

TRANSDUCERS AND INSTRUMENTATION – I

Sub code: EI310

Total Hours: 39 Hrs

Credit Pattern: 3:0:0

Contact Hours: 03 Hrs/Week

Pre-requisite: Elements of Electrical and Electronics Engineering

Course Objective : To gain knowledge of measurement concepts and transducers that can be used for measurement of different physical and electrical parameters.

Course Outcomes:

Students will be able to,

1. Explain fundamentals of measurement, errors associated with measurement and methods of minimization of errors.
2. Discuss the working principle of various types of sensors.
3. Identify the appropriate sensor for the measurement of parameters.
4. Analyze the sensor output and do the appropriate/ necessary conversions.
5. Think independently and make an effective oral presentation on the applications of Transducers.

Generalized configurations & functional descriptions of measuring instruments: Functional elements of an instrument, Active and Passive Transducers, Analog and Digital modes of operation, Null and Deflection methods, I/O configuration of measuring instruments & instrument system- methods of correction for interfering & modifying inputs. **07 Hrs**

Generalized performance characteristics of instruments: Static characteristics: Meaning of static calibration, accuracy, precision and bias, Static sensitivity, linearity, threshold, resolution, hysteresis and dead space. Scale readability, Span, generalized static stiffness & input impedance, Basics of Dynamic characteristics. **05 Hrs**

Measurement of Resistance, Inductance and Capacitance: Wheatstone bridge, sensitivity analysis, limitations, Kelvin double bridge, Maxwell bridge, Schering bridge, **05 Hrs**

Measurement of displacement: Relative displacement, resistive potentiometers, Resistance strain gage, variable inductance & variable reluctance pickups, LVDT, capacitance pickup, Laser displacement sensor. **05 Hrs**

Force, torque & shaft power Measurement: Standards and calibration: basic methods of force measurement; characteristics of elastic force transducer- bonded strain gauge, differential transformer, piezo-electric transducer, variable reluctance/ FM- Oscillator digital systems, loading effects; torque measurement on rotating shafts, shaft power measurement (dynamometers). **07 Hrs**

Temperature measurement: Contact type : Standards & calibration; thermal expansion methods-bimetallic thermometers, liquid-in-glass thermometers, pressure thermometers thermoelectric sensor (thermocouple)- common thermocouples, reference junction consideration, Electrical resistance sensors- conductive sensor (resistance thermometers), bulk semiconductor sensors (thermistor), junction semiconductor sensors(AD590) and Digital thermometers.

Non- contact type: Radiation methods- radiation fundamentals, radiation detectors, automatic null balance radiation thermometers, optical pyrometers. Two color radiation thermometers, black body-tipper fiber optic radiation thermometer, IR imaging systems. **10 Hrs**

Self Study: Measurement Errors: Gross errors and systematic errors, Absolute and relative errors,

TEXT BOOKS:

1. **Measurement Systems**, Ernest O Doebelin, 6th Edition, TMH, 2007
2. **Electrical & Electronic Measurement and Instrumentation**, A.K.Sawhney, 10th Edition, Dhanpat Rai & sons, Delhi.

REFERENCE BOOKS:

1. **Instrument Engineers Hand book (Process Measurement.)**, B G Liptak, 3rd Edition, Chilton book, 1995.
2. **Instrumentation Devices and Systems**, Rangan Sharma Mani, 2nd Edition, TMH.
3. **Transducers and Instrumentation**, Murthy.D.V.S. 2nd Edition, PHI, 2008.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/112103174/3>

CIRCUIT THEORY AND ANALYSIS

Sub code: EI320

Total Hours: 39 Hrs + 2 Hrs/Week Tutorials

Credit Pattern: 3:1:0

Contact Hours: 05 Hrs/Week

Pre-requisite: Elements of Electrical and Electronics Engineering.

Course Objective: To introduce various circuit analysis methods.

Course Outcomes:

Students will be able to,

1. Recall the fundamentals of electrical circuits and simplify any given circuit.
2. Solve for the circuit parameters by reducing the given circuit.
3. Illustrate the behavior of circuit elements and analyze the behavior of the circuits.
4. Analyze the given circuits using different methods.
5. Determine the performance parameters of the given circuits.

Basic concepts: Introduction, Network terminologies, Review of KVL & KCL, Energy sources – ideal & practical, Source Transformations, Mesh Analysis of DC & AC circuits, Nodal analysis of DC & AC circuits, Star – Delta transformations. **10 Hrs**

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. **6 Hrs**

Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions using differential equations of circuits with AC and DC excitation. **8 Hrs**

Resonance: Series resonance: resonant frequency, reactance curves, voltage & current variation with frequency, Selectivity & bandwidth, Q – factor, circuit magnification factor Selectivity with variable C & variable L. Parallel resonance: resonant frequency, impedance, selectivity, bandwidth Maximum impedance conditions with C, L, & f variable, current & Q – factor. **6 Hrs**

Circuit Analysis using Laplace Transforms: Step response of RL, RC & RLC circuits, Circuit analysis with LT using partial fraction expansion. **6 Hrs**

Two Port parameters: Short circuit admittance parameters, Open circuit impedance parameters, Transmission parameters, Hybrid parameters, relationships between parameters. **3 Hrs**

TEXT BOOK:

1. **Basic Engineering Circuit Analysis**, J. David Irwin, R. Mark Nelms, 8th edition, John Wiley & Sons, 2006.

REFERENCE BOOKS:

1. **Engineering Circuit Analysis**, William H.Hayt, Jr, Jack E.Kimmerly, Steven M.Durbin, 6th edition, Tata McGraw-Hill, 2002.
2. **Networks and Systems**, D. Roy Choudhury, New Age International, Reprint 2005. .
3. **Network Analysis**,M.E.VanValkenburg, 3rd edition, Pearson/ PHI, Reprint 2006.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/108102042/>.

ANALOG ELECTRONIC CIRCUITS

Sub code: EI330
Total Hours: 52 Hrs

Credit Pattern: 4:0:0
Contact Hours: 04 Hrs/Week

Pre-requisite: Elements of Electrical and Electronics Engineering.

Course Objective: To introduce the basic concepts of electronic circuits and their analysis.

Course Outcomes:

Students will be able to,

1. Explain the working principles of various types of amplifiers and oscillators.
2. Design amplifier and oscillator circuits
3. Analyze the designed circuits.
4. Determine the performance parameters of the circuits.
5. Design and demonstrate circuits for different applications.

BJT AC Analysis : BJT modeling, r_e model, hybrid model, hybrid π model, common emitter - fixed bias, voltage divider bias and emitter bias configurations, emitter follower and common base configuration, cascaded systems, Darlington connection and feedback pair, low frequency response of BJT amplifier, Miller effect capacitance, high frequency response of BJT amplifier.

12 Hrs

MOS Field-Effect Transistor (MOSFETs) : Device structure and physical operation, current voltage characteristics, MOSFET circuits at DC, MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits.

04 Hrs

MOSFET AC Analysis : Small signal operation and models, single stage MOS amplifiers, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier.

08 Hrs

Differential amplifiers: MOS differential pair, BJT differential pair, common mode rejection, DC offset.

08 Hrs

Feedback Amplifiers and Oscillators: Concepts of feedback, types of feedback, practical feedback circuits. Oscillator operation, Phase shift, Wien Bridge, Tuned and Crystal oscillators.

1

10 Hrs

Power Amplifiers: Types of amplifiers, series fed class A amplifier, transformer coupled class A amplifier, class B and class AB amplifiers, amplifier distortion, power transistor heat sinking, class C and class D amplifier. **10 Hrs**

TEXT BOOKS:

1. **Electronic Devices and Circuit Theory**, Robert L. Boylestad and Louis Nashelsky, 11th Edition, Pearson, 2015.
2. **Microelectronic Circuits, Theory and Applications**, Adel S. Sedra Kenneth C. Smith, 7th Edition, Oxford University Press, 2017.

REFERENCE BOOK:

- 1 **Fundamentals of Microelectronics**, Behzad Razavi, 2nd Edition, Wiley, 2013.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/117101106/>

<http://nptel.ac.in/courses/108102095/>

LOGIC DESIGN

Sub code: EI340

Total Hours: 39 Hrs +2Hrs/Week lab session

Credit Pattern: 3:0:1

Contact Hours: 05 Hrs /Week

Pre-requisite: Elements of Electrical and Electronics Engineering.

Course Objective: To introduce the basic concepts of digital circuits and design of digital systems.

Course Outcomes:

Students will be able to,

1. Recall the fundamentals of Boolean algebra to simplify and realize digital circuits using universal gates.
2. Apply different simplification techniques for solving the Boolean expression.
3. Build truth table and Boolean expression for an application, and propose a cost effective circuit.
4. Design and analyze simple sequential circuits.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to build and test digital circuits.

Boolean Algebra and Combinational Networks: Min/Max terms, Canonical formula, Complements of equations, Universal Gates, Combinational network.

3 Hrs

Simplification of Boolean Expressions: Prime implicants, Prime Implicates, Two, Three, four variables Karnaugh Maps, Sum of Products, Product of Sums, The Quine –McCluskey method, the binary method, The Variable Entered Maps.

