## 1st SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Basic Science Course | UBSCH101 | CHEMISTRY | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 2 | Basic Science Course | UBSMH102 | MATHEMATICS - I | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 3 | Engineering Science Course | UESCS103 | PROGRAMMING FOR PROBLEM SOLVING | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 4 | Basic Science Course | ULCCH101 | CHEMISTRY LAB | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 5 | Engineering Science Course | ULCCS103 | PROGRAMMING FOR PROBLEM SOLVING LAB | 0 | 0 | 4 | 2 | 0 | 0 | 100 | 100 |
| 6 | Engineering Science Course | ULCME104 | ENGINEERING GRAPHICS AND DESIGN LAB | 1 | 0 | 4 | 3 | 0 | 0 | 100 | 100 |
| | | | | | | | **17.5** | | | | **600** |
| **7** | **Mandatory Course** | | **Induction Programme** | | | | | | | | |

## 2nd SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Basic Science Course | UBSPH111 | PHYSICS | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 2 | Basic Science Course | UBSMH202 | MATHEMATICS-II | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 3 | Engineering Science Course | UESEE113 | BASIC ELECTRICAL ENGG. | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 4 | Humanities &Social Sciences | UHSMH205 | ENGLISH | 2 | 0 | 0 | 2 | 30 | 70 | 0 | 100 |
| 5 | Basic Science Course | ULCPH111 | PHYSICS LAB | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 6 | Engineering Science Course | ULCEE113 | BASIC ELECTRICAL ENGG. LAB | 0 | 0 | 2 | 1 | 0 | 0 | 100 | 100 |
| 7 | Engineering Science Course | ULCME114 | WORK SHOP/BASIC MANUFACTURING PROCESS LAB | 1 | 0 | 4 | 3 | 0 | 0 | 100 | 100 |
| 8 | HS | ULCMH204 | ENGLISH LAB | 0 | 0 | 2 | 1 | 0 | 0 | 100 | 100 |
| | | | **Total** | | | | **20.5** | | | | **800** |

## 3rd SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Core Course | UPCIE301 | Network Theory | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 2 | Core Course | UPCIE302 | Analog Electronics Circuit | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 3 | Core Course | UPCIE303 | Electrical & Electronics Measurement | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 4 | Engg. Science Course | UESIE301 | Signal & System | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 5 | Basic Science Course | UBSMH301 | Mathematics-III | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 6 | Humanities Science Course | UHSMH212 | Organizational Behavior | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 7 | Lab Course | ULCIE301 | Analog Electronic Circuit Laboratory | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 8 | Lab Course | ULCIE302 | Electrical & Electronics Measurement Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| | | | **Total** | | | | **23** | | | | **800** |

## 4th SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Core Course | UPCIE401 | Digital System Design | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 2 | Core Course | UPCIE402 | Electromagnetic field theory | 3 | 1 | 0 | 4 | 30 | 70 | 0 | 100 |
| 3 | Core Course | UPCIE403 | Instrumentation Devices & Systems-I | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 4 | Engg. Science Course | UESIE401 | Fundamental of Communication Theory | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 5 | Humanities Science Course | UHSMH211 | Engineering Economics | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 6 | Lab Course | ULCIE401 | Digital System Design Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 7 | Lab Course | ULCIE402 | IDS-I Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 8 | Lab Course | ULCIE403 | Communication Engg. Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 9 | Mandatory Course | UMCCE401 | Environmental Science | 2 | 0 | 0 | 0 | 30 | 70 | 0 | 100 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Total** | | | | **20.5** | | | | **900** |

## 5th SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Core Course | UPCIE501 | Microprocessor & Microcontroller | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 2 | Core Course | UPCIE502 | Control System Engineering | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 3 | Core Course | UPCIE503 | Instrumentation Device Systems-II | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 4 | Core Course | UPCIE504 | Process Control-I | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 5 | Programme Elective-I | UPEIE501 | Optoelectronic Devices and Instrumentation | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| | | UPEIE502 | Fibre optics Instrumentation | | | | | | | | |
| 6 | Open Elective-I | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 7 | Lab Course | ULCIE501 | Microprocessor & Microcontroller Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 8 | Lab Course | ULCIE502 | Control System Engineering Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 9 | Lab Course | ULCIE503 | Process Control I Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| | | | **Total** | | | | **22.5** | | | | **900** |

## 6th SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Core Course | UPCIE601 | Process Control-II | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 2 | Core Course | UPCIE602 | Digital Signal Processing | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 3 | Programme Elective-II | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 4 | Programme Elective-III | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 5 | Open Elective-II | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 6 | Lab Course | ULCIE601 | Instrumentation design lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Lab Course | ULCIE602 | Digital Signal Processing Lab | 0 | 0 | 3 | 1.5 | 0 | 0 | 100 | 100 |
| 8 | Lab Course | ULCIE603 | Design and simulation lab | 0 | 0 | 4 | 2 | 0 | 0 | 100 | 100 |
| 9 | Mandatory Course | | | 2 | 0 | 0 | 0 | 30 | 70 | 0 | 100 |
| | | | **Total** | | | | **20** | | | | **900** |

## Programme Elective-II & III

| Sl. no | Code | Subjects | L | T | P | Contact hrs. /wk. | Credits |
|---|---|---|---|---|---|---|---|
| 1 | UPEIE601 | Analytical Instrumentation | 3 | 0 | 0 | 3 | 3 |
| 2 | UPEIE602 | Biomedical Instrumentation | 3 | 0 | 0 | 3 | 3 |
| 3 | UPEIE603 | Power Electronics and drive | 3 | 0 | 0 | 3 | 3 |
| 4 | UPEIE604 | Advanced Electronics Circuit | 3 | 0 | 0 | 3 | 3 |

## 7th SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Programme Elective-IV | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 2 | Programme Elective-V | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 3 | Open Elective-III | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 4 | Open Elective-IV | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 5 | Humanities Science Course | UHSMH701 | Entrepreneurship Development | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 6 | Project Course | UPRIE701 | Project Stage-1 | 0 | 0 | 6 | 3 | 0 | 0 | 100 | 100 |
| 7 | Seminar | USEIE701 | Seminar | 0 | 0 | 2 | 1 | 0 | 0 | 100 | 100 |
| | | | **Total** | | | | **19** | | | | **700** |

## Programme Elective-IV & V

| Sl no | Code | Subjects | L | T | P | Contact hrs. /wk. | Credits |
|---|---|---|---|---|---|---|---|
| 1 | UPEIE701 | Adaptive Signal Processing | 3 | 0 | 0 | 3 | 3 |
| 2 | UPEIE702 | Advanced Control System | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | UPEIE703 | Embedded System | 3 | 0 | 0 | 3 | 3 |
| 4 | UPEIE704 | MEMS | 3 | 0 | 0 | 3 | 3 |
| 5 | UPEIE705 | VLSI | 3 | 0 | 0 | 3 | 3 |

## 8th SEMESTER

| Sl. No. | Subject Type | Subject Code | Subject Name | Teaching Hours/Week | | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | IA | EA | PA | Total |
| 1 | Programme Elective-VI | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 2 | Open Elective-V | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 3 | Open Elective-VI | | | 3 | 0 | 0 | 3 | 30 | 70 | 0 | 100 |
| 4 | Project Course | UPREE801 | Project Stage-2 | 0 | 0 | 14 | 7 | 0 | 0 | 100 | 100 |
| 5 | Core Course | UPCEE801 | Comprehensive Viva Voce | 0 | 0 | 2 | 1 | 0 | 0 | 100 | 100 |
| | | | **Total** | | | | **17** | | | | **500** |

## Programme Elective-VI

| Sl. no | Code | Subjects | L | T | P | Contact hrs. /wk. | Credits |
|---|---|---|---|---|---|---|---|
| 1 | UPEIE801 | Artificial Intelligence | 3 | 0 | 0 | 3 | 3 |
| 2 | UPEIE802 | Satellite Communication system | 3 | 0 | 0 | 3 | 3 |
| 3 | UPEIE803 | Digital Image processing | 3 | 0 | 0 | 3 | 3 |
| 4 | UPEIE804 | Machine Learning | | | | | |
| 5 | UPEIE805 | Wireless Sensor Network | 3 | 0 | 0 | 3 | 3 |

**Suggested Open Elective for other branches:**

1. Digital Image and Video Processing
2. Satellite Communication
3. Digital Communication
4. MEMS
5. Analog VLSI
6. Wireless Sensor Networks

| Semester Wise Credits Break Up | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Subject Type**<br><br>**Semester** | **Professional Core** | **Basic Science** | **Engineering Science** | **Humanities** | **Program Elective** | **Open Elective** | **Project /Seminar** | **Total** |
| **1st** | | 9.5 | 8 | | | | | **17.5** |
| **2nd** | | 9.5 | 8 | 3 | | | | **20.5** |
| **3rd** | 13 | 4 | 3 | 3 | | | | **23** |
| **4th** | 14.5 | | 3 | 3 | | | | **20.5** |
| **5th** | 16.5 | | | | 3 | 3 | | **22.5** |
| **6th** | 11 | | | | 6 | 3 | | **20** |
| **7th** | | | | 3 | 6 | 6 | 4 | **19** |
| **8th** | | | | | 3 | 6 | 8 | **17** |
| **Total** | **55** | **23** | **22** | **12** | **18** | **18** | **12** | **160** |

## NETWORK THEORY UPCIE301

**Prerequisites**: Fundamental laws of electrical circuits

**Course outcomes:**

After successful completion of the course, students will be able to:

1. Apply the concept of tie set and cut set matrix for solving different circuits.
2. Solve electrical circuits using different two port networks such as z, y, ABCD and h parameters.
3. Analyze the stability of a network based on Pole-Zero plots.
4. Select appropriate and relevant techniques for solving the Electrical networks in different conditions.
5. Analyze different network filters and their frequency response.
6. Synthesize networks using Cauer and Foster forms.

**Module I (8 Hrs)**
Network Theorems & Coupled Circuits: Substitution theorem; Reciprocity theorem; Maximum power transfer theorem; Tellegen's theorem; Millman's theorem; Compensation theorem; Coupled Circuits; Dot Convention for representing coupled circuits; Coefficient of coupling.

**Module II (12 Hrs)**
Laplace Transform & Its Application: Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Circuit Analysis (Steady State and Transient).
Two Port Network Functions & Responses: z, y, ABCD and h-parameters; Reciprocity and Symmetry; Interrelation of two-port parameters, Interconnection of two-port networks; Network Functions; Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behaviour from Pole-Zero plots.

**Module III (12 Hrs)**
Brief idea about filters (Low pass, High pass, Band pass and Band elimination) and their frequency response. Realization of Active filters (both high and low pass Butterworth filter) –first and second order filters.
Synthesis of Passive Networks: Hurwitz polynomial and its properties, Cauer and Foster Canonic forms of reactive networks.
Network Topology: Graph of a network; Concept of tree; Incidence matrix; Tie-set matrix;Cut-set matrix; Formulation and solution of network equilibrium equations on loop and node basis.

**Textbook(s):**

1. Network Analysis, M E Van Valkenburg, PHI, third edition.

2. Fundamentals of Electric Circuits, Charles K Alexander & Mathew N.O. Sadiku, Tata McGraw Hill, fifth edition.

**Reference Book(s):**

1. Network Analysis and Synthesis – Franklin F. Kuo – Wiley Student Edition.
2. Network Theory, P K Satpathy, P Kabisatpathy, S P Ghosh and A K Chakraborty, Tata McGraw Hill, New Delhi.

## ANALOG ELECTRONICS CIRCUIT UPCIE302

**Prerequisite:** Network Theory.

**Course outcome:**

After successful completion of the course, student will be able to

1. Analyse simple electronic circuits based on transistors with special focus on designing amplifiers with discrete components.
2. Develop the skill to build, and troubleshoot Analog circuits.
3. Design higher order transistor amplifiers and oscillators.
4. Determine transfer function for frequency dependent amplifier circuits, draw bode plots (magnitude and phase) and calculate frequency bandwidth.
5. Design different signal conditioning circuits like differentiator, integrator and instrumentation amplifier using Op-Amp.

**MODULE I (12 Hrs)**

**Biasing of BJTs:** Load lines (AC and DC); Operating Points; DC Bias with Voltage Feedback; Bias Stabilization; Examples.

**MOS Field-Effect Transistor:** Principle and Operation of FETs and MOSFETs; PChannel and N-Channel MOSFET; Complimentary MOS; V-I Characteristics of EMOSFET and D-MOSFET; MOSFET as an Amplifier and as a Switch.

**Biasing of FETs and MOSFETs:** Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design.

**MODULE II (12 Hrs)**

**Small Signal Analysis of BJTs:** Small-Signal Equivalent-Circuit Models; Small Signal Analysis of CE, CC, CB amplifiers. **Brief Introduction to-**Emitter Follower, Cascade amplifier, Darlington Connection and Current Mirror Circuits.

**Small Signal Analysis of FETs:** Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers. Effects of RSIG and RL on CS Amplifier; Source Follower and Cascaded System. **High Frequency Response of FETs and BJTs:** High Frequency equivalent models and frequency Response of BJTs and FETs; Frequency Response of CS Amplifier, Frequency Response of CE Amplifier.

**Operational Amplifier:** Ideal Op-Amp, Differential Amplifier, Op-Amp Parameters, Non-inverting Configurations, Open-loop and Closed-loop Gains, Differentiator and Integrator, Instrumentation amplifier.

**MODULE III (10 Hrs)**

**Feedback amplifier and Oscillators:** Concepts of negative and positive feedback; Four Basic Feedback Topologies, Practical Feedback Circuits, Principle of Sinusoidal Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits.

**Power Amplifier:** Brief Introduction to different classes of amplifier (A, B, AB, C).

**Regulated DC Power Supply:** Transistor series voltage regulator, series feedback voltage regulator, Transistor shunt voltage regulator, shunt feedback voltage regulator.

**Textbook(s):**

1. Electronic Devices and Circuits theory, R.L. Boylestad and L. Nashelsky, Pearson Education, New Delhi, 9th/10th Edition,2013. (Selected portions of Chapter 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14)
2. Microelectronics Circuits, Adel Sedra and Kenneth C Smith, Oxford University Press, New Delhi, 5th Edition, International Student Edition,2009. (Selected portion of Chapter 2,4, 5, 6, 8, 13, and 14)
3. Milliman's Electronics Devices and Circuits, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition,2008.
4. Analog Circuit Design: Discrete & Integrated, 1st Edition by Sergio Franco

**Reference Book:**

1. Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi,2nd Edition.2004.
2. Electronic device and circuits, David A. Bell, Oxford University Press, 5thedition,2008.
3. Electronic Principles, Albert Malvino, David Bates, Mcgraw-Hill, Eighth Edition
4. Microelectronic Circuits: Analysis and Design, Muhammad H Rashid, Cengage Learning, Second Edition

## ELECTRICAL AND ELECTRONICS MEASUREMENT UPCIE303

**Prerequisite:** Network Theory.

**Course outcome:**

After successful completion of the course, student will be able to

1. Select type of meter and extend the range of measurement in deflecting type instruments (Ammeter & Voltmeter) and Potentiometer. Select the required components for desired measurement. Design measurement circuit for improving resolution of Potentiometer. Choose and Design Electronics Voltmeter for measurement of Average Value, RMS Value and Peak Value. Calibrate these instruments for measurement.
2. Analyse dynamics of response of electro-mechanical deflecting instruments. Identify and choose the parameters for desired performance in dynamic response. Design electrical damping for achieving desired damping.
3. Analyse the concept of electrical power and energy measurement. Calculate error, estimate correction factor and calibrate the instrument.
4. Select type of instrument required for measurement of Power Factor and Frequency of Electric Power Supply. Identify suitable components required in the measuring circuits.
5. Evaluate measurement range and select type of instrument required for the measurement of Resistance (Low, Medium and High), Inductance (Low & High) and Capacitance (low & High). Identify and choose components in the instruments.

