# SYLLABUS
# FOR
# M.TECH. PROGRAMME
# IN
# ELECTRONICS AND COMMUNICATION ENGINEERING


## Department of Electronics & Communication Engineering
## INSTITUTE OF TECHNOLOGY
## UNIVERSITY OF KASHMIR
## SRINAGAR

## NOVEMBER – 2021
**(Applicable to Batch 2021 & Onwards)**

| Code | Nomenclature |
|---|---|
| **PCC** | Professional Core Course |
| **PEC** | Professional Elective Course |
| **OEC** | Open Elective Course |
| **ISE** | Internal Semester Evaluation |
| **MSE** | Mid Semester Evaluation (35 Marks) |
| **ESE** | End Semester Evaluation |

| Code | Nomenclature |
|---|---|
| **L** | Lecture |
| **T** | Tutorial |
| **P** | Practical |
| **IA** | Internal Assessment (Assignment + Quiz/ Viva Voce (10 Marks) + Attendance (5 Marks) |

**COURSE STRUCTURE**

| **Semester-1 (One)** | | | | | | **Examination Scheme (Distribution of Marks)** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** | **ISE** | | **ESE** | **Total** |
| | | | | | | **MSE** | **IA** | | |
| PCCMECE101 | Analog Integrated Circuit Design | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PCCMECE102 | Advanced DSP | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PCCMECE103L | Advanced Computation & Simulation Tools | 0 | 0 | 4 | 2 | 35 | 15 | 50 | 100 |
| PEC1MECE1XX | Professional Elective Course-I | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PCCMECE102L | Advanced DSP Lab | 0 | 0 | 2 | 1 | 35 | 15 | 50 | 100 |
| PCCMECE104 | Research Methodology & Language | 0 | 2 | 2 | 3 | 35 | 15 | 50 | 100 |
| PECMECE1XXL | Professional Elective Course Lab-I | 0 | 0 | 2 | 1 | 50 | | 50 | 100 |
| Total | | 9 | 5 | 10 | 19 | | | | 700 |

| **Semester-2 (Two)** | | | | | | **Examination Scheme (Distribution of Marks)** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** | **ISE** | | **ESE** | **Total** |
| | | | | | | **MSE** | **IA** | | |
| PCCMECE201 | VLSI Design | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PCCMECE202 | Modern Wireless Communication Systems | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PEC2MECE2XX | Professional Elective Course -II | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PCCMECE201L | VLSI Design Lab | 0 | 0 | 2 | 1 | 35 | 15 | 50 | 100 |
| PCCMECE202L | Modern Wireless Communication Systems Lab | 0 | 0 | 2 | 1 | 35 | 15 | 50 | 100 |
| PEC2MECE2XXL | Professional Elective Course Lab-II | 0 | 0 | 2 | 1 | 35 | 15 | 50 | 100 |
| PCCMECE203 | Optimization Techniques | 2 | 1 | 0 | 3 | 35 | 15 | 50 | 100 |
| PCCMECE207 | Seminar | 0 | 0 | 6 | 3 | 50 | | 50 | 100 |
| Total | | 11 | 4 | 12 | 21 | | | | 800 |

| Semester-3 (Three) | | | | | | Examination Scheme (Distribution of Marks) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | L | T | P | Credits | ISE | | ESE | Total |
| | | | | | | MSE | IA | | |
| PEC3MECE3XX | Professional Elective Course-III | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PEC4MECE3XX | Professional Elective Course -IV | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| OECMECE3XX | Open Elective Course -I | 3 | 1 | 0 | 4 | 35 | 15 | 50 | 100 |
| PEC3MECE3XXL | Professional Elective Course Lab-III | 0 | 0 | 2 | 1 | 35 | 15 | 50 | 100 |
| PEC4MECE3XXL | Professional Elective Course Lab IV | 0 | 0 | 2 | 1 | 35 | 15 | 50 | 100 |
| OECMECE3XXL | Open Elective Course Lab-I | 0 | 0 | 2 | 1 | 35 | 15 | 50 | 100 |
| PCCMECE314 | Project Phase-I | 0 | 0 | 10 | 5 | 35 | 15 | 50 | 100 |
| Total | | 9 | 3 | 16 | 20 | | | | 700 |

| Semester-4 (Four) | | | | | | Examination Scheme (Distribution of Marks) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | L | T | P | Credits | ISE | | ESE | Total |
| | | | | | | MSE | IA | | |
| PCCMECE401 | Phase – II Dissertation | 0 | 0 | 0 | 15 | 50 | | 50 | 100 |
| Total | | 0 | 0 | 0 | 15 | | | | 100 |

XX: will take the code from the elective list Total Credits=75

## ELECTIVE COURSES

| Professional Elective Course–I | | |
|---|---|---|
| **S.N.** | **Course Code** | **Subject Title** |
| **01.** | **PEC1MECE104** | Internet of Things |
| **02.** | **PEC1MECE104L** | Internet of Things Lab |
| **03.** | **PEC1MECE105** | Optical communication Systems |
| **04.** | **PEC1MECE105L** | Optical communication Systems Lab |
| **05.** | **PEC1MECE106** | Digital Image Processing |
| **06.** | **PEC1MECE106L** | Digital Image Processing Lab |
| **07.** | **PEC1MECE107** | Mathematics for Machine Learning |
| **08.** | **PEC1MECE-107L** | Mathematics for Machine Learning Lab |
| **09.** | **PEC1MECE108** | Mathematics for Signal Processing |
| **10.** | **PEC1MECE108L** | Mathematics for Signal Processing Lab |
| **11.** | **PEC1MECE109** | Advanced Digital System |
| **12.** | **PEC1MECE109L** | Advanced Digital System Lab |
| **Professional Elective Course-II** | | |
| **S.No.** | **Course Code** | **Subject Title** |
| **1.** | **PEC2MECE203** | Introduction to Machine Learning |
| **2.** | **PEC2MECE203L** | Introduction to Machine Learning Lab |
| **3.** | **PEC2MECE204** | Computer architecture and parallel processing |
| **4.** | **PEC2MECE204L** | Computer architecture and parallel processing Lab |
| **5.** | **PEC2MECE205** | Network security and cryptography |
| **6.** | **PEC2MECE205L** | Network security and cryptography Lab |
| **7.** | **PEC2MECE206** | RF Circuit Design |
| **8.** | **PEC2MECE206L** | RF Circuit Design Lab |
| **9.** | **PEC2MECE207** | Embedded System using PIC-18 |
| **10.** | **PEC2MECE207L** | Embedded System using PIC-18 Lab |
| **Professional Elective Course-III** | | |
| **S.No.** | **Course Code** | **Subject Title** |
| **1.** | **PEC3MECE301** | Mixed signal design |
| **2.** | **PEC3MECE301L** | Mixed signal design Lab |
| **3.** | **PEC3MECE302** | Sensors and actuators for IOT |
| **4.** | **PEC3MECE302L** | Sensors and actuators for IOT Lab |
| **5.** | **PEC3MECE303** | Advanced Digital Communication |
| **6.** | **PEC3MECE303L** | Advanced Digital Communication Lab |
| **7.** | **PEC3MECE304** | Modern Signal Processing Architectures |
| **8.** | **PEC3MECE304L** | Modern Signal Processing Architectures Lab |
| **9.** | **PEC3MECE305** | Deep Learning |
| **10.** | **PEC3MECE305L** | Deep Learning Lab |
| | | |

