THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

# COURSES SCHEME

# &

# SYLLABUS

# FOR

# Bachelor of Engineering

# ELECTRONICS (INSTRUMENTATION AND CONTROL) ENGINEERING

# 2016

BACHELOR OF ENGINEERING (2016)

ELECTRONICS (INSTRUMENTATION AND CONTROL) ENGINEERING

(*Revised Course Scheme and Syllabus*)

**SEMESTER – I**

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UMA003 | MATHEMATICS-I | 3 | 1 | 0 | 3.5 |
| 2 | UTA007 | COMPUTER PROGRAMMING-I | 3 | 0 | 2 | 4.0 |
| 3 | UPH004 | APPLIED PHYSICS | 3 | 1 | 2 | 4.5 |
| 4 | UEE001 | ELECTRICAL ENGINEERING | 3 | 1 | 2 | 4.5 |
| 5 | UHU003 | PROFESSIONAL COMMUNICATION | 2 | 0 | 2 | 3.0 |
| 6 | UTA008 | ENGINEERING DESIGN-1 | 2 | 4 | 0 | 4.0 |
| **TOTAL** | | | 16 | 7 | 8 | 23.5 |

**SEMESTER – II**

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UMA004 | MATHEMATICS-II | 3 | 1 | 0 | 3.5 |
| 2 | UTA009 | COMPUTER PROGRAMMING-II | 3 | 0 | 2 | 4.0 |
| 3 | UES009 | MECHANICS | 2 | 1 | 2* | 2.5 |
| 4 | UEC001 | ELECTRONIC ENGINEERING | 3 | 1 | 2 | 4.5 |
| 5 | UCB008 | APPLIED CHEMISTRY | 3 | 1 | 2 | 4.5 |
| 6 | UTA010 | ENGINEERING DESIGN PROJECT-II (Catapult and more such projects) (with 6 self effort hours) | 1 | 0 | 2 | 5.0 |
| **TOTAL** | | | 15 | 4 | 8 | 24 |

***** *Each student will attend one lab session of 2 hours in a semester for a bridge project in this course (mechanics)*

**SEMESTER – III**

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UMA031 | OPTIMIZATION TECHNIQUES | 3 | 1 | 0 | 3.5 |
| 2 | UTA002 | MANUFACTURING PROCESS | 2 | 0 | 3 | 3.5 |
| 3 | UES010 | SOLIDS AND STRUCTURES | 3 | 1 | 2 | 4.5 |
| 4 | UES011 | THERMO-FLUID | 3 | 1 | 2 | 4.5 |
| 5 | UTA019 | ENGINEERING DESIGN – III (Buggy and more such projects) (With 6 self-effort hours) | 1 | 0 | 4 | 6.0 |
| 6 | UEI403 | ELECTRICAL AND ELECTRONIC MEASUREMENTS | 3 | 1 | 2 | 4.5 |
| **TOTAL** | | | 15 | 4 | 13 | 26.5 |

## SEMESTER – IV

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UHU005 | HUMANITIES FOR ENGINEERS | 2 | 0 | 2 | 3.0 |
| 2 | UES012 | ENGINEERING MATERIALS | 3 | 1 | 2 | 4.5 |
| 3 | UMA007 | NUMERICAL ANALYSIS | 3 | 1 | 2 | 4.5 |
| 4 | UEN002 | ENERGY AND ENVIRONMENT | 3 | 0 | 0 | 3.0 |
| 5 | UEI304 | SENSORS AND SIGNAL CONDITIONING WITH PROJECT (With 7 self-effort hours) | 3 | 1 | 2 | 8.0 |
| 6 | UEI303 | TECHNIQUES ON SIGNALS AND SYSTEMS | 3 | 1 | 0 | 3.5 |
| **TOTAL** | | | 17 | 4 | 8 | 26.5 |

** The L T P of Department Specific subjects may vary for different branches but the weekly contact hours should not exceed 32. The design projects have higher number of credits to compensate for self-effort hours each student is expected to put in.*

## SEMESTER-V

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UEI501 | CONTROL SYSTEMS | 3 | 1 | 2 | 4.5 |
| 2 | UEE505 | ANALOG AND DIGITAL SYSTEMS | 3 | 1 | 2 | 4.5 |
| 3 | UEI601 | INDUSTRIAL INSTRUMENTATION | 3 | 1 | 2 | 4.5 |
| 4 | UEI609 | FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS | 3 | 1 | 2 | 4.5 |
| 5 | UEE503 | NETWORK ANALYSIS AND SYNTHESIS | 3 | 1 | 0 | 3.5 |
| 6 | - | ELECTIVE-I | 3 | 1 | 0 | 3.5 |
| 7 | UTA012 | INNOVATION AND ENTREPRENEURSHIP (With 5 self effort hours) | 1 | 0 | 2 | 4.5 |
| **TOTAL** | | | 19 | 6 | 10 | 29.5 |

## SEMESTER-VI

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UEI605 | PROCESS DYNAMICS AND CONTROL | 3 | 0 | 2 | 4.0 |
| 2 | UEI841 | ADVANCED CONTROL SYSTEMS | 3 | 1 | 0 | 3.5 |
| 3 | UEE504 | POWER ELECTRONICS | 3 | 1 | 2 | 4.5 |
| 4 | UEI607 | DIGITAL SIGNAL PROCESSING AND APPLICATIONS | 3 | 1 | 2 | 4.5 |
| 5 | UEI608 | BIO-MEDICAL INSTRUMENTATION | 3 | 0 | 2 | 4.0 |
| 6 | UEI693 | CAPSTONE PROJECT START (4 Self effort hours) | 0 | 0 | 2 | 0.0 |
| 7 | | GENERIC ELECTIVE | 3 | 0 | 0 | 3.0 |
| **TOTAL** | | | 18 | 3 | 10 | 23.5 |

## SEMESTER-VII

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UEI701 | DATA ACQUISITION AND SYSTEM DESIGN | 3 | 0 | 2 | 4.0 |
| 2 | UEI801 | ADVANCED PROCESS CONTROL | 3 | 1 | 2 | 4.5 |
| 3 | UEI702 | VIRTUAL INSTRUMENTATION | 2 | 0 | 3 | 3.5 |
| 4 | UEI793 | CAPSTONE PROJECT (COMPLETION) (8 SEH) | 0 | 0 | 2 | 8.0 |
| 5 | UEE606 | ELECTRICAL MACHINES AND DRIVES | 3 | 1 | 2 | 4.5 |
| 6 | | ELECTIVE-II | 3 | 1 | 2 | 4.5 |
| **TOTAL** | | | 14 | 3 | 13 | 29.0 |

## SEMESTER-VIII

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UEI892 | PROJECT | – | – | – | 20.0 |
| OR | | | | | | |
| **Alternate Project Semester** | | | | | | |
| 1 | UEI894 | DESIGN PROJECT | – | – | – | 13.0 |
| 2 | UEE806 | ALTERNATE SOURCES OF ENERGY | 3 | 0 | 2 | 4.0 |
| 3 | UEI805 | ENVIRONMENTAL INSTRUMENTATION | 3 | 0 | 0 | 3.0 |
| **TOTAL** | | | 6 | 0 | 2 | 20.0 |
| OR | | | | | | |
| 1 | UEI895 | START- UP SEMESTER | – | – | – | 20.0 |

