's principle, uniqueness theorem, Application of the equivalence principle to Aperture problems, uniform Rectangular aperture and radiating slit. Techniques for evaluating Gain .Reflector antennas - Parabolic reflector antenna principles, Axi - symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model.

**UNIT IV**

**Antenna Synthesis:** Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier series, Woodward — Laws on sampling method, etc

**UNIT V**

**CEM for Antennas**: General Introduction. **Method of Moments**: Introduction to method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of Antenna and scatter characteristics. **Finite Difference Time Domain Method**: Maxwell equations for FTDT method, E - Plane analysis of Horn antennas. **High Frequency Methods:** Geometric optics, Wedge diffraction theory, E - Plane analysis of Horn antennas. Cylindrical parabolic antenna, radiation by a slot and monopole on a finite ground plane, Application of UTD to wireless mobile propagation.

**UNIT VI**

**Basic Concepts of Smart Antennas**: Concept and benefits of smart antennas, Fixed weight beam forming basics, Adaptive beam forming. **Instructional Activities:** Design, simulation and analysis of different antennas for wireless applications using related simulation tools.

## References


1. Stutzman and Thiele, "Antenna Theory and Design", 2nd Ed, John Wiley and Sons Inc.
2. C. A. Balanis: "Antenna Theory and Design", John Wiley, 3rd Edition, 2005
3. Kraus J D and Marhefka R J, "Antennas for All Applications", 3rd Edition, Tata McGraw Hill, 2002.
4. Elliot R S, "Antenna Theory and Design", Revised Edition, John Wiley and Sons, India, 2006.
5. F . B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.
6. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.

# PEC2ECE716E
# ANTENNA DESIGN LAB

### List of Experiments

**A: Using Antenna Training System**

1) Study different types of Antennas
2) Measurement of Radiation pattern of monopole, dipole, folded dipole, helix, Loop (rectangular and circular) antennas.
3) Study the structure, operation and radiation pattern of wired, aperture, planar and array antennas.
4) Proof of Inverse square law and Reciprocity theorem
5) Measurement of radiation pattern of reflector antennas
6) Study of variation in the radiation strength at a given distance from the antenna
7) Study of Yagi-UDA 5 Element Simple dipole antenna

**B: Simulation using HFSS/CST:**

1) Analysis of co-polarization and cross polarization.
2) Measurement of radiation pattern of planar antennas
3) Antennas Arrays and beamforming
4) Design micro strip patch antennas
5) Design reflector antennas
6) Design Horn antennas

**Tools Required: HFSS Antenna design Suite, MATLAB, CST, Antenna Training System**

# Open Elective Courses

# OECECE801E
# INTERNET OF THINGS

**UNIT I**

What is IoT, why IoT matters, the power of IoT, Examples and Applications, How an IoT System Actually works, Structure of IoT.

**UNIT II**

Sensors and Devices: Hardware Capabilities Scaling & Operations, Industrial sensors, First Generation – Description, Advanced Generation, Integrated IoT Sensors, Polytronics Systems, Sensors' Swarm ,Printed Electronics ,IoT Generation Roadmap ,Wireless Sensor Structure– Energy Storage Module–Power Management Module–RF Module–Sensing Module

**UNIT III**

Connectivity: An introduction to Connectivity, LPWAN, Cellular, Satellite, WiFi, Bluetooth, Data Processing: Introduction to Cloud, Introduction to IoT platforms, Choosing an IoT Platform, API's, Data Analytics vs Machine Learning

**UNIT IV**

User Interface & User Experience in IoT, Introduction to UIs & UX for IoT2, Key Considerations for UIs, The Future of IoT and Case Study: Smart Cities, Healthcare, Agriculture

**References**


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

# OECECE802E
# INTERNET OF THINGS LAB

### List of Experiments:

1. Arduino Uno Architecture, Arduino Simulation Environment, Setup the IDE, Introduction Arduino Libraries.

2. Basics of Embedded C programming for Arduino.

3. Interfacing LED, push button and buzzer with Arduino.

4. Interfacing Arduino with LCD.

5. Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino.

6. Interfacing of Relay Switch and Servo Motor with Arduino.

7. Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library.

8. Web server- introduction, installation, configuration.

9. Posting sensor(s) data to web server.

10. Study of IOT Cloud platforms Thing Speak API and MQTT.

11. Interfacing ESP8266 with Web services.

12. Introduction to Contiki-Cooja Platform.

**Tools Required:**

1. **Hardware:** Arduino, Raspberry Pi, Intel Galileo, BeagleBone, Smart Phones.
2. **Software:** Contiki on Ubuntu machine.