| Professional Elective Course- IV | | |
|---|---|---|
| **S.No.** | **Course Code** | **Subject Title** |
| **1.** | **PEC4MECE306** | Industrial IOT |
| **2.** | **PEC4MECE306L** | Industrial IOT Lab |
| **3.** | **PEC4MECE307** | Robotics Engineering |
| **4.** | **PEC4MECE307L** | Robotics Engineering Lab |
| **5.** | **PEC4MECE308** | Antenna design |
| **6.** | **PEC4MECE308L** | Antenna design Lab |
| **7.** | **PEC4MECE309** | Quantum computing |
| **8.** | **PEC4MECE309L** | Quantum computing Lab |
| **9.** | **PEC4MECE310** | Computer Vision |
| **10.** | **PEC4MECE310L** | Computer Vision Lab |
| **Open Elective Course-I** | | |
| **S.No.** | **Course Code** | **Subject Title** |
| **1.** | **OECMECE311** | Embedded Design and Prototyping |
| **2.** | **OECMECE311L** | Embedded Design and Prototyping Lab |
| **3.** | **OECMECE312** | Mechatronics |
| **4.** | **OECMECE312L** | Mechatronics Lab |
| **5.** | **OECMECE313** | Block chain and cryptocurrency |
| **6.** | **OECMECE313L** | Block chain and cryptocurrency Lab |
| **7.** | **OECMECE314** | Coding Techniques |
| **8.** | **OECMECE314L** | Coding Techniques Lab |

# CORE SUBJECTS

## (DETAILED SYLLABUS)

# PCCMECE101
# ANALOG INTEGRATED CIRCUIT DESIGN

**UNIT I**

Introduction to the semiconductor industry, introduction to layouts and industry design flow for analog circuits (design flow for analog circuits, introduction to layout, case study), Single Stage MOS Amplifiers, analysis of CG amplifier, Analysis of CS amplifier with source degeneration, analysis of cascode and folded cascade, cascade as a current source.

**UNIT II**

Introduction to current mirror, simple CMOS current mirror, source-degenerated current mirror, small-signal analysis, large-signal analysis (PA), and common mode properties of current mirror, Differential amplifier (single ended operation, differential mode operation, common mode response, common mode rejection), Differential amplifier (differential pair with active loads, cascade differential amplifier), Gilbert Cell.

**UNIT III**

Frequency Response, fundamental concepts, relationship between transfer function and frequency response, Bode's Rules, Association of Poles with Nodes, Miller Effect and Miller's Theorem and its dual, General Frequency Response, Frequency Response of CS Amplifier, Frequency Response of Differential Amplifier, Feedback, Feedback Topologies, Properties of Feedback Circuits, Stability in Feedback Systems.

**UNIT IV**

Multi-stage Op Amps (one-stage and two- stage Op Amps, Comparison, Common-Mode Feedback, Input Range Limitations, Slew Rate), Noise in CMOS Circuits (Concepts, PSD, PDF, Noise in Single Stage Amplifier).

**UNIT V**

High speed and low noise amplifiers, Output stage amplifiers, Oscillators.

**Recommended Books:**


1. Design of Analog CMOS Circuits, Behzad Razavi, Tata McGraw Hill
2. CMOS Analog Circuit Design, Allen and Holberg, 3rd Indian Edition, Oxford University Press
3. Analysis and Design of Analog Integrated Circuits, Gray, Paul R., et al. John Wiley & Sons
4. Trade-offs in Analog Circuit Design: the designer's companion, by Toumazou, Chris, Moschytz, and Barrie Gilbert, eds. Springer Science & Business Media, 2004.
5. Analog Integrated Circuit Design by Tony Chan Carusone, David A. Johns, Kenneth W. Martin, John Wiley & Sons, Inc

# PCCMECE102
# ADVANCED DSP

## UNIT I

Review of Discrete time signals and systems and frequency analysis of discrete time linear time invariant systems: Discrete time systems, analysis of discrete time linear invariant systems, implementation of discrete time systems, correlation of discrete time systems, z-transforms, linear time invariant systems as frequency selective filters. Sampling, The Discrete Fourier transforms its properties and applications. Frequency domain sampling, properties of DFT, linear filtering methods based on DFT, Frequency analysis of signals using the DFT, Design of Digital filters, Design of FIR filters, Design of IIR filters.

## UNIT II

Multirate Digital Signal Processing: Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion, Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals.

## UNIT III

Linear Prediction and Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters.

## UNIT IV

Power Spectral Estimation: Estimation of Spectra from Finite Duration Observations of a signal, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods ,Parametric Methods for power spectrum estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models Minimum Variance Method, Piscaranko's Harmonic Decomposition Methods, MUSIC Method.

## Recommended Books:

1. Digital Signal Processing Principles, Algorithms, and Applications John G. Proakis, Prentice Hall International.Inc, 4th Edition, 2012.
2. Theory and Application of Digital Signal Processing by Lawrence R.Rabiner and Bernard Gold.
3. Oppenheim, Alan V. Discrete-time signal processing. Pearson Education India, 1999.
4. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer-based approach. Vol. 2. New York: McGraw-Hill Higher Education, 2006.

## Simulation Books:

1.Samuel D Stearns, "Digital Signal Processing with examples in Matlab. "CRC Press.
2. ES Gopi. "Algorithm collections for Digital Signal Processing Applications using Matlab, "Springer.
3.Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab," CRC Press,2005.