6 Hrs

Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Carry Lookahead adder, Decimal adders, comparators, Encoders, Decoders, Logic design using decoders, Multiplexers. **Programmable Logic Devices:** PROMs, PLAs, PALs.

12 Hrs

Flip Flops and Applications: SR Flip Flop, RS Flip Flop, Switch debouncer, Gated SR, Gated D Flip Flops, JK Flip Flops, Master Slave Flip Flops, Race around condition, Shift Registers, Universal shift register, Counters, Binary ripple counters Mod N counters, ring counter, Johnson counter, Synchronous Binary counters using T, SR, JK, D Flip Flops.

12 Hrs

Synchronous Sequential Networks: The excitation and Transition equations, the excitation and transition tables, state tables, state diagrams.

6 Hrs

LIST OF EXPERIMENTS:

1. Realization of parallel adder/ subtractor and BCD to Excess-3 code and Excess -3 to BCD code conversion using 7483 IC.
2. Arithmetic circuits using Multiplexer IC.
3. Code converters circuits using Decoder IC's.
4. Realization of one bit comparators and study of 4 bit magnitude comparator (7485).
5. Use of decoder chip to drive LED display and Priority encoder.
6. Demonstrate SR, T, D, JK, JK master slave Flip Flops using logic gates.
7. Study of 7476,7490,74192,74193 ICs and realization of MOD N counter.
8. Study of Shift Register 7495 and realization of Johnson and ring counter using 7495 IC.

In-course project: Propose, design the digital circuit for an application and successfully work on the project in a team and give an oral and written report.

TEXT BOOKS:

1. **Digital Principles and Design**, Donald D.Givone, TMH, 2002.
2. **Digital Logic Applications & Design**, John M Yarborgh, Thomson learning, 2001.

REFERENCE BOOKS:

1. **Fundamental of Logic design**, Charles H Roth Jr, Thomson learning, 2004
2. **Digital Systems Principles and Applications**, Ronald J Tocci, PHI, 2001.

LEARNING MATERIALS:

1. <http://nptel.ac.in/courses/117106086/1>
2. <https://swayam.gov.in/course/1392-digital-circuits-and-systems>

C++ AND DATA STRUCTURES

Sub code: EI350

Total Hours: 39 Hrs +2Hrs/Week lab session

Credit Pattern: 3:0:1

Contact Hours: 05 Hrs/Week

Pre-requisite: Problem solving using C.

Course Objective: To gain the knowledge of developing and analyzing C++ programs to handle structured data and perform more complex tasks.

Course Outcomes:

Students will be able to,

1. Recall procedural systems and describe the object-oriented programming(OOPs) approach in connection with C++.
2. Demonstrate the use of various OOPs concepts with the help of programs.
3. Develop programs based on the concepts of operator overloading, polymorphism, inheritance and pointers.
4. Explain different types of data structures, operations, algorithms and implement them using C++ language.
5. Select and apply appropriate concepts for solving computing problems and demonstrate it in the laboratory.

C++ programming Basics: Need of object oriented programming, procedural languages, characteristics of OOPs, preprocessor directives, data types, manipulators, Type Conversion. Structures: Structures, enumerated data types, Boolean type, Functions: passing arguments, returning values, reference arguments, overloaded functions, inline functions, Default Arguments variable and storage classes. **08 Hrs**

Objects and classes: objects as data types, constructors, destructors, Objects as Function Arguments, Returning Objects from Function. Arrays: Arrays as class member data types, passing arrays, arrays as objects, strings, arrays of strings. **07 Hrs**

Operator overloading: overloading of unary operators, binary operators, Data conversion. **Inheritance:** Inheritance, derived class and base class, derived class constructors, overriding member functions, scope resolution, inheritance in the English distance class, class hierarchies, public and private inheritance, levels of inheritance, multiple inheritance, ambiguity in multiple inheritance. **08 Hrs**

Pointers: pointers to objects, virtual functions, static functions, files and streams, Linked List, input/output operations. **08 Hrs**

Data structures: Linear List - Array representation, Linear List – Linked representation, Arrays and matrices and their applications. Stacks: Array representation, linked representation, queues array representation, linked representation, skip lists and hashing, binary trees and their applications. **08 Hrs**

LIST OF EXPERIMENTS:

Write C++ programs,

1. On Basics of OOPs and functions
 - a) Count the number of words in a phrase typed in by the user.
 - b) Implement Different Function Call Mechanisms,
 - i) Call by reference. ii) Call by value
 - c) Implement
 - i) Function overloading ii) Default arguments
 - d) Show the effect of declaring a variable as automatic external and static.
2. On Classes and Objects
 - a) Constructor and destructor.
 - b) Pass and Return an object from function.
 - c) Software stack.
3. On Operator overloading and data conversion.
 - a) Overload Unary operators.
 - b) Overload Binary Operators.
 - c) Conversion between basic type and user defined type.
 - d) Conversion between objects of two different classes.
4. On Inheritance
 - a) Inheritance and Function Overriding.
 - b) Multiple inheritances.
 - c) Multilevel inheritance.
 - d) Access Specifiers.
5. On Pointers
 - a) Sort an array of integer using pointers
 - b) Implement pointer to an object using 'New' and 'delete' operator.
 - c) Show the effect of declaring a function as static.
 - d) Show the effect of declaring a function as Virtual.
 - e) Read/Write data from/to a file.
 - f) Implement Linked List.

6. To implement
 - a) Linear List
 - b) Stack
7. To implement
 - a) Queue
 - b) Skip list
8. To implement
 - a) Hash Table
 - b) Binary tree

In-course project: By applying OOPs concepts develop programs for solving real world problems.

TEXT BOOKS:

1. **Object oriented programming in TURBO C++**, RobertLafore, 4th edition, Galgotia Publications, 2014.
2. **Data Structures, Algorithms and Applications in C++**, SartajSahni, 2nd edition, TataMcGrawHill Publications, 2009.

REFERENCE BOOKS:

1. **Object Oriented Programming with C++**, E Balaguruswamy, 3rd edition, TMH, 2006.
2. **C++ the complete reference**, Herbert Schildt, 4th edition, TMH, 2003.
3. **Data Structures using C++**, D.S.Malik, 2nd edition Thomson learning, 2003.
4. **Data Structures Using C and C++**, Tanenbaum A. M, 2nd edition, Pearson Education, 2007.

LEARNING MATERIALS:

1. <http://nptel.ac.in/courses/106106127/>
2. <http://nptel.ac.in/courses/106103069/>

ANALOG ELECTRONIC CIRCUITS LAB

Sub code: EI36L

Credit Pattern: 0:0:1.5

Contact Hours: 03 Hrs/Week

Pre-requisite: Elements of electrical and electronics engineering, Analog electronic circuits.

Course Objective: To introduce the students to working principle of basic electronic circuits, design and test amplifier and oscillator circuits.

Course Outcomes:

Student will be able to,

1. To conduct experiments to understand the applications of diodes.
2. To conduct the experiments to understand the behaviour of the transistor at different configurations.
3. To conduct the experiments to understand the behaviour of the transistor with different biasing circuits.
4. To design, demonstrate and analyze the amplifiers and oscillators to meet the given specifications.

List of experiments

1. RC circuits
2. Clipping circuits
3. Clamping circuits
4. Rectifier circuits with and without filter
5. BJT characteristics
6. BJT biasing circuits
7. Single stage RC coupled amplifier
8. Emitter follower
9. FET amplifier
10. Oscillators

TRANSDUCERS AND INSTRUMENTATION-II

Sub code: EI 410

Total Hours: 52Hrs + 2Hrs/Week lab session

Credit Pattern: 4:0:1

Contact Hours: 04 Hrs/Week

Pre-requisite: Transducers and instrumentation-I.

Course Objective: To gain the knowledge of transducers for measurement of different physical quantities.

Course Outcomes:

Students will be able to,

1. Explain the principle, construction and working for the measurement of various physical quantities.
2. Identify a suitable transducer for measurement of the physical quantity.
3. Classification of different transducers used for the measurement and list its merits, demerits.
4. Calibrate the transducer used for measurement and discuss its applications.
5. Demonstrate theoretical and practical skills by working in the laboratory to build and test physical quantity detection and indication circuits.