6. Apply the usefulness of Oscilloscope for measurement of Voltage, Current, Power, Phase Angle, Time Period, Frequency and Plotting X-Y Voltages.

**Module I (12 Hrs)**

Ammeter and Voltmeter: PMMC, MI and Electro Dynamometer type and Rectifier types Ammeter and Voltmeter; Wattmeter: Construction, Theory and Principle of operation of Electro-Dynamometer and Induction type single phase wattmeter, compensation; Energy Meter: Construction, Basic Theory and Principle of operation; Sources of Error, Types of Error.

**Module II (12 Hrs)**

Resistance: Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Portable Resistance Testing set (Meg-ohmmeter), Measurement of Resistance of Earth Connections. AC Bridges for measurement of Inductance (Self and Mutual) and Capacitance, Errors in bridges.

**Module III (12 Hrs)**

Galvanometer: Construction, Theory and Principle of operation of D'Arsonval, Vibration, Influence of Resistance on Damping, Logarithmic decrement, Calibration of Galvanometers, Galvanometer Constants. Potentiometer: Construction, Theory and Principle of operation of DC Potentiometers Electronic Instruments for Measuring Basic Parameters: Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q meters and Frequency Meters; Power Factor Meters.

Digital Signal Oscilloscope-Principles and Working of DSO.

**Text books:**

1. Electrical Measurements and Measuring Instruments – Golding & Widdis, Reem Publication.

2. Modern Electronic Instrumentation and Measurement Techniques – Helfrick & Cooper– Pearson Education.
3. Digital and Analogue Instrumentation-Testing and Measurement, Nihal Kularatna, IET Press, 2003

**Reference Books:**

1. Electronic Instrumentation – H C Kalsi – 2nd Edition, Tata McGraw Hill.
2. Electronic Measurement and Instrumentation – Oliver & Cage – Tata McGraw Hill.
3. A Course in Electrical and Electronic Measurements and Instrumentation – A KSawhney – Dhanpat Rai & Co

## SIGNALS AND SYSTEMS UESIE301

**Prerequisite:** Basic knowledge of Engineering Mathematics required, which includes - Differential equations and Integrals, Laplace transform, Ordinary differential equations, Complex numbers, Series and expansions, Fourier analysis.

**Course outcomes:**

At the end of this course students will be able to

1. Analyze different types of signals
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal

**Module I (12Hrs)**

**An introduction to signals and systems:** Signals and systems as seen in everyday life, and in various branches of engineering, Continuous-Time and Discrete-Time Signals, Transformations of the Independent Variable, Exponential and Sinusoidal Signals, The Unit Impulse and Unit

Step Functions, Continuous-Time and Discrete-Time Systems, Basic System Properties.

**Linear Time-Invariant Systems:** Continuous-Time LTI Systems: The Convolution Integral, Properties of Linear Time-Invariant Systems, Causal LTI Systems Described by Differential and Difference Equations, Singularity Functions.

**Fourier analysis of Continuous Time signal and system:** A Historical Perspective, The Response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series, Fourier Series and LTI Systems, Filtering, Examples of Continuous-Time Filters Described by Differential Equations.

**Module II (10Hrs)**

**The Continuous-Time Fourier Transform:** Representation of Aperiodic Signals: The Continuous-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Continuous- Time Fourier Transform, The Convolution Property, The Multiplication Property, Fourier Properties and Basic Fourier Transform Pairs, Systems Characterized by Linear Constant-Coefficient Differential Equations.

**Time- and Frequency Characterization of Signals and Systems:** The Magnitude-Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems, Time-Domain Properties of Ideal Frequency-Selective Filters, Time- Domain and Frequency-Domain Aspects of Nonideal Filters, First-Order and Second-Order Continuous-Time Systems.

**Module III (10 Hrs)**

**The Laplace Transform:** The Laplace Transform for continuous time signals and systems: the notion of Eigen functions of LSI systems, a basis of Eigen functions, region of convergence, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Generalization of Parseval's Theorem.

**Sampling:** Representation of a Continuous-Time Signal by Its Samples: The Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation, The Effect of Undersampling: Aliasing, Discrete-Time Processing of Continuous-Time Signals.

**Text books:**

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. A Nagoor Kani, Signals & Systems" 2ND edition,Mc-Graw Hill. 2017
3. Schaum's outlines, Signal and System, H.P.Hsu, 2nd Edition

**Reference books:**

1. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall.
2. Douglas K. Lindner, "Introduction to Signals and Systems", Mc-Graw Hill International Edition.
3. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited.
4. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", Tata Mc Graw Hill Edition.

## Mathematics-III

**Prerequisites:**

1. Mathematics-I
2. Mathematics-II

**Course Outcomes**

On successful completion of this course, the students will be able to:

1. Have a fundamental knowledge of the concepts of probability theory.
2. Do correlation and regression and fitting of different types of curves.
3. Apply sampling theory and theory of estimation in various engineering problems and do

various tests of hypothesis and significance.

4. Use calculators and tables to perform simple statistical analyses for small samples and use popular statistics packages, such as SAS, SPSS, S-Plus, R or MATLAB to perform simple and sophisticated analyses for large samples.

**Module 1: (10 Hours)**

Probability: Introduction, Probability of an event, additive rule & multiplication rule, conditional probability, Bayes' rule, random variable, discrete and continuous probability distribution, Joint probability distribution, Mathematical expectations, Variance and Co- variance of random variables, Mean and Co- variance of linear combination of random variables, Chebyshev theorem.

**Module 2: (10 Hours)**

Discrete Probability Distribution: Binomial & Multinomial, Hyper- geo- metric, Geometric, Poisson distribution.

Continuous Probability Distribution: Uniform, Normal, Exponential Distribution, Weibull's Distribution, Chi-square Distribution, Sampling Distribution: Sampling Distribution of S2, t Distribution, F Distribution.

**Module 3: (10 Hours)**

Estimation of parameter: methods of estimation, Estimating the mean of a single sample, Standard error, Prediction interval, Tolerance limits, Estimating the difference between means of two samples, estimating proportion and variance of single sample, Estimating the difference between two proportions and variances of two samples, maximum likelihood estimation.

**Module 4: (10 Hours)**

Testing of hypothesis: one and two tailed test, test on a single mean when variance is known & variance is unknown. Test on two means, test on single mean and two mean populations. One and two sample test for variance. $\chi 2$ test for goodness of fit and test for independence.

Introduction to linear regression: Simple regression models, method of least squares, Properties of least square estimators, Inferences concerning the regression coefficients, Coefficients of determination and its application.

Statistical quality control (Simple Idea only)

**Text Books:**

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers & Keying Ye," Probability & Statistics for Engineers & Scientists", Eighth Edition, 2007, Pearson Education Inc., New Delhi.
2. Jay L. Devore," Probability and Statistics for Engineering and Sciences", Seventh Edition, Thomson/CENGAGE Learning India Pvt. Ltd.

**Reference Books:**

1. William Mendenhall, Robert J. Beaver & Barbara M. Beaver," Introduction to Probability and Statistics", 13th Edition, 2009, CENGAGE Learning India Pvt. Ltd., New Delhi.
2. T. Veerarajan," Probability, Statistics and Random Processes", Tata McGraw Hill
3. Ronald Deep," Probability and Statistics", Academic Press

## Organizational Behavior

**Prerequisites:**

1. English.

**Module 1: (10 Hours)**

The study of Organizational Behaviour: Definition, Meaning, Why study OB; Learning - Principles of learning and learning theories; Personality- Meaning, Determinants, Types, Personality and OB; Perception- Perceptual Process, perceptual errors, Importance of perception in organizations; Motivation-Nature and Importance, Theories of motivation (Herzberg, Maslow, McGregor).

**Module 2: (10 Hours)**

Group level: Groups in Organizations -Nature, Types, Reasons behind forming groups, Determinants, factors contributing to Group Cohesiveness, Group Decision Making- Process, advantages and disadvantages; Team- Effective Team Building; Types of Leadership- Effective Leadership, Styles of leadership, Leadership Theories-Trait Theory and Contingency Theory, Leadership and Followership; Conflict- Healthy Vs Unhealthy conflict, Conflict Resolution Techniques.

**Module 3: (10 Hours)**

Structural level: Organizational Culture: culture and organizational effective- ness; Organizational Change: Types of change, Reasons to change, Resistance to change and to manage resistance. Introduction to organizational development.

**Text Books:**

1. Stephens P. Robbins, Organizational Behaviour, PHI.
2. K. Aswatthappa, Organizational Behaviour, HPH.

**Reference Books:**

1. Kavita Singh, Organizational Behaviour, Pearson.
2. D. K. Bhattacharya, Organizational Behaviour, OUP.
3. Pradeep Khandelwal, Organizational Behaviour, TMH.
4. Keith Davis, Organizational Behaviour, McGraw Hill.
5. Nelson Quick, ORGB, Cengage Learning.

## ELECTRICAL AND ELECTRONICS MEASUREMENT LAB ULCIE302

**Course Outcome:**

1. Recognise and eliminate sources of error in measurement of low resistance.
2. Select ac bridge to measure unknown inductance and capacitance
3. Analyse static and dynamics of electro-mechanical deflecting type instruments
4. Choosing a standard for calibration and calibrate an instrument.
5. Recognise sources of error and employing testing procedures of single phase energy meter.

6. Analyse effect of frequency, type of material and volume of material on B-H Curve.
7. Select Q meter for measurement of impedance.
8. Choose Wattmeter and calculate correction factor for measurement of power and power factor.
9. Apply oscilloscope techniques for measurement of frequency, phase angle and time delay.
10. Design electronic voltmeters for measurement of average and rms values.
11. Analyse choice of selecting A/D converter for a desired application
12. Analyse choice of selecting D/A converter for a desired application

**Experiment List: (At least 10 experiments should be done)**

1. Measurement of Low Resistance by Kelvin's Double Bridge Method.
2. Measurement of Self Inductance and Capacitance using Bridges.
3. Study of Galvanometer and Determination of Sensitivity and Galvanometer Constants.
4. Calibration of D.C. Voltmeters and Ammeters using Potentiometers.
5. Testing of Energy meters (Single phase type).
6. Measurement of Iron Loss from B-H Curve by using CRO.
7. Measurement of R, L, and C using Q-meter.
8. Measurement of Power and Power Factor in a three phase AC circuit by two wattmeter method.
9. Measurement of Frequency, Phase and Time Delay using Oscilloscope.
10. Calibration of Electronic Voltmeter.

11 Study of principles & techniques of Analog to Digital Conversion

13. Study of principles & techniques of Digital to Analog Conversion.

14. Mini Project for Hands on Experience

## ANALOG ELECTRONICS CIRCUIT LAB ULCIE301

**Course outcome:**

After successful completion of the course, student will be able to:

1. Acquire a basic knowledge in solid state electronics including FET, MOSFET, BJT, and operational amplifier.
2. Designing and evaluation of BJT amplifier in CE configuration.
3. Design and test JFET/MOSFET amplifier.
4. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.

**Experiment List: (At least 10 experiments should be done)**

1. Usage of different electronics components (active and passive) and devices and diode characteristics.
2. Input output characteristic of BJT in common emitter configuration.
3. Design and simulate BJT voltage divider bias (CE) circuit and compare the results.
4. Design and test MOSFET bias circuit and compare the results.
5. Design and test BJT common-emitter circuit and compare D.C and A.C performance.
6. Analysis of transfer and drain characteristic of MOSFET.
7. Determining the frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response and compare with simulated results.
8. Analysis of differential amplifiers circuits: D.C bias and A.C operation without and with current source.
9. Realize BJT Darlington connection and Current Mirror circuits.
10. Analysis of frequency response of a voltage series feedback amplifier with and without feedback.
11. Applications of OPAMP-Inverting and non-inverting, differentiator, integrator

12. Obtain the band width of FET/ BJT using Square wave testing of an amplifier.
13. Analysis of R.C phase shift oscillator/Wien-Bridge Oscillator using OP-Amp/Crystal Oscillator.
14. Study of Class A and Class B Power Amplifier and analysis of conversion efficiency.
15. Software based (SPICE) simulation of a few of the experiments (1-14).

## DIGITAL SYSTEM DESIGN UPCIE401

**Prerequisites:** Basic concepts of number system, Basic knowledge of electronic circuits

**Course Outcomes:**

At the end of the course, a student will be able to:

1. Convert different type of codes and number systems which are used in digital communication and Computer systems and Employ the codes and number systems converting circuits and Compare different types of logic families.
2. Analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.
3. Design different types of digital electronic circuits (with and without memory element) for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.
4. Design & analyze synchronous sequential logic circuits
5. Use HDL & appropriate EDA tools for digital logic design and simulation

**Module I (12 Hrs)**

**Introduction to Digital Circuits:** Representation of numbers in binary, octal, decimal and hexadecimal systems. Conversion between systems, 1's and 2's complement representation of numbers.

**Logic Gates and Combinational Circuits:** Functions, representations and truth tables of logic gates. Universal logic gates, Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and DeMorgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

**Module II (12 Hrs)**

**Multivibrator**: Bistable Multivibrator, fixed-bias bistable multivibrator, self-biased transistor binary, Triggering the binary, Unsymmetrical Triggering of the bistable multivibrator, Symmetrical Triggering, Schmitt Trigger Circuit (Emitter coupled Bistable Multivibrator).

Monostable Multivibrator, Gate Width of a Collector-Coupled Monostable Multivibrator, Waveforms of the Collector-Coupled Monostable Multivibrator, Astable Collector-Coupled Multivibrator.

**Module III (10 Hrs)**

**Sequential Logic Design:** Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

**Logic Families and Semiconductor Memories:** TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

**Textbook(s):**

1. Morris Mano and Michael D. Ciletti, "Digital Design", 4$^{th}$ Ed., Pearson Education, 2008.
2. C.H. Roth, "Fundamentals of Logic Design", 5th Ed. Cengage Learning, 2004.
3. John F. Wakerly, “Digital Design: Principles & Practices”, 3$^{rd}$ Ed, PHI.
4. A Anand Kumar, “Fundamentals of Digital Circuits”, 2$^{nd}$ Ed., PHI.