# PCCMECE102L
# ADVANCED DSP LAB

**List of Experiments:**

1. Generate various fundamental discrete time signals.

2. Basic operations on signals (Multiplication, Folding, Scaling).

3. Find out the DFT & IDFT of a given sequence without using inbuilt instructions.

4. Interpolation & decimation of a given sequence.

5. Generation of DTMF (Dual Tone Multiple Frequency) signals.

6. Estimate the PSD of a noisy signal using periodogram and modified periodogram.

7. Estimation of PSD using different methods (Bartlett, Welch, Blackman-Tukey).

8. Design of Chebychev Type I,II Filters.

9. Cascade Digital IIR Filter Realization.

10. Parallel Realization of IIR filter.

11. Estimation of power spectrum using parametric methods (yule-walker & burg).

12. Design of LPC filter using Levinson-Durbin algorithm.

13. Time-Frequency Analysis with the Continuous Wavelet Transform.

14. Signal Reconstruction from Continuous Wavelet Transform Coefficients.

**Tools Required: MATLAB, MATLAB supported DSP hardware.**

# PCCMECE103L
# ADVANCED COMPUTATION AND SIMULATION TOOLS

## Part-I: MATLAB

- M files: Working with script tools, Writing Script file, executing script files, The MATLAB Editor, Saving m files.
- Plots: Plotting vector and matrix data, Plot labelling, curve labelling and editing, 2D and 3D plotting, surface, mesh and grid plotting.
- GUI Design: Introduction of Graphical User Interface, GUI Function Property, GUI Component Design, GUI Container, Writing the code of GUI Callback, Dialog Box, Menu Designing, Applications.
- MATLAB Simulink: Introduction of Simulink, Simulink Environment & Interface, Study of Library, Circuit Oriented Design, Equation Oriented Design, Model, Subsystem Design, Connect Call back to subsystem, Application.
- MATLAB Programming: Automating commands with scripts, Writing programs with logic and flow control, Writing functions, Control statement Programming, Conditional Statement Programming, Examples.
- Image Processing with MATLAB: Importing and Visualizing Images, Importing and displaying images, Converting between image types, Exporting images, Interactive Exploration of Images.
- Symbolic Math in MATLAB: Calculus-Numerical Integration, Linear Algebra, Roots of Polynomials, Algebraic equations, Differential Equations (1st & 2nd order), Transforms (Fourier, Laplace, etc), Ordinary Differential equations, Examples of few ODEs.

## Part–II: ORCAD

- **OrCAD Capture CIS (Electronic Schematic design software)**

- Introduction to OrCAD Capture
- Introduction to component database
- How to place the parts in the design
- Connecting the parts with wire, bus, net alias and power symbol in the design
- How to modify the properties of the parts (Property Editor)
- How to edit the physical appearance of the parts (Part Editor)
- How to create a new library
- How to create a new part
- How to work in Multi sheet projects
- How to make connectivity between schematic pages
- Design Processing (Annotate, Back Annotate, DRC, Create Netlist, Cross reference parts and BOM)

- **OrCAD PSpice (Electronic circuit simulation software)**

- Modifying Schematic for Simulation
- PSpice Netlist creation
- Error identification and rectification (DRC Markers)

- Creation and configuration of Simulation profile.
- Bias Point analysis (To display DC bias values)
- Transient analysis (Time domain Response)
- Single Window, Single window with multiple Y-axis, Split window and Multi window representation
- Parametric analysis (Design response variation with respect to Design element parameters)
- DC Sweep analysis (Design response variation with respect to DC parameters)
- AC Sweep analysis (Design response variation with respect to Frequency)

**Part III: PYTHON**

1. Python interpreter and interactive mode; values and types, variables, expressions, statements,
2. Tuple assignment, precedence of operators, comments; modules and functions
3. Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.
4. Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elifelse);
5. Iteration: state, while, for, break, continue, pass;
6. Fruitful functions: return values, parameters, local and global scope, function composition, recursion;
7. Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.
8. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.
9. Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters.
10. Tuples: tuple assignment, tuple as return value;
11. Dictionaries: operations and methods; advanced list processing – list comprehension;
12. Illustrative programs: selection sort, insertion sort, mergesort, histogram.
13. Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

# PCCMECE104
# RESEARCH METHODOLOGY & LANGUAGE

**UNIT I**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

**UNIT II**

Approaches of investigation of solutions for research problems, data collection, analysis, interpretation, Necessary instrumentations. Effective literature studies approach, analysis, Plagiarism, Research ethics.

**UNIT III**

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

**UNIT IV**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**UNIT V**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

**UNIT VI**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**UNIT VII**

Writing Practices; Comprehension; Précis Writing; Essay Writing. Oral Communication (This unit involves interactive practice sessions in Language Lab); Listening Comprehension; Pronunciation, Intonation, Stress and Rhythm; Common Everyday Situations: Conversations and Dialogues; Communication at Workplace; Interviews; Formal Presentations;

**Recommended Books:**


- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd
- On Writing Well. William Zinsser. Harper Resource Book.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.
- Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

# PCCMECE201
# VLSI DESIGN

**UNIT I**

Issues in Digital Integrated Circuit Design, Review of MOS transistor models. –Static and Dynamic Behavior, Secondary effects. CMOS Inverter Static and Dynamic Behavior, Noise Margin, Power Consumption and Power Delay Product, Latch up, Technology Scaling.

**UNIT II**

Low power design, scaling effects, scaling versus power consumption, power reduction using Voltage scaling and multiple voltage supplies, Timing Issues in synchronous design. Interconnect Parasitics.

**UNITIII**

Circuit design style, Non-clocked logic families and clocked logic families, CMOS logic families including static, dynamic and dual rail logic, DCSL. Logic gates- Static CMOS Design: Complementary CMOS, Ratioed Logic, Pass Transistor Logic. Dynamic CMOS Design: basic principles, performance of dynamic logic, Noise consideration, Power consumption in CMOS gates – switching activity, Glitches. Logical effort in basic CMOS circuits, Predicting Delay, Logical area and logical efficiency.

**UNITIV**

Sequential Circuits: introduction Bi-stability, bi-stable elements, CMOS static flip-flop, Pseudostatic latch, Dynamic two-phase flip-flop, C2MOS latch, NORA (no race)-CMOS logic design style, CMOS D latch and edge triggered Flip Flop, Schmitt Trigger, Astable and monostable circuits.

**UNITV**

Arithmetic Building blocks: CMOS full Adder and Multiplier, organization of a static RAM, MOS static RAM cell, 4T SRAM

**Recommended Books:**


- Neil Weste and K. Eshragian, “Principles of CMOS VLSI Design: A System Perspective”, Pearson Education (Asia) Pvt. Ltd., 2nd Edition ,2000.
- Wayne Wolf, “Modern VLSI design: System on Silicon” Pearson Education, Second Edition, 1998
- Douglas A Pucknell& Kamran Eshragian , “Basic VLSI Design” PHI 3rd Edition (original Edition – 1994)
- Sung Mo Kang &Yosuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, McGraw- Hill, 3rd Edition, 2003

# PCCMECE201L
# VLSI DESIGN LAB

**Section I: Introduction about the CAD tool:**

Setting the Cadence environment, Introduction to Cadence Based ASIC- Digital Design flow, Introduction to HDL Features.

**Section II: List of Experiments:**

1.HDL based Implementation of Logic Gates.

2.HDL based Implementation of Half Adder and Full Adder.

3.HDL based Implementation of Half Subtractor and Full Subtractor.

4.HDL based Implementation of Multi-bit Adder circuit.

5.HDL based Implementation of Multiplier circuit.

6.HDL based Implementation of Counter circuit.

7.HDL based test bench for verification of implemented designs.

8.Cadence based synthesis and layout generation of Digital circuits.

9.DRC, LVS and Antenna rule checks of Digital circuits.

10.ASIC design flow of NAND gate.