Pressure Measurement: Standards & calibration; basic methods of pressure measurement; dead weight gauges & manometer, manometer dynamics; elastic transducers, high pressure measurement; low pressure (vacuum) measurement- McLeod gage, Knudsen gage, momentum-transfer (viscosity) gages, thermal conductivity gages, ionization gages. **07 Hrs**

Flow Measurement: Introduction, Classification of flow meters, Constant-area, variable-pressure-drop meters (Obstruction meters). Constant pressure-drop, variable area meters (Rotameters), turbine meters, Pitot tube, Hot wire and hot film anemometer, Laser Doppler velocimeter, Electromagnetic flow meters, Drag force flow meters, Ultrasonic flow meters, vortex-shedding flow meters. **10 Hrs**

Level Measurement: Capacitance probe, conductivity probes, differential pressure level detector, float level devices, optical level switches, radiation level sensor, ultrasonic level detector, thermal level sensors. **05 Hrs**

Vibration Measurement: Introduction, Characteristics of vibration, Vibration sensing devices, Signal conditioners for vibration sensors, Shock measurements, System characteristics, Vibration exciters & Calibration. **05 Hrs**

Density Measurement : Definition & units of density and specific gravity, Liquid density measurement – Ball type, capacitance type, displacement type, hydrometers, oscillating coriolis, radiation type, sound velocity type. Gas density measurement – displacement type, electromagnetic suspension type. **05 Hrs**

Viscosity Measurement: Definition and units, selection of viscometer, viscometer applications. Laboratory Viscometers – Capillary, capillary extrusion, Saybolt viscometer, Falling ball, Rotational viscometer, Cone & plate viscometer. Industrial Viscometers - differential pressure continuous capillary viscometer, falling piston viscometer, single and two float viscometer, cone and plate viscometer, rotational viscometer, vibrating reed viscometer. **08 Hrs**

Humidity Measurement: Definition and terminologies, dry and wet bulb psychrometers (Sling psychrometer), hair hygrometers, thin film capacitance humidity sensor, dew-point hygrometers, electrolytic hygrometers. **06 Hrs**

Moisture Measurement: Definition and terminologies, Electrolytic hygrometer, capacitance hygrometer, impedance hygrometer, piezoelectric hygrometer, infrared absorption hygrometer. Measurement of moisture in solids – Nuclear moisture gauge, infrared absorption moisture gauge, capacitance moisture gauge, conductance moisture gauge. **06 Hrs**

LIST OF EXPERIMENTS:

1. Measurement of resistance using Wheatstone bridge.
2. Measurement of Self- inductance using Maxwell Bridge.
3. Measurement of capacitance using Schering bridge.
4. Characteristics of LVDT.
5. Characteristics of Capacitive transducer.
6. Characteristics of thermistor & RTD.
7. Characteristics of thermocouple & AD590.
8. Level indication using conductivity method.

TEXT BOOKS:

1. **Measurement Systems Application and Design**, Ernest O Doebelin, 6th Edition, TMH, 2007.
2. **Instrument Engineers Hand book (Process Measurement.)**, B G Liptak, 3rd Edition, Chilton book, 1995.
3. **Instrumentation: Devices and Systems-** C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition, McGraw Hill Education (India), 2014.

4. **Industrial Instrumentation**, K. Krishnaswamy and S. Vijayachitra, New Age International Pub., 2005.

REFERENCE BOOKS:

1. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
2. Introduction to Measurements and Instrumentation, A. K. Ghosh, 2nd Edition, PHI, 2007
3. Instrumentation Measurement and Analysis, B.C.Nakra and K.K.Choudhry, 3rd Edition, Mc Graw Hill Education (India) Pvt.Ltd. 2009.

LEARNING MATERIALS:

1. <http://nptel.ac.in/courses/108105064/>
2. <http://nptel.ac.in/courses/112103174/10>
3. <https://swayam.gov.in/courses/4523-mechanical-measurement-system>
4. <https://swayam.gov.in/course/3764-industrial-instrumentation>

BIOMEDICAL INSTRUMENTATION

Sub code: EI420

Total Hours: 39 Hrs

Credit Pattern: 3:0:0

Contact Hours: 03 Hrs/Week

Pre-requisite: Transducers and Instrumentation.

Course Objective : To gain the knowledge of biomedical instruments for measurement of biomedical signals.

Course Outcomes:

Students will be able to,

1. Explain the origin of various biological signals that are useful for diagnostic purpose.
2. Express the importance of the arrangement of electrodes used for acquisition of biological signals.
3. Explain the importance of invasive and non-invasive techniques used for measuring biomedical signals
4. Measure and record physiological parameters using different types of instruments.
5. Explain the working of life saving devices and safety measures taken during design and use of biomedical instruments.

Fundamentals: Sources of biomedical signals, Basic medical instrumentation system, Consumer and portable medical equipment, Implantable medical devices, Micro-Electro-Mechanical systems, General constraints in design of biomedical instrumentation systems. **04 Hrs**

Bioelectric Signals and Electrodes: Origin of bioelectric signals-ECG EEG EMG, Recording electrode-Electrode-Tissue interface, Polarization, Skin contact impedance, Motion artifacts, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG. **05 Hrs**

Biomedical Recorders: Electrocardiograph : Block diagram of an ECG machine, Block diagram of an isolation preamplifier commonly used in modern ECG machine, ECG Leads, Multi-channel ECG machine. Electroencephalograph : Block diagram description of an Electroencephalograph, 10-20 electrode system, Electromyograph, other biomedical recorders . **07 Hrs**

Patient Monitoring System: bedside patient monitoring systems, central monitors, measurement of heart rate – instantaneous heart rate meter (cardio tachometer), measurement of pulse rate, measurement of blood pressure – direct & indirect method, oscillometric method, ultrasonic doppler shift method, measurement of respiration rate – impedance pneumography, co2 method, apnea detectors, pulseoximeters. **08 Hrs**

Blood Flow and Cardiac Output Measurement: Electromagnetic blood flow meters, Square wave electromagnetic blood flow meters, Ultrasonic blood flow meters – Doppler shift flow velocity meters, Range gated pulsed Doppler flow meters, Cardiac Output Measurement : Measurement of continuous cardiac output derived from the aortic pressure waveform. **07 Hrs**

Therapeutic equipments: Cardiac Pacemakers, Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers, Defibrillators : DC defibrillators. Ventilators: Artificial ventilation, ventilators, ventilator terms, Patient Safety: Electric shock hazards, Leakage currents. **08 Hrs**

TEXT BOOK:

1. **Handbook of Biomedical Instrumentation**, R. S. Khandpur, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, 2014.

REFERENCE BOOKS:

1. **Biomedical Electronics & Instrumentation**, S. K. Venkata Ram, 3rd Edition, Galgotia Publications Pvt. Ltd., 2009.
2. **Principles of applied biomedical instrumentation**, Lesely Cromwell & others, 2nd Edition, John Wiley and sons,
3. **Encyclopedia of medical devices and instrumentation**, J. G. Webster, John Wiley, 1999.

SIGNAL CONDITIONING CIRCUITS

Sub code: EI430

Total Hours: 52 Hrs

Credit Pattern: 4:0:0

Contact Hours: 04 Hrs/Week

Pre-requisites: Analog Electronic Circuits, Circuit theory and Analysis.

Course Objective: To introduce the applications of analog IC's and develop signal conditioning circuits using op-amp.

Course Outcomes:

Students will be able to,

1. Explain the basic principles and configuration of op-amp, timer and phase locked loop (PLL).
2. Analyze the working of negative and positive feedback amplifiers, timer and PLL.
3. Construct different types of linear and nonlinear circuits using op-amp, timer and PLL.
4. Develop and analyze the higher level applications using op-amp, timer and PLL
5. Explain the working of data acquisition systems and design signal conditioning circuits

Operational amplifier Basics & negative feedback amplifiers: Introduction to differential amplifiers, equivalent circuit of op-amp, Ideal and practical parameters of operational amplifiers, measurement of op-amp parameters. Inverting amplifier, non-inverting amplifier, Summing amplifier, Differential amplifier, instrumentation amplifier. Log and anti log amplifiers, Current to voltage and voltage to current converters. **12 Hrs**

Applications of Negative feedback amplifiers: Integrating and Differentiating circuits with frequency response, Precision rectifiers, Peak detectors, active filters I and II order butter worth filter (In detail). Problems Waveform generators: Principle, Sine wave oscillators, Wein Bridge and phase shift oscillator **10 Hrs**

Comparators & Positive feedback amplifiers and its applications: Inverting and non inverting comparators, ZCD, window detector, Schmitt trigger (design), monostable and astable multivibrators, triangular and sawtooth wave generator. **10 Hrs**

Phase locked loop & Timers: Operating principles, lock range, capture range, working of NE565. PLL as frequency multiplier, frequency synthesizer, frequency translation, 555 timer, astable, monostable and Elementary design of specific applications **10 Hrs**

Design: Signal conditioning and linearizing circuit for thermocouple, RTD, AD590, thermistor and strain gage **04 Hrs**

Data converters: Data acquisition system, Sample and Hold circuits, Binary weighted DAC, R-2R DAC, Successive approximation ADC, Dual slope ADC. Problems **06Hrs**

TEXT BOOKS:

1. **Linear Integrated Circuits & OPAMP**, Gayakwad, 3rd edition, PHI, 2002
2. **OPAMP and applications**, Coughlin and Driscoll, 4th edition, PHI, 2000.
3. **Hand book of A/D & D/A converters**, HNATEK, John Wiley, 1976.

REFERENCE BOOK:

1. **Design of Operational Amplifiers & Analog IC's**, Sergio Franco, 3rd edition, McGraw Hill, 2002.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/117103063/26>

SYSTEM DESIGN USING HDL

Sub code: EI440

Credit Pattern: 3:0:1

Total Hours: 39Hrs + 2Hrs/Week lab session

Contact Hours: 05 Hrs /Week

Pre-requisites: Logic Design, Concepts of Computer Programming.

Course Objective: To provide the knowledge necessary to synthesize and simulate systems using hardware description languages (HDLs), FPGA programming and interfacing.

Course Outcomes:

Students will be able to,

1. Explain the concept of HDL as a software tool and programming language.
2. Develop combinational digital circuits with time constraints using different description styles.
3. Examine sequential circuits with behavioral and structural hardware description code.
4. Make use of programming skills to inculcate structured and modular design approach.
5. Demonstrate skills in programming of FPGA and interfacing of modules.