# LIST OF ELECTIVES

## ELECTIVE–I

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UEE507 | ENGINEERING ELECTROMAGNETICS | 3 | 1 | 0 | 3.5 |
| 2 | UEI831 | BIO–SENSOR AND MEMS | 3 | 1 | 0 | 3.5 |
| 3 | UEI833 | OPTICAL INSTRUMENTATION | 3 | 1 | 0 | 3.5 |
| 4 | UEI846 | BIO–MEDICAL DSP | 3 | 1 | 0 | 3.5 |
| 5 | UEI847 | ROBOTICS AND AUTOMATION | 3 | 1 | 0 | 3.5 |

## ELECTIVE–II

| SR. NO. | COURSE NO. | TITLE | L | T | P | CR |
|---|---|---|---|---|---|---|
| 1 | UEI401 | ARTIFICIAL INTELLIGENT TECHNIQUES AND APPLICATIONS | 3 | 1 | 2 | 4.5 |
| 2 | UEI721 | DIGITAL IMAGE PROCESSING | 3 | 1 | 2 | 4.5 |
| 3 | UCS740 | DATA STRUCTURES AND ALGORITHMS | 3 | 1 | 2 | 4.5 |
| 4 | UEI720 | ANALYTICAL INSTRUMENTATION | 3 | 1 | 2 | 4.5 |
| 5 | UCS739 | OBJECT ORIENTED PROGRAMMING AND APPLICATIONS | 3 | 1 | 2 | 4.5 |
| 6 | UEI719 | EMBEDDED CONTROL SYSTEM | 3 | 1 | 2 | 4.5 |

**GENERIC ELECTIVE**

| S. NO. | COURSE NO. | COURSE NAME | L | T | P | CR. |
|---|---|---|---|---|---|---|
| 1 | UHU007 | EMPLOYABILITY DEVELOPMENT SKILLS | 2 | 2 | 0 | 3.0 |
| 2 | UHU006 | INTRODUCTORY COURSE IN FRENCH | 2 | 2 | 0 | 3.0 |
| 3 | UHU009 | INTRODUCTION TO COGNITIVE SCIENCE | 3 | 0 | 0 | 3.0 |
| 4 | UHU008 | INTRODUCTION TO CORPORATE FINANCE | 3 | 0 | 0 | 3.0 |
| 5 | UCS001 | INTRODUCTION TO CYBER SECURITY | 3 | 0 | 0 | 3.0 |
| 6 | UPH063 | NANOSCIENCE AND NANOMATERIALS | 3 | 0 | 0 | 3.0 |
| 7 | UEN004 | TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT | 3 | 0 | 0 | 3.0 |
| 8 | UMA066 | GRAPH THEORY AND APPLICATIONS | 3 | 0 | 0 | 3.0 |
| 9 | UMA061 | ADVANCED NUMERICAL METHODS | 3 | 0 | 0 | 3.0 |
| 10 | UBTXXX | BIOLOGY FOR ENGINEERS | 3 | 0 | 0 | 3.0 |

**TOTAL CREDITS: 202.5**

## UEI403: ELECTRICAL AND ELECTRONIC MEASUREMENTS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objectives:** To understand concepts of various electrical and electronic measuring instruments.

**Electrical Standards:** Standards of e.m.f. and resistance, Frequency dependence of resistance, Inductance and Capacitance, Time and frequency standards.
**Electromechanical Indicating Instruments:** PMMC galvanometer, Ohmmeter, Electrodynamometer, Moving iron meter, Rectifier and thermo-instruments, Comparison of various types of indicating instruments.
**Power and Energy Measurement:** Electrodynamometer type of wattmeter and power factor meter, Power in poly phase system: two wattmeter method, Single-phase induction and Electronic energy meters.
**Instrument Transformers:** Current and Voltage transformers, Constructional features, Ratio and Phase angle errors.
**Magnetic Measurements:** Determination of B-H curve and hysteresis loop, Measurement of iron losses with Llyod Fisher square.
**Bridge Measurements:** AC bridges: Applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, De Sauty's bridge, Insulation testing, Ground resistance measurement, Varley and Murray loop test.
**Electronic Instruments:** Electronic multimeter, Digital voltmeters, General characteristics ramp type voltmeter, Quantization error, Digital frequency meter/Timer, Q meter and its applications, Distortion meter, Wavemeter and Spectrum Analyzer, Block diagram and Applications of oscilloscopes, Storage type digital oscilloscopes.
**Laboratory Work:**
Experiments around sensitivity of wheat stone bridge, Comparison of various types of indicating instruments, Single□phase induction type energy meter, AC bridges, Measurement of iron losses with Llyod Fisher square, Storage type digital oscilloscopes.
**Project:** Development of power supplies using transformers.
**Course Learning Outcomes (CLO):** After the completion of the course the students will be able to:
1. compare various electromechanical indicating instruments,
2. measure power and energy
3. design various AC bridges
4. analyze various waveform with the help of storage oscilloscope

***Text Book:***
*1. Golding, E.W., and Widdis, F.C., Electrical Measurements and Measuring Instruments, Pitman (2003).*
*2. Helfrick, A.D., and Cooper, W.D., Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India (2007).*

***Reference Books:***
*1. Kalsi, H.S., Electronic Instrumentation, Tata McGraw□Hill (2007).*
*2. Nakra, B.C., Chaudhry, K.K., Instrumentation Measurement and Analysis, Tata McGraw□Hill (2003).*

**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 40 |

## UEI304: SENSORS AND SIGNAL CONDITIONING (WITH PROJECT)

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 8 |

**Course Objectives:** To introduce the basics of measurements. To elucidate sensors and signal conditioning circuits. To introduce different error analysis methods. To familiarize with different sensors and transducers. To explain signal conditioning circuits.

**Introduction:** Definition, Application and types of measurements, Instrument classification, Functional elements of an instrument, Input-output configuration of measuring instruments, Methods of correction for interfering and modifying inputs, Standards, Calibration, Introduction to Static characteristics and Dynamic characteristics, Selection of instruments, Loading effects.

**Error Analysis:** Types of errors, Methods of error analysis, Uncertainty analysis, Statistical analysis, Gaussian error distribution, Chi-Square test, Correlation coefficient, Student's t-test, Method of least square, Curve fitting, Graphical analysis, General consideration in data analysis, Design of Experiment planning.

**Sensors/Transducers:** Definition, Types, Basic principle and applications of Resistive, Inductive, Capacitive, Piezoelectric and their Dynamic performance. Fiber optic sensors, Bio-chemical sensors, Hall-Effect, Photoemissive, Photo Diode/ Photo Transistor, Photovoltaic, LVDT, Strain Gauge Digital transducers: Principle, Construction, Encoders, Absolute and incremental encoders, Silicon micro transducers.