**Required Tools: Vivado, Cadence Digital Design Tool Package, Mentor Graphics.**

# PCCMECE202
# MODERN WIRELESS COMMUNICATION SYSTEMS

**UNIT I**

**Large-scale Path loss:** Propagation of EM signals in wireless channel, Reflection, Diffraction and scattering, Free-space propagation model, Two-ray ground reflection model, Log- distance path loss model, Log-normal shadowing, Outdoor propagation models, Longley-Rice model, Okumura model, Hata model, COST-231, Link power budget analysis

**UNIT II**

**Small-scale Fading and Multipath:** Factors influencing small-scale fading, Doppler shift, Impulse response model of multipath channel, Parameters of mobile multipath channels, Types of small-scale fading, Statistical models for multipath fading channels, Rayleigh and Rician distributions, Jakes Doppler spectrum.

**UNIT III**

**Equalization:** Introduction, Fundamentals of Equalization, training a generic adaptive equalizer, Equalizes in a communication receiver, Linear Equalizers, Non-Linear Equalization- Decision Feedback Equalization (DFF) and Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization- Zero forcing Algorithm, Least mean square algorithm and recursive least squares algorithm.

**UNIT IV**

**Diversity Techniques:** Condition for deep-fading, Probability of error analysis under fading channel, Time diversity, Frequency diversity, Polarization diversity, Space diversity, Selective diversity combining, scanning diversity, Maximal ratio-combining and Equal gain combining, Performance analysis of Rayleigh fading channel, RAKE Receiver, Analysis of BER of Multi-Antenna system, Diversity order.

**UNIT V**

**Spread Spectrum Techniques:** Introduction to spread spectrum, Orthogonal spreading codes, Benefits of spreading, Multi-user CDMA, Performance Analysis of CDMA uplink and downlink with multiple users, Asynchronous CDMA, Near-far problem, Power control.

**UNIT VI**

**OFDM:** Introduction to Multi-carrier modulation, Importance of cyclic prefix, Adaptive modulation and coding techniques, OFDM issues,PAPR, Frequency and timing offset, ICI mitigation techniques. Overview of various evolutions of wireless communication technologies: GSM, GPRS, EDGE, CDMA, 3G, 4G and beyond 4G.

**Recommended Books:**

1. Aditya K. Jagannatham, Principles of Wireless Communication Systems, 2015, Ist Edition, McGraw-Hill India.
2. T. S. Rappaport, "Wireless Communications," Pearson Education, 2003.

**Reference Books:**

1. Simon Haykin, Micheal Moher, Modern Wireless Communications, 2011 I$^{st}$ Edition, Pearson Education, India.
2. T L Singal, "Wireless Communications", Tata McGraw Hill, 2010.
3. Wireless Communication and Networking- William Stallings, 2003, PHI.

# PCCMECE202L
# MODERN WIRELESS COMMUNICATION SYSTEMS LAB

**List of Experiments:**

1.Simulation of Free-space propagation model using MATLAB.

2.Simulation of Hata and Okumura model using MATLAB.

3.Determination of path loss using Okumura Hata model for urban, suburban and rural areas.

4.Plot Path loss curve with respect to distance for different values of path loss exponent between 2 to 4.

5.Simulation of Adaptive Linear Equalizer using MATLAB.

6.Simulation of RAKE receiver for CDMA communication using MATLAB.

**Tools Required: MATLAB, and supported SDR hardware**

# PCCMECE203
# OPTIMIZATION TECHNIQUES

**UNIT-I**

Introduction &Concepts of Optimization Formulation of Linear Programming Problems, General Statement of LPP, Assumptions Underlying LP, Solution of Linear Programming Problems: Graphic Method. Some Special Cases of Graphic Method, Convex Set: Extreme points of Convex Set, Convex hull.

**UNIT-II**

Simplex Techniques LP Model in Equation Form, Transition From Graphical To Algebraic Solution, Simplex Algorithm, Artificial starting solution: Big M-Method, Two-phase Method, Special cases in Simplex Method: Degeneracy, Alternative Optima, Unbounded solution, infeasible solution.

**UNIT-III**

Transportation Models Mathematical Model of Transportation Problem, Methods of finding Initial basic feasible solution by NWC Rule, LCM,VAM, Test for optimality by Stepping Stone and MODI method, Balanced and Unbalanced Transportation Problems, Degeneracy. Assignment Model: Mathematical Model of Assignment Problem, The Hungarian Method, Simplex Explanation of the Hungarian Method.

**UNIT-IV**

Engineering Applications Network Models: Shortest route Algorithm, network Construction, Rules for network diagram, Techniques in project planning and Construction, CPM, Project Crashing. Sequencing Model: Advantages of Sequencing, Johnsons Algorithm of Sequencing problems, Type I: n jobs two machines, Type II: n jobs three machines, Type III: two jobs m machines. General Structure of Queuing System, Operating Characteristics of Queuing System, Queuing Models, Role of Poisson and Exponential Distributions, Pure Birth and Death Models, Generalized Poisson Queuing Model, Specialized Poisson Queues: Single, Multiple and Machine Serving Models.

**Recommended Books:**

1.Linear Programming by G. Hadlay, Addison Wasley.
2.Operations Research – An Introductory by Hamidi A. Taha, Macmillan.
3.Operations Research – Methods and problems by M. Sasieni, A. Yaspam and L. Friedman, John Wily and Sons Inc. London.

**References:**

1.Linear Programming by S.I. Gass, Mc-Graw Hill.
2.Introduction to Operations Research. John Wiley and Sons, New York.
3.Operations Research: An Introduction. Prentice Hall of India Private Limited, New Delhi Wagner.

# PROFESSIONAL ELECTIVE-I
(DETAILED SYLLABUS)

# PEC1MECE104
# 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.

**Recommended Books:**


- Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014
- Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
- Editors OvidiuVermesan Peter Friess,'Internet of Things – From Research and Innovation to Market
- N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

# PEC1MECE104L
# 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.

**Required Tools:**

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

# PEC1MECE105
# 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

# PEC1MECE105L
# 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.

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

# PEC1MECE106
# 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.

**Recommended Books:**

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

# PEC1MECE106L
# DIGITAL IMAGE PROCESSING LAB

**List of Experiments in MATLAB:**

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

**Required Tools:**

**MATLAB Software, Hardware support for DIP toolbox**

# PEC1MECE107
# 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, eigen values and eigenvectors, Calculating eigenvectors, Visualizing 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, Linearization, 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,

**Recommended Books:**

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

# PEC1MECE107L
# Mathematics for Machine Learning Lab

List of Experiments:

1. Experiment on vector operations.
2. Experiment on parameter space.
3. Experiment on solving simultaneous equations.
4. Experiment on changing basics.
5. Experiment on dot product of vectors.
6. Experiment on linear dependency of a set of vectors
7. Experiment on vector operations assessment.
8. Experiment on identifying special matrices.
9. Experiment on using matrices to make transformations.
10. Experiment on mapping to spaces with different number of dimensions.
11. Experiments on characteristic polynomials, eigenvalues and eigenvectors.
12. Experiment on differentiation of functions.
13. Experiment on matching functions visually.
14. Experiment on practicing the chain rule.
15. Experiment on practicing the product rule.
16. Experiments of the Sandpit, Jacobians and Hessians.
17. Experiments of Taylor Series.