Introduction: Structure of HDL module, operators, data types, types of descriptions, simulation and synthesis, software for synthesis and simulation, brief comparison of VHDL and Verilog. FPGA architecture and circuit design, data flow descriptions, highlights of data-flow descriptions, structure of data-flow description, data type vectors, examples

08 Hrs

Behavioral Descriptions: Behavioral description highlights, structure of HDL behavioral description, VHDL variable assignment, signal assignment statement, sequential statements, examples, Structural descriptions, highlights of structural description, organization of the structural descriptions, binding, examples.

08 Hrs

Procedures, Tasks, and Functions: Highlights of procedures, tasks, and functions, procedures and tasks examples, functions examples, generate generic, and parameter statements. Advanced HDL descriptions, file processing procedures and tasks, examples of file processing.

06 Hrs

Mixed Type Descriptions: VHDL user-defined data types, VHDL packages, mixed type description examples, two dimensional array and matrix algebra in HDL, mixed language descriptions, highlights of mixed-language description, how to invoke one language from the other, mixed-language description examples, limitations of mixed-language description.

09Hrs

FPGA Interfacing & Mini projects: Interface of switches and LEDs to FPGA, Interface of matrix keyboard and display units to FPGA, Interface of actuators to FPGA, stepper motor, DC motor, interface of DAC, development of simple applications using FPGA.

08Hrs

LIST OF EXPERIMENTS:

1. Synthesis and simulation of logic gates, full adder, comparator.
2. Synthesis and simulation of encoder, multiplexer, simple 4 bit ALU.
3. Synthesis and simulation of flip flops(D,T, JK), counters(binary, BCD).
4. Interfacing of switches, LEDs and 7 segment display units to FPGA.
5. Interface of matrix keyboard, and LCD display to FPGA.
6. Interface of stepper motor to FPGA and control its operations.
7. Interface of DC motor to FPGA and control its operations.
8. Interface of DAC unit to FPGA and generation of waveforms.

In-course project: Develop and demonstrate HDL code for simple applications based on combinational and sequential digital circuits.

TEXT BOOKS:

1. **HDL Programming VHDL and Verilog**, Nazeih M. Botros, Thomson Learning, 2007.
2. **Principles of Digital Systems Design using VHDL**, Charles H Roth, Lizy Kurian John, Cengage Learning, 2009.

REFERENCE BOOKS:

1. **Digital Electronics and Design with VHDL**, Volnei A Pedroni, Elsevier, 2008.
2. **Fundamentals of Digital logic Design with VHDL**, second edition, Stephen Brown, Zvonko Vranesic, 2007.

LEARNING MATERIA

<http://nptel.ac.in/courses/117108040/1>

SIGNALS AND SYSTEMS

Sub code: EI450

Total Hour: 39 Hrs +2Hrs/Week Tutorial

Credit Pattern: 3:1:0

Contact Hours: 05 Hrs/Week

Pre-requisite: Engineering Mathematics

Course Objective: To introduce the basic concepts of signals and systems in time and frequency domains.

Course Outcomes:

Students will be able to,

1. Recall the concepts of signals and systems.
2. Interpret the properties of the system.
3. Determine the response of the system in time domain.
4. Apply the knowledge of Z transform to analyze discrete time systems.
5. Analyze the system using Fourier representation.

Continuous time and discrete time signals and Systems: Classification of signals, Standard signals, Basic operations on signals, System, Classification of systems. **08 Hrs**

Analysis of systems: Convolution sum, differential equation representation of LTI systems, solution of differential equation, difference equation representation of LTI systems, solution of difference equation, Correlation and correlation coefficient. **08 Hrs**

Fourier Series and Fourier Transform of discrete time signals: Fourier series for discrete time periodic signals (DTFS), properties of DTFS, Fourier transform of discrete time non periodic signal, properties of DTFT, DTFT of periodic signals, analysis of LTI discrete time system using DTFT. **08 Hrs**

Z-Transform: Introduction, Z-transform, Properties of Z-transform, Pole zero model, Region of convergence, Inversion of Z-transforms, Analysis of LTI discrete time system using Z transform, stability and causality analysis. **08 Hrs**

Discrete Fourier Transform: Properties of DFT and IDFT, Analysis of LTI discrete time systems using DFT. **07 Hrs**

TEXT BOOKS:

1. **Signals and Systems**, Simon Haykin and Barry Van Veen, 2nd edition, John Wiley & Sons.
2. **Modern Digital Signal Processing**, V. Udayashankara, 3rd edition, PHI, 2015.

REFERENCE BOOKS:

1. **Signals and Systems**, Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, , 2nd edition, Pearson education Asia/PHI 1997, Indian Reprint 2002.
2. **Signals and Systems**, Nagoor Kani, TMH, 2011.
3. **Signals and Systems**, H P Hsu, R Ranjan, Scham's Outlines, TMH, 2006.
4. **Linear Systems and Signals**, B P Lathi, Oxford University Press, 2005.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/117104074/>

SIGNAL CONDITIONING CIRCUITS LAB

Sub code : EI46L

Credit Pattern : 0:0:1.5

Contact Hours : 03/Week

Prerequisites: Transducer & Instrumentation

Course Objectives: This course aims to expose the students to design elementary applications using operational amplifiers & also develop signal conditioning circuits for temperature transducers. Designing of multivibrators using timers for different duty cycles.

Course Outcomes:

Students will be able to

1. Apply the fundamental knowledge of an amplifier and design using an opamp.
2. Test the designed circuit using an opamp & Timer and observe the output
3. Analyze and draw conclusion on the result
4. Demonstrate the application of various circuits using IC's

LIST OF EXPERIMENTS:

1. Differential amplifiers & Instrumentation amplifiers for different gains.
2. Precision half wave and full wave rectifiers.
3. II order Low pass and High pass filters.
4. Comparators and Schmitt triggers.
5. Astable and monostable multivibrators using op-amp.
6. Astable and monostable multivibrators using 555 Timer.
7. Signal conditioning circuit for thermocouple and RTD.
8. Design of linearizing circuit for Thermistor.
9. Sample and hold circuits.
10. Analog multiplexers.
11. Digital to analog converter using DAC 0800.
12. Analog to Digital converter using ADC 0804.

LINEAR ALGEBRA

Sub code: EI510

Credit Pattern : 3:1:0

Total number of hours: 39 Hrs + 2 Hrs/Week Tutorials

Contact Hours: 05 Hrs/Week

Pre-requisite: Engineering Mathematics.

Course Objective: To introduce concepts of linear equations, vector spaces and matrices.

Course Outcomes:

Students will be able to,

1. Explain the concepts of linear equations, vector equations and matrix operations.
2. Solve linear equations, vector equations, matrix equation and factorization.
3. Analyze vector spaces, Eigen values and linear transformation.
4. Solve Eigen values, orthogonality and least squares problems.
5. Evaluate diagonalization of symmetric matrices and SVD.

Linear Equations: System of linear equations, Row reduction and echelon forms, Vector equations, Matrix equations, Solution sets of linear systems, matrix operations, inverse of a matrix, Matrix factorization **08 Hrs**

Vector Spaces: Vector spaces and subspaces; Linearly independent sets, bases, coordinate systems, dimension of a vector space, Rank, Change of basis **08 Hrs**

Linear Transformations: Linear transformations, Eigen vectors and Eigen values, characteristic equation, diagonalization, Eigen vectors and linear transformation **07 Hrs**

Orthogonality and Least Squares: Inner products, length and orthogonality, orthogonal sets, orthogonal projections, Gram-Schmidt process, QR-factorization, least-squares problems **08 Hrs**

Symmetric Matrices and Quadratic Forms: Diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition. **08 Hrs**

TEXT BOOK:

1. **Linear Algebra and its Applications**, David C. Lay, 5th Edition, Pearson Education (Asia) Pvt. Ltd, 2015.

REFERENCE BOOKS:

1. **Linear Algebra and its Applications**, Gilbert Strang, 4th Edition, Thomson Learning Asia, 2007.

2. **Introductory Linear Algebra with Applications**, Bernard Kolman and David R. Hill, 7th edition, Pearson Education (Asia) Pvt. Ltd, , 2003.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/111106051/>

CONTROL SYSTEMS

Sub code: EI520

Credit Pattern: 4:0:1

Total number of hours: 52Hrs +2Hrs/week Lab session

Contact Hour: 06 Hrs/Week

Pre-requisites: Mathematics, Signals and Systems.

Course Objective: To introduce the basic concepts of control systems, feedback systems and their representation and analysis.

Course Outcomes:

Student will be able to,

1. Explain the concepts of control system.
2. Model electrical, mechanical and electromechanical systems.
3. Determine the transfer function of a system from different types of representation.
4. Explain the characteristics of the system in time domain and frequency domain.
5. Investigate the stability of the system in time domain and frequency domain.