**Signal Conditioning:** Operational Amplifiers: application in instrumentation, Charge amplifier, Carrier amplifier, Introduction to active filters, Classification, Butterworth, Chebyshev, Couir filters, First order, Second order and higher order filters, Voltage to frequency and frequency to voltage converters.

**Laboratory Work:** Measurement of Linear Displacement, Angular displacement, Temperature, Light intensity, Capacitance, Resistance, Inductance.

**Project:** Projects based upon sensors and signal conditioning i.e. temperature measuring system, Pressure Measuring system, Level measuring system etc.

**Course Learning Outcomes (CLO):**

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

1. Apply different methods for the measurement of length and angle
2. Elucidate the construction and working of various industrial parameters / devices used to measure pressure, sound and flow
3. Explicate the construction and working of various industrial parameters / devices used to measure temperature, level, vibration, viscosity and humidity
4. Ability to analyse, formulate and select suitable sensor for the given industrial applications
5. Describe signal conditioning circuits

***Text Books***:

1. *Doebelin, E.O. and Manic, D.N., Measurement Systems: Applications and Design, McGraw –Hill (2004).*
2. *Sawhney, A.K. and Sawhney, P., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai (2008).*

***Reference Books:***

1. *Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India (2003).*
2. *Nakra, B.C. and Chaudhry, K.K., Instrumentation, Measurement and Analysis, Tata McGraw Hill (2003).*

**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 20 |
| 2 | EST | 30 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 50 |

## UEI303: TECHNIQUES ON SIGNALS AND SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 0 | 3.5 |

**Course Objectives:** To introduce the basic concepts and processing of analog and digital signals.

**Introduction:** Signals and Systems, Classification of signals, Continuous time signals and its classifications, Standard continuous time signals, Classification of continuous time systems, Discrete time signals and its classifications, Concept of frequency in discrete time signals, Standard discrete time signals, Discrete time systems, Classification of discrete time systems, Nyquist rate, Sampling theorem, Aliasing, Convolution, Correlation.

**Fourier Transform:** Introduction, Condition for existence of Fourier Integral, Fourier Transform and its properties, Energy density and Power Spectral Density, Nyquist Theorem, System Analysis using Fourier Transform.

**Z–Transform:** Introduction, Region of Convergence(ROC), Properties of z–transform. Initial value theorem, Final Value theorem, Partial Sum, Parseval’s Theorem, z–transform of standard sequences, Inverse z–transform, Pole–Zero plot, System function of LTI system, Causality and Stability in terms of z–transform.

**Random Signals:** Introduction, Probability, Random variables, Gaussian distribution, Transformation of random variables, random processes, stationary processes, Correlation and Covariance Functions.

**Course Learning Outcomes (CLO):**
After the successful completion of the course the students will be able to:

1. Apply sampling theorem for different applications
2. Solve problems related to Fourier transforms
3. Apply Fourier transforms for different applications
4. Apply z-transform and Laplace transform for system characterization
5. Elucidate the concepts of random signals

***Text Books:***

1. *Oppenheim, A.V. and Willsky, A.S., Signals and Systems, Prentice Hall of India (1997).*
2. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall (2007).*

***Reference Books:***

1. *Lathi, B.P., Signal Processing and Linear System, Oxford University Press (2008).*
2. *Roberts, M.J., Fundamentals of Signals and Systems, McGraw Hill (2007).*

**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 25 |

## UEI501: CONTROL SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| **3** | **1** | **2** | **4.5** |

**Course Objectives:** To understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains

**Basic Concepts:** Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, , Block diagrams and signal flow graphs.

**Components:** D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors

**Analysis:** Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

**Stability:** Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.

**Compensation:** Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.

**State Space Analysis:** Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

**Laboratory** : Linear system simulator, Compensation design, D.C. position control and speed control, Synchro characteristics, Servo demonstration, Stepper motor, Potentiometer error detector, Rate control system, Series control system, Temperature control system.

**Course Learning Outcomes (CLO):**

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

1. develop the mathematical model of the physical systems.
2. analyze the response of the closed and open loop systems.
3. analyze the stability of the closed and open loop systems.
4. design the various kinds of compensator.
5. develop and analyze state space models

***Text Books:***


1. *Gopal, M., Digital Control System, Wiley Eastern (1986).*
2. *Nagrath, I.J. and Gopal, M., Control System Engineering, New Age International (P) Limited, Publishers (2003).*
3. *Ogata, K., Modern Control Engineering, Prentice –Hall of India Private Limited (2001).*


***Reference Books:***


1. *Kuo, B.C., Automatic Control System, Prentice –Hall of India Private Limited (2002).*
2. *Sinha, N.K., Control System, New Age International (P) Limited, Publishers (2002).*


**Evaluation Scheme:**

| **S.NO.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 40 |

## UEI601: INDUSTRIAL INSTRUMENTATION

| L | T | P | Cr |
|---|---|---|---|
| **3** | **1** | **2** | **4.5** |

**Course objectives:** To provide the knowledge of Pressure, Sound, Flow, Temperature, Level,Humidity, Torque, Viscosity and Vibration measurements.

**Metrology (Measurement of Length, Angle and Area):** Dimensional measurement, Dial gauges, Gauge blocks, Comparators, Flatness measurement, Optical flats, Sine bar, Angle gauges, Planimeter.

**Motion and Vibration Measurement:** Translational and rotational displacement using potentiometers, Strain gauges, Differential transformer, Different types of tachometers, Accelerometers

**Pressure Measurement:** Moderate pressure measurement, Bourdon tube, Bellows and diaphragms, High pressure measurement: Piezoelectric, Electric resistance, Low pressure measurement: Mcleod gauge, Knudsen Gauge, Viscosity gauge, Thermal conductivity, Ionization gauge, Dead weight gauges.

**Flow Measurement:** Obstruction meter, Orifice, Nozzle, Venturi, Pitot tube, Rotameter, Turbine, Electromagnetic, Vortex, Positive displacement, Anemometers, Weirs and flumes, Laser Doppler anemometer, Ultrasonic flow meter, Mass flow meter.

**Temperature Measurement:** Bimetallic thermometers, Liquid-in-glass, Pressure thermometer, Semiconductor sensors, Digital thermometers, Pyrometers.

**Level Measurement:** Visual level indicators, Purge method, Buoyancy method, Resistance, Capacitance and inductive probes, Ultrasonic, Laser, Optical fiber, Thermal, Radar, Radiation.

**Miscellaneous Measurements:** Humidity, Dew point, Viscosity, nuclear radiation measurements.

**Laboratory work:** Experiments around Measurement of Length, Angle, Pressure, Temperature, Flow, Level, Humidity, Vibration using different techniques.