**Tools Required:** Python.

# PEC1MECE108
# Mathematics for Signal Processing

**UNIT I**

Defining Random Variables (RVs) Events, Measurability, Independence •Sample Spaces, Events, Measures, Probability •Independence, Conditional probability, Bayes' theorem Random Variables •RVs: Bernoulli, Binomial, Geometric, Poisson; Uniform, Exponential, Normal, Lognormal •Expectations, Moments and Moment generating functions Random Vectors •Random Vectors: Joint and Marginal distributions, Dependence, Covariance, Copulas •Transformations of random vectors, Order statistics

**UNIT II**

Applied Linear Algebra: Linear independence, Linear transformations, Cramer's rule, volume and linear transformations, Vector spaces and subspaces, Null spaces, column spaces, and linear transformations, Linearly independent sets; bases, Coordinate system, The dimension of a vector space, Matrix of a linear transformation, Linear models in business, science and engineering.

**UNIT III**

Markov Chains •Markovian property and Transition probabilities •Irreducibility and Steady-State probabilities. Hidden Markov Chains: Exponential Distribution and Poisson Process •Construction of Poisson Process from Exponential Distribution •Thinning and Conditional Arrival Times •Service Applications: Waiting Times, Normal Distribution and Brownian Process •Finance Applications: Option Pricing and Arbitrage Theorem.

**UNIT IV**

Queuing Theory And Reliability Models: General concepts of queuing, Measures of performance, Arrival and Service processes, Single server and multi-server models, channels in parallel with limited and unlimited queues –M/M/1/K, M/M/C. Queues with unlimited service, Finite source queues, Applications of Simple Queuing Decision Models, Design and Control Models.

**UNIT V**

Linear Programming: Introduction, geometry, duality, sensitivity analysis. Simplex method, large scale optimization, network simplex. Ellipsoid method, problems with exponentially many constraints, equivalence of optimization and separation. Convex sets and functions, generalized inequalities and convexity, convex optimization problems, quasi-convex, linear, quadratic, geometric, vector, semi-definite. Duality, optimality conditions, sensitivity analysis. Integer Programming. Mixed integer optimization.

**Recommended Books:**


- Probability, Random Variables & Random Signal Principles -Peyton Z. Peebles, TMH.
- Probability and Random Processes-Scott Miller, Donald Childers, 2Ed,Elsevier.
- Statistical Theory of Communication -S.P. Eugene Xavier, New Age Publications.
- Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill
- Khanna, V. K. and Ghamdri, S. K.- Course of Abstract Algebra, Vikash Pub.
- Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., ―Fundamentals of Queuing Theory", Wiley.

# PEC1MECE108L
# Mathematics for Signal Processing Lab

List of Experiments:

1. Experiments on Random Variables.
2. Experiments on Linear Algebra.
3. Experiments on Markov Chains.
4. Experiments on Queuing Theory.
5. Experiments on Reliability Models.
6. Experiments on Linear Programming.

# PEC1MECE109
# ADVANCED DIGITAL SYSTEM

**UNIT I:**
Review of flip-flop basics -Excitation tables, and characteristic equations of flip-flops. Analysis and Design of synchronous sequential circuits-state table, state diagram and State- Equations Derivation of state table and state diagrams for sequential circuits. State Reduction, state assignment, Rules for state assignments.

**UNIT II:**
Design of sequential circuits using state assignment rules for assigning states. Design of the clocked sequential circuits for given state diagram. Design of the clocked sequential circuits for given state diagram using state reduction technique. Lockout conditions. Design of clocked sequential circuits avoiding lock-out condition.

**UNIT III:**
Sequence generators using counters and shift registers. Design digital system to generate the sequence 1101011 using JK flip-flops. Design digital system to generate the sequence 1101011 by shift register method. Modulus –N synchronous counter. Design of Digital watch. Design of 3-bit up/down counter.

**UNIT IV:**
Deterministic Machine, Mealy machine, Block diagram of Mealy machine Moore machine, block diagram of Moore machine Hazards, gate delays, the generation of spikes, production of static hazards in combinational circuits. Elimination of static hazards.

**UNIT V:**
Design and implementation of carry look ahead adder circuit. Implementation of Boolean functions using PLA and PAL.

**Recommended Books:**

Digital logic Design by B. Holdsworth (Tata McGraw-Hill)
VHDL Programming by Example by Douglas L. Perry(Tata McGraw-Hill).
Digital Logic Applications and Design by John M. Yarbrough.(Thomson Brooks/cole).
Introduction to Logic Design by Alan B. Marcovitz(Tata McGraw-Hill).

# PEC1MECE109L
# ADVANCED DIGITAL SYSTEM LAB

**List of experiments:**

1. Write VHDL code for basic AND gate.
2. Using VHDL program, Design J-K Flip-Flop.
3. Using VHDL program, Design of D Flip- Flop.
4. Write VHDL code for 2:1 Multiplexer.
5. Write VHDL code for Half-adder.
6. Write VHDL code for Half-Subtractor.
7. Designing of T Flip Flop using VHDL.
8. Using VHDL program, for 2:4 decoder.
9. Write VHDL program for shift register.

# PROFESSIONAL ELECTIVE-II
(DETAILED SYLLABUS)

# PEC2MECE203
# 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, Regularizing Linear models ML pipeline Bootstrap sampling Grid search Cross Validation.

**Recommended Books:**

**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

# PEC2MECE203L
# INTRODUCTION TO MACHINE LEARNING LAB

1. Basic concepts of object programming in Python A short journey from procedural to object approach Properties Methods Inheritance

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.

# PEC2MECE204
# 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.

**Recommended Books:**


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

# PEC2MECE204L
# 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**

# PEC2MECE205
# 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.

# PEC2MECE205L
# 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:**

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

# PEC2MECE206
# 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 Materials**:

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

# PEC2MECE206L
# RF CIRCUIT DESIGN LAB

**Tools to be used**: Advanced Design System

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

**Section II:**

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

# PEC2MECE207
# EMBEDDED SYSTEM USING PIC-18

**Unit-I**

The PIC Microcontrollers: Introduction to Computer Systems, Introduction to Harvard & Von Neumann Architectures, CISC & RISC, Architecture, History and features, Microcontrollers and Embedded Processors, Overview of PIC- 18 Family. Working Register in the PIC.PIC-18 File Registers, PIC Data format and Directives, Program counter and program ROM space in the PIC -18. Program Ram Space in the PIC-18. Viewing registers and memory with MPLAB Simulator.

**Unit-II**

Port programming in PIC-18: TRIS register role in outputting, TRIS register role in inputting, Reading LATx for ports, BSF, BCF, BTG, BTFSS, and BTFSC instructions. Bank Switching in the PIC-18.