Introduction to control systems: Definition, open loop and closed loop systems, types of feedback. **04 Hrs**

Mathematical modeling of systems: Modeling of electrical, mechanical, and electromechanical systems, differential equations of physical systems. **06 Hrs**

Block diagram and Signal flow graph: Transfer function, block diagram representation and reduction, signal flow graph representation and reduction using Mason's gain formula. **07 Hrs**

Time response of feedback control systems: Standard test signals, steady state error analysis, unit step response of first and second order systems, time domain specifications and transient response of a prototype second order system. **07 Hrs**

Stability Analysis: Bounded input and bounded output stability, zero input and asymptotic stability, methods of determining stability, Routh-Hurwitz criterion. **06 Hrs**

Root-Locus techniques: Basic properties and construction. **07 Hrs**

Frequency domain analysis: Bode plots, gain and phase cross over points, polar plot, Nyquist stability criterion, relative stability using polar plot and Bode plot, frequency domain specifications – resonant peak, resonant frequency and bandwidth, effect of adding a zero or pole to the forward path transfer function. **15 Hrs**

TEXT BOOKS:

1. **Control Systems Engineering**, I J Nagarath and M Gopal, 5th edition, New age international publishers, 2008.
2. **Modern Control Engineering**, D Roy Choudhury, 1st edition, PHI, 2005

REFERENCE BOOK:

1. **Automatic Control System**, Kuo B C, 8th edition, John-Wiley and Sons Publications, 2002.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/108101037/1>

LIST OF EXPERIMENTS:

Using MATLAB/SCILAB (Experiments 1 to 5)

1. a) Simulate a typical second order system and determine the impulse response and step response and evaluate the time domain specifications.
b) Evaluate the effect of additional poles and zeroes on time response of second order system
c) Evaluate the effect of pole location on stability.
d) Evaluate of loop gain of a negative feedback system on stability.
2. a) Simulate a D. C. position control system and obtain its step response.
b) To verify the effect of the input, loop gain and system type on steady state errors.
3. Determine the stability of the given system using Root locus.
4. Determine the stability of the given system using Bode plot.
5. Determine the stability of the given system using Nyquist plot.
6. a) Design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and obtain its frequency response.
b) Determine the transfer function of the lead compensating network.
7. a) Design RC lag compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs and obtain its frequency response.
b) Determine the transfer function of the lag compensating network.
8. Determine the frequency response of a lag- lead compensating network.

INDUSTRIAL COMMUNICATION

Sub code: EI 530

Credit Pattern: 4:0:0

Total number of hours: 52 Hrs

Contact hours: 04 hrs/Week

Pre-requisite: Electronic Devices and circuits, Signals and Systems

Course Objective: To introduce the basic concepts of data communication, serial communication standards and Industrial protocols.

Course Outcomes:

Students will be able to,

1. Explain the various methods of data communication.
2. Identify the importance and applications of different communication methods.
3. Define different serial communication standards
4. Analyze the working of various protocols used for data communication.
5. Determine the role of Cabling and effect of noise in communication system

Introduction: Need, principles of analog and digital communication systems **02 Hrs**

Pulse modulation: Sampling theorem for low pass and band pass signal, statement and proof, PAM, Channel bandwidth for a PAM signal, Natural Sampling, Flat-Top sampling, Signal recovery through Holding, Quantization of Signals, Quantization error, PCM, Electrical representations of binary digits, The PCM System, DPCM, Delta Modulation, ADM.

10 Hrs

Digital modulation: Introduction, BPSK, DPSK, Type D flip-flop, QPSK, Non-offset QPSK Signal space representation, BFSK, Spectrum, Receiver for BFSK, Geometrical Representation of Orthogonal BFSK, line codes, TDM, Problems

08 Hrs

Data Communication: Data communication principle, Communication modes, Synchronous and asynchronous system, Error, Transmission Characteristics, Channel Capacity, Baud Rate, Data Rate, Bandwidth, SNR, Data throughput, Error rate, Data coding, UART: Principle, Transmitter and Receiver.

05 Hrs

Serial Communication Standard: Standards organizations, Serial data communication interface standards, Balanced and unbalanced transmission lines, RS 232 interface standard, Troubleshooting serial data communication circuits, Test equipment, RS 423 interface standards, RS 422 Standard, RS 485 Standard, Troubleshooting and testing with RS 485, The 20 mA Current loop, serial interface converters, interface to serial computers, GPIB, USB.

12 Hrs

Electrical Noise and Interference : Definition of noise, External and Internal noise, Noise calculation, Noise Figure, Noise Temperature, Frequency analysis of noise, Source of electrical noise, Electrical coupling of noise, Shielding, Cable ducting, Cable spacing, Earthing and grounding requirement, Suppression techniques. Filtering

08 Hrs

Industrial Protocols: Introduction to protocols, Modbus protocol, HART Protocol, Open industrial Fieldbus and DeviceNet systems, Profibus

07 Hrs

TEXT BOOKS:

1. **Principles of communication systems.** Taub and Schilling, 3rd edition. TMH, 2009.
2. **Practical Data Communications for Instrumentation and Control,** John Park, 1st Edition, Elsevier, 2003

REFERENCE BOOK:

Instrument Engineers Hand book (Process Measurement.), B G Liptak, 3rd Edition, Chilton book, 1995.

LEARNING MATERIALS:

<https://nptel.ac.in/courses/108/104/108104098/>

8051 & AVR Microcontroller

Sub code: EI540

Credit Pattern: 3:0:1

Total number of hours: 39 Hrs + 2 Hrs/WeekLab Session Contact Hours: 05 Hrs/Week

Pre-requisites: Logic Design, Basic C Programming.

Course Objective: To introduce architecture, programming and interfacing concepts of microcontrollers.

Course Outcomes:

Students will be able to,

1. Compare and explain different types of architectures.
2. Illustrate the working of the microcontroller and develop programs.
3. Design systems using built – in peripherals.
4. Design systems by interfacing external devices.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to solve real world problems using microcontrollers.

Fundamentals: Introduction, comparison between microprocessors and microcontrollers, RISC & CISC CPU architectures, Von-Neumann & Harvard architecture. architecture of 8051, pin diagram of 8051, memory organization, ports, **07 Hrs**

8051 Instruction Set: Introduction, instruction syntax, data types, addressing modes: immediate addressing , register addressing, direct addressing, indirect addressing, relative addressing, absolute addressing, long addressing, indexed addressing, bit inherent addressing, bit direct addressing. Instruction set: instruction timings, data transfer instructions, arithmetic instructions, logical instructions, branch instructions, subroutine instructions, bit manipulation instruction. Assembly Language Programs (ALP). **08 Hrs**

8051 Timers/counters, Serial Communication & Interrupts: Introduction to timers and counters, 8051 timers/counters, timer/counter modes, data communication, basics of serial data communication, 8051 serial communication, serial communication modes. basics of interrupts, 8051 interrupt structure, programming in assembly and C. **08 Hrs**

8051 Interfacing and Applications: Basics of I/O concepts, interfacing 8051 to seven segment display, LCD, keyboard, ADC, DAC, stepper motor and DC motor, programming in assembly and C. external memory interfacing. **08 Hrs**

ATmega328B Microcontroller: Features, architecture of ATmega328B, pin out of ATmega328B, registers, port functions ATmega328B, power management, timer/counter, serial ports, ADC. **08 Hrs**

LIST OF EXPERIMENTS:

1. ALP to perform Arithmetic & Logical operations.
2. ALP to perform Array operations & Code conversions.
3. Programs to perform Timer/Counter operations.
4. Programs to perform Serial Communication.
5. Programs to interface LED and Keypad.
6. Programs to interface Stepper motor & DC Motor.
7. Programs to interface DAC & ADC.
8. Programs to interface seven segment display and LCD.

MINI PROJECT: Application development using ATmega328B AVR microcontroller (ARDUINO)

TEXT BOOKS:

1. **The 8051 Microcontroller and Embedded Systems – using assembly and C**, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006.
2. **8051 Microcontroller-Hardware, Software and Applications**, V. Udayashankara and M.S. Mallikarjunaswamy, Tata McGraw-Hill, 2009.
3. **Technical Datasheets**, ATmega328B AVR Microcontroller

REFERENCE BOOKS:

1. **The 8051 Microcontroller and embedded systems**, Kenneth J. Ayala and DhananjayV.Gadre, Cenegage learning. 2004.
2. **The 8051 Microcontroller Based Embedded Systems**, Manish K. Patel, McGraw Hill Education (India) Pvt. Ltd., 2014.

LEARNING MATERIALS:

1. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home1_1.htm
2. <http://nptel.ac.in/courses/108105102/>
3. <http://www.keil.com/c51/>
4. <https://www.arduino.cc>

DIGITAL SIGNAL PROCESSING

Sub code: EI550

Credit Pattern: 4:0:1

Total number of hours: 52Hrs + 2Hrs Lab session/Week Contact hours: 06 Hrs/Week

Pre-requisite: Signals and systems.

Course Objective: To introduces the concepts of FFT, DCT, FIR, IIR and adaptive filters.

Course Outcomes:

Students will be able to,

1. Explain basic concepts of the signals in frequency domain and filtering
2. Develop algorithms for transformation of signals from time domain to frequency domain and vice versa.
3. Analyze and build the different forms of filter structures.
4. Design and implement FIR and IIR filters.
5. Explain multirate signal processing and adaptive filters.