# OECECE803E
# SENSORS AND ACTUATORS FOR IOT

**UNIT I**

Sensors / Transducers: Principles – Classification – Parameters – Characteristics - Environmental Parameters (EP) – Characterization Mechanical and Electromechanical Sensors: Introduction – Resistive Potentiometer – Strain Gauge – Resistance Strain Gauge – Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor –Types-Capacitive Sensors:– Electrostatic Transducer– Force/Stress Sensors Using Quartz Resonators – Ultrasonic Sensors

**UNIT II**

Thermal Sensors: Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermos sensors – Resistance Change Type Thermometric Sensors –Thermo emf Sensors– Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magneto resistive Sensing – Semiconductor Magneto resistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors– Angular/Rotary Movement Transducers – Synchros– Synchro-resolvers - Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors SQUID Sensors

**UNIT III**

Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors Electro analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential - Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization–– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media.

**UNIT IV**

Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors –– Sensors for Manufacturing – Sensors for environmental Monitoring

**UNIT V**

Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves – Pressure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection Electrical Actuation Systems-Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors

**Recommended Books:**

1. D. Patranabis – “Sensors and Transducers” –PHI Learning Private Limited.

2. W. Bolton – “Mechatronics” –Pearson Education Limited.

**Reference Books:**

1. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.

# OECECE804E
# SENSORS AND ACTUATORS FOR IOT LAB

**List of Experiments:**

1. Calibration of various electromechanical sensors and Interfacing with PC or Microcontrollers.
2. Calibration of various Thermal sensors and Interfacing with PC or Microcontrollers.
3. Calibration of various Optical sensors and Interfacing with PC or Microcontrollers.
4. Calibration of various automation sensors and Interfacing with PC or Microcontrollers.
5. Study of various off the shelf sensor modules and interfacing with PC or Microcontrollers.
6. Design and implementation of Signal conditioning circuits for basic transduction elements.
7. Interfacing of various actuators with PC or microcontrollers.
8. Design of a full automation system with sensors, actuators and processing elements.

**Tools Required: MATLAB, LABVIEW, Proteus, Arduino.**

# OECECE805E
# DEEP LEARNING

**UNIT I**

Introduction: Course logistics and overview. Linear Algebra Review: Brief review of concepts from Linear Algebra. Optimization: Types of errors, bias-variance trade-off, overfitting-underfitting, brief review of concepts from Vector Calculus and optimization, variants of gradient descent, momentum.

**UNIT II**

Logistic Regression: Basic concepts of regression and classification problems, linear models addressing regression and classification, maximum likelihood, logistic regression classifiers.

**UNIT III**

Neural Networks: Basic concepts of artificial neurons, single and multi-layer perceptrons, perceptron learning algorithm, its convergence proof, different activation functions, softmax cross entropy loss function.

**UNIT IV**

ConvNets: Basic concepts of Convolutional Neural Networks starting from filtering. Convolution and pooling operation and arithmetics. Regularization, Dropout, Batchnorm, etc. Convnet architectures - AlexNet, VGG, GoogLeNet, ResNet, MobileNet-v1, InceptionNet, etc.

**UNIT V**

Deep Learning Tasks: Detection, segmentation problem definition, challenges, evaluation. Classification, region proposals, RCNN and other architectures and techniques. Applications of deep learning to computer vision, speech recognition, etc.

**References**


1. "Deep Learning", I Goodfellow, Y Bengio and A Courville, 1st Edition, MIT Press
2. Python Machine Learning for Beginners: Handbook for Machine Learning, Deep Learning and Neural Networks Using Python, Scikit-Learn and TensorFlow by Sanders, Finn
3. Deep Learning with Python, François Chollet

# OECECE806E
# DEEP LEARNING LAB

### List of Experiments:

1. Introduction to Python based Deep Learning-I
2. Introduction to Python based Deep Learning-II
3. Introduction to online Python Coding Platforms: Google COLAB, KAGGLE, etc.
4. Designing, training and evaluating a basic shallow neural net in Python.
5. Designing, training and evaluating a deep neural net in Python.
6. Using Transfer Learning for fine-tuning of a pre-trained CNN
7. Experiment on Computer Vision using Deep Learning.
8. Experiment on Speech Recognition using Deep Learning.
9. Using Tensor Processing Units (TPUs) for Deep Learning.