**Unit-III**

PIC18F458: PIC18F458 pin diagram, Configuration Registers (CONFIG1H, CONFIG2L), programming of Timers 0and 1.PIC-18 Serial Port programming. SPBRG register and baud rate in PIC-18. TXREG, RCREG TXSTA and RCSTA registers. Importance of the TXIF Flag.

**Unit-IV**

Interrupt programming in assembly and C: Sources of interrupts in the PIC-18, steps in executing an interrupt, Interrupt priority in PIC-18, steps in enabling an interrupt. programming using Microchip MPLAB software.

**Unit-V**

Interfacing with PIC-18: interfacing and programming of LCD with pic-18 using C and assembly programming, interfacing of 4x4 keypad to PIC-18. Programming PIC18F458 ADC in C and assembly.DAC interfacing and programming in C. Interfacing of temperature sensorLM35 to the PIC-18. DC Motor interfacing and PWM.

**Text and Reference Books:**

1. Designing Embedded Systems with PIC Microcontrollers: Principles and Applications, 2nd Edition, Tim Wilmshurst, Elsevier Publication.
2. Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation by Martin Bates, Elsevier Publication.
3. PIC Microcontroller and Embedded Systems Using Assembly and C for PIC 18 by Muhammad Ali Mazidi, Rolin D. McKinlay and Danny Causey, Pearson Publication.
4. Advanced PIC Microcontroller Projects in C from USB to RTOS with the PIC18F Series by Dogan Ibrahim, Elsevier

# PEC2MECE207L
# EMBEDDED SYSTEM USING PIC-18 LAB

**List of Experiments:**

1. Study of implementation, analysis and interfacing of LED using Microchip MPLAB software and PIC-16/18.

2. Study and analyze the interfacing of 16x2 LCD Microchip MPLAB software and PIC-16/18.

3. Study of implementation, analysis and interfacing of seven segment display using PIC-16/18.

4. Study and Interfacing of ADC Microchip MPLAB software and PIC-16/18.

5. Study and Interfacing of DAC Microchip MPLAB software and PIC-16/18.

6. To study & observe direction control of D.C Motor using with Microcontroller PIC-16/18.

7. To study & implement ultrasonic sensor for finding range using Arduino UNO Development Platform.

8. To study & implement pulse sensor using Arduino UNO Development Platform.

9. To study practically, how advanced microcontroller PIC 16/18 pins are used as input and output pin.

# PROFESSIONAL ELECTIVE-III
(DETAILED SYLLABUS)

# PEC3MECE301
# 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.

**Recommended Books:**


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.

# PEC3MECE301L
# MIXED SIGNAL DESIGN LAB

**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

# PEC3MECE302
# 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 thermosensors – 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 Magnetoresistive Sensing – Semiconductor Magnetoresistors– 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.

# PEC3MECE302L
# 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.Designand 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.**

# PEC3MECE303
# ADVANCED DIGITAL COMMUNICATION

**UNIT I**

**Introduction Elements of Digital Communication System**: Communication channels and their characteristics - mathematical models for channels - representation of digitally modulated signals - performance of memoryless modulation methods - signalling schemes with memory - CPFSK - CPM.

**UNIT II**

**Optimum Receivers for AWGN Channels Waveform and Vector Channel Models**: Detection of signals in Gaussian noise - optimum detection and error probability for band limited signalling and power limited signalling - non coherent detection - comparison of digital signalling methods - lattices and constellations based on lattices - detection of signalling schemes with memory - optimum receiver for CPM - performance analysis for wireline and radio communication systems; Introduction to partially coherent, double differentially coherent communication systems.

**UNIT III**

**Channel Coding Introduction to Linear Block Codes:** Convolution coding - Tree, Trellis and state diagrams – systematic - non-recursive and recursive convolutional codes - the inverse of a convolutional encoder and catastrophic codes - decoding of convolutional codes - maximum likelihood decoding - Viterbi algorithm and other decoding algorithms - distance properties - punctured convolutional codes - dual k codes - concatenated codes - MAP and BCJR algorithms - turbo coding and iterative decoding - factor graphs and sum-product algorithms - LDPC codes - trellis coded modulation - performance comparison.

**UNIT IV**

**Pulse Shaping and Equalization Pulse Shaping**: Characterization of band limited channels - ISI - Nyquist criterion - controlled ISI - channels with ISI and AWGN - pulse shaping for optimum transmissions and reception; Equalization: MLSE - linear equalization - decision feedback equalization - ML detectors - iterative equalization - turbo equalization - adaptive linear equalizer - adaptive decision feedback equalization - blind equalization.

**UNIT V**

**Synchronization, Signal Parameter Estimation**: Carrier phase estimation - symbol timing estimation - joint estimation of carrier phase and symbol timing - performance characteristics of ML estimators.

**Recommended Books:**


1. John G. Proakis and Masoud Salehi, “Digital communications”, 5th Edition, Tata McGraw Hill, 2008.
2. Ian A. Glover and Peter M. Grant, “Digital Communications”, 2nd Edition, Pearson Education, 2008.
3. Bernard Solar, “Digital Communications: Fundamentals and Applications”, 2nd Edition, Pearson Education, 2002.
4. Marvin K.Simon, M. Hinedi and William C. Lindsey, “Digital Communication Techniques: Signal Design and Detection”, Prentice Hall of India, 2009.
5. John R. Barry, Edward A. Lee, David G. Messerschmitt, “Digital Communication”, Kluwer Academic Publishers, 2004.

# PEC3MECE303L
# ADVANCED DIGITAL COMMUNICATION LAB

**Hardware related experiments:**

1. Sampling and reconstruction of low pass signals
2. Time Division Multiplexing
3. BPSK/DPSK generation & detection
4. QPSK/OQPSK generation & detection
5. 8-QAM generation & detection
6. FSK generation and detection

**Simulation based experiments: (Matlab / Labview simulation)**

1. Sampling & reconstruction of low pass signals
2. BPSK Modulation & detection
3. BER of BPSK in AWGN channel
4. QPSK generation & detection
5. BER of QPSK in AWGN channel
6. QAM generation & detection
7. 16 QAM constellation diagram
8. Generation of Nyquist-I pulse
9. Designing an equalizer in the context of baseband binary data transmission
10. OFDM generation and detection

(Any of the 5 five "Hardware related experiments" and Five 5 more "Simulation based experiments" are compulsory while rest of the experiments will be optional.).

Tools Required: MATLAB, MATLAB supported Dcom hardware

# PEC3MECE304
# MODERN SIGNAL PROCESSING ARCHITECTURES

**UNIT I:**

Introduction for DSP algorithms: VLSI Design flow, Mapping algorithms into Architectures: Graphical representation of DSP algorithms – signal flow graph (SFG), data flow graph (DFG), critical path, dependence graph (DG). Data path synthesis, control structures, Optimization at Logic Level and architectural Design, Loop bound and iteration bound, Algorithms for computing iteration bound, Iteration bound of Multirate data-flow graphs.