Computation of FFT: Radix-2 Decimation in Time FFT, Radix-2 Decimation in Frequency FFT, inverse FFT Algorithm. Introduction to DCT, DCT-2 and IDCT-2 algorithm. **08 Hrs**

Digital Filter Realization: Basic IIR filter structures: Direct form (I & II), Parallel, Cascade form and lattice form. Basic FIR Filter structures: Direct and cascade form structure and lattice form. **10 Hrs**

FIR filters: Introduction, Properties, Filter Design using Windows (Rectangular, Hamming, Hanning and Kaiser Window), and Filter design using Frequency sampling technique. **09 Hrs**

IIR Filters: Specification and design techniques, Impulse Invariant and Bilinear Transformation techniques. Design of digital Butterworth and Chebyshev low pass filters using Analog filter design techniques, Transform of Low pass to High pass, Band pass and Band rejection filters, Comparison of IIR and FIR filters, **12Hrs**

Multirate digital signal processing: Introduction, decimation by a factor D, interpolation by a factor I, application of multirate signal processing: Interfacing of digital systems with different sampling rate, implementation of digital filter banks, DFT filter banks, Quadrature mirror filter banks. **08 Hrs**

Adaptive filters: Adaptive filters, LMS adaptive algorithms, Applications of adaptive filters. **05 Hrs**

LIST OF EXPERIMENTS:

Implementation of following using Scilab/Matlab,

1. FFT & IFFT
2. DCT and IDCT
3. FIR filters using windows
4. FIR filters using Frequency sampling
5. Butterworth IIR filter
6. Chebyshev IIR filter
7. Realization of digital filters structures
8. LMS Algorithms

TEXT BOOKS:

1. **Digital Signal Processing**, Proakis and Manolakis, 3rd Edition. PHI/Pearson, 2015.
2. **Modern digital signal processing**, Dr. V. Udayashankara, 3rd Edition, PHI, 2015.

REFERENCE BOOKS:

1. **Theory and Application of DSP**, Rabinar L R and Gold B, PHI, 1999.
2. **Introduction to digital signal processing**, Johnson, Prentice Hall of India 1999.
3. **Digital Signal Processing**, by Alan V. Oppenheim and Ronald W. Schaffer, Pearson.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/117102060/>

AIRCRAFT INSTRUMENTATION

Sub code: EI561

Credit Pattern: 3:0:0

Total Hours: 39Hrs

Contact hours: 03Hrs/Week

Pre-requisites: Basic Electronics, Transducers & Instrumentation.

Course Objective: To introduce the fundamentals of aircraft and the instrumentation involved in aircraft system.

Course Outcomes:

Students will be able to,

1. Explain the basics of Aircraft systems.
2. Demonstrate the principles of basic instruments and the directional systems.
3. Analyze the gyroscopic instruments.
4. Show functions of fuel flow and fuel quantity measuring system.
5. Explain safety measures for an aircraft.

Aircraft Basics: Introduction, Basic components of aircraft, Forces involved in flight, Newton laws Bernoulli's principle applicable to flight. Aircraft Instruments, Instruments grouping, Instrument Displays, Quantitative and Qualitative displays, Director Displays, Standard atmosphere **08Hrs**

Air data Instruments: Basic air data system, Pitot static probe, heating circuit arrangement, Air speed indicator, Mach/airspeed indicator, Altimeters, Effects of atmospheric temperatures, Vertical airspeed indicators, Instantaneous vertical airspeed indicator, Air temperature indicator **08Hrs**

Warning systems: Air data Alerting system, Mach warning system, Altitude alert system. Direct reading compasses: Terrestrial Magnetism, Compass construction, Errors in indication, Acceleration error, and compensation. **07Hrs**

Gyroscopic Flight Instruments: The gyroscope and its properties, determining direction of precession, limitations of gyroscopes, operating gyroscopic flight instruments, Gyro horizon, Erection systems for gyro horizons, errors due to acceleration and turning, Direction Indicator, Turn and bank indicator. **08Hrs**

Engine Instruments: Pressure measurement, Indicating systems, pressure switches, Temperature measurement, Fuel quantity Indicating Systems: Capacitance type system, Effects of fuel temperature changes, Measurement of fuel quantity by weight, Engine power and control instruments: RPM measurement, Generator and indicating system, Tacho probe and indicator

system, Exhaust gas temperature, engine pressure ratio measurement, fuel flow measurement system. **08Hrs**

TEXT BOOK:

1. **Aircraft Instruments and Integrated Systems**, EHJ Pallet, Longman Scientific & Technical, 1992.

REFERENCE BOOKS:

1. **Aircraft Instrument Design**, WH Coulthard, Pitman & sons 1981.
2. **Aircraft Instruments**, C A Williams, Golgotia Publications, New Delhi.

PRODUCT DESIGN TECHNOLOGY

Sub code: EI 562

Total number of hours: 39Hrs

Credit Pattern: 3:0:0

Contact hours: 03Hrs/Week

Pre-requisite: Electronic devices and Circuits

Course Objective: To create awareness about the basic requirements of a user friendly product and introduce the manufacturing process to meet the target specifications.

Course Outcomes:

Students will be able to,

1. Analyse the product design and development processes in manufacturing industry.
2. Define the components and their functions in product design and development processes.
3. Analyse, evaluate and apply the methodologies for product design, development and management.
4. Make use of a methodical approach to the management of product development to satisfy customer needs.
5. Work in the laboratory to design and present a product that meets ergonomical and industrial requirements.

Introduction: Development process and Organizations: characteristics of successful product development, duration and cost of product development, challenges of product development.

06 Hrs

Generic development process, concept development: Front-end process, adapting the generic product development process.

05 Hrs

Identifying Customer needs and Establishing Product specifications: Defining scope, gathering data from customers, establishing relative importance of needs. Target specifications & refining specifications.

05 Hrs

Concept generation: Five-step methodology of concept generation, with a case study of any electronic instrument.

05 Hrs

Human Engineering Considerations in product Design: Anthropometry, the design of controls, the design of displays, man/machine information exchange.

05 Hrs

Concept Embodiment: Overview, basic methods, advanced methods, case study-computer monitor with reference to ergonomics and esthetics.

05 Hrs

PCB Technology: Introduction, types, applications, base materials, design methods and fabrication processes. **08 Hrs**

TEXT BOOKS:

1. **Product Design and Development**, Karl T Ulrich, Steven D Eppinger, 3rd edition, Tata McGraw Hill.
2. **Printed Circuit board Design and Technology**, Walter C Boshart, McGraw International.

REFERENCE BOOKS:

1. **Product design and manufacturing**, AK. Chitale and RC Gupta, Prentice Hall.
2. **Product Design**, Kevin Otto, Kristin Wood, 2nd edition, Pearson Education.

OPERATING SYSTEMS

Sub code: EI563

Credit Pattern: 3:0:0

Total number of hours: 39Hrs

Contact hours: 03Hrs/Week

Pre-requisite: Programming in C.

Course Objective: To introduce the concepts and design of operating system and services provided by it.

Course Outcomes:

Students will be able to,

1. Explain the functions, structures and history of operating systems.
2. Explain various process management concepts including scheduling, synchronization, and deadlocks and select appropriate concept.
3. Discuss the concepts of memory management including virtual memory and disk management.
4. Analyze design issues associated with management of different operating system resources.
5. Apply different techniques to avoid unauthorized access to the system.

Introduction to operating systems: OS objectives and functions, Process concepts and views, OS design issues, OS supports & services, evolution of system structure. **07Hrs**

Process management: Functions, process states models, threads: thread states, types of threads, thread priority, multithreading, Scheduling: short-term scheduler types of schedulers, non-preemptive & preemptive strategies. **07Hrs**

Interprocess synchronization: concepts, critical section problem, Peterson's solution, synchronization hardware, semaphores, bounded buffer problem, readers-writers problem, dining philosophers problem. Deadlocks: deadlocks & starvation, conditions for deadlocks, deadlock detection, deadlock prevention, deadlock recovery, deadlock avoidance, starvation. **07Hrs**

Memory management: Key Characteristics, memory Hierarchies, functions, some fundamental responsibilities, management schemes: contiguous memory allocation & non contiguous memory allocation, virtual memory: Basic concepts, paging, segmentation, cache memory design issues. **07Hrs**

Device & file management: Device Characteristics, Types, Device controller, Types of operations, buffering & types of buffering, clock, disk, management, disk arm scheduling policies, File system, management, design principles, organization, directory, sharing, blocking, management, allocation, **07Hrs**

Security & Protection: Overview, goals, security threats, attacks, design issues, protection structure, intruders, Encryption: symmetric encryption, public key encryption.

04Hrs

TEXT BOOKS:

1. **Operating Systems, A concept-based evolutionary approach**, PChakra borty, Jaico publishing house, 2011.
2. **Operating System Principles**, Abraham Silberschatz, Peter Galvin, Greg Gagne, 8th Edition Wiley-India, 2015.

REFERENCE BOOKS:

1. **Modern Operating Systems**, Andrew S Tanenbaum,. 3rd Edition, PHI. 2009.
2. **Operating Systems**, Harvey M. Deitel Paul J. Deitel David R. Choffnes , 3rd Edition , PHI.
3. **Operating Systems, Internals & design principles**, William Stallings, 7th Edition, PHI, 2012.

LEARNING MATERIALS:

<http://nptel.ac.in/downloads/106108101/>

JAVA PROGRAMMING

Sub code: EI 564

Total number of hours: 39Hrs

Credit Pattern: 3:0:0

Contact hours: 03Hrs/Week

Pre-requisite: C Programming.