**Reference Book(s):**

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989

## ELECTROMAGNETIC FIELD THEORY UPCIE402

**Prerequisite:** Vector Algebra, Calculus and Differentiation

**Course Outcomes:**

At the end of the course, students will able to

1. Obtain the electric and magnetic fields for simple configurations under static conditions.
2. Analyze time varying electric and magnetic fields.
3. Derive Wave equations using Maxwell's equations.
4. Analyze the propagation of EM waves under different medium.

**Module I (13 Hrs)**

**Vectors and Fields:** Cartesian Coordinate System, Cylindrical and Spherical coordinate system, Vector Algebra, Scalar and Vector Fields, gradient, divergence, curl operations, The Laplacian, Divergence Theorem, Stoke's Theorem, Useful vector identities and their derivations

**Electric and Magnetic fields:** Field due to a line/sheet/volume charge, Biot Savart Law, Gauss's Law for Electric Field and Magnetic Field, Fields of electric and magnetic dipoles, Applications of electrostatics and magnetostatics, Faraday's Law, Ampere's Circuital Law.

**Module II (13 Hrs)**

**Maxwell's Equations:** Divergence and Differential Form, Line Integral, Surface Integral and

Integral form, Faradays Law, Ampere's Circuital Law, Gauss's Law for Electric Field and Magnetic Field.

**Wave Propagation in Free Space**: The electromagnetic wave equation and its solution, Uniform Plane Waves, Direction cosines, Concept on TEM mode, Poynting Vector and Power density

**Module III (10 Hrs)**

**Wave Propagation in Material Media:** Conductors and Dielectrics, Magnetic Materials, Wave Equation and Solution, Uniform Plane Waves in Dielectrics and Conductors, Polarization, Boundary Conditions, Reflection and Transmission of Uniform Plane Waves at the boundary of two media for normal and oblique incidence, Brewster's angle.

**Transmission Line Analysis:** Transmission lines, Circuit representation of a parallel plane transmission line, Transmission line Parameters, Input Impedance, Standing Wave Ratio.

**Textbook(s):**

1. Electromagnetic Waves and Radiating Systems, 2nd Edition, E.C. Jordan and K.G. Balmain, Pearson Education, New Delhi.
2. Elements of Electromagnetic, Mathew N.O. Sadiku, Oxford University Press, New Delhi.
3. Engineering Electromagnetic, 2nd Edition, Nathan Ida, Springer

**Reference Book(s):**

1. Fundamentals of Electromagnetic for Engineering, First Impression – 2009, N. N. Rao, Pearson Education, New Delhi.
2. Engineering Electromagnetic, 7th Edition, William H. Hyat, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Electromagnetic Field Theory Fundamentals, B.S. Guru and H.R. Hiziroglu, PWS Publishing Company, a division of Thomson Learning Inc

4. Griffith

## INSTRUMENTATION DEVICES & SYSTEMS–I UPCIE403

**Prerequisites:** One must have prior knowledge of physics.

**Course Outcomes:**

At the end of the course, a student will be able to,

1. Identify static and dynamic characteristics of general measurement system, identification and compensation of system dynamics.
2. Choose a sensor suitable for measurement of temperature, displacement, strain, force, pressure.
3. Design of signal conditioning circuit for enhancement of sensor signal

**Module I (10 Hrs)**

**Elements of a general measurement system**; Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems. Techniques for dynamic compensation, loading effect, signal and noise in measurement system, Propagation of errors.

**Module II (15 Hrs)**

**Sensing elements**: Transducers and sensors, Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), Thermistors, strain gauges. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance, LVDT and RVDT displacement sensors; Electromagnetic sensing elements velocity sensors; ultrasonic, radar, nucleonic type sensing elements, thermoelectric sensing elements: thermocouple laws, characteristics, installation problems, cold junction compensation. IC temperature sensor, Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement.

**Module III (8 Hrs)**

**Signal Conditioning Elements**: Deflection bridges: design of resistive and reactive bridges, push- pull configuration for improvement of linearity and sensitivity Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, noninverting and differential amplifiers, instrumentationamplifier, and filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation.

**Textbook(s):**

1. Principles of Measurement Systems- J.P. Bentley (3/e), Pearson Education, New Delhi, 2007.
2. Introduction to Measurement and Instrumentation- A.K. Ghosh(3/e), PHI Learning, New Delhi, 2009.
3. Measurement Systems Application and Design- E.O. Doeblin (4/e), McGraw-Hill, International, NY.
4. Transducers and Instrumentation- D.V.S. Murthy (2/e), PHI Learning, New Delhi, 2009.

**Reference Book(s):**

1. Instrumentation for Engineering Measurements- J.W. Dally, W.F. Riley and K.G. McConnel (2/e), John Wiley, NY, 2003.
2. Industrial Instrumentation- T.R. Padmanabhan, Springer, London, 2000.

## FUNDAMENTALS OF COMMUNICATION THEORY UESIE401

**Prerequisite:** Knowledge of various Analog Hardware Components, Basics of Calculus, Probability and Statistics.

**Course Outcomes:**

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

1. Apply the knowledge of basic components in communication system.
2. Analyse and design analog communication systems.
3. Evaluate the performance of analog communication in presence of noise.
4. Interpret various radio transmitter and receiver with their parameters.

**Module I (12 Hrs)**

Introduction to basic elements of communication systems

**Signal transmission through linear systems:**

condition for distortion less transmission of signals through networks. Different types of distortion and their effect on the quality of output signals, transmission of transient signals, distortion analysis.

**Amplitude modulation:**

Modulation principle and definitions, sideband and carrier power, generation of AM signal, demodulation of AM signal. Different type of modulator circuits, square law modulator, balanced modulator. Demodulator basic principle of coherent detections, square law detectors, average envelope and peak envelope detectors. Quadrature amplitude modulation (QAM), amplitudemodulation: single sideband (SSB), generation of SSB signals, selective filtering method, phase shift method, demodulation of SSB-SC signals, envelop detection of SSB signals with a carrier (SSB+C), amplitude modulation: vestigial sideband (VSB), envelop detection of VSB+C signals, noise in AM receivers using envelope detection, concept of SNR.

**Module II (10Hrs)**

**Frequency and phase modulation:**

Principles and definitions, relationship between frequency and phase modulations. phase and frequency deviations, spectrum of FM signal, bandwidth considerations. Effect of modulation index on bandwidth, narrow band and sideband FM and PM principles, circuit for realization of FM and PM. Demodulation: Principle of demodulation: different type of demodulator, discriminator, use of PLL etc. **Module III (10Hrs)**

**Radio transmitter:**

Basic block diagram of radio transmitter (AM and FM), Analysis of a practical circuit diagram used for medium power transmitter.

**Radio receiver:**

Basic block diagram of TRF, Superheterodyne principle, its advantages, Mixer principle and circuit, AVC, Radio receiver measurement.

**System noise calculation:**

Signal to noise ratio of SSB, DSB, AM for coherent and envelope and square law detection, threshold effect. Signal to noise calculation for FM and threshold

**Text books:**

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. *B.P. Lathi, Modern Digital and Analog Communication Systems, Oxford*
3. R P Singh, S D Sapre," Communication Systems", TMH,2nd Edition

**Reference Books:**

1. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education,2002.
3. Schaum's Outlines "Analog and Digital Communication", 3rd edition

## Engineering Economics (UHSMH211)

**Prerequisites:**

1. Mathematics.
2. Basic Economics.

**Module 1: (10 Hours)**
Engineering Economics: Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.
Demand: Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Demand Estimation and Forecasting, Elasticity of demand & its measurement (Simple numerical problems to be solved), Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).
Production: Production function, Laws of returns: Law of variable proportion, Law of returns to scale.
**Module 2: (10 Hours)**
Cost and revenue concepts, Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).
Banking: Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.
Inflation: Meaning of inflation, types, causes, measures to control inflation.
National Income: Definition, Concepts of national income, Method of measuring national income.
**Module 3: (10 Hours)**
Time value of money: Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.
Evaluation of engineering projects: Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.
Depreciation: Depreciation of capital assert, causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method), After tax comparison of project.
**Text Books:**
1. Riggs, Bedworth and Randhwa,” Engineering Economics”, McGraw Hill Education India.
2. Deviga Vengedasalam,” Principles of Economics”, Oxford University Press.
3. William G. Sullivan, Elin M. Wicks, C. Patric Koelling,” Engineering Economy”, Pearson.
4. R. Paneer Selvam,” Engineering Economics”, PHI.
5. S. P. Gupta,” Macro Economics”, TMH.
6. S. B. Gupta,” Monetary Economics”, Sultan Chand and Co.

## DIGITAL SYSTEM DESIGN LAB ULCIE401

**Prerequisites:** Basic concepts of number system, Basic knowledge of electronic circuits

**Course Outcomes:**

At the end of the course, a student will be able to:

1. Design and analyze combinational logic circuits

2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation

**List of Experiments: (At least 10 experiments should be done)**

**Hardware:**

1. Digital Logic Gates: Investigate logic behaviour of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates.
2. Combinational Circuits: design, assemble and test: adders and subtractors, code converters, gray code to binary and 7 segment displays.Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number of Gates.
3. Design with multiplexers and de-multiplexers.
4. Flip-Flop: assemble, test and investigate operation of SR, D & J-K flip-flops.
5. Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallel load.
6. Clock-pulse generator: design, implement and test.

**Software:**

1. Design CMOS Inverter using Mentor Graphics/any open source software
2. Design AND, OR, NAND, NOR, EX-OR, EX-NOR gate using VHDL/Verilog and Implement on FPGA
3. Design adders and subtractors, code converters using VHDL/Verilog and Implement on FPGA
4. Design 4-BIT Magnitude Comparator using VHDL/Verilog and Implement on FPGA
5. Design 8X1 Multiplexer, 1X4 Demultiplexer using VHDL/Verilog and Implement on FPGA
6. Design ALU using VHDL/Verilog and Implement on FPGA.

7. Design Decade Counter using VHDL/Verilog and Implement on FPGA.

**Reference Book(s):**

1. Morris Mano and Michael D. Ciletti, "Digital Design", 4th Ed., Pearson Education, 2008.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.

## INSTRUMENTATION DEVICES & SYSTEMS LAB ULCIE402

**Course Outcome**

1. To measure/ characterize and calibrate different sensors/ Transducer
2. To compare a group of similar sensors
3. To design and simulate different control scheme using PLC
4. To design and simulate different circuits using MATLAB/ Multisim/Lab VIEW

**List of Experiments (Any 10 experiments to be carried out)**

1. Temperature sensing using RTD, Thermistor, Semiconductor type temperature sensor and Thermocouple.
2. Study of Load cell for measurement of weight.
3. Measurement of linear displacement using LVDT.
4. Flow measuring transducers (Pitot Tube, Rotameter, Orifice plate, Venturi meter etc…)
5. Pressure measurement using Bourdon tube and diaphragm type sensor.
6. Design of Regulated power supply unit.
7. Study of RLL for a PLC based sequential control scheme.
8. Design of Instrumentation amplifier.

9. Design of active low pass, high pass & band pass filters.
10. Speed measurement using variable reluctance type transducer.
11. Design of a microcontroller-based storage & display device.
12. Study of Piezoelectric, pH, Humidity senors.
13. Experiments based on LabVIEW.

## COMMUNICATION SYSTEM LAB ULCIE403

**Prerequisite:** Basic knowledge and use of, various analog and digital components and systems.

**Course Outcomes:**

After completing the course, the student will be able to,

1. Practice the basic theories of communication system
2. Design different types of modulators and demodulators like AM, FM, PWM, PAM, PPM
3. Verify the operation of multiplexing, mixer circuit, PLL characteristics etc.
4. Use computer simulation tools such as P-SPICE, LabVIEW and MATLAB to carry out design experiments as it is a key analysis tool of engineering design.

**List of Experiments: (At least 10 experiments should be done)**

1. Basic Measurements using Spectrum Analyzer
2. Study of Amplitude Modulation and Demodulation
3. DSB-SC modulator and Demodulator
4. SSB Modulation and Demodulation
5. Study of Frequency Modulation and Demodulation
6. Study of PAM, PPM and PWM Modulator and Demodulator
7. TDM Multiplexer and De-multiplexer
8. FDM Multiplexer and Demultiplexer
9. AM Super Heterodyne Receivers
10. Study the functioning of PCM and Delta modulator

**Simulation experiments using P-SPICE/ ORCAD /LabVIEW / MATLAB.**

11. AM modulation and demodulation system.
12. FM modulation and demodulation system.
13. AM modulator with AWGN noise in MATLAB.
14. Pre-emphasis and De-emphasis in FM using P-SPICE

## Environmental Science

**4th Sem**

**Course Objectives:**

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures
- Understanding the environmental policies and regulations

**Course Outcomes:**

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn help in sustainable development

**UNIT – I**

An Introduction to – Multidisciplinary nature of Environmental Studies.

The Earth and Biosphere (The Earth Science)

**Ecology:** Concept and Principle of Ecology, Ecological Succession, Population Ecology, Community Ecology, Relationship, Human Ecology, Origin and Evolution of Life, Plant and Speciation.

**Ecosystems: Definition, Properties, Function and Structure of Ecosystem.** Ecological Balance: Cause, Food chains, food webs, Flow of Energy, Ecological Pyramids, Types of Ecosystem: Land, Aquatic and Artificial ecosystem. Biogeochemical cycles, Bioaccumulation, Bio magnification, ecosystem value, Degradation of Ecosystem.

Bio-diversity and Conservation

**Natural Resources:** Classification of Resources, Conservation of Resources, Environmental Degradation, Equitable use of Resources for Sustainable Life styles, Role of Individual in

Conservation of natural Resources.

**Water Resources: Sources,** Status of World and Indian's Water Resources, Over Utilization of Water, Conservation, Flood and Control measure, Others.

Mineral Resources. Land Resources, Energy Resources, Food Resources, etc.: Classification, Conservation, Environmental Impacts.

**UNIT – II**

**Environmental Pollution:** Types of Pollution and Control Measures, Role of Individual in Pollution Prevention.

**Waste Management:** MSW, WM Techniques, Agricultural Solid Waste Management and Legislation on Solid Waste management.

**Disaster Management:** Objectives, Type of Disaster. Elements, Organisational Set- up, NDMA, Preparedness, Mitigation, Prevention, Response.

**Environment and Development:** Social Issues, environmental Ethics, Sustainable Development, Sustainable Energy and materials, Environmental Challenges,: Climate Change, Green House Effect, Global Warming, Ozone Layer Depletion, Protection of Ozone Layer, Acid Rain, EL Nino, Waste land and its Reclamation

Human Population and the Environment: Pupation Growth and Explosion, Pupation Growth and Environment, Family Welfare Programme, Women and Child welfare, HIV/ AIDS, Environment and Health, Human Rights, Value of Education.

**Resettlement and Rehabilitation:** Introduction, Social Impact Assessment, Methodology of SIA, Land Acquisition and Impact, Stake holder participation and consultation, Socio-economic Issue,, Mitigation Measure.