**UNIT II:**

Parallel and pipeline of signal processing application : Architecture for real time systems, latency and throughput related issues, clocking strategy, power conscious structures, array architectures; Pipelining processing of Digital filter, Parallel processing, Parallel and pipelining for Low power design, Optimization with regard to speed, area and power, asynchronous and low power system design, ASIC (application specific integrated circuits) and ASISP application specific instruction set processors) design;

**UNIT III:**

Architecture of different signal processing modules: Convolution technique, Re-timing concept, Folding /Unfolding Transformation, CORDIC architecture.

**UNIT IV:**

Low power Design: Theoretical background, Scaling v/s power consumption, power analysis, Power reduction techniques, Power estimation approach

**UNIT V:**

Application in communication and signal processing system: Transformation architectures, source and channel coding structures, Motion Estimation and motion compensation for video, Speech processing algorithm

**Recommended Books:**

1) VLSI Digital Signal Processing Systems: Design and Implementation By K.K. Parhi , John Wiley & Sons, 1999 (ISBN Number: 0-471-24186-5)
2) Richard J, Higgins, Digital Signal Processing in VLSI, Prentice Hall, ISBN-10: 013212887X, ISBN-13: 9780132128872
3) M.A. Bayoumi, VLSI Design Methodology for DSP Architectures, Kluwer, 1994
4) U. Meyer – Baese , Digital Signal Processing with FPGAs, Springer, 2004

# PEC3MECE304L
# MODERN SIGNAL PROCESSING ARCHITECTURES LAB

**List of Experiments:**

1.Mapping of elementary DSP SFGs into Architectures.

2.Study and Analysis of Critical paths in various SFG based architectures.

3.Study and Analysis of effect of Pipelining in basic algorithms.

4.Study and Analysis of effect of Pipelining on critical paths in various SFG based hardware architectures.

5.Study and Analysis of Parallel processing in basic DSP architectures.

6.Comparison of pipelining and Parallel processing using basic SFGs.

7.Optimization of basic algorithms with regard to speed, area and power.

8.Study and Analysis of Retiming concept using Folding /Unfolding Transformation.

**Resources required for the course:**

**Software**: Xilinx Vivado

**Hardware**: Computers, FPGA Kits of appropriate generation.

# PEC3MECE305
# 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.

**Recommended Books:**


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 a Neural Networks Using Python, Scikit-Learn and TensorFlow by Sanders, Finn
3. Deep Learning with Python, François Chollet

# PEC3MECE305L
# DEEP LEARNING LAB

**List of Experiments:**

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

**Tools required:**

- Python Software
- MATLAB Software
- Online Computing Platforms: Google Colab, Kaggle.

# PROFESSIONAL ELECTIVE-IV
(DETAILED SYLLABUS)

# PEC4MECE306
# 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

**Recommended Books:**

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

# PEC4MECE306L
# 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**

# PEC4MECE307
# 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:**


1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
2. Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.
3. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
4. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning, 2009.
5. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
6. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing Company Ltd., 1995.
7. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
8. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
9. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985

# PEC4MECE307L
# 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.

Experiments on Robotic Simulation Software.

# PEC4MECE308
# 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.

**Recommended Books:**


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.

# PEC4MECE308L
# 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**

# PEC4MECE309
# QUANTUM COMPUTING

**UNIT I**

Introduction to Quantum Computation: Quantum computing fundamentals, Quantum bits, Bloch sphere representation of a qubit, multiple qubits.

**UNIT II**

Background Mathematics and Physics: Linear Algebra, Hilbert space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

**UNIT III**

Quantum Circuits: single qubit gates, multiple qubit gates, Universal quantum gates, design of quantum circuits, Quantum decomposition.

**UNIT IV**

Quantum Information and Cryptography: Comparison between classical and quantum information theory. Stern-Garlach experiment, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

**UNIT V**

Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search Algorithm. Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation.

**Recommended Books:**

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press,2002.
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms, 2000.

# PEC4MECE309L
# QUANTUM COMPUTING LAB

**List of Experiments:**

- Introduction to Python and various quantum libraries qiskit, qutip.
- Design of universal quantum gates like CNOT, Toffoli and Fredkin gates using qiskit
- Access a rich set of well-studied circuits, which can be used as benchmarks, building blocks in more complex circuits
- Study and reduce the impact of noise using built-in modules for noise characterization and circuit optimization.

**Tools Required: PYTHON.**

# PEC4MECE310
# COMPUTER VISION

**UNIT I:**
Introduction: overview of computer vision, related areas, and applications; overview of software tools; overview of course objectives. Introduction to OpenCV. Image formation and representation: imaging geometry, radiometry, digitization, cameras and projections, rigid and affine transformations.

**UNIT II:**
Filtering: convolution, smoothing, differencing, and scale space. Feature detection: edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, shape context descriptors. Model fitting: Hough transform, line fitting, ellipse and conic sections fitting, algebraic and Euclidean distance measures.

**UNIT III:**
Camera calibration: camera models; intrinsic and extrinsic parameters; radial lens distortion; direct parameter calibration; camera parameters from projection matrices; orthographic, weak perspective, affine, and perspective camera models. Epipolar geometry: introduction to projective geometry; epipolar constraints; the essential and fundamental matrices; estimation of the essential/fundamental matrix.

**UNIT IV:**
Model reconstruction: reconstruction by triangulation; Euclidean reconstruction; affine and projective reconstruction. Motion analysis: the motion field of rigid objects; motion parallax; optical flow, the image brightness constancy equation, affine flow; differential techniques; feature-based techniques; regularization and robust estimation; motion segmentation through EM.

**UNIT V:**
Motion tracking: statistical filtering; iterated estimation; observability and linear systems; the Kalman filter; the extended Kalman filter. Object recognition and shape representation: alignment, appearance-based methods, invariants, image eigenspaces, data-based techniques.

**Recommended Books:**


1. Computer Vision: Algorithms and Applications, R. Szeliski, Springer, 2011.
2. Computer Vision: A Modern Approach, D. Forsyth and J. Ponce, Prentice Hall, 2nd ed., 2011.
3. Introductory techniques for 3D computer vision, E. Trucco and A. Verri, Prentice Hall, 1998.

# PEC4MECE310L
# COMPUTER VISION LAB

**List of Experiments:**

1. Basic experiments related to Python programming.
2. Basic experiments related to Matlab programming.
3. Experiments related to installation, configuration and troubleshooting for Python.
4. Experiments related to installation, configuration and troubleshooting for Matlab.
5. Using Google-Colab, Kaggle, and other online computing platforms.
6. Experiments on feature detection for Computer Vision related experiments.
7. Using SIFT and HOG features for Computer Vision related experiments.
8. Using K-Nearest Neighbor (KNN) Classifier for Computer Vision related experiments.
9. Using Support Vector Machine (SVM) Classifier for Computer Vision related experiments.
10. Using Deep Learning based Classifiers for Computer Vision related experiments.
11. Basic experiments on OpenCV for Computer Vision related experiments.
12. Experiments on object recognition in images.
13. Experiments related to Computer Vision using Kalman filter.