Course Objective: To provide the basics of Java programming and knowledge of application development using JAVA.

Course Outcomes:

Student will be able to,

1. Explain the concepts of java programming.
2. Analyze concepts such as variables, conditional and iterative execution methods etc.
3. Apply Java language syntax and semantics to write Java programs.
4. Develop graphical interface and java applets for web programming.
5. Demonstrate concepts and features of SWINGS and database connectivity in JAVA.

Introduction: Java and java applications, java development kit (JDK),java is interpreted, byte code, JVM, object-oriented programming, simple java programs. data types and other tokens: Boolean variables, int, long, char, operators, arrays, white spaces, literals, assigning values; creating and destroying objects, access specifiers, operators and expressions: arithmetic operators, bitwise operators, relational operators, the assignment operator, the ? Operator, operator precedence, logical expression, type casting, strings. Control statements: selection statements, iteration statements, jump statements.

08 Hrs

Classes, Inheritance, Exceptions, and Applets: **Classes:** Classes in Java, Declaring a class, Class name, Super classes, Constructors, Creating instances of class, Inner classes. **Inheritance:** Simple, multiple, and multilevel inheritance, Overriding, overloading. **Exception handling:** Exception handling in Java.

08 Hrs

The APPLET Class: Two types of applets, applet basics, applet architecture, an applet skeleton, simple applet display methods, requesting repainting, using the status window, the html applet tag passing parameters to applets, getdocumentbase() and getcodebase(), appletcontext and showdocument(), the audioclip interface, the applet stub interface, output to the console.

08 Hrs

Multi Threaded Programming, Event Handling: Multi threaded programming: what are threads? How to make the classes threadable, extending threads; implementing runnable, synchronization, changing state of the thread, bounded buffer problems, read-write problem, producer-consumer problems. **event handling:** two event handling mechanisms; the delegation event model, event classes; sources of events, event listener interfaces, using the delegation event model, adapter classes, inner classes. **08 Hrs**

SWINGS: Swings: the origins of swing, two key swing features, components and containers, the swing packages, a simple swing application, create a swing applet, Label and image icon, JTextfield, the swing buttons, JTabbedPane, JScrollPane; JList, JComboBox, JTable. **servlets:** background, the life cycle of a servlet, using tomcat for servlet development, a simple servlet, the servlet api, the javax.servlet package, reading servlet parameter, the javax.servlet HTTP package handling HTTP requests and responses, using cookies, session tracking. **JSP, RMI.**

07 Hrs

TEXT BOOKS:

1. **Java the Complete Reference** -Herbert Schildt, 7th Edition, Tata McGraw Hill, 2007.
2. **J2EE the Complete Reference** -Jim Keogh, Tata McGraw Hill, 2007.

REFERENCE BOOKS:

1. **Introduction to JAVA Programming** -Y. Daniel Liang, 6th Edition, Pearson Education, 2007.
2. **The J2EE Tutorial** -Stephanie Bodoff, 2nd Edition, Pearson Education, 2004.

LEARNING MATERIALS:

1. Java basics: textofvideo.nptel.ac.in/106106147/lec1.pdf
2. Java Applets: nptel.ac.in/courses/106105084/28

PROCESS CONTROL

Sub code: EI610

Credit Pattern: 4:0:0

Total number of hours: 52Hrs

Contact hours: 04Hrs/Week

Pre-requisites: Transducers and Instrumentation, signal conditioning circuits, control systems.

Course Objective: To impart knowledge about process control, controller design, annunciator systems and tuning concepts.

Course Outcomes:

Students will be able to,

1. Explain the basic principles & importance of process control in process plants.
2. Select the required instruments and control elements for a process control application.
3. Design and tune process controllers.
4. Explain the importance and application of good instrumentation for monitoring, diagnosis and control of a process.
5. Evaluate the performance of various controller modes in the laboratory.

Introduction to Process Control: Process control block diagram, Identification of elements in process control loops – examples. **04 Hrs**

Final Control: Introduction to final control operation, signal conversions, actuators, control elements. **10 Hrs**

Controller principles: Introduction, process characteristics, control system parameters, discontinuous control modes, continuous control modes, and composite control modes. **10 Hrs**

Analog controllers: Introduction, general features, electronic controllers, pneumatic controllers, design considerations. **06 Hrs**

Digital Controllers: Introduction, digital electronics methods, computers in process control. **06Hrs**

Discrete-State Process Control: Introduction, definition and characteristics of discrete state process control, examples for defining control system as discrete state system. **04 Hrs**

Control-loop characteristics: Introduction, control system configuration, multivariable control systems, control system quality, stability, and process loop tuning. **08 Hrs**

Control drawings: P& ID symbols and Diagrams: Introduction, Typical Instrumentation symbols for temperature, flow and level. **04 Hrs**

Self-study: 1. Industrial safety

2. Case studies

TEXT BOOKS:

1. **Process Control Instrumentation Technology**, C D Johnson, PHI, 8th edition, 2009.
2. **Instrument Engineers Handbook (Vol 1 & 2)**, B G Liptak, 3rd edition, Chilton Book Company, 1995

REFERENCE BOOK:

1. **Chemical process control: an introduction to theory and practice**, Stephanopoulos, PHI, 2006.

LEARNING MATERIALS:

1. <http://nptel.ac.in/courses/103103037/>

ADVANCED CONTROL SYSTEMS

Sub code: EI620

Credit Pattern: 4:0:0

Total number of hours: 52 Hrs

Contact hours: 04Hrs/Week

Pre-requisite: Control systems

Course Objective: To introduce the basic concepts of modeling and analysis of continuous and discrete time control systems.

Course Outcomes:

Students will be able to,

1. Recall the concepts of state space representation and nonlinearities of the system.
2. Interpret the characteristics of the system using different methods.
3. Analyze state space models of linear time invariant systems.
4. Evaluate the system in z-domain.
5. Design various kinds of compensators.

Discrete time control systems and the Z-Transform method: Introduction to discrete systems, pulse transfer function, stability analysis in the Z-plane. **10Hrs**

State space analysis of control systems: State space representation of systems, solving the time invariant state equations, transfer matrix, linear time invariant systems, state space representation of discrete time systems and solving discrete time state equation. **12Hrs**

Pole Placement: Controllability, Observability for continuous time systems, Pole placement design and State Observabilities. **08Hrs**

Describing function analysis of Nonlinear Control systems: Introduction to nonlinear systems, describing function analysis of nonlinear control systems, stability of nonlinear control system using phase plane and phase trajectories. **10Hrs**

Compensation Techniques: Lead, lag, lead lag network and compensator design using Bode/Root locus techniques. **12Hrs**

TEXT BOOKS:

1. **Modern Control Engineering**, Katsuhiko Ogata, 5th edition, PHI, 2006
2. **Discrete time Control Systems**, Katsuhiko Ogata, 2nd edition, PHI, 2015.

REFERENCE BOOKS:

1. **Digital control and state variable methods**, Madan Gopal, 4th edition, McGrawHill publications, 2012.
2. **Modern Control Engineering**, Roy Choudhury, 1st edition, PHI, 2009.

LEARNING MATERIALS:

<http://nptel.ac.in/courses/108103008/10>

PYTHON PROGRAMMING AND RASPBERRY PI

Sub code: EI630

Credit Pattern: 4:0:1

Total number of hours: 52 Hrs + 2Hrs Lab session/Week **Contact hours: 06 hrs/Week**

Pre-requisites: Logic Design, Basic C Programming, Microcontrollers.

Course Objective: To introduce basics of Python programming, architecture of Raspberri Pi and programming Raspberry Pi using Python.

Course Outcomes:

Students will be able to,

1. Explain the fundamental concepts of python.
2. Demonstrate Data structures and file handling techniques in Python
3. Explain the components of Raspberry Pi.
4. Design Raspberry Pi based systems.
5. Demonstrate theoretical, practical and soft skills by working in the laboratory to solve real world problems using Raspberry Pi.

Basics of Python: Data types, arithmetic, relational, bitwise and logical operations on numerical types, control flow operators, functions. **12 Hrs**

Data structures and I/O: String operations, creating lists, list operations, tuples, creating dictionaries, dictionary operations, set operations, reading and writing files **10 Hrs**

Raspberry Pi Architecture and Features: Raspberry Pi Hardware, CPU, GPU, GPIO, Serial ports, RCA, audio out, USB, HDMI, power, SD card slot, Ethernet, camera module. **10 Hrs**

Interfacing Hardware and Motor Control: Controlling LEDs and switches, switch using interrupt, keypad interface, motor interface. PWM generation. PWM control for LED/motors. **10 Hrs**

Interfacing Sensors, Display and Accessing Internet: Sensor interface (Temperature, Light, Gas etc.), display interfaces, Installing PySerial for Access to the Serial Port from Python, serial communication, extracting data from internet. **10 Hrs**

LIST OF EXPERIMENTS:

Write Python Programs to,

1. Understand Python data types
2. Understand Control Flow
3. Understand Functions
4. Implement
 - a) String Operations
 - b) List and Tuple Operations
5. Implement
 - a) Set Operations
 - b) Dictionary Operations
6. Interface input device to Raspberry Pi
7. Interface output device to Raspberry Pi
8. Perform data transmission

MINI PROJECT: Develop Python program to design a simple instrumentation system using Raspberry Pi.