Rehabilitation Action Plan, Legal Frame work, Training and capacity Building, Grievance and Redressal Mechanism.

**UNIT - III**

**Environmental Protection**: Introduction, International efforts, Government Effort, environmental Organisations, Public Awareness, Environmental Education and Training, Green Building, Clean Development Mechanism, carbon Credits.

Environmental Legislation: Environmental Legal Framework, environmental Protection Act, 1986, the Air Act 1981, Water Act 1974, Wild Life Act, 1972, Forest Conservation Act, 1980.

**Environmental Management:** Environmental Impact Assessment, TOR for EIA, EIA Methodology

| |
|---|
| (Brief), Baseline Data, Environmental Clearance, MoEF Notification Dated September 2006, Stake holder in EIA Process<br><br>Environment Management and EMP: Introduction, Issues covered, Environmental Management System- ISO-14000, Institution and Implementation Arrangement, Mitigation measures, Environmental Monitoring, Environmental Auditing. |

**TEXT BOOKS:**

1. Environmental Studies(Concept, Impacts, Mitigation and management) by M. P. Poonia and S. C. Sharama, Khana Book Publishing Co. (P) T Ltd. 2019 Edition
2. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
3. Environmental Studies by R. Rajagopalan, Oxford University Press.

**REFERENCE BOOKS:**

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

## MICROPROCESSOR AND MICROCONTROLLER UPCIE501

**Prerequisite:** Digital Electronic Circuits, Hexadecimal Arithmetic, Basic Programming Skills

**Course Outcome:**

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

1. Recall and apply a basic concept of digital fundamentals to Microprocessor based system.
2. Identify a detailed software and hardware structure of the Microprocessor and Microcontrollers.
3. Analyze the data transfer information through serial & parallel ports.
4. Analyze and implement different applications using different peripherals with Microprocessor and Microcontroller.

### Module I (12 Hrs) Microprocessor

The Processors: 8085 - block diagram as well as its pin description, addressing modes of 8085,instruction sets and its data formats, timing diagram of 8085, Assembly language programing , memory and I/O interfacing, memory address decoding, data transfer schemes, interrupts of 8085, Interfacing- Memory, I/O Ports, ADC/ DAC, 8255 PPI, Timer/ Counter, LED, LCD, keyboard etc.

### Module II (12 Hrs) Microcontrollers

Introduction to 8 microcontrollers 8051- Introduction to 8051 Micro-controller; Basic features, Timing Diagram, Instructions Register organization, Addressing Modes; Overview of PIC and AVR Microcontrollers.

### Module III (8 Hrs)
### Advanced Microprocessors

Introduction to 8086/ 80286/ 80386/ 80486/ Pentium (80586) Internal Architecture, Pentium IV-Micro architecture, RISC Architecture, Introduction to ARM Processors.

**Text books:**

1. K M Burchandi and A K Ray, “Advanced Microprocessors and Peripherals”, 3rd edition, Tata McGraw-Hill Education, 2012, ISBN: 9781259006135.

2. The **8051** Microcontroller and Embedded Systems: Using Assembly and C. Front Cover. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Pearson/Prentice Hall, 2006.

**Reference Books:**

1. Steve Furber, Arm System-On-Chip Architecture, 2/E, Pearson Education, 2009.
2. Fernando E. Valdes-Perez Ramon Pallas-Areny Fundamentals and Applications with PIC Microcontrollers, CRC Press, Taylor Francis, International Standard Book Number-13: 978-1- 4200-7767-4.
3. Dhananjaya Gadre, Programming and Customizing the AVR Microcontroller, McGraw Hill Education 2003, ISBN: 9780070582293.
4. Ajay V Deshmukh, Microcontrollers: Theory and Applications, McGraw Hill Education 2004, ISBN: 9780070585959

## CONTROL SYSTEM ENGINEERING UPCIE502

**Prerequisite:** Basic Electrical Engineering, Circuit Theory, Laplace transform, second order differential Equation.

**Course Outcomes:**

On completion of the course students will be able to:

1. Analyze the basic concepts of control systems, pole, zero and can analyze system stability on that basis.
2. Develop electrical models/ mechanical models to design a physical system for a specific operation.
3. Implement mathematical tools (such as SFG) to analyze a complete system.
4. Define different time domain specification parameters and thus can apply that knowledge to conclude dynamic performance of a system.
5. Analyze system's absolute, relative, local stability using different frequency domain methods.

6. Design analog controllers, compensators and their selection to meet desired response.

**Module I (11 Hrs)**

**Introduction:** definition, control system, open loop, close loop, automatic control, modern control, properties of transfer function Mathematical Modeling: translational, rotational systems and their electrical analogy, mechanical coupling, liquid level systems, servo motors, sensors, magnetic amplifiers, stepper motor, synchros, block diagram, signal flow graph, gain formula.

**Feedback characteristics of Control Systems:** Feedback and non-feedback systems, Reduction of parameter variations, Control over system dynamics, Effect of disturbance signal by use of feedback, Linearizing effect of feedback, Regenerative feedback, Sensitivity of control system, parameter variation and disturbance of signal.

**Module II (10 Hrs)**

**Time Domain Analysis:** typical test signals, transient analysis of second order systems, overshoot, damping, settling time and rise time, Analysis of multi-order control system with dominant poles, steady state error analysis, error confidents, generalised error series, transient analysis with derivative control, integral control and proportional control, rate feedback control, Routh Hurwitz stability criteria.

**Root Locus Technique:** Basic conditions for root loci, rules for construction, stability and conditional stability on root locus.

**Module III (12 Hrs)**

**Frequency Response Analysis:** Polar plot, Bode-plot, frequency domain behaviour of control, gain margin and phase margin, WpandMp for second order system, stability criteria. Nyquist Criteria: Stability criteria, conformal mapping, Cauchy's theorem, Nyquist stability criteria, conditionally stable system.

**State variable Technique:** state variable for continuous system, transfer function to state variable, state variable to transfer function, state transition matrix, time domain solution of single input single output system. Derivation of Transfer Function for State Model.

**Diagonalization:** Eigenvalues and Eigenvectors, Generalized Eigenvectors. Solution of State Equations: Properties of the State Transition Matrix, Time domain solutions of multi-input and multi- output systems

**Text book(s):**

1. J. Nagrath and M Gopal, Control system engineering; New Age International Publisher2010.
2. K Ogata, Modern Control Engineering, PHI, 5th edition
3. Schaum's Outlines "Control Systems", 3rd edition.

**Reference Book(s):**

1. B S Manke, Linear Control System, Khanna Publication, 11th edition.
2. R C Dorf and R H Bishop, Modern Control Systems; Pearson Education, 2009
3. B C Kuo, Automatic Control System; PHI, 7thEdition

## INSTRUMENTATION DEVICES & SYSTEMS–II UPCIE503

**Prerequisites:** One must have prior knowledge of physics.

**Course Outcomes:**

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

1. Select sensor for suitable measurement of low pressure, flow and Temp.
2. Select sensors/Transducers for level, humidity, viscosity, pH, acceleration.
3. Select suitable Optical source, detector and modulation techniques in optical instrumentation.

**Module I (13 Hrs)**

**Pressure measurement:** Comparison with known dead-weights, Manometer for use of pressure measurement, Hall Effect transducer, Low pressure (vacuum) measurements (Mechanical, Thermal, Ionization based).

**Flow Measurement:** Basics of flow measurement; differential pressure flow meters- Pitot tube, Orifice plate, Venturi tube; Rotameter, turbine type flow meter, electromagnetic flow meter. Doppler shift flow meter.

**Temperature measurement**: Temperature scale, Change in Dimensions-Bimetals, liquid-in-glass thermometers, Filled system thermometers**.**

**Module II (12 Hrs)**

**Miscellaneous Measurements:**

Level measurements using floats, hydrostatic pressure gage and capacitive type; Humidity measurement: capacitive type Hygrometer. pH measurements (Indicator and Electrode method) and liquid conductivity measurements (two poles, four pole type), Viscosity Measurement (Methods of Viscosity Measurement).

**Acceleration Measurement:** Piezoelectric transducers: basic principle, equivalent circuit, frequency response, charge amplifier; acceleration measurement: basic principle and frequency response; piezoelectric accelerometer, Servo accelerometer (Feedback Instrumentation).

**Module III (8 Hrs) Optical sensing:**

Optical sources (LED, LASER), Photo detectors (photo conductive cells, photo voltaic, photo emissive and photodiodes); Radiation pyrometer: Planck’s law, Stefan Boltzmann’s law, broad band and narrow band pyrometer; Optical measurement systems (Modulation of intensity and phase).

**Text books:**

1. Introduction to Measurement and Instrumentation- A.K. Ghosh,3rd edition, PHI Learning.
2. Process Control Instrumentation Technology- C.D. Johnson,8th edition, PHI Learning.

3. Principles of Measurement Systems- J.P. Bentley, 3rd edition, Pearson Education, N Delhi,

4. Measurement Systems Application and Design- E.O. Doeblin, 4th edition McGraw-Hill, International, NY.

**Reference Books:**

2. Transducers and Instrumentation- D.V.S. Murthy,2nd edition PHI Learning, New Delhi, 2009.

3. Industrial instrumentation, D Patronabis, 2nd edition, TMH

4. Modern Control Technology Components and Systems- C.T. Kilian, 3rd edition, Cengage Learning, New Delhi, 2006.

## PROCESS CONTROL- I UPCIE504

**Prerequisites:** Basic Electronics, Control System

**Course Outcomes:**

Upon successful completion of this course, a student will be able to

1. Interpret different industrial processes.
2. Predict the appropriate controller for a specific process.
3. Design electronic, hydraulic and pneumatic controllers.
4. Identify different final control elements used for process control.
5. Analyze a control valve based on its type and characteristics.

**Module I (12 hrs)**

Introduction to process control-Process definition, what is process-control Block diagram with examples (Ch-1) [C. D Johnson]. Controller Principle-Introduction, Process characteristics-process equation, process load, process lag, self-regulation. Control system parameters-error, variable range, control parameter range, control lag, Dead Time, Cycling, Controller modes, Discontinuous controller modes-two position mode, Multi position mode, Floating control mode. Continuous control modes: P, I, D mode. Composite control modes: PI, PD, PID (Ch-9) [C.D. Johnson]. Comparison of various controller principle. Controller tuning –process reaction curve (PRC). Ziegler Nichols tuning [K. Ogata] [(Ch-4.10) S. Bhanot]

**Module II (11 hrs)**

Electronics Controller-Introduction, Electronics discontinuous controllers, electronic proportional controller, electronics Integral controller, electronic derivative controller, PI, PD, PID controller. [Ch- 10, C. D. Johnson][Ch-6, S. Bhanot].Hydraulic and Pneumatic Controllers-Only PID design. [Ch-10,
C. D. Johnson] [Ch-5, S. Bhanot]. Digital controller: Introduction, components and working of Direct Digital Control (DDC), benefits of DDC, Digital control realization. [Ch-7, S. Bhanot]

**Module III (10 hrs)**

Final control element [Ch-4, K. Kant]: Introduction, Final control operation-signal conversion, Actuator-pneumatic actuation, hydraulic actuation, Electric actuation. Control element-Control valve characteristics, control valve categories [Ch-4.6, K. Kant] [Ch-7, C. D. Johnson]

**Text books:**

1. Process control instrumentation technology, 8$^{th}$ ed. by C. D. Johnson, Pearson.
2. Process control principles and applications by S. Bhanot.,Oxforduniversity Press, 2010.
3. Computer based Industrial Control, 2$^{nd}$ ed. by K. Kant.PHI.

**Reference Books:**

1. M. Gopal, “Digital Control and State Variable Methods” Tata McGraw Hill, 2003.
2. C. Johnson, “Process Control Instrumentation Technology”, PHI, New Delhi.

## OPTOELECTRONICS DEVICES & INSTRUMENTATION UPEIE501

**Prerequisite:** Vector Algebra in rectangular and cylindrical system of coordinates, Field Theory, Elementary Optics

**Course Outcomes:**

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

1. Identify a fibre type, evaluate its parameters and analyze modes associated with it
2. Evaluate performance indices of LED, lasers, PIN and APD type of photodetectors
3. Measure physical parameters using fibre optic sensors (FoS) and finding new applications thereof
4. Design and analyze a given FoS.

**Module I** (**14 Hrs)**

**Wave Optics:** Wave Polarization, Transmission of light through slab, Numerical aperture, Wave propagation in cylindrical waveguides, Modes in step and graded index fibres, single mode and multimode fibres, Fibre losses and dispersion characteristics (Chapter 3, 3.4-3.6 of TB-1, Chapter 4, 4.2-4.3 of TB-1/ Chapter 7, 7.2-7.5 of TB-2)Module II (10 Hrs)

**Optical Components, Sources:** LED, Lasers-fundamentals, conditions for oscillations, construction and principle of operation of semiconductor lasers, pulsed and continuous type lasers (Chapter 4 of TB-1, 11.2-11.4 of TB-1, Chapter 4, 4.2-4.9 of TB-2)
Detectors: photodiodes- PIN and APD. (Chapter 12, 12.1-12.4 of TB-1)
couplers, splicer, polarizer, power coupled to a fibre (Chapter 9 9.2-9.12 of TB-2)

**Module III (12 Hrs)**

**Optoelectronic Instrumentation Modulation techniques:** intensity, polarization, interference, electro-optic, electromagnetic; Sensing techniques for displacement, pressure, acceleration, flow, current and voltage measurement, Fibre optic gyroscope, Distributed fibre optic sensors-OTDR and OFDR principles. (Chapter 11, 11.2-11.3.5, 11.3.9, 11.4-11.6 and 11.9 of TB-2)

**Textbook(s):**

1. A. Ghatak and K. Tyagrajan: Introduction to Fiber Optics: Cambridge University Press, New Delhi, 2004. (Chapter 2, Sections 7.2-7.3, Chapter 3, Sections 4.3,8.2, 17.2, 17.8, Section 11.3, 11.6, Chapter 12, Chapter 18)
2. A. Tripathy, Opto Electronics and Systems: Studium Press, New Delhi, 2016

**Reference Book(s):**

1. John M. Senior, Optical Fibre Communications, Principles and Practice, 3rd Edition, Pearson, 2010
2. J.P. Bentley- Principles of Measurement Systems (3/e), Pearson Education, New Delhi, 2007.
3. J. Wilson and J.F.B. Hawkes: Optoelectronics: An Introduction (2/e), PHI, New Delhi, 2001. (Chapter 1, Sections 3.1-3.2; 8.1-8.2, Sections 8.3-8.4, 8.5, Sections 4.6, 5.1-5.6, 5.10.2, 7.2, Sections 3.4, 3.7, 3.8, Chapter 10)

3. R.P.Khare: Fibre Optics & Optoelectronics, Oxford University Press, New Delhi, 2010.

## Fiber Optics Instrumentation UPEIE502

**Prerequisite:** **A basic course on Electromagnetic Theory**

**Course outcome:**

**At the end of this course student will be able to:**

**(1)** To expose the students to the basic concepts of optical fibres and their properties.
**(2)** To provide adequate knowledge about the Industrial applications of optical fibres.
**(3)** To expose the students to the Laser fundamentals
**(4)** To provide adequate knowledge about Industrial application of lasers.