**Tools required:**

1. Python Software
2. MATLAB Software
3. Online Computing Platforms: Google Colab, Kaggle.

# OECECE807E
# INDUSTRIAL IOT

**UNIT I**

**Introduction to Industrial Internet of Things**• Embedded systems & computer networks• Machine-to-machine (M2M) communication• Internet of Everything (IoE)• Machine learning & artificial intelligence• Distributed computing• Industrial automation• Interoperability, identification localization, communication, and software-defined assets• Evolution of IIoT – understanding the IT & OT convergence• OT components like Industrial control systems, PLC, SCADA, and DCS• IT components like hardware, software, and people processes• Adoption of IIoT• Market trends and opportunities in IIoT

**UNIT II**

**Industrial automation – PLC & SCADA**• History of automation – plants to parts• Knowledge discovery process• The DIKW (Data, Information, Knowledge, and Wisdom) pyramid and its relevance in IoT• PLC vs. Microcontrollers• Industrial networks• Machine-to-machine networks

**UNIT III**

**Sensor data mining and analytics**• Transducers: Sensors & actuators• Data acquisition, storage, and analytics• Real-time analytics• Understanding the differences between IoT and Big Data• Improving operational efficiency with IoT• Edge analytics & data aggregation

**UNIT IV**

**Wireless Sensor Area Networks (WSAN)**• Sensor nodes• WSN communication technology• Fundamentals and applications of Bluetooth, Zigbee, and WiFi• Fundamentals and applications of Cellular communication and LPWAN technology

**UNIT V**

**Design & development of IIoT systems**• IIoT reference architectures• Standardization initiatives• Interoperability issues• Industrial internet reference architecture from Industrial Internet Consortium (IIC)• IIoT design considerations• Centralized vs. distributed architectures• Industrial networks, communication technologies, protocols

**UNIT VI**

**Industry 4.0 – Smart Factories**• Integration of products, processes, and people• Smart factories and cyber-physical systems• Design principles• Challenges on the path to be a smart factory

**UNIT VII**

**Industrial cloud platforms**• Industrial gateways• Commercial gateways by Intel and Cisco• Cloud-based gateway solutions• IaaS, PaaS, and SaaS models• Cloud components and services• Device management, databases, visualization, and reporting• Notification management• Security management• Cloud resource monitoring and management• AWS IoT• Microsoft Azure IoT• GE Predix• PTC Thingworx

**References**


1. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0 Paperback – 1 January 2018 by Giacomo Veneri Antonio Capasso
2. Introduction to Industrial Internet of Things and Industry 4.0 1st Edition CRC Press by Sudip Misra
3. IoT Fundamentals | Networking Technologies, Protocols, and Use Cases for the Internet of Things | First Edition Pearson Paperback – 16 August 2017 by Hanes David, Salgueiro Gonzalo, Grossetete Patrick
4. IoT - Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT Paperback – February 21, 2020 by Charles Crowell
5. Getting started with the Internet of Things O'RELLY publications by Cuno Pfister

# OECECE808E
# INDUSTRIAL IOT LAB

**List of Experiments:**

1: Study hardware and software used in PLC

2: Implementation of Logic Gates

3: Develop a ladder program for DOL Starter

4: Develop an application using On-Delay Timer

5: Develop an application using Up-Down Counter

6: Implementation of PLC Arithmetic Instructions for a pilot plant

7: Study of PID controller instruction for a pilot plant

8: Study hardware and software platforms for DCS

9: Simulate analog and digital function blocks

10: Study, understand and perform experiments on timers and counters

11: Logic implementation for traffic Control Application

12: Logic implementation for Bottle Filling Application

**Tools Required: PLC kits, DCS kits, SCADA software.**

# OECECE809E
# ROBOTICS ENGINEERING

**UNIT I**

Introduction, History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

**UNIT II**

Drive systems and Sensors Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

**UNIT III**

Kinematics and Dynamics of Robots 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

**UNIT IV**

Robot Control, Programming and Applications Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples. Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding.

**Recommended Books:**

[T1] Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.

[T2] Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.

**Reference Books:**

[R1] S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
[R2] Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
[R3] Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
[R4] P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
[R5] Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
[R6] Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
[R7] Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985

# OECECE810E

# ROBOTICS ENGINEERING LAB

**List of Experiments:**

1. Basic experiments on introduction to Robot Configuration.
2. Demonstration of Robot with 2 DOF, 3 DOF, 4 DOF, etc.
3. Experiments on programming a robot for applications.
4. Two case studies of Robotics Applications in Industry.
5. Experiments on Robotic Simulation Software.