**Course Learning Outcomes (CLO):** After the successful completion of the course the students will be able to:

1. illustrate the different methods for the measurement of length and angle
2. elucidate the construction and working of various industrial devices used to measure pressure, sound and flow
3. explicate the construction and working of various industrial devices used to measure temperature, level, vibration, viscosity and humidity
4. ability to analyze, formulate and select suitable sensor for the given industrial applications

***Text Books:***

1. *Doeblin, E.O., Measurement systems, Applications and Design, McGraw–Hill (1982).*
2. *Nakra, B. C. and Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGraw–Hill (2003).*

***Reference Books:***

1. *Murthy, D.V.S., Transducers and Instrumentation, Prentice–Hall of India Private Limited (2003).*
2. *Sawhney, A.K., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co. (P) Ltd. (2007).*

**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 40 |

**UEI609: FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS**

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objectives:** To make the students able to understand microprocessors and microcontroller and their applications.

**INTEL 8086 Microprocessor:** Pin Functions, Architecture, Characteristics and Basic Features of Family, Segmented Memory, Addressing Modes, Instruction Set, Data Transfer Instructions, Arithmetic, Logical, Shift and Rotate Instructions, String Instructions, Flag Control Instructions, Transfer of Control Instructions, Processor Control Instructions, Programming Examples, Interrupt Structures, Multitasking and Multiprogramming, MIN/MAX Modes of 8086,Co-processors 8087 and 8089.

**Introduction to 8051 Microcontroller :** 8051-architecture and pin diagram, Registers, Timers Counters, Flags, Special Function Registers, Addressing Modes, Data types, instructions and programming, Single –bit operations, Timer and Counter programming, Interrupts programming, Serial communication, Memory accessing and their simple programming applications.

**Hardware interfacing:** I/O Port programming, Bit manipulation, Interfacing to a LED, LCD, Keyboard, ADC, DAC, Stepper Motors and sensors.

**Laboratory work:** Introduction to INTEL kit, Programming examples of 8086, Interfacing using 8086 kits,ADC, DAC, 8253, Microprocessor based project, Programming and Application development around 8051, Interfacing to LED, LCD, Keyboard, ADC, DAC, Stepper Motors and sensors etc.

**Course Learning Outcome (CLO):**

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

1. demonstrate the concept of microprocessor and to be able to design a microprocessor based system to get desired results.
2. use 8086 microprocessor in advanced applications, which will give them a good platform to work further.
3. graduates will be able to update with current trends through self-study and show genuine need to learn on continuous basis.
4. students will be able to use hardware interfacing of 8051 to develop solutions of real world electrical problems.

***Text Books:***


1. *Hall, D.V., Microprocessor- Interfacing Programming and Hardware, Tata McGraw–Hill (1997).*
2. *Ayala, K.J., The 8051 Microcontroller Architecture, Programming and applications, Penram International Publishing (India) Pvt. Ltd. (2007).*
3. *Mazidi, M.A., The 8051 Microcontroller and Embedded System, Pearson Education (2008).*


***Reference Books:***


1. *Brey, B.B., The INTEL Microprocessors, Prentice–Hall of India Private Limited (2002).*
2. *Liu, Y. C. and Gibson, G.A., Microcomputer Systems: The 8086/8088 Family– Architecture, Programming and Design, Prentice–Hall of India Private Limited (2007).*
3. *Uffenbeck, J., The 8086/ 8088 Family, Prentice–Hall of India Private Limited (1994).*
4. *Predko, M., Customizing The 8051 Microcontroller, Tata McGraw–Hill (2002).*


**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 40 |

## UEE503: NETWORK ANALYSIS AND SYNTHESIS

| L | T | P | Cr |
|---|---|---|---|
| **3** | **1** | **0** | **3.5** |

**Course Objective:** To make the students understand concepts of graph theory, two port networks, and network synthesis.

**Graph theory:** Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and topological equation for nodal voltage, Duality

**Network Theorems:** Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem and Maximum power transfer theorem as applied to A.C. circuits, Compensation theorem, Tellegen's theorem and their applications.

**Two Port Networks:** Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinites admittance matrix and its applications

**Network Functions:** Concepts of complex frequency, Transform impedance, Networks function of one port and two port network, concepts of poles and zeros, property of driving point and transfer function.

**Passive Network Synthesis:** Introduction, Positive Real Functions **:** Definition, Necessary and sufficient conditions for a function to be positive real, Elements of circuit synthesis, Foster and cauer forms of LC Networks, Synthesis of RC and RL networks.

**Course Learning Outcomes (CLO):**

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

1. understanding the various laws and theorems related to electric networks.
2. understanding the concept of two port networks.
3. familiarisation with network synthesis.

***Text Books:***


1. *Hayt, W., Engineering Circuit Analysis, Tata McGraw–Hill (2006).*
2. *Hussain, A., Networks and Systems, CBS Publications (2004).*
3. *Valkenberg, Van, Network Analysis, Prentice–Hall of India Private Limited (2007).*
4. *Gayakwad, A. Op-Amps and Linear Integrated Circuits, Prentice–Hall of India (2006).*


***Reference Books:***


1. *Chakarbarti,A., Circuit Theory, Dhanpat Rai and Co. (P) Ltd. (2006).*
2. *Roy Chowdhuary, D., Networks and Systems, New Age International (P) Limited, Publishers (2007).*
3. *Sudhakar, A., Circuits and Networks, Tata McGraw–Hill (2006).*
4. *Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).*


**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 25 |

## UEI605: PROCESS DYNAMICS AND CONTROL

| L | T | P | Cr |
|---|---|---|---|
| **3** | **0** | **2** | **4.0** |

**Course objective:** To make the students understand basic ideas, challenges, techniques, and applications of process control for controlling various processes.

**Introduction:** Historical perspective, Incentives of process control, Synthesis of control system. Classification and definition of process variables.

**Mathematical Modeling:** Need and application of mathematical modeling, Lumped and distributed parameters, Analogies, Thermal, Electrical and chemical systems, Modeling of CSTR, Modeling of heat exchanger, Interacting and non-interacting type of systems, Dead time elements

**Control Modes:** Definition, Characteristics and comparison of on-off, Proportional (P), Integral (I), Differential (D), PI, PD, PID, Dynamic behavior of feedback controlled processes for different control modes ,Control system quality, IAE, ISE, IATE criterion, Tuning of controllers Ziegler-Nichols, Cohen-Coon methods

**Realization of Control Modes:** Realization of different control modes like P, I, D, In Electric, Pneumatic, Hydraulic controllers.

**Actuators:** Hydraulic, Pneumatic actuators, Solenoid, E-P converters, Control valves, Types, Functions, Quick opening, Linear and equal percentage valve, Ball valves, Butterfly valves, Globe valves, Pinch valves, Valve application and selection

**Advanced Controls:** Introduction to advanced control schemes like Cascade, Feed forward, Ratio, Selective, Override, Split range and Auctioneering control

**Laboratory Work:** I to P, P to I, Valve characteristics, Simulation of different control modes, Experiments around Basic Process RIG.