**Module 1(11hrs)**

**Optical Sources:**

Light emitting diodes (LED), Materials for LED, Types of LEDs, Quantum efficiency, Light Intensity, Modulation capability, Output Power, LED drive circuits Laser Diode: Laser fundamentals, Absorption and emission of radiation, conditions for amplification by stimulated emission, threshold condition for laser oscillation, resonant frequencies, quantum efficiency, semiconductor laser, modulation of laser diode, radiation pattern, optical transmitters, laser drivers Optical Detectors: PIN photo detector, impulse response and frequency response, avalanche Photodiode (APD).

**Module 2(12hrs)**

**Optical Fibre:**

Fibre materials, modes in step index fibre (TE and TM modes only), numerical aperture in graded index ((GI)) fibres modes in GI fibre Power launching and coupling: Source-to-fibre power launching, power launching calculation, equilibrium numerical aperture, lensing schemes for coupling improvement

**Module 3 (9hrs)**

**Industrial Application of Optical Fibres:**

Fiber optic sensors – Classifications of sensors, Fiber optic instrumentation system – Different types of modulators – Interferometry method of measurement of length – Moire fringe modulation sensors for displacement measurement, interferometry sensors fiber based Fabrey-Parot interferometry sensors.

**Text Books:**

- John M. Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson, 2010
- Gerd Keiser, Optical Fiber Communications, 2nd Edition, McGraw Hill, Inc.

## MICROPROCESSOR AND MICROCONTROLLER LABORATORY ULCIE501

**Prerequisite**

Digital Electronics, Basic Programming Skills

**Course Outcomes**

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

1. Distinguish and analyze the working of Microprocessors & Microcontrollers.
2. Train their practical knowledge through laboratory experiments.
3. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
4. Develop their skill in the use of tools like Keil, Proteus etc.

**Microprocessors- 8085 (at least 5 from the list)**

1. Understanding Arithmetic and Logical OperationsAscending order/ Descending order
2. Fibonaci Series
3. Sum of finite series
4. Factorial of Given Numbers
5. Binary to BCD/ BCD to Binary code conversions
6. Rolling and Flashing Display
7. To find Largest and Smallest from a series of numbers
8. To control the operation of stepper motor torotate forward and reverse direction
9. Digital Analog conversion/ Analog digital conversion
10. Traffic Light control
11. Interfacing- 8255 PPI, Timer/ Counter
12. Application of ARM Processors

**Microcontroller (8051/ AVR/ PIC) (at least 2 from the list)**

2. PWM Interfacing
3. Bluetooth Interfacing
4. RFID Card based application
5. Ultrasonic Sensor based application

Some experiments based on Proteus (At least 1)

Mini projects

## CONTROL SYSTEM ENGINEERING LAB ULCIE502

**Course Outcomes:**

At the end of the course, student will be able to,

1. Analyze the first and second order systems using time domain and frequency domain analysis.

2. Compare the stability analysis using root locus, bode, and Nyquist criteria.
3. Design PID controller and analyze the lag, lead compensating network.
4. Design and Implement PID controller for any applications.

**List of Experiments: (At least 10 experiments should be done)**

1. Simulation of a typical second order system and determination of step response and evaluation.
2. To draw the root locus for a given transfer function and verification of breakaway point and imaginary axis crossover point using MATLAB.
3. To study the effect of P, PI, and PID controller on step response of a feedback control system using MATLAB.
4. To study the effect of P, PI, and PID controller on step response of a feedback control using trainer kit.
5. Design of PID Controller for first order and second order systems.
6. Design of PID Controller for speed control of DC Motor System.
7. To draw the Bode plot of a given transfer function using MATLAB.
8. To draw the Nyquist plot of a given transfer function using MATLAB.
9. To design passive RC-lag compensation network for given specification and to obtain its frequency response.
10. To design passive RC-lead compensating network for given specifications is maximum phase lead and frequency at which it occurs and obtain frequency response.
11. To observe the DC-position control system for different values of angular position command.

## PROCESS CONTROL I LAB ULCIE503

**Prerequisite:** Control System.

**Course Outcome:**

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

1. Design P/PI/PID controller for temperature and flow control as a process variable.

2. Design lead, lag, lead-lag compensatory network.
3. Realize different characteristics of I/P and P/I converter and control valves.Design of any dynamic process using PLC.

**List of experiments (Any 10 experiments should be carried out):**

1) Design and simulation of linear system for different excitation.
2) Design of a compensatory network (lead, lag, lead-lag) for the given specifications.
3) Performance analysis of P/PI/PID controllers for temperature control as a process variable.
4) Realization of the characteristics of I/P and P/I converter.
5) Design and implementation of water level tank system using PLC.
6) Performance analysis of PID controller for a flow control as a process variable.
7) Design of RLL for elevator using PLC.
8) Performance analysis of PID controller for pressure control as a process variable.
9) Determination of valve coefficient of a control valve and analyze its characteristics.
10) Realization of pneumatic system as a process control loop.
11) Realization of feed-forward control loop and determination of its characteristics. 12)Mini Project based on experiment no 1-11.

## PROCESS CONTROL-II UPCIE601

**Prerequisite:** Control System

**Course Outcomes:**

Upon successful completion of this course, a student will be able to

1. Describe an industrial process.
2. Analyze the techniques used to get desirable performance of a process.
3. Apply different safety measures to avoid hazardous condition in industry.
4. Evaluate appropriate control strategy for a specific process.

5. Design a scheme to automate simple processes using PLC / DCS.
6. Describe monitor and control of a plant using SCADA system.

**Module I (10 Hrs)**

History of process control systems- Examples of process control system (Heat exchanger, Continuous Stirred –Tank Heater/Reactor(CSTR) ,Incentives for process control: suppress the influence of external disturbances, ensure the stability of a process, optimize the performance of a process [S.K. Singh, G. Stephanopoulos(Ch.1)], Hazardous areas and instrumentation: classification, explosion protection of electrical apparatus, intrinsically safe electronic transmission. (Ch.13, Bentley & Ch.15 A.K Ghosh)

**Module II (12 Hrs)**

Control system with multiple loops-cascade control, selective control, split range control (Ch-20) [G. Stephanopoulos] .Feed forward and ratio control-Logic of feed forward control, problem of designing feed forward controllers, practical aspects on the design of FF controllers, Feed forward-Feedback control, Ratio control.(Ch-21) [ G. Stephanopoulos] .Adaptive and Inferential control systems: Adaptive control and Inferential control (Ch-22) [G. Stephanopoulos]

**Module III (14 Hrs)**

PLC (Programmable Logic Controllers)-Introduction, Principle of operation, Architecture, Programming (Ch-10) [K. Kant] .Distributed Digital Control-introduction, Distributed Vs. centralized control, Advantage of DCS (Ch-7-7.2) [K. Kant] .DCS(Distributed Control System):Distributed Control sub-System, local field station, presentation and monitoring device, communication options in Distributed Control System (Ch-7.5) [K. Kant].SCADA(Supervisory Control and Data AcquisitionSystems):channel scanning, conversion to engineering units, data processing, distributed SCADA system.(Ch-3.6)[K. Kant]

**Text books:**

1. George Stephanopoulos, *Chemical process control*, PHI Learning Private Limited, New Delhi, 2009.
2. Computer based Industrial Control, 2nd ed. by K. Kant.,2009
3. Industrial Instrumentation and Control, 3rd ed. by S K Singh.

**Reference Books:**

1. Process control (Instrument Engineer Handbook), by Bela G. Liptak, Butterworth Heinemann Publication, 3rd Edition.
2. Process control Systems and Instrumentation By-Terry Bartle, Cengage Learning Publication
3. D.R. Coughnowr, "Process System analysis and Control", McGraw Hill.
4. Smith Carlos and Corripio, "Principles and Practice of Automatic Process Control", John Wiley & Sons, 2006.
5. Jon Stenerson, "Industrial Automation and Process Control", Prentice Hall, 2003.

## DIGITAL SIGNAL PROCESSING UPCIE602

**Prerequisites:** Basic knowledge in Signals and systems, Fourier series and transform, differential equations

**Course Outcomes:**

On successful completion of the course, students will be able to,

1. Determine the spectral coefficients of discrete-time signals.
2. Determine the frequency response and the z-transform representation of discrete-time systems.
3. Determine the discrete Fourier transform of discrete-time signals.
4. calculate the outputs of discrete-time systems in response to inputs.
5. Design Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, and

evaluate the performance to meet expected system specifications using MATLAB.

6. Demonstrate an understanding of contemporary issues by reviewing recent technical articles and establishing relationships between the course material and the content of the article.

**Module I (12 Hrs)**

**Introduction to Digital Signal Processing:** Discrete time complex exponentials and other basic signals, scaling of the independent axis and differences from its continuous, system properties (linearity, time invariance, memory, causality, BIBO stability), LTI systems described by linear constant coefficient difference equations (LCCDE), auto correlation.**Discrete-Time Signals and Systems (Frequency Domain analysis):** Linear convolution and its properties, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems. Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete Time Fourier Transform, and correlation of signals.

**Module II (12 Hrs)**

**Z Transform:** Generalized complex exponentials as eigen signals of LTI systems, z-transform definition, region of convergence (ROC)properties of ROC, properties of the z-transform, inverse z- transform methods (partial fraction expansion, power series method, contour integral approach),pole, zero plots, time domain responses of simple pole, zero plots, ROC implications of causality and stability.

**Discrete-Fourier Transform & Fast Fourier Transform:** Representation of Periodic sequences: The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT. FFT-Efficient Computation of DFT, Goertzel Algorithm, radix-2 Decimation-in-Time and Decimation -in-Frequency FFT Algorithms

**Module III (10 Hrs)**

**Filter Design Techniques:** Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters.

**Textbook(s):**

1. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall, Upper Saddle River, NJ.
2. Digital Signal Processing by John G. Proakis and Dimitris K. Manolakis, 4th edition, 2007, Prentice Hall, Upper Saddle River, NJ.
3. Digital *Signal Processing* by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY.

**Reference Book(s):**

1. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
2. Digital Signal Processing, A. Nagoor Kani, TMH Education

## ANALYTICAL INSTRUMENTATION UPEIE601

**Prerequisite:** Basic chemistry

**Course Outcomes:**

Upon successful completion of this course, a student will be able to

1. Select the required instruments for spectroscopic analysis.
2. Separate the constituents from a complex mixture using the knowledge of chromatography.
3. Evaluate different online and offline processes and identify suitable instruments for analysis of gaseous, liquid or solid substance.
4. Evaluate the physical properties of samples using PH meters and conductivity meters.
5. Measure the composition of dissolved oxygen, sodium, silica elements present in

the given samples quantitatively

6. Analyse the interaction of electromagnetic radiations with matter and apply analytical techniques to accurately determine the elements present in the given sample.

**Module I (12 Hrs)**

**Statistical Analytic Techniques-** Mean Variance, Covariance, Confidence Level, Chi-square Test etc.

**Fundamentals of Analytical Instruments:** Elements and types of Analytical Instruments, Ultraviolet and Visible Absorption Spectroscopy, Different types of Spectrophotometers, Sources of Errors and Calibration, Infrared Spectrophotometers – Basic Components and Types, Sample Handling Techniques, Flame Photometers – Principle, Constructional Details, Types and accessories, Atomic Absorption Spectrophotometers and their instrumentation.

**Module II (12 Hrs)**

**Chromatography:** Gas Chromatograph – Basic Parts of a Gas Chromatograph, Methods of Measurement of Peak Areas, Liquid Chromatograph – Types, High Pressure Liquid Chromatograph. **pH meters and Ion Analyzers**: Principle of pH Measurement, Electrodes for pH Measurement, pH Meters, Ion Analyzers, Blood pH Measurement.**Gas Analyzers:** Measurement of Blood $pCO_2$ and $pO_2$, Industrial Gas Analyzers – Types, Paramagnetic Gas Analyzer, Infrared Gas Analyzers, Industrial gas Analyzers Based on Other Methods.

**Module III (10 Hrs)**

**Nucleonic or Radiation Techniques of Measurement**

**Radiochemical Instruments:** Fundamentals of Radiochemical Methods, Radiation Detectors, Liquid Scintillation Counters, Gamma Spectroscopy. X-Ray Spectrometers: Instrumentation for X-Ray Spectrometry, X-Ray Diffractometers, X-Ray Absorption Meters, Electron Probe Micro analyzer.

**Text Book(s):**

1. Handbook of Analytical Instruments – by R.S. Khandpur, TMH Education Pvt. Ltd.
2. Measurement and Instrumentation: Trends and Applications - M.K. Ghosh, S.Sen and S. Mukhopadhyay (ed.), Ane Books, New Delhi, 2008.

**Reference Book(s):**

1. Instrumental Methods of Analysis – by Willard H.H., Merrit L.L., Dean J.A. and Seattle F.L., CBS Publishing and Distributors, 6/e, 1999
2. Instrument Technology – by Jones B.E., Butterworth Scientific Publ., London, 1987. Mechanical and Industrial Measurements by Jain R.K., Khanna Publishing,N Delhi, 2/e, 1992.
3. Principles of Instrumental Analysis – by Skoog D.A. and West D.M., Holt Sounder Publication, Philadelphia, 1985.
4. Instrumental Analysis – by Mann C.K., Vickerks T.J. &Gullick W.H., Harper and Row
5. Jone's instrument Technology (vol. 2 and 3) - B.E. Noltingk, Butterworth-Heinmann, N Delhi.
6. Instrumental Methods of Chemical Analysis - E.W. Ewing, McGraw-Hill.
7. Instrumentation, Measurement and Analysis - B.C. Nakra and K.K. Chowdhurry, TMH.

## BIOMEDICAL INSTRUMENTATION UPEIE602

**Prerequisite:** Basic circuit theory, Differential Equations, Basic time/frequency domain concepts.

**Course outcomes:**

At the end of this course student will be able to, Familiarize with various medical equipment and their technical aspects.

1. Introduce the measurements involved in some medical equipment.
2. Identify, explain and judge patient safety issues related to biomedical instrumentation.

**Module I (12 Hrs)**

Introduction to Bioengineering, Biochemical and Biomedical Engineering, Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, general constraints in design of medical Instrumentation system &Regulation of Medical devices. Bioelectrical Signals: Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, SkinContact Impedance, Motion Artifacts.

**Module II (12 Hrs)**

Electrodes for ECG: Limb Electrode, Floating Electrodes, Prejelled disposable Electrodes, Electrodes for EEG, Electrodes for EMG.

Transducers for Biomedical Applications, Displacement, Position and flow pressure and temperature Transducers, Biosensors or Biochemical Sensor (Urea, Glucose, spO2, pcO2 measurement).