# OECECE811E

# MECHATRONICS

**UNIT I**
Introduction, Examples of Mechatronic systems, Electric circuits and components, Semiconductor Electronics, Transistor Applications

**UNIT II**
Sensors and transducers: Performance terminology of sensors, Displacement, Position & Proximity Sensors-I, Displacement, Position & Proximity Sensors-II, Force, Fluid pressure, Liquid flow sensors, temperature, light sensor, Acceleration and Vibration measurement, Semiconductor sensor and MEM, SAW

**UNIT III**
Actuators and mechanisms: Mechanical Actuation System, Hydraulic & Pneumatic Actuation System, Electrical Actuation System-I, Electrical Actuation System-II, Data Presentation system

**UNIT IV**
Signal conditioning: Introduction to signal processing & Op-Amp, Op-Amp as signal conditioner, Analogue to Digital Converter, Digital to Analogue Converter, Artificial intelligence

**UNIT V**
Microprocessors and microcontrollers: Digital circuits-I, Digital circuits-II, Microprocessor Micro Controller, Programming of Microcontrollers

**UNIT VI**
Modeling and system response: Mechanical system model, Electrical system model, Fluid system model, Dynamic response of systems, Transfer function and frequency response.

**UNIT VII**
Closed loop controllers: P, I, PID Controllers, Digital Controllers, Program Logic Controllers, Input/output & Communication systems, Fault findings

**References**

1. William Bolton, “Mechatronics electronic control systems in mechanical and electrical engineering”, 6th Edition, Pearson Education, 2002.
2. David G. Alciatore, Micheal B. Histand “Introduction to MECHATRONICS and measurement systems”, 4th edition, Mc Graw Hill Education-2014
3. M.D. Singh, J.G. Joshi, “Mechatronics”, PHI Publications

# OECECE812E
# MECHATRONICS LAB

**List of Experiments:**

1. Interfacing of various sensor and actuator modules with microcontrollers.

2. Use of A/D and D/A converters for signal conditioning of sensor signals.

3. Design and Implementation of OP-AMP based signal conditioning circuits for optical and thermal sensors.

4. Mechanical system modeling on PC.

5. Electrical system modeling on PC.

6. Working with PID controllers.

7. Project using Microcontroller-Atmega 328, Myoelectrically Controlled Robotic Arm, Design of a Legged Robot

**Tools Required: MATLAB, MATLAB supported EMBEDDED hardware, LABVIEW.**

# OECECE813E
# MICROPROCESSORS IN AUTOMATION

**UNIT I**

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

**UNIT II**

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing

**UNIT III**

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt Requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

**UNIT IV**

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features,

**UNIT V**

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z-Transform, Digital Filters, Implementation of Digital Algorithm.

**References**


1. Digital Electronics: An Introduction to Theory and Practice by William H. Gothmann, PHI Learning Private Limited
2. Digital Computer Electronics: An Introduction to Microcomputers by Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd
3. Microprocessor Architecture, Programming, and Applications with the 8085 by Ramesh Gaonkar, PENRAM International Publishers.
4. Digital Control Systems by Benjamin C. Kuo, Oxford University Press
5. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal Prentice Hall

# OECECE814E
# MICROPROCESSORS IN AUTOMATION LAB

1. Design and implementation of:
    a. basic Gates: AND, OR, NOT.
    b. Universal gates.
    c. Basic Flip-Flops
2. Using 8085 microprocessor:
    i. develop a program to add two double byte numbers.
    ii. develop a subroutine to add two floating point quantities.
    iii. develop program to multiply two single byte unsigned numbers, giving a 16-bit product
    iv. develop subroutine which will multiply two positive floating-point numbers.
    v. To write program to evaluate P* Q*+R* & S where P, Q, R, S are 8-bit binary numbers.
    vi. To write a program to divide an 8-bit number by another 8-bit number up-to a
    vii. fractional quotient of 16 bit.
    viii. Write a program for adding first N natural numbers and store the results in memory location X.
    ix. Write a program which decrements a hex number stored in register C. The Program should half when the program register reads zero.
    x. Write a program to introduce a time delay of 100 ms using this program as a subroutine display numbers from 01H to OAH with the above calculated time delay between every two numbers.
    xi. N hex numbers are stored at consecutive memory locations starting from X. Find the largest number and store it at location Y.
3. Interface a display circuit with the microprocessor either directly with the bus or by using I/O ports. Write a program by which the data stored in a RAM table is displayed.
4. To design and interface a circuit to read data from an A/D converter, using the 8255 A in the memory mapped I/O.
5. To design and interface a circuit to convert digital data into analog signal using the 8255A in the memory mapped I/O.
6. To interface a keyboard with the microprocessor using 8279 chip and transfer the output to the printer.
7. To design a circuit to interface a memory chip with microprocessor with given memory map.
8. Write a program to control the operation of stepper motor using 8085 and 8255 PPI.