**Tools: Python, Matlab.**

# OPEN ELECTIVE COURSES
## (DETAILED SYLLABUS)

# OECMECE311
# EMBEDDED DESIGN AND 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 flavors, 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.

**Recommended Books:**


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

# OECMECE311L
# EMBEDDED DESIGN AND PROTOTYPING LAB

**Basic IDE**

Creating and Saving a Sketch-Structuring an Arduino Program-Using Simple Primitive Types- Using Floating-Point Numbers Working with Groups of Values Using Arduino -Structuring Your Code into Functional Blocks Returning More Than One Value from a Function-Taking Actions Based on Conditions-Repeating a Sequence of Statements-Repeating Statements with a Counter-Breaking Out of Loops-Taking a Variety of Actions Based on a Single Variable-Comparing Character and Numeric Values-Comparing Strings -Performing Logical Comparisons Performing Bitwise Operations-Combining Operations and Assignment

**Using Mathematical Operators**

Finding the Remainder After Dividing Two Values-Determining the Absolute Value Constraining a Number to a Range of Values Finding the Minimum or Maximum of Some Values Raising a Number to a Power Taking the Square Root Rounding Floating-Point Numbers Up and Down Using Trigonometric Functions Generating Random Numbers Setting and Reading Bits Shifting Bits Extracting High and Low Bytes in an int or long Forming an int or long from High and Low Bytes

**Serial Communications**

Sending Debug Information from Arduino to Your Computer Sending Formatted Text and Numeric Data from Arduino, Receiving Serial Data in Arduino Sending Multiple Text Fields from Arduino in a Single Message Receiving Multiple Text Fields in a Single Message in Arduino Sending Binary Data from Arduino Receiving Binary Data from Arduino on a Computer Sending Binary Values from Processing to Arduino Sending the Value of Multiple Arduino Pins Logging Arduino Data to a File on Your Computer

**Digital and Analog input/Output**

Using a Switch Using a Switch Without External Resistors Reliably, Detecting the Closing of a Switch Determining How Long a Switch Is Pressed .Detecting Movement Detecting Light Detecting Motion (Integrating Passive Infrared Detectors) Measuring Distance Measuring Distance Accurately Detecting Vibration Detecting Sound Measuring Temperature Connecting and Using LEDs Adjusting the Brightness of an LED Driving High-Power LEDs Adjusting the Color of an LED Sequencing Multiple LEDs: Creating a Bar Graph Sequencing Multiple LEDs: Driving a 7-Segment LED Display Driving Multidigit, Increasing the Number of Analog Outputs Using PWM Extender Chips (TLC5940) Controlling Servos from the Serial Port Driving a Brushless Motor (Using a Hobby Speed Controller) Controlling Solenoids and Relays Making an Object Vibrate Driving a Brushed Motor Using a Transistor Controlling the Direction of a Brushed Motor with an H-Bridge Controlling the Direction and Speed of a Brushed Motor with an H-Bridge Using Sensors to Control the Direction and Speed of Brushed Motors (L293 H-Bridge) Driving a Bipolar Stepper Motor Driving a Bipolar Stepper Motor (Using the EasyDriver Board)Driving a Unipolar Stepper Motor (ULN2003A)

**Tools Required: MATLAB, LABVIEW, ARDUINO IDE AND SUPPORTED HARDWARE**

# OECMECE312
# 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

**Recommended Books:**

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

# OECMECE312L
# 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 modelling on PC.

5.Electrical system modelling 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.**

# OECMECE313
# BLOCKCHAIN AND CRYPTOCURRENCY

**UNIT I**

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

**UNIT II**

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

**UNIT III**

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

**UNIT IV**

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum -
Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

**UNIT V**

Cryptocurrency Regulation: Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

**Recommended Books:**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

**Reference Books:**

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

# OECMECE313L
# BLOCK CHAIN AND CRYPTOCURRENCY LAB

Naive Blockchain construction, Memory Hard algorithm – Hashcash implementation, Direct Acyclic Graph, Play with Go-ethereum, Smart Contract Construction, Toy application using Blockchain, Mining puzzles.

**Tools Required: PYTHON, BLOCKCHAIN SW.**

# OECMECE314
# CODING TECHNIQUES

**A) Python**

**A-I**

Introduction to Python. Sequence String, List, Tuples, Indexing sequences, Slicing, Passing arguments to functions, Call by value Call by reference, Argument passing in Python, Performance considerations, Input and Output: Printing to standard, Conditionals: If-then-else, For loop, While loop, Relational operators (comparisons) in if and while, Exceptions, Raising Exceptions.

**A-II**

SymPy: Numeric types Differentiation and Integration, Ordinary differential equations Series expansions and plotting Linear equations and matrix inversion Nonlinear equations. Numerical Computation, Numbers and numbers, Limitations of number types Using floating point numbers, Arrays Numpy introduction, Arrays Convert from array to list or tuple.

**A-III**

Visualizing Data with Matplotlib and Pylab, Numerical Methods using Python (scipy). Overview SciPy Numerical integration, Solving ordinary differential equations.

**B) R Language**

**B-I**

Introducing to R – R Data Structures – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorized if-then else – Vector Equality – Vector Element names. Creating matrices – Matrix operations – Creating lists – General list operations.

**B-II**

Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Recursion.

**B-III**

S3 Classes – S4 Classes – Managing your objects – Input/Output – accessing keyboard and monitor – reading and writing files – accessing the internet – String Manipulation – Graphics – Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots

**Recommended Books:**


- Python The Complete Reference by Martin C. Brown, Tata McGraw-Hill Education India
- Python Crash Course by Eric Matthes published by O'Reilly

# OECMECE314L
# CODING TECHNIQUES LAB

**List of Experiments for Python:**

1. Basic concepts of object programming in Python
2. Introduction to Python Packages NumPy, Pandas, Matplotlib, Seaborn, ScikitLearn
3. Visualizing Data with Matplotlib and Pylab
4. Numerical Methods using Python (scipy)
5. Solving ordinary differential equations.
6. Introduction to traditional Datasets used in Machine Learning
7. Introduction to Classification: Intuitive understanding of the Naïve Bayes Classification, Mathematical Formulation, Implementation of Naïve Bayes Classification using Python- ScikitLearn
8. Introduction to Regression: Intuitive understanding of the Linear Regression, visualizing linear regression, Machine learning applications of linear regression.

**List of Experiments for Python:**

1. Study of data analysis using MS-Excel(Prerequisite)
2. Study of basic Syntaxes in R
3. Implementation of vector data objects operations
4. Implementation of matrix, array and factors and perform va in R
5. Implementation and use of data frames in R
6. Create Sample (Dummy) Data in R and perform data manipulation with R
7. Study and implementation of various control structures in R
8. Data Manipulation with dplyr package
9. Data Manipulation with data.table package
10. Study and implementation of Data Visualization with ggplot2
11. Study and implementation data transpose operations in R