**Course Learning Outcomes (CLO):**

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

1. demonstrate fundamental understanding of process control.
2. develop the mathematical model of various chemical processes.
3. explain different control modes and their application in controlling various processes.
4. explain the working of electric, hydraulic and pneumatic controllers.
5. demonstrate the working and application of different type of actuators and control valves

***Text Books:***

1. *Johnson, C.D., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited (1992).*
2. *Stephanopoulos, G., Chemical Process Control, Prentice–Hall of India Private Limited (1983).*

***Reference Books:***

1. *Harriot, P., Process Control, Tata McGraw–Hill (1982).*
2. *Liptak, B.G., Instrument Engineers Handbook, Butterworth, Heinemann (2002).*
3. *Seborg, D.E. and Edgar, T., Process Dynamics and Control, John Wiley and Sons (1989).*

**Evaluation Scheme:**

| **S.NO.** | **Evaluation Elements** | **Weightage** (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 40 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 35 |

## UEI841: ADVANCED CONTROL SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 0 | 3.5 |

**Course objective:**To learn the methods for analyzing the behavior of nonlinear control systems and the designing of control systems.

**Nonlinear Control Systems:** Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle.

**Optimal Control Theory:** Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin's optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle

**z-Plane Analysis of Discrete-Time Control Systems:** Introduction, Impulse sampling and data hold, Reconstructing original signal from sampled signals, concept of pulse transfer function, Realization of digital controllers.

**Design of Discrete-time Control Systems:** Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the root-locus method, Design based on the frequency-response method.

**State-Space Analysis:** Introduction, State-space representations of discrete-time systems, Solving discrete-time state-space equations, Pulse transfer function matrix, Discretization of continuous time state space equations,Lyapunov stability analysis, Controllability and Observability, Design via pole placement, State observer design.

**Course Learning Outcomes (CLO):**
After the successful completion of the course the students will be able to:

1. demonstrate non-linear system behavior by phase plane and describing function methods and the
2. perform the stability analysis nonlinear systems by Lyapunovmethoddevelop design skills in optimal control problems
3. derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
4. predict and analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.
5. acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers

***Text Books:***


1. *Slotine& Li, Applied Non-Linear Control*, Englewood Cliffs, NJ: Prentice-Hall, (1991).
2. *Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited (2003).*
3. *Ogata, K., Discrete-time Control Systems, Pearson Education (2005).*


**Evaluation Scheme:**

| **S.NO.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 25 |

## UEI607: DIGITAL SIGNAL PROCESSING AND APPLICATIONS

| L | T | P | Cr |
|---|---|---|---|
| **3** | **1** | 2 | **4.5** |

**Course Objective:** To understand the basic concepts and techniques for digital signal processing, familiarization with DSP concepts by studying the design of different digital filters and transform-domain processing.

**Introduction:** Review of Discrete Time Signals and Systems and z-Transforms, Solution of Difference Equations Using One-sided z-Transform, Frequency domain Characteristics of LTI Systems, LTI Systems as Frequency-Selective Filters.

**Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT):** Discrete Fourier Transform and its Properties, Divide and Conquer Approach, Decimation in Time and Decimation in Frequency FFT Algorithms.

**Digital Filter Structure:** Describing Equation of digital filter, Structures for FIR Systems: Direct Form Structure, Cascade Form Structure, Structure for IIR Systems: Direct Form Structures, Cascade Form Structure, Parallel Form Structure and Lattice Structure.

**Design of Digital Filters:** Causality and its Implications, Difference between analog filters and digital filters, FIR filter design using windows, Design of IIR filters from analog filters using: Approximation of Derivatives, Impulse Invariance and Bilinear Transformation, Frequency transformations.

**Analysis of Finite Word length Effects:** Introduction, The quantization process and errors, Analysis of coefficient quantization effects in FIR filters, A/D noise analysis, Analysis of arithmetic round off errors, Limit cycles in IIR filters,

**Laboratory work:** Convolution and correlation, Solution of difference equations using z- Transform and Fourier tools, FFT and spectrum analysis, design of high pass, low pass, band pass and band stop FIR filter using window method, design of IIR filter using Matched Z Transform (MZT), Bilinear Z Transform (BZT), Pole Zero Placement and Impulse Invariant methods.

**Course Learning Outcomes (CLO):**
After the successful completion of the course the students will be able to:
1. Analyze the signals in time and frequency domain
2. Apply the transformation tools on signals and systems and analyze their significance and applications.
3. design the structures of different types of digital filters
4. design various digital filters and analyze their frequency response
5. Analyse finite word length effects.

***Text Books***

1. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing, Prentice Hall of India Private Limited (2006).*
2. *Rabiner, C.R. and Gold, B., Theory and Applications of Digital Signal Processing,Prentice Hall of India Private Limited (2000).*


***Reference Books:***

1. *Antonion, A., Digital Filters: Analysis Design and Application, Prentice Hall of India Private Limited (1999).*
2. *Oppenhein, A.V. and Schafer, R.W., Digital Signal Processing, Prentice Hall of India Private Limited (1998).*


**Evaluation Scheme:**

| **S.NO.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 40 |

## UEI608: BIO-MEDICAL INSTRUMENTATION

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objectives:** The objective of this course is to introduce student to basic biomedical engineering technology and introduce different biological signals, their acquisition, measurements and related constraints.

**Introduction of Bio-medical Instrumentation, Sources of Bioelectric Potentials and Electrodes**: Introduction to man-instrument system, components of the man-instrument system, Physiological system of the body, Problems encountered in measuring a living system. Resting and action potentials, Propagation of action potentials, Bioelectric potentials, Biopotential electrodes, Biochemical transducers. Review of transducers

**Cardiovascular System and Measurements:** The heart and cardiovascular system, ECG, blood pressure and its measurement, respiration and pulse rate, characteristics and measurement of blood flow meter, cardiac output, phethysmography, pacemaker, defibrillators, heart sounds and its measurement,

**Respiratory and Neuro-muscular System:** The physiology of the respiratory system, test and instrument for the mechanics of breathing, the somatic nervous system, EEG, EMG and GSR.

**Measurement and Recording of Noninvasive Diagnostic Instrumentation, Patient Care and Electrical Safety:** Principle of ultrasonic measurement, ultrasonic, thermography, elements of intensive care monitoring,X-ray, CT – Scan and MRI, tonometer, dialysis**,** diathermy,Shock hazards from electrical equipment.

**Laboratory work:** Study the variance in pulse rate of subject in a batch, use Spiro meter on the subject, auditory system checkup using Audiometer, Measurement of Heart Rate using Stethoscope, Blood pressure using Sphygmomanometer, Pulse Rate and $SpO_2$ using Pulse Oximeter, Skin Conductance and Skin Potential using Galvanic Skin Response Module, Pulse Rate using Polyrite machine, Respiration Rate using Polyrite. Electromygram test using EMG biofeedback Trainer.

**Course Learning Outcomes (CLO):**

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

1. differentiate and analyse the biomedical signal sources.
2. elucidate cardiovascular system and related measurements.
3. explain the respiratory and nervous systems and related measurements
4. measure non-invasive diagnostic parameters.

.