Laser Based Applications.

Blood flow and Blood Pressure Measurement (Invasive and Non Invasive techniques), Pulse oximeter,

**Module III (10 Hrs)**

General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling), Biomedical Safety and Standards.

**Textbook(s):**

1. Biomedical Instrumentation And Measurement, 2 Ed by Cromwell, Pearson India, 2015, Paperback, 9789332556911
2. Introduction to Biomedical Engineering by Michael M. Domach, Pearson Education Inc, - 2004

**Reference Book:**

1. Hand Book of Biomedical Instrumentation-2nd Ed by R.S.Khandpur, Tata McGraw Hill,2003

## POWER ELECTRONICS AND DRIVE UPEIE603

**Prerequisites:** Basic Electronics, Digital Electronics

**Course Outcomes:**

At the end of the course students will be able to

1. Analyse Various power semiconductor devices, Controlled Rectifiers, Ac-dc, ac-ac conversion and source power factors, dc-dc, dc-ac conversion
2. Evaluate Transient and steady-state analysis of controlled rectifier on R/R-L/R-L-Eb load and their effects on source pf.
3. Analyse Methods of power conversion and soft-switching in various converters
4. Implement PWM control and its use in various converter

**Module I (12 Hrs)**

**Power semiconductor devices:** Switching and V-I characteristic of devices Thyristor family: SCR, TRIAC, GTO, RCT, MCT, and Transistor Family: BJT, IGBT, and MOSFET

**Triggering Methods:** SCR: UJT and R-C triggering scheme, Power Transistor: MOSFET Gate drive, BJT base drive, IGBT gate drive, Isolation of gate and base drive.

**Protection of Devices:** SCR: Over voltage, over current, dv/dt, di/dt, Gate Protection.

**Transistor:** protection of power BJT, IGBT and power MOSFET.

**Module II (12 Hrs)**

**AC to DC converter:** Un controlled Diode rectifier: Single phase half wave and full wave rectifiers with R-L and R-L-E load ,3 phase bridge rectifier with R-L and R-L-E load

**Controlled rectifiers:** Principle of phase controlled converter operation, single phase full converter with R-L and R-L-E load,3 phase full converter with R-L and R-L-E load single phase semi converter with R-L and R-L-E load, 3 phase semi converter with R-L and R-L-E load.

Single phase PWM rectifier, Three phase PWM rectifier.

**AC - AC converter:** AC voltage controller: Single phase bi-directional controllers with Rand R-L load, single phase cyclo-converters, ac-voltage controllers with PWM control.

**Module III (12 Hrs)**

**DC - DC converter:** Classification: First quadrant, second quadrant, first and second quadrant, third and fourth quadrant, fourth quadrant converter. Switching mode regulators: Buck regulators, Boost regulators, Buck-Boost regulators, CUK regulators, Isolated Types: Fly Back Converters, Forward converters, Push Pull Converters, Bridge Converter.

**DC - AC converter:** Inverters: PWM inverters, Single phase Bridge Inverters, 3-Phase Inverters-180 deg. conduction, 120 deg. conduction. voltage control of 3-Phase Inverters: Sinusoidal PWM, space vector modulation, Current Source Inverter, Soft-switching, Zero Current Switching resonant inverters, Zero Voltage Switching resonant inverter. UPS, SMPS, Battery Chargers, Electronic Ballast.

Introduction to drives

**Textbooks:**

1. Power Electronics: Converters, Applications, and Design by Ned Mohan, Undeland and Robbins, Wiley Student Edition.
2. Power Electronics: Circuits, Devices and Applications by M H Rashid, 3rd Edition, Pearson

**Reference Books:**

1. Modern power Electronics and AC Drives, B.K. Bose, PHI
2. Power Converter Circuits by W Shepherd and L Zhang, CRC, Taylor and Francis, Special Indian Edition
3. Power Electronics, P.S. Bimbhra, Khanna Publication.

## ADVANCED ELECTRONICS CIRCUITS UPEIE604

**Prerequisite:** Basic Electronics, Analog Electronic Circuit.

**Course Outcome:**

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

1. Analyze the functioning of Wave shaping circuits
2. Analyze current flow and time base waveform of different multivibrators.
3. Design Schmitt trigger circuit and Time base generator
4. Apply NE555 timer IC and PLL in different scenarios.

**Module I (10 Hrs)**

**Linear Wave Shaping Circuit**: High pass and low pass RC circuits and their response for Sinusoidal, Step, Pulse, Square, & Ramp inputs, High pass RC network as Differentiator, Low pass RC circuit as an Integrator, Attenuators and its application as a CRO Probe, RL and RLC Circuits and their response for Step Input, Ringing Circuit.

**Non-Linear Wave Shaping Circuit**: Diode clippers, Transistor clippers, Clipping at two independent levels, Comparators, Applications of Voltage comparators. Clamping Operation, Clamping circuit taking Source and Diode resistances into account, Clamping Circuit Theorem, Practical Clamping Circuits, Effect of Diode Characteristics on Clamping Voltage, Synchronized Clamping.

**Module II (12 Hrs)**

**Multivibrator:** Bistable Multivibrator, fixed-bias bistable multivibrator, self-biased transistor binary, commutating capacitors, Triggering the binary, Unsymmetrical Triggering of the bistable multivibrator, Triggering Unsymmetrically through a Unilateral Device, Symmetrical Triggering, Triggering of a Bistable Multi Symmetrically without the Use of Auxiliary Diodes, Schmitt Trigger Circuit (Emitter- coupled Bistable Multivibrator).

**Monostable and Astable Multivibrator:** Monostable Multivibrator, Gate Width of a Collector-Coupled Monostable Multivibrator, Waveforms of the Collector-Coupled Monostable

Multivibrator, Emitter-Coupled Monostable Multivibrator, Triggering of the Monostable Multivibrator. Astable Collector-Coupled Multivibrator, Emitter-coupled Astable multivibrator.

**Module III (10 Hrs)**

**Negative Resistance Switching Devices:** Voltage Controllable Negative resistance devices, Tunnel Diode operation and characteristics, Time-Base Generators, General features of a Time-base signal, Methods of generating a voltage time-base waveform, Exponential sweep circuit, Miller and bootstrap time base generators-Basic principles, Transistor miller time base generator, Transistor bootstrap time base generator, Current Time-Base Generators, A Simple Current sweep, Linearity Correction through adjustment of driving waveform, Transistor current time base generator.

**Specialized IC Applications**: IC 555 Timer: IC 555 Timer as a Monostable Multivibrator and its applications, IC 555 Timer as Astable Multivibrator and its applications.

**Phase Locked Loop:** Operating principle of PLL, Phase detectors, Exclusive-OR phase detector, Monolithic phase detector, Instrumentation Amplifier and its applications.

**Text books:**

1. Pulse, Digital and switching Waveforms, Second Edition - Jacob Millman, Herbert Taub and Mothiki S Prakash Rao (TMH Publication). (Selected portion from Chapter 3, 8, 9, 10, 11, 12 and 13)
2. OP-Amps and Linear Integrated Circuits- Ramakant A. Gayakwad (PHI Publication). (Selected portion from Chapter 7, 8 and 9)
3. Pulse & Digital Circuits by K.Venkata Rao, K Rama Sudha & G Manmadha Rao, Pearson Education, 2010.

**Reference Books:**

1. Pulse and Digital Circuits by A. Anand Kumar, PHI.
2. OP-Amps and Linear Integrated Circuits - Robert F. Coughlin, Frederick F. Driscoll

(Pearson Education Publication).

## ADAPTIVE SIGNAL PROCESSING UPEIE701

**Prerequisites:** Discrete time system and their properties, FIR and IIR filter, DFT, Z-transform, and Fourier Transform etc.

**Course Outcome**:

The student will be able to:

1. Apply adaptive modeling systems for real time applications.
2. Realize the estimation theory for linear systems and modeling algorithms.
3. Optimize various parameters of the electronic circuits using LMS and RLS technique.
4. Know the difference between LMS and RLS technique and their limitations.
5. Evaluate the design criteria and modeling adaptive systems.Module I (8 Hrs)

**Introduction: Adaptive Systems** – General concept of adaptive filtering, Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications

**The Adaptive Linear Combiner**: Performance function, Gradient and Mean Square Error with examples

**Module II (10 Hrs)**

**Theory of Adaptation with Stationary Signals**: Properties of the Quadratic Performance Surface, Significance of Eigen values, Eigen vectors, correlation matrix. Searching the Performance Surface: A simple gradient search algorithm, Stability and Rate of convergence, the learning curve, Gradient Estimation and its effects on Adoption: The performance penalty, Variance of the gradient estimate.

**Module III (16 Hrs)**

**Adaptive Algorithms and Structures**: The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error, Convergence, learning Curve, Performance analysis, Filtered X LMS algorithm,

**Introduction to recursive least squares (RLS)**: Vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters **Applications:** Adaptive Modelling and System Identification using adaptive filter, Inverse Adaptive Modelling, Deconvolution, and equalization using adaptive filter, Adaptive Control Systems using Filtered X LMS Algorithm, Adaptive Noise Cancellation using Adaptive filter

**Text books:**

1. Bernard Widrow and Samuel D. Stearns, Adaptive Signal Processing, Pearson Education, 2nd impression 2009.

**Reference Books:**

1. Simon Haykin, Adaptive Filter Theory, 4th Edn., Pearson Education.

## ADVANCED CONTROL SYSTEM UPEIE702

**Prerequisites:** Engineering Mathematics, Control System Engineering

**Course Outcome:**

After completion of the course students will be able to,

1. Analyze, design & implement SISO & MIMO systems using state space approach
2. Demonstrate discrete, digital, non-linear control systems.
3. Apply Z- transform, pulse transfer function in digital system analysis.
4. Analyze digital system and non-linear system stability using different analysis tools.

**Module I (12 Hrs)**

**Discrete - Time Control Systems:** Introduction: Discrete Time Control Systems and Continuous Time Control Systems, Sampling Process. Digital Control Systems: Sample and Hold.

**The Z-transform:** Discrete-Time Signals, The Z-transform, Z-transform of Elementary functions, Important properties and Theorems of the Z-transform. The inverse Z-transform, Z-Transform method for solving Difference Equations. Z-Plane Analysis of Discrete Time Control Systems: Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals: Sampling theorem, folding, aliasing. Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems.

**Module II (12 Hrs)**

**State Variable Analysis & Design:** Introduction: Concepts of State, State Variables and State Model (of continuous time systems): State Model of Linear Systems, State Model for Single-Input-Single- Output Linear Systems, Linearization of the State Equation. State Models for Linear Continuous – Time Systems: State-Space Representation Using Physical Variables, State – space Representation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State

– space Representation using Canonical Variables, Derivation of Transfer Function for State Model. **Solution of State Equations:** Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley- Hamilton Theorem. Concepts of Controllability and Observability: Controllability, Observability, Effect of Pole-zero Cancellation in Transfer Function.

**Module III (10 Hrs)**

**Nonlinear Systems:** Introduction: Behaviour of Nonlinear Systems, Investigation of nonlinear systems. Common Physical Non Linearities: Saturation, Friction, Backlash, Relay, Multivariable Nonlinearity.

**The Phase Plane Method:** Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus

Point, Centre or Vortex Point, Stability of Non Linear Systems: Limit Cycles, Construction of Phase Trajectories: Construction by Analytical Method, Construction by Graphical Methods.

**The Describing Function Method:** Basic Concepts: Derivation of Describing Functions: Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Backlash.

**Text books:**

1. Discrete-Time Control System, by K.Ogata,2nd edition(2009), PHI.
2. Control Systems Engineering, by I.J. Nagrath and M. Gopal., 5th Edition (2007 / 2009), New Age International (P) Ltd. Publishers.

**Reference Books:**

1. Design of Feedback Control Systems by Stefani, Shahian, Savant, Hostetter, Fourth Edition (2009), Oxford University Press.
2. Modern Control Systems by K.Ogata, 5thEdition (2010),PHI.
3. Modern Control Systems by Richard C. Dorf. And Robert, H.Bishop, 11thEdition (2008), Pearson Education Inc. Publication.
4. Control Systems (Principles & Design) by M.Gopal, 3rdEdition (2008), TMH Publishing Company Ltd.
5. ControlSystemsEngineeringbyNormanS.Nise,4th Edition(2008), WileyIndia(P)Ltd.

## EMBEDDED SYSTEMS UPEIE703

**Prerequisites:** Microprocessor and Microcontroller

**Course Outcomes:**

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

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.

4. Implement simple embedded applications

**Module I (10 Hrs)**

Introduction to Embedded Systems- Classification, Challenges, design Issues, Von Neumann versus Harvard Architecture, RISC, CISC, Application Areas, Typical Embedded System- Core of Embedded System, Memory, Sensor, Actuator, Communication interface, Embedded Firmware, Other Components, Characteristics of Embedded Systems, Quality Attributes of Embedded Systems, Embedded Systems- Application and Domain Specific.

**Module II (12 Hrs)**

PIC Architecture Introduction to PIC microcontrollers, PIC architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, memory mapping, assembly language programming, addressing modes, instruction set. Overview of AVR Controllers and ARM Processors. I/O Programming I/O ports, I/O bit manipulation programming, timers/counters, programming to generate delay and wave form generation, I/O programming, LEDs, 7segment LED display, LCD and Keypad interfacing, Introduction to Proteus.

**Module III (10 Hrs)**

Real Time Operating System for Embedded Systems- Tasks, Process, Threads, Multi Processing, Multi-Tasking, Task Communication, Task Synchronization, Deadlock, Scheduling Algorithms-Pre- emptive, Non Pre-emptive, Periodic, Aperiodic. How to choose an RTOS, Embedded Product Development Life Cycle.

Case Studies: Digital Camera, Washing Machine, Automotive, Smart Card

**Textbook(s):**

1. Shibu K V, Introduction to Embedded Systems, Tata McGraw Hill, 2009

2. Chuck Hellebuyck, Programming PIC microcontrollers with PIC basic, Elsevier, 2003

**Reference Book(s):**

1. Peter Marwadel, Embedded System Design, Springer, 2014.
2. Embedded Systems: Architecture, Programming and Design, Tata McGraw-Hill Education, 2011

## MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS) UPEIE704

**Prerequisites:** Physics, Mechanics.

**Course Outcomes:**

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

1. Compute different methods for Processing MEMS materials
2. Analyze Characteristic techniques of micro system fabrication process
3. Elaborate the evolution of Nano technology
4. Impart knowledge about nano materials and various nano measurements techniques

**Module I (12 Hrs)**

MEMS and Microsystems: Introduction to MEMS and Microsystems, typical MEMS and Microsystem products, Materials for MEMS and Microsystems, Microsystem fabrication processes, wafer bonding. Overview of Micro manufacturing – Bulk micromachining, Surface micromachining, LIGA Process. Working principles of Microsystems, MEMS Applications.