***Text Books:***

1. *Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) $2^{nd}$ ed.*
2. *Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) $4^{th}$ ed.*

***Reference Books:***

1. *Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley InterScience (1989) $3^{rd}$ ed.*
2. *Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) $2^{nd}$ ed.*
3. *Webster, J.G., Medical Instrumentation Application and Design, John Wiley (2007) $3^{rd}$ ed.*

**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 40 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 35 |

## UEI701: DATA ACQUISITION AND SYSTEM DESIGN

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objectives:** To understand concepts of acquiring the data from transducers/input devices, their interfacing and instrumentation system design.

**Data Acquisition Techniques:** Analog and digital data acquisition, Sensor/Transducer interfacing, unipolar and bipolar transducers, Sample and hold circuits, Interference, Grounding and Shielding.

**Data Acquisition with Op-Amps:** Operational Amplifiers, CMRR, Slew Rate, Gain, Bandwidth. Zero crossing detector, Peak detector, Window detector. Difference Amplifier, Instrumentation Amplifier AD 620, Interfacing of IA with sensors and transducer, Basic Bridge amplifier and its use with strain gauge and temperature sensors, Filters in instrumentation circuits,

**Data Transfer Techniques:** Serial data transmission methods and standards RS 232-C: specifications connection and timing, 4-20 mA current loop, GPIB/IEEE-488, LAN, Universal serial bus, HART protocol, Foundation-Fieldbus, ModBus, Zigbee and Bluetooth.

**Data Acquisition System (DAS):** Single channel and multichannel, Graphical Interface (GUI) Software for DAS, RTUs, PC-Based data acquisition system.

**Laboratory Work:** Op-amp as a comparator and its application, Integrator and differentiator, Active filters, Simulation of the above applications using ORCAD, Instrumentation Amplifier/AD 620, Interfacing of sensors and transducers using DAQ cards.

**Course Learning Outcomes (CLO):**
After the successful completion of the course the students will be able to:
1. elucidate the elements of data acquisition techniques.
2. design and simulate signal conditioning circuits.
3. explain various data transfer techniques
4. understand the components of data acquisition system

***Text Books:***

1. *Coughlin, R.F., Operational Amplifiers and Linear Integrated Circuits, Pearson Education (2006).*
2. *Kalsi, H.S., Electronic Instrumentation, Tata McGraw Hill (2002).*
3. *Gayakwad, R.A., Op-Amp and Linear Integrated Circuits, Pearson Education (2002).*
4. *Mathivanan, N., Microprocessor PC Hardware and Interfacing, Prentice Hall of India Private Limited (2007).*


***Reference Books:***

1. *Ananad, M.M.S., Electronic Instruments and Instrumentation Technology, Prentice Hall of India Private Limited (2004).*
2. *Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India Private Limited (2006).*


**Evaluation Scheme:**

| **S.NO.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 40 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 35 |

## UEI801: ADVANCED PROCESS CONTROL

| L | T | P | Cr. |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objectives:** To make the students understand the basic concepts of advanced process control schemes, DCS, Artificial intelligence techniques used in Process Control, PLC and digital control system.

**Introduction to advanced Control Schemes:** Cascade, Feed-forward, Feed-forward plus Feedback, Ratio control, Inferential control, Dead time and Inverse response compensation, Adaptive control, Model reference adaptive control, Self tuning regulator Interactions and Decoupling of Control Loops: Design of cross controllers and selection of loops using Relative Gain Array

**Distributed Control System (DCS):** Evolution and advantages of computer control, Configuration of Supervisory, Direct digital control (DDC) and DCS.

**Artificial Intelligence in Process Control:** Expert systems, Neural networks, Fuzzy logic, Neuro Fuzzy , Genetic algorithm, Virtual instrumentation.

**Programmable Logic Controllers:** Comparison with hard wired relay and semiconductor logic, Hardware, Ladder diagram programming, Case studies, Introduction to CPLD, SPLD, FPGA

**Digital Control:** Sampling and reconstruction, Discrete systems analysis, Stability and controller design using z transform and difference equations, Smoothing filter realization using difference equations

**Course Learning Outcomes (CLO):**

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

1. explain the concept of advanced control schemes used in process control.
2. explain the working of distributed control system
3. elaborate the use of artificial intelligence techniques in process control.
4. explain the fundamental concepts of PLC.
5. explain the concept of digital control system.

***Text Books:***

1. *Stephanopoulos, G., Chemical Process Control, Prentice–Hall of India Private Limited (1983).*
2. *Liptak, B.G., Instrument Engineers Handbook , Chilton Book Company (1994).*

***Reference Books:***

1. *Deb, S.R., Robotics Technology and Flexible Automation, Tata McGraw–Hill (1994).*
2. *Johnson, C.D., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited (2007).*
3. *Zaidi, A., SPC Concepts, Methodologies and Tools, Prentice–Hall of India Private Limited (1995).*

**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 40 |

## UEI702: VIRTUAL INSTRUMENTATION

| L | T | P | Cr. |
|---|---|---|---|
| 2 | 0 | 3 | 3.5 |

**Course Objective:** The objective of this course is to introduce the concept of virtual instrumentation and to develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control.

**Review of Virtual Instrumentation:** Historical perspective, Block diagram and Architecture of Virtual Instruments

**Data-flow Techniques:** Graphical programming in data flow, Comparison with conventional programming.

**VI Programming Techniques:** VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

**Data Acquisition Basics:** ADC, DAC, DIO, Counters and timers.

**Common Instrumentation Interfaces:** RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

**Use of Analysis Tools:** Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control.

**Additional Topics:** System buses, Interface buses: PCMCIA, VXI, SCXl, PXI, etc.

**Laboratory Work :** Components of Lab VIEW, Celsius to Fahrenheit conversion, Debugging, Sub-VI, Multiplot charts, Case structures, ASCII files, Function Generator, Property Node, Formula node, Shift registers, Array, Strings, Clusters, DC voltage measurement using DAQ

**Course Learning Outcomes (CLO):**
After the successful completion of the course the students will be able to:

1. demonstrate the working of LabVIEW.
2. explain the various types of structures used in LabVIEW.
3. analyze and design different type of programs based on data acquisition.
4. demonstrate the use of LabVIEW for signal processing, image processing etc.

Text Books:

*1. Johnson, G., LabVIEW Graphical Programming, McGraw –Hill (2006).*
*2. Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).*
*3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).*

***Reference Book:***

*1. Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1988).*

**Evaluation Scheme:**

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 40 |

**UEE606: ELECTRICAL MACHINES AND DRIVES**

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objectives:** In this course fundamental electromechanical, power electronic, and control theory in the context of electric drive systems will be covered. The capabilities and limitations of different types of electric machines in various drive applications will also be addressed.

**Fundmentals of electromechanical devices:**flux linkage/current relationships, concept of energy and co-energy, calculation of forces and torques.

**Power Electronic Converters:** voltage control using uncontrolled switches, controlled rectification, inversion, voltage controllers, converter waveforms, acoustic noise and cooling

**Control Theory:**Importance of Feedback control, requirement of feedback loops in drive applications, current-limit control, speed, torque and position control for electric drives, concept of PLL in speed control application.