**Module II (12 Hrs)**

Microsystem Modeling and Design: Mechanics of deformable bodies, Energy method, Estimation of stiffness and damping for different micro-structures, Modeling of electromechanical systems, Pull-in voltage, Mechanical sensors and actuators: Piezo resistive pressure sensors, MEMS capacitive accelerometer, Gyroscopes, Micro actuation using SMA and Piezoelectric crystals. Mag-MEMS Materials.

**Module III (10 Hrs)**

MEMS and Microfluidic Systems: Principle of MOEMS – Light modulator, beam splitter, digital micro- mirror device, light detectors and optical switch. Micro-fluidic system – Fluid actuation method, Dielectrophoresis, Electrowetting, Micro fluid Dispenser, Micro needle, Micro pumps.

**Text books:**

1. Tai-Ran Hsu, "MEMS and Microsystems, Design and manufacture ", McGraw Hill ,2002.
2. Nitaigour Premchand Mahalik, "MEMS ", McGraw Hill, fifth reprint, 2011.
3. G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi, 2010.

**Reference Books:**

1. Gabriel M. Rebeiz: RF MEMS Theory, design & Technology, Wiley India Education,2010.
Ellis Meng, "Biomedical Microsystems ", CRC Press, 2011.

## VLSI UPEIE705

**Pre requisites:** Analog Electronics, Digital Electronics

**Course Outcomes:**

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

1. Interpret the submicron issues in VLSI Design
2. Design different CMOS circuits using various logic families along with their circuit layout.
3. Analyse parasitic effects, switching delays, power dissipation issues in VLSI designs.
4. Implement VLSI IC design using EDA tools.

**Module I (10 Hrs)**

Basic MOSFET Characteristics -The MOS Threshold Voltage, Body Bias, CV Characteristics, Scaling, Small-Device Effects-Threshold Voltage Modifications, Mobility Variations, Hot

Electrons, Small Device Model, Basic Circuit and DC Operation (CMOS) - DC Characteristics, Noise Margins, Transistor as a switch.

**Module II (12 Hrs)**

Inverter Switching Characteristics-Switching Intervals, High-to-Low Time, Low-to-High Time, Maximum Switching Frequency, Transient Effects on the VTC, RC Modelling, Propagation Delay, Use of the Step-Input Waveform, Output Capacitance, Inverter Design- DC Design, Transient Design, Power Dissipation, Driving Large Capacitive Loads, Pass Transistor Logic, Pseudo-nMOS Logic Gates- Complex Logic in Pseudo-nMOS, Simplified XNOR Gate, Transmission Gate, Sequential Circuit Design, CMOS DifferentialLogic Families, Dynamic Logic, Domino Logic, NORA, Zipper Logic.

**Module III (10 Hrs)**

Integrated Circuit Layout: Design Rules, Parasitics, Delay: RC Delay model, linear delay model, logical path efforts, Power, interconnect and Robustness in CMOS circuit layout, Issues in Chip Design-On-Chip Interconnects-Line Parasitics, Modelling of the Interconnect Line, Clock Distribution, Coupling Capacitors and Crosstalk, Input and Output Circuits- Networks, Output Circuits, Transmission Lines- Ideal Transmission Line Analysis, Reflections and Matching, Introduction to VHDL/ Verilog.

**Text books:**

1. J.P.Uyemura, CMOS Logic Circuit Design, Kluwer Academic Publishers 2001.
2. Kang and Leblebici
3. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4thEdition, Pearson Education India, 2011.
4. J. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson Education India 2016ISBN-13: 9788120322578.

**Reference Books:**

1. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.

## Entrepreneurship Development UHSMH701

**Prerequisites:**

1. Organizational Behaviour.
2. English.

**Module 1: (06 Hours)**

Entrepreneurship: Concept of Entrepreneurship and Intrapreneurship, Types of Entrepreneur, Nature and Importance, Entrepreneurial Motivation and Achievement, Entrepreneurial Personality & Traits and Entrepreneurial Skills.

**Module 2: (08 Hours)**

Entrepreneurial Environment, Identification of Opportunities, Converting Business, Opportunities into reality. Start-ups and business incubation, Skill Development. Setting up a Small Enterprise. Issues relating to location, Environmental Problems and Industrial Policies and Regulations.

**Module 3: (08 Hours)**

Basics of Accounting, Terms: Assets, Liabilities, Equity, Revenue, Expense, Working capital, Marketing Mix and STP.

HRM: Concepts and Function, Labour Laws- Factories Act, Organizational sup- port services - Central and State Government, Incentives and Subsidies.

**Module 4: (08 Hours)**

Sickness of Small-Scale Industries, Causes and symptoms of sickness, cures of sickness, Role of Banks and Government in reviving sick industries.

**Text Books:**

1. Entrepreneurship Development and Management, Vasant Desai, HPH.
2. Entrepreneurship Management, Bholanath Dutta, Excel Books.
3. Entrepreneurial Development, Sangeeta Sharma, PHI.
4. Entrepreneurship, Rajeev Roy, Oxford University Press.

## ARTIFICIAL INTELLIGENCE UPEIE801

**Prerequisite:** Familiarity with Calculus, Theory of Probability and Statistics.

**Course outcome:**

After successful completion of the course, student will be able to

1. Implement the ideas of intelligent agents and search methods.

2. Analyze knowledge representation and reasoning.
3. Illustrate about planning and learning methodologies.
4. Construct plans and methods for designing controllers.

**Module I (15 Hrs)**

**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**

Overview of AI – History and developments in AI, general concepts – production systems and examples, Intelligent agents, Perception, Introduction to natural language processing.

**SEARCH STRATEGIES AND ALGORITHMS**

Structures and strategies for state space search- Data and Goal driven search, search techniques– BFS, DFS, DFS with iterative deepening, best first search and Heuristic search – A* algorithm, AO* algorithm, constraint satisfaction.

**Module II (10 Hrs)**

**KNOWLEDGE REPRESENTATION AND REASONING**

Representing knowledge– propositional calculus, predicate calculus, AI representational schemes, semantic networks, conceptual dependency, scripts and frames, theorem proving by resolution refutation, Basic probability notation, Axioms of probability, Baye’s rule, Probabilistic reasoning.

**Module III (10 Hrs)**

**PLANING AND LEARNING**

Planning: Planning problem – Partial order planning – Planning and acting in non- deterministic domains – Learning: Learning decision trees, Knowledge in learning, Neural networks- basic architectures and types, Reinforcement learning – Passive and active.

Text books:

1. George. F, Luger, “Artificial Intelligence – Structures and Strategies for Complex Problem Solving”, Fourth Edition, Pearson Education, 2002.

2. Elain Rich and Kevin Knight, “Artificial Intelligence”, Second Edition Tata McGraw Hill, 2004.
3. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, Prentice Hall, Englewood Cliffs, New Jersey 07632

**Reference Books:**

1. Donald. A, Waterman, “A Guide to Expert Systems”, Pearson Education.2009.
2. Oliver Pourret, PatrikNaim and Bruce Marcot, “Bayesian Networks-A Practical guide to applications”, 2008.
3. Artificial Intelligence: A New Synthesis (The Morgan Kaufmann Series in Artificial Intelligence) by Nils J Nilsson, Elsevier India, First edition.

## SATELLITE COMMUNICATION SYSTEM UPEIE802

**Prerequisites:** Basics of Analog and Digital Communication

**Course Outcomes:**

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

1. Define orbital mechanics and launching methodologies of satellites.
2. Analyze the satellite subsystems
3. Design link power budget for satellites.
4. Compare different multiple access techniques for satellite communications.

**Module I (8 Hrs) Satellite Orbits**

Kepler’s Laws, Newton’s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non-Geo-stationary orbits – Look Angle Determination- Limits of visibility eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

**Module II (12 Hrs)**

**Space Segment and Satellite Link Design**

**Spacecraft Technology-** Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. **Satellite link budget:** Flux density and received signal power equations, Calculation ofSystem noise temperature for satellite receiver, noise power calculation, Drafting of satellite linkbudget and C/N ratio calculations in clear air and rainy conditions.

**Module III (12 Hrs) Satellite Access**

**Modulation and Multiplexing:** Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication,

**Satellite Applications**

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH).

**Text books:**

1. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition,2010.
2. S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.

**Reference Books:**

1. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
2. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

## DIGITAL IMAGE PROCESSING UPEIE803

**Prerequisites:** Signals and systems, Digital Signal Processing

**Course Outcomes:**

On successful completion of the course, students should be able to:

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.

5. Interpret Image compression standards.
6. Interpret image segmentation and representation techniques.

**Module I (13 Hours)**

**Digital Image Fundamentals and Transforms:** Elements of visual perception, Image sampling and quantization Basic relationship between pixels, Basic geometric transformations, Properties of 2D Fourier Transform, FFT, Separable Image Transforms, Walsh – Hadamard, Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

**Image Enhancement Techniques:** Spatial Domain methods: Basic grey level transformation, Histogram equalization, Image subtraction, Image averaging, Spatial filtering: Smoothing, sharpening filters, Laplacian filters, Frequency domain filters: Smoothing, Sharpening filters, Homomorphic filtering.

**Image Restoration:** Model of Image Degradation/restoration process, Noise models, Inverse filtering, Least mean square filtering, Constrained least mean square filtering, Blind image restoration, Pseudo inverse, Singular value decomposition.

**Module II (11 Hours)**

**Image Segmentation:** Point, Line, Edge detection, Thresholding, Region Based segmentation, Hough Transform.

**Image Compression:** Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

**Module III (10 Hours)**

**Color Image Processing:** Color Representation, Laws of color matching, chromaticity diagram, color enhancement, color image segmentation, color edge detection, color demosaicing.

**Morphological Image Processing:** Dilation, Erosion, Duality, Opening, Closing, Hit-or-Miss Transformation, Basic morphological algorithm.

**Textbook(s):**

1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing, Pearson Education 2003.
2. A.K. Jain, Fundamentals of Digital Image Processing, PHI

**Reference Book(s):**

1. William K Pratt, Digital Image Processing, John Willey Publishers
2. Millman Sonka, Vaclav Hlavac, Image Processing Analysis and Machine Vision,Thompson Learning (1999).

## MACHINE LEARNING UPEIE804

**Pre-requisites:** Familiarity with Theory of Probability and Statistics.

**Course outcome:**

After successful completion of the course, student will be able to

1. Design algorithms that allow machines (e.g., a computer) to learn patterns and concepts from data without being explicitly programmed.
2. Implement the ideas to the design (and some analysis) of Machine Learning algorithms, with a modern outlook focusing on recent advances, and examples of real-world applications of Machine Learning algorithms.

**Module I (10 Hours)**

**Supervised Learning (Regression/Classification)**

Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naïve Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking, Different error evaluation metrics ( etc, F1 score, confusion matrix, precision, recall)

Module II (10 Hours) Unsupervised Learning

Clustering: K-means/Kernel K-means, Density based clustering (DBSCAN), Association Rule learning, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Assorted Topics, Evaluating Machine Learning algorithms and Model Selection

**Module III (12 Hours)**

Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests), Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning, Scalable Machine Learning (Online and Distributed Learning), A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

**Text books:**

1. Tom Mitchell, Machine Learning, McGraw-Hill.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

**Reference books:**

1. Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Morgan- Kaufmann, 1st edition (October 23, 2002)
2. Foundations of Machine Learning by Mohri Mehryar, Afshin Rostamizadeh, and Ameet Talwalkar, MIT Press, 2012
3. Machine Learning: Step-by-Step Guide To Implement Machine Learning Algorithms with Python by Rudolph Russell.

4. Hal Daumé III, A Course in Machine Learning, 2015.

## WIRELESS SENSOR NETWORK UPEIE805

**Prerequisites:** Various network topology, different types of sensors, Real-time application of wireless sensor network.

**Course Outcomes:**

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

1. Evaluate the type of sensor nodes required in a particular application.
2. Apply the various network deployment techniques while designing a sensor network large amount of sensor nodes.
3. Calibrate the parameters required for designing an energy-efficient sensor network keeping in- eye the effective time-synchronization.

**MODULE I (12 Hrs)**

Sensor Network Concept: Introduction, networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges.

Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, and Mobile deployment.

Localization and Tracking: Issues and approaches, Coarse-grained and Fine-grained node localization. Problem formulations: Sensing model, collaborative localization.

**MODULE II (14 Hrs)**

Tracking multiple objects: State space decomposition. Synchronization: Issues and Traditional approaches.

Communication Protocols for Senor Networks: Application layer protocols for WSN, Transport Layer, Network Layer, Data Link Layer, and Physical Layer, Time synchronization. Wireless Characteristics: Link quality.

**MODULE III (10 Hrs)**

Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques.

Energy-efficient and robust routing: Overview, Lifetime-maximizing energy-aware routing techniques, Geographic routing.

**Text books:**

1. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press

**References Books:**

2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati, Springer.
3. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas, Morgan Kaufmann Series in Networking 2004.
4. Wireless Sensor Networks: Technology, Protocols, and Applications: KazemSohraby, Daniel Minoli, Taieb Znati, Wiley Inter Science.

## OPEN ELECTIVE OFFERED BY OTHER BRANCHES TO "INSTRUMENTATION & ELECTRONICS ENGINEERING"

### OPEN ELECTIVE - I (5TH SEM)

| Sl. No | Branch | Subject Code | Subject |
|---|---|---|---|
| 1 | CIVIL ENGINEERING | UOECE501 | Fluid Mechanics |
| 2 | ELECTRICAL ENGINEERING | UPEEE804 | Industrial Electrical Systems |
| 3 | MECHANICAL ENGG. | UOEME501 | Thermodynamics and Heat Transfer |
| | | UOEME502 | Applied Thermal Engineering |
| 4 | COMPUTER SCIENCE ENGG | UOECS504 | Real-Time Systems |
| | | UOECS505 | Advance Algorithms |
| | | UOECS506 | Parallel & Distributed Systems |
| 5 | INFORMATION TECHNOLOGY | UOEIT501 | Data Structure |
| 6 | BIOTECHNOLOGY | UOEBT501 | Physiology for Engineers |
| 7 | FASHION TECHNOLOGY | UOEFT501 | Fundamental Techniques of Apparel Design |
| 8 | TEXTILE ENGG. | UOETE501 | Textile Structural composite |

### OPEN ELECTIVE - II (6TH SEM)

| Sl. No | Branch | Subject Code | Subject |
|---|---|---|---|
| 1 | CIVIL ENGINEERING | UOECE601 | Mechanics of Solids |
| 2 | ELECTRICAL ENGINEERING | UPEEE601 | Renewable Energy Systems |
| 3 | MECHANICAL ENGG. | UOEME601 | Basic Manufacturing Process |
| 4 | COMPUTER SCIENCE ENGG | UOECS609 | Cambinatorics & Graph Theory |
| | | UOECS610 | Human Computer Interaction. |
| 5 | INFORMATION TECHNOLOGY | UOEIT601 | Object Oriented Programming using C++ |

**Abbreviations Used:** **L = Lectures, P = Practical or Laboratory, T = Tutorial**

**IA = Internal Assessment , PA = Practical Assessment, EA = End-Semester Assessment**

| | | | |
|---|---|---|---|
| 6 | BIOTECHNOLOGY | UOEBT601 | Introduction to Biopharmaceutical Technology |
| 7 | FASHION TECHNOLOGY | UOEFT601 | Visual Art and Illustration Techniques |
| 8 | TEXTILE ENGG. | UOETE601 | Clothing Science and Technology |

**OPEN ELECTIVE - III (7TH SEM)**

| Sl. No | Branch | Subject Code | Subject |
|---|---|---|---|
| 1 | CIVIL ENGINEERING | UOECE701 | Composite Materials |
| 2 | ELECTRICAL ENGINEERING | UPEEE704 | Control System Design |
| 3 | MECHANICAL ENGG. | UOEME701 | Mechanics of Solids |
| 4 | COMPUTER SCIENCE ENGG | UOECS709 | Big Data Analytics |
| | | UOECS710 | Information Retrieval |
| 5 | INFORMATION TECHNOLOGY | UOEIT701 | Java Programming |
| 6 | BIOTECHNOLOGY | UOEBT701 | Computational Biology |
| 7 | FASHION TECHNOLOGY | UOEFT701 | Fashion Photography |
| 8 | TEXTILE ENGG. | UOETE701 | Specialty Yarn and Fabric |

**OPEN ELECTIVE - IV (7TH SEM)**

| Sl. No | Branch | Subject Code | Subject |
|---|---|---|---|
| 1 | CIVIL ENGINEERING | UOECE702 | Solid Waste & Hazardous Waste Management |
| 2 | ELECTRICAL ENGINEERING | UPEEE602 | Electric & Hybrid Vehicles |
| 3 | MECHANICAL ENGG. | UOEME702 | Project and Production Management |
| 4 | COMPUTER SCIENCE ENGG | UOECS711 | Machine Learning |
| | | UOECS712 | Neural Network & Deep Learning. |

**Abbreviations Used:** **L = Lectures, P = Practical or Laboratory, T = Tutorial**

**IA = Internal Assessment , PA = Practical Assessment, EA = End-Semester Assessment**

| | | | |
|---|---|---|---|
| 5 | INFORMATION TECHNOLOGY | UOEIT702 | Data Base Engineering |
| 6 | BIOTECHNOLOGY | UOEBT702 | Industrial Biotechnology |
| 7 | FASHION TECHNOLOGY | UOEFT702 | Fashion Business and Forecasting |
| 8 | TEXTILE ENGG. | UOETE702 | Color Measurement |

**OPEN ELECTIVE - V (8TH SEM)**

| Sl. No | Branch | Subject Code | Subject |
|---|---|---|---|
| 1 | CIVIL ENGINEERING | UOECE801 | Building Materials & Building Constructions |
| 2 | ELECTRICAL ENGINEERING | UPEEE606 | Electrical Engineering Materials |
| 3 | MECHANICAL ENGG. | UOEME801 | Fluid Mechanics & Hydraulic Machines |
| | | UOEME802 | Mechanism of Machines |
| 4 | COMPUTER SCIENCE ENGG | UOECS804 | Internet of Things |
| | | UOECS805 | Fog Computing |
| 5 | INFORMATION TECHNOLOGY | UOEIT801 | Computer Organization |
| 6 | BIOTECHNOLOGY | UOEBT801 | Bioseparation Technology |
| 7 | FASHION TECHNOLOGY | UOEFT801 | Visual Merchandising |
| 8 | TEXTILE ENGG. | UOETE801 | Application of Nanotechnology in Textile |

**OPEN ELECTIVE - VI (8TH SEM)**

| Sl. No | Branch | Subject Code | Subject |
|---|---|---|---|
| 1 | CIVIL ENGINEERING | UOECE802 | Engineering Geology |
| | | UOECE803 | Environmental Impact Assessment |

**<u>Abbreviations Used:</u> L = Lectures, P = Practical or Laboratory, T = Tutorial**

**IA = Internal Assessment , PA = Practical Assessment, EA = End-Semester Assessment**

| | | | |
|---|---|---|---|
| 2 | ELECTRICAL ENGINEERING | UOEEE802 | Power Station Engineering and Economy |
| | | UPEEE503 | Electrical Energy Conservation and Auditing |
| 3 | MECHANICAL ENGG. | UOEME803 | Quality Engineering and Management |
| 4 | COMPUTER SCIENCE ENGG | UOECS806 | Multi-Agent Intelligent Systems |
| | | UOECS807 | Virtual Reality |
| 5 | INFORMATION TECHNOLOGY | UOEIT802 | Data Mining |
| 6 | BIOTECHNOLOGY | UOEBT802 | Tissue Engineering |
| 7 | FASHION TECHNOLOGY | UOEFT802 | Smart and Functional Apparel |
| 8 | TEXTILE ENGG. | UOETE802 | Costing of Textile Materials |

# OPEN ELECTIVE

## Digital Image and Video Processing

**Module I (10 Hrs)**

**Image representation:** Gray scale and colour Images, image sampling and quantization. Two dimensional orthogonal transforms: DFT, Haar transform, KLT, DCT. Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering. Edge detection - non parametric and model based approaches, LOG filters.

**Image Restoration:** Degradation Models, PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.

**Module II (12 Hrs)**

**Image Segmentation:** Pixel classification, Bi-level thresholding, Multi-level thresholding, P-tile method, Adaptive thresholding, Spectral & spatial classification, Edge detection, Region growing.

**Image compression:** Fundamental concepts of image compression - Compression models – Information theoretic perspective - Fundamental coding theorem - Lossless Compression: Huffman Coding- Run length coding - Lossy compression: Transform coding - Image compression standards.

**Module III: (10 Hrs)**

Video Processing: Representation of Digital Video, Spatio-temporal sampling; Motion Estimation; Video Filtering; Video Compression, Video coding standards.

**Text Books:**

1. Digital Image processing Gonzalez and Woods, 3rd edition, Pearson and Prentice Hall, 2009

2. Image processing, analysis and machine vision Sonka, Hlavac and Boyle, Cengage learning, 2008

**References**

1. W.K. Pratt: Digital image processing, 4th edition, Wiley India, 2007.
2. K.R. Castleman: Digital image processing, 2nd edition, Pearson, 2012.
3. A.K. Jain: Fundamentals of digital image processing, Prentice Hall, 1989.

# DIGITAL COMMUNICATION

**MODULE – I (17 HOURS)**

Sampling Theorem, Some applications of sampling theorem.

**Digital Representation of Analog Signal** - Quantization of Signals, Quantization error, PCM, Electrical representation of binary digits, PCM System, Companding (4); Line coding, scrambling, T1 Digital System, Multiplexing T1 lines – The T2, T3 and T4 lines (3); Differential PCM- Linear predicted design, Delta Modulation, and Adaptive Delta Modulation.

**Noise in PCM and DM** - Calculation of Quantization Noise, Output Signal Power, Thermal Noise, Output SNR in PCM, Quantization noise in Delta Modulation, output signal power, output SNR, Comparison with PCM and DM.

**MODULE – II (7 HOURS)**

**Digital Modulation Technique**- Generation, Transmission, Reception; Spectrum and Geometrical Representation in the Signal Space of BPSK, DPSK, QPSK, QASK, M-ary PSK, BFSK, M-ary FSK, and Minimum Shifting Keying (MSK).

**MODULE – III (8 HOURS)**

**Principle of Digital Data Transmission**- Digital Communication Systems – Source, Line coder, Multiplexer, Regenerative repeater; Line Coding- PSD of various line codes, polar signalling, constructing a DC Null in PSD by pulse shaping, On Off signalling, Bipolar signalling; Pulse shaping – ISI and effect, Nyquist first criterion for zero ISI; Scrambling, Digital receiver and regenerative repeaters; Equalizers, Timing extraction, Detection error, Eye Diagram.

**TEXT BOOKS**

1. Principles of Communication Systems, H Taub, D L Schilling and G Saha, TMH Education Pvt Ltd, 4th Edition 2013.
2. An Introduction to Analog and Digital communications, Simon Haykin, Wiley Publication, 2nd edition, 2007

**3.** Modern Digital and Analog Communication Systems, B.P. Lathi and Z Ding, Oxford University Press, New Delhi. 4th Edition 2010.

**REFERENCE BOOKS**

1. Digital and Analog Communication System, Leon W. Couch-II, Prentice Hall of India, Pearson Education, 6th Edition 2001.
2. Digital and Analog Communication System, K. Sam Shanmugam, Wiley India Pvt. Ltd 2006.
3. Digital Communications – Fundamentals and applications, Bernard Sklar, Pearson education Publication, 2nd Edition, 2009.
4. R N Mutagi, Digital Communication- Theory, Techniques and Applications, Oxford University Press

## SATELLITE COMMUNICATION

**MODULE-I (12 Hours)**

**Introduction to satellite communication:** Orbital mechanics and parameters look angle determination, Launches and Lunch vehicle, Orbital effects in communication system performance. Attitude and orbit control system (AOCS), TT&C, Description of spacecraft System ; Transponders,
**Satellite Link Design:** Basics of transmission theory, system noise temperature and G/T ratio, Uplink and Downlink design, design of satellite links for specified (C/N) performance.

**MODULE–II (10 Hours)**

Analog telephone and television transmission: Energy dispersal, digital transmission Multiple Accesses: Multiplexing techniques for satellite links, Comprehensive study on FDMA, TDMA and CDMA; Spread Spectrum Transmission and Reception; Estimating Channel requirements, SPADE, Random access

**MODULE-III (10 Hours)**

Propagation on satellite: Earth paths and influence on link design; Quantifying attenuation and depolarization, hydrometric & non hydrometric effects.
Satellite Antennas: Types of antenna and relationships; Basic Antennas Theory – linear, rectangular & circular aperture; Gain, pointing loss,

**Text Books**

1) Satellite Communication, T. Pratt, C. Bostian, John Wiley Co, 2nd Edition.
2) Satellite Communication, Principles & Applications, R.N.Mutagi, Oxford University Press, 1st Edition, 2016

**Reference Books**

1. Digital Communication with Satellite and Fiber Optic Application, HarlodKolimbins, PHI

2. Satellite Communication, Robert M. Gagliardi, CBS Publishers
3. Satellitte Communication Systems, Richharia. BSP BOOKS PVT LTD.
4. Satellitte Communication Engg., MichealKolawole, BSP BOOKS PVT LTD

## MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS)

**Module-I (14 hrs)**
Overview of MEMS and Microsystems.(Chapter 1 of Text Book 1) Micromachining Techniques:Silicon as material for micromachining, Photolithography, thin film deposition, doping,wet and dry etching, surface and bulk micromachining, Wafer bonding,LIGA packaging. (Chapter 3 and Section 8.2 of Text Book 1, Chapter 2 of Text Book 2)

**Module II (10 hrs)**
Microsystem Modeling and Design:Mechanics of deformable bodies, Energy method, Estimation of stiffness and damping for different micro-structures, Modeling of electromechanical systems, Pull-in voltage. (Section 4.1 to 4.3 and 6.2.2 of Text Book 1, Section 3.4 of Text Book 2)

**Module III (09 hrs)**
MEMS Applications:Mechanical sensors and actuators: Piezoresistive pressure sensors, MEMS capacitive accelerometer, Gyroscopes, (Section 8.3 of Text Book 1 and Section 5.3 and 5.11 of Text Book 2)

**Text Books:**
1. G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi, 2010.
2. N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi, 2007.
**Reference Book:**
*1. T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi, 2002.*
*3. Gabriel M.Rebeiz: RF MEMS Theory,design&Technology,Wiley India Education,2010.*

# WIRELESS SENSOR NETWORK

**MODULE-I (8 Hours)**
Sensor Network Concept: Introduction, Networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges.
Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.
**MODULE-II (7 Hours)**
Localization and Tracking: Issues and approaches, Problem formulations: Sensing model, collaborative localization. Coarse-grained and Fine-grained node localization. Tracking multiple objects.
**MODULE-III (8 Hours)**
Wireless Communications: Link quality, shadowing and fading effects
Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.
**MODULE-IV (7 Hours)**
Routing: Metric-based approaches, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing.
Sensor network Databases: Data-centric routing, Data-gathering with compression,

**Text Books**
1) Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.
**References Books**
2) Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press
3) Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam,  TaiebZnati, Springer.
4) Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, TaiebZnati, Wiley Inter Science.

# ANALOG VLSI

**MODULE – I (10 HOURS)**

1. **Introduction to Analog Design-** General Concepts, Levels of Abstraction, Robust Analog Design.
2. **Single-Stage Amplifiers-** Basic Concepts, Common-Source Stage, Common- Source Stage with Resistive Load, CS Stage with Diode-Connected Load, CS Stage with Current-Source Load, CS Stage with Triode Load, CS Stage with Source Degeneration, Source Follower, Common-Gate Stage, Cascode Stage, Folded Cascode.
3. **Differential Amplifiers-** Single-Ended and Differential Operation, Basic Differential Pair, Qualitative Analysis, Quantitative Analysis, Common-Mode Response, Differential Pair with MOS Loads, Gilbert Cell.

**MODULE – II (12 HOURS)**

4. **Passive and Active Current Mirrors-** Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors, Large-Signal Analysis, Small-Signal Analysis, Common-Mode Properties.
5. **Band gap References-** General Considerations, Supply-Independent Biasing, Temperature-Independent References, Negative-TC Voltage, Positive-TC Voltage, Bandgap Reference.

**MODULE-III (10 HOURS)**

6. **Operational Amplifiers-** General Considerations, Performance Parameters, One- Stage Op Amps, Two-Stage Op Amps, Gain Boosting, Comparison, Common- Mode Feedback, Input Range Limitations, Slew Rate, Power Supply Rejection.
7. **Frequency Response of Amplifiers-** General Considerations, Miller Effect, Association of Poles with Nodes, Common-Source Stage, Source Followers, Common-Gate Stage, Cascode Stage, Differential Pair.

**Feedback-** General Considerations, Properties of Feedback Circuits, Types of Amplifiers, Feedback Topologies, Voltage-Voltage Feedback, Current-Voltage Feedback, Voltage-Current Feedback, Current-Current Feedback, Effect of Loading,

**TEXT BOOKS**

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, Tata McGraw-Hill Publishing Company Limited, 2002.
2. CMOS Analog Circuit Design, D. Holberg and P. Allen, Oxford University Press, 2002.

**REFERENCE BOOKS**

1. Analysis and Design of Analog Integrated Circuits,P. Gray, P. Hurst, S. Lewis, and R. Meyer, John Wiley, 4th Edition, 2001.
2. Fundamentals of Microelectronics, BehzadRazavi, John Wiley, 1st Edition, 2008.
3. Analog Integrated Circuit Design, D. Johns and K. Martin, John Wiley, 1997.
4. Design of Analog Integrated Circuits and Systems, K.R. Laker and W.M.C. Sansen, McGraw-Hill, Inc., 1994.

5. Microelectronic Circuits, A. Sedra and K.C. Smith, Oxford University Press,5th Edition, 2004.