**DC Motor Drives:** EMF and torque production of DC motor, dc motor types, transient and steady-state characteristics, four quadrant operation, thyristor and chopper fed dc motor drives.

**Induction Motor Drives:**concept of rotating magnetic field and torque production, motor types, torque-speed and torque-slip characteristics, methods of starting of squirrel cage motors, generating and braking modes, speed control using stator voltage control, variable frequency operation, rotor resistance control and slip power recovery schemes.

**Motor/Drive Selection:**power ratings and capabilities, drive characteristics, load requirements and general application considerations.

**Laboratory work:**The lab will consist of giving the students hands-on experience with electric machines (AC and DC), power electronic circuitry, and control algorithms for electric drives.

**Course Learning Outcomes:**
On successful completion of this course, the student should be able to:

1. Analyse the various forces and torques in electromechanical devices
2. explain the working of power electronic converters and inverters
3. elucidate the concepts of feedback control theory
4. analyze and compare the performance of DC and AC machines in various drive applications
5. design controllers for electric drives which achieve the regulation of torque, speed, or position in the above machines.

***Text Books:***

1. *Dubey, G.K., Fundamentals of Electric Drives, Narosa Publications (2001).*
2. *Mohan, N., Electric Drives: An Integrative Approach. MNPERE, (2001).*
3. *Krishnan, R., Electric Motor Drives: Modeling, Analysis, and Control. Prentice Hall, (2001).*

***Reference Books:***

1. *Hughes, A. and Drury, B., Electric Motors and Drives: Fundamentals, Types and Applications, Newnes,4th Ed., (2014).*
2. *Sharkawi, Mohammed.A.El, Fundamentals of Electric Drives, PWS-Brooks/Cole Pub. Company, (2000).*

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional | 40 |

## UEI805: ENVIRONMENTAL INSTRUMENTATION

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objectives:** To understand the concepts of pollution monitoring, to enable select, design and configure pollution monitoring instruments

**Air Pollution:** Impact of man of the environment: An overview, Air pollution sources and effects, Metrological aspect of air pollutant dispersion, Air pollution sampling and measurement, Air pollution control methods and equipment, Air sampling techniques, soil pollution and its effects, Gas analyzer, Gas chromatography, Control of specific gaseous pollutants, Measurement of automobile pollution, Smoke level meter, CO/HC analyzer.

**Water pollution**: Sources And classification of water pollution, Waste water sampling and analysis, Waste water sampling techniques and analyzers: Gravimetric, Volumetric, Calometric, Potentiometric, Flame photometry, Atomic absorption spectroscopy, Ion chromatography, Instruments used in waste water treatment and control, Latest methods of waste water treatment plants.

**Pollution Management**: Management of radioactive pollutants, Noise level measurement techniques, Noise pollution and its effects, Solid waste management techniques, social and political involvement in the pollution management system

**Course Learning Outcomes (CLO):**
After the successful completion of the course the students will be able to:

1. explain sources and effects of air and water pollutants
2. explain air pollution sampling and measurement techniques
3. explain water sampling and analysis techniques
4. explain solid waste management and noise level measurement techniques

***Text Books:***


1. *Bhatia, H.S., A Text Book in Environmental Pollution and control, Galgotia Publication (1998).*
2. *Dhameja, S.K., Environmental Engineering and Management, S.K Kataria (2000).*
3. *Rao, M.N. and Rao, H.V., Air Pollution, Tata McGraw Hill (2004).*
4. *Rao. C.S., Environmental Pollution Control, New Age International (P) Limited, Publishers (2006) 2nd ed.*


***Evaluation Scheme:***

| S.NO. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 50 |
| 3 | Sessional (May include Assignments//Quizzes/Lab Evaluations) | 20 |

## UEI719 EMBEDDED CONTROL SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objectives:** This course is intended to explain the various concepts used in embedded control systems. Students will also familiarize with real time operating systems.

**Introduction:** Introduction to Embedded Systems, Its Architecture and system Model, Introduction to the HCS12/S12X series Microcontrollers, Embedded Hardware Building Block.

**HCS12 System Description and Programming**: The HCS12 Hardware System ,Modes of Operation, The B32 Memory System , The HCS12 DP256 Memory System, Exception Processing–Resets and Interrupts, Clock Functions, TIM, RTI, Serial Communications, SPI-Serial Peripheral Interface, I2C, HCS12 Analog-to-Digital Conversion System.

**Basic Input /Output Interfacing Concepts:** Input Devices, Output Devices and their Programming, Switch Debouncing, Interfacing to Motor, LCDs, Transducer, The RS-232 Interface and their Examples.

**Development tools and Programming**: Hardware and Software development tools, C language programming, Codewarior tools- Project IDE, Compiler, Assembler and Debugger, JTAG and Hardware Debuggers, Interfacing Real Time Clock and Temperature Sensors with I2C and SPI bus.

**Real-time Operating Systems (RTOS):** Basic concepts of RTOS and its types, Concurrency, Reentrancy, Intertask communication, Implementation of RTOS with some case studies.

**Laboratory Work**:
Programming of HCS12 with Code warrior for Interrupts, Clock Functions, TIM, RTI, SPI, LCD interfacing, Use of JTAG and Hardware Debuggers, Interfacing Keypad, ADC, DAC, LCD, Real Time Clock and Temperature Sensors with I2C and SPI bus.

**COURSE LEARNING OUTCOME (CLO):** The student will be able to

1. Explain the concept of embedded Systems and its architecture
2. Elucidate the concept of programming for different interfacing devices
3. Analyze various software and hardware tools
4. Explain real-time operating systems

***Text Books:***

1. *Barrett, S.F. and Pack, J.D., Embedded Systems, Pearson Education (2008).*
2. *Haung, H.W., The HCS12 / 9S12: An Introduction to Software and Hardware Interfacing, Delmar Learning (2007).*

***Reference Books:***

1. *Fredrick, M.C., Assembly and C programming for HCS12 Microcontrollers, Oxford University Press (2005).*
2. *Ray, A.K., Advance Microprocessors and Peripherals – Architecture, Programming and Interfacing, Tata McGraw–Hill (2007).*

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessionals (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 40 |

## CAPSTONE PROJECT

| | L | T | P | Cr |
|---|---|---|---|---|
| **UEI693: Semester VI (starts)** | **0** | **0** | **2** | **--** |
| **UEI793: Semester VII (Completion)** | **0** | **0** | **2** | **8.0** |

**Course Objective:** To facilitate the students learn and apply an engineering design process in instrumentation engineering, including project resource management. As a part of a team, the students will make a project, that emphasizes, hands-on experience, and integrates analytical and design skills. The idea is to provide an opportunity to the students to apply what they have learned throughout the course of graduate program by undertaking a specific problem.

**Course Description:** Capstone Project is increasingly interdisciplinary, and requires students to function on multidisciplinary teams. It is the process of devising a system, component or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. It typically includes both analysis and synthesis performed in an iterative cycle. Thus, students should experience some iterative design in the curriculum. As part of their design experience, students have an opportunity to define a problem, determine the problem scope and to list design objectives. The project must also demonstrate that students have adequate exposure to design, as defined, in engineering contexts. Engineering standards and realistic constraints are critical in engineering design. The program must clearly demonstrate where standards and constraints are taught and how they are integrated into the design component of the project. Each group will have 4-5 students. Each group should select their team leader and maintain daily diary. Each Group will work under mentorship of a Faculty supervisor. Each group must meet the assigned supervisor (2hrs slot/week) till the end of the semester (record of attendance will be maintained), as per the time slot which will be provided to them by the respective supervisor. This is mandatory requirement for the fulfilment of the attendance as well as the successful completion of the project. The faculty supervisor of the project will continuously assess the progress of the works of the assigned groups. Some part of the analysis and design of the system will be done in the first section of project in semester VI. The second section would comprise of completion of the project in semester VII in whicheach team will have to submit a detailed report of the project along with a poster.

**Course Learning Outcomes:**
After the completion of the course, the students will be able:
1. To identify design goals and analyze possible approaches to meet given specifications with realistic engineering constraints.
2. To design an instrumentation engineering project implementing an integrated design approach applyingknowledge accrued in various professional courses.
3. To perform simulations and incorporate appropriate adaptations using iterative synthesis.
4. To use modern engineering hardware and software tools.
5. To work amicably as a member of an engineering design team.
6. To improve technical documentation and presentation skills.

## UEI892: PROJECT

| L | T | P | Cr |
|---|---|---|---|
| - | - | - | 20.0 |

**Course Objectives**

The project semester is aimed at developing the undergraduate education programme in Instrumentation Engineering to include a practical training in a professional engineering set up (a company, top educational institution, research institute etc.) hereafter referred to as host “organization” as deemed appropriate. The participating organizations are selected that are either already visiting Thapar University for placement or are forming new relationships of mutual benefit. The project semester gives the student the opportunity to translate engineering theory into practice in a professional engineering environment. The technical activity in the project semester should be related to both the student’s engineering studies and to the host organization’s activities and it should constitute a significant body of engineering work at the appropriate level. It should involve tasks and methods that are more appropriately completed in a professional engineering environment and should, where possible, make use of human and technology resources provided by the organization. It consolidates the student’s prior learning and provides a context for later research studies. The student remains a full time registered student at Thapar University during the project semester and this activity is therefore wholly distinct from any industrial interactions which may occur over vacation periods.

**Assessment Details**

Each student is assigned a faculty supervisor who is responsible for managing and assessment of the project semester. The faculty supervisor monitors the student’s progress in a semester and interacts with the industry mentor during his/her visit to the host organization twice. This includes a Reflective Diary which is updated throughout the project semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva which involves the faculty Supervisor and some other members from the department. The mentor from the host organization is asked to provide his assessment on the designated form. The faculty supervisor is responsible for managing and performing the assessment of the project semester experience.

**Course learning Outcomes (CLO):**
Upon completion of project semester, the students will be able to:

1. Acquire knowledge and experience of software and hardware practices in the area of project.
2. Carry out design calculations and implementations in the area of project.
3. Associate with the implementation of the project requiring individual and teamwork skills.
4. Communicate their work effectively through writing and presentation.
5. Demonstrate the knowledge of professional responsibilities and respect for ethics.

## UEI894: DESIGN PROJECT

| L | T | P | Cr |
|---|---|---|---|
| - | - | - | 13.0 |

**Course Objectives**

The design project is introduced in Instrumentation Engineering undergraduate programme to include a practical training in the university itself for six months. The project offers the student the opportunity to demonstrate engineering theory into practice under the supervision of a faculty supervisor in instrumentation engineering department. The students are also offered with two courses. The technical activity in the project semester should be related to both the student's engineering studies and the faculty supervisor's guide lines to make working model in the area of application of instrumentation engineering. It involves tasks and methods that are more appropriately completed in an academic practical environment and should, where possible, make use of human and technology resources provided by the university. It consolidates the student's prior learning and provides a context for later research studies. The student remains a full time registered student at Thapar University during the project semester and this activity is, therefore, wholly distinct from any industrial interactions which may occur over vacation periods.

**Assessment Details**

Each student is assigned a faculty supervisor who is responsible for managing and assessment of the alternate project semester. The faculty supervisor guides the students till the end of semester and monitors the student's progress throughout the same. This includes a Reflective Diary which is updated throughout the alternate project semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva which involves the faculty Supervisor and some other faculty members from the department.

**Course learning Outcomes (CLO):**

Upon completion of project semester, the students will be able to:

1. Acquire knowledge and experience of software and hardware practices in the area of project.
2. Carry out design calculations and implementations in the area of project.
3. Associate with the implementation of the project requiring individual and teamwork skills.
4. Communicate their work effectively through writing and presentation.
5. Demonstrate the professional responsibilities and respect for ethics in university ambiance.

## UEI895: STARTUP SEMESTER

| L | T | P | Cr |
|---|---|---|---|
| 0 | 0 | 0 | **20.0** |

**Course Objective:** This course provides the students with competence building workshops and need based skill trainings that enable them to develop their prototype/working model/software application, which is supported by a Business Plan. This semester long interaction with entrepreneurial ecosystem, will provide ample opportunity to students to lay a strong foundation to convert their idea into a startup immediately or in the near future.
This course would include a practical training in a professional set up (a startup or a company, Business incubator, Startup Accelerator etc.) hereafter referred to as host "organization" as deemed appropriate.

**Activities during the Startup semester**

Fundamentals of 'Entrepreneurship & Innovation'
Opportunity identification and evaluation, Customer validation
Developing a Business Model Canvas
Business Development Process related to the startup, relating theoretical framework with the business idea, Industry dynamics, opportunity canvas and regulatory aspects related to the business idea.
Design thinking
Technical development
Financial management
Entrepreneurial Marketing
Interaction with existing Startups and pitching of projects,
Presentation of Prototype/Working model/useful App or a working Software

**Assessment Details**

Each student is assigned a faculty supervisor and industry mentor.Faculty supervisor is responsible for managing and assessment of the Startup semester. The faculty supervisor monitors the student's progress in a semester and interacts with the industry mentor during his/her visit to the host organization twice.

The semester includes maintenance of a Reflective Diary, which is updated throughout the startup semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva, which involves the faculty Supervisor, and some other members from the department.

The mentor from the host organization is asked to provide the assessment on a designated form. The faculty supervisor is responsible for managing and performing the assessment of the startup semester experience.

**Course learning outcome (CLO):**
Upon successful completion of the startup semester, the students should be able to:

1. Demonstrate an ability to develop a business plan.
2. Carry out design calculations/simulations and implementations in the area of project.
3. Develop a prototype/working model/software application.
4. Comprehend the fundamentals of business pitching.
5. Demonstrate the knowledge of professional responsibilities and respect for ethics.