TEXT BOOK:

1. **Python for Everybody: Exploring Data Using Python 3, Dr. Charles R. Severance, 2016**
2. **Raspberry Pi Cookbook: Software and Hardware Problems and Solutions, Simon Monk, O'Reilly Media, Inc, Third Edition, 2019**

REFERENCE BOOKS:

1. **Python Programming for the Absolute Beginner, Michael Dawson, 3rd Edition, Cengage Learning, 2010**
2. **Getting Started with Python and Raspberry Pi, Dan Nixon, Packt Publishing, 2015**
3. **Python Programming with Raspberry Pi, Sai Yamanoor, Srihari Ymanoor, Packt Publishing, 2017**
4. **Learning Python with Raspberry Pi, Alex Bradbury, Ben Everard, John – Wiley and Sons, 2014**

LEARNING MATERIALS:

1. <http://www.python.org>
2. <http://www.raspberrypi.org>
3. <http://nptel.ac.in/courses/115104095/>
4. <http://nptel.ac.in/courses/106105166/28>

DSP ARCHITECTURE

Sub code: EI640

Total Hours: 39 Hrs + 2 Hrs/Week Lab Session

Credit Pattern: 3:0:1

Contact hours: 05Hrs/Week

Pre-requisites: Signals and systems, Digital signal processing.

Course Objective: To introduce the basic concepts of digital signal processor and implementation of DSP algorithms on digital signal processor TMS320C5416 and TMS 320C6713.

Course Outcomes:

Students will be able to,

1. Recall the basic concepts of Digital signal processing devices.
2. Explain the architectural features of DSP devices TMS 320C5416.
3. Discuss Addressing modes, Programming & Implement DSP algorithms on TMS320C5416.
4. Design circuits to interface devices with TMS320C5416.
5. Understand architectural features of TMS320C6713 and applications of DSP devices.

Data formats, arithmetic operations and errors in digital signal processors: Introduction, Fixed and floating point DSP, Data formats, Fixed and floating point arithmetic operations, Dynamic range, precision and resolution, sources of errors in DSP. **4 Hrs**

Introduction to digital signal processing devices: Architectural features of DSP, Bus architecture, DSP Computational building blocks, On-chip memory, Special function instructions, Special addressing modes, parallel move support and pipelining. **4 Hrs**

Architecture of TMS 320c54xx processor: Features, architecture, Interrupts, Internal memory organization, On-chip peripherals. **4 Hrs**

Addressing modes and instruction set of TMS 320c54xx processor: Addressing modes, Instruction set. **4 Hrs**

TMS 320VC5416 Assembly language programming: DSP System Design kit, Assembly language programming. **8 Hrs**

Interfacing with TMS 320c54xx processor: Memory space organization, External memory interface, Parallel I/O interface, Serial I/O interface. **5 Hrs**

TMS 320C6713 Architecture: Features, architecture, Addressing modes, Applications of DSP devices. **10 Hrs**

TEXT BOOKS:

1. **Modern Digital Signal Processing**, V. Udayashankara, Third edition, PHI, 2015.
2. **Digital Signal Processing**, Avtar Singh and S Srinivasan, Thomson Publishing, 2004, Singapore.

REFERENCE BOOKS:

1. **Digital Signal Processing- A Practical Approach**, Emmanuel C Ifeachor and B W Jervis, Pearson Education, New Delhi.
2. **Digital Signal Processors**, B Venkataramani and M Bhaskar, Tata-McGraw Hill, New Delhi, 2002.
3. **DSP and applications with TMS320C6713**, Wiley IEEE press, 1/e, 2008
4. **TMS320C67x/C67x+ DSP CPU and Instruction Set Reference Guide**, literature number SPRU733A, 2006.
5. **Data sheets of TMS320C6713B Floating-Point Digital Signal Processor**, literature number: SPRS294B, 2005.

LIST OF EXPERIMENTS:

1. Implementation of Assembly language programs using TMS320C5416.
2. Implementation of Assembly language programs (ALP) linear convolution and correlation on TMS320C5416.
3. Implementation of ALP of Circular convolution on TMS320C5416.
4. Implementation of ALPs of FIR & IIR filters on TMS320C5416.
5. Implementation of ALP interpolation concepts using TMS320C5416.
6. Implementation of ALP decimation concepts using TMS320C5416
7. Implementation of C programs of linear convolution and correlation on TMS320C5416.
8. Implementation of C programs of FIR & IIR filters and FFT on TMS320C5416

LEARNING MATERIALS:

<http://nptel.ac.in/courses/108102045/9>

ANALYTICAL INSTRUMENTATION

Sub code: EI651

Credit Pattern: 3:0:0

Total number of hours: 39Hrs

Contact hours: 03Hrs/Week

Pre-requisite: Basic sciences.

Course Objective: To gain the knowledge of applying analytical techniques to perform qualitative and quantitative analysis of given sample.

Course Outcomes:

Students will be able to,

1. Explain the fundamental principles of analytical science from multi disciplinary perspective.
2. Compare UV, Visible, IR spectrometer for quantitative and qualitative applications.
3. Discuss Mass spectrometer and Flame photometers for quantitative and qualitative applications.
4. Distinguish gas and liquid chromatography for quantitative and qualitative applications.
5. Explain appropriate analytical technique to solve a given real world problem

Visible ultraviolet spectrophotometers: Electromagnetic radiation, Beer Lambert law, absorption instruments, colorimeters, spectrophotometers. **06Hrs**

Infrared spectrophotometers infrared spectroscopy theory, Basic components of infrared spectrophotometers, Types of infrared spectrophotometers, Sample handling techniques. **07 Hrs**

Flame photometers: Principle of flame photometers constructional details of flame photometers, accessories of flame photometers, interference in flame photometry and determinations. **06Hrs**

Fluorimeters & phosphorimeters: Principle of fluorescence, measurement of fluorescence, spectrofluorescence, microprocessor based spectrofluorescence, Measurement of Phosphorescence. **06Hrs**

Mass spectrometer & NMR spectrometer: Basic concept, types of mass spectrometer, components of mass spectrometer, resolution and applications. Principle of NMR, constructional details, sensitivity enhancement for analytical NMR spectroscopy. Use of computers with NMR spectrometers. **07Hrs**

Chromatography: Gas chromatography- basic concepts, parts of gas chromatograph. Method of peak areas, liquid chromatography- basic concepts, types of liquid chromatography, the liquid chromatography. **07Hrs**

TEXT BOOK:

1. **Hand book of analytical Instruments** by R. S. Khandpur, TMH Publications 1st Edition, 1989, New Delhi.

REFERENCE BOOKS:

1. **Instrumental methods of analysis** , H. H. Willard, L. L. Merritt & J. A. Dean, CBS Publications 7th Ed., 1988.
2. **Principles of Instrumental analysis** , S. J. Holler & T. A. Nilman Saunders college Publications 5st Ed., 1998.

AUTOMOBILE INSTRUMENTATION

Sub code: EI652

Credit Pattern: 3:0:0

Total number of hours: 39Hrs

Contact hours: 03Hrs/Week

Pre-requisite: Transducers & Instrumentation

Course Objective: To introduce the principles, performance & applications of instrumentation in automobile.

Course Outcomes:

Students will be able to,

1. Explain the working of electrical and electronic systems in modern vehicles.
2. Define the role of electronic components and sensors in a vehicle.
3. Develop stability and safety systems using sensors/transducers.
4. Determine the role of control units and mechatronics in automobile engineering.
5. Analyze the requirement of sensors and actuators for automobile applications.

Electrical and electronic systems in the vehicle: Overview, Motronic-engine management system, Electronic diesel control (EDC), Electronic stability program (ESP), Adaptive cruise control (ACC), Occupant protection systems **12 Hrs**

Architecture of electronic systems: Overview, vehicle system architecture, Electronic components in the vehicle: Basic principles of semiconductor technology, passive components, semiconductor components.

Mechatronics: Mechatronics systems and components, development methods, outlook: Control units: Operating conditions, design, data processing, digital modules in the control units, control unit software. **09 Hrs**

Automotive sensors: Basics and overview, automotive applications, details of the sensor market, features of vehicle sensors, sensor classification, error types and tolerance requirements, reliability, main requirements, trends, overview of the physical effects for sensors, overview and selection of sensor technologies

Actuators: Electromechanical actuators, fluid mechanical actuators, electrical actuators. **09Hrs**

Sensor measuring principles: Position sensors, speed and rpm sensors, acceleration sensors, pressure sensors, force and torque sensors, flow meters , gas sensors and concentration sensors, imaging sensors (video). **09 Hrs**

TEXT BOOK:

1. **Automotive electrics Automotive electronics**, 5th Edition, Robert Bosch GmbH. John-Wiley, 2007

REFERENCE BOOK:

1. **Understanding Automobile electronics**, William B Ribbon, 6th Edition, Elsevier Science. 2003

COMPUTER NETWORKS

Sub code: EI653

Credit Pattern: 3:0:0

Total number of hours: 39 Hrs

Contact hours: 03Hrs/Week

Pre-requisite: Industrial communication.

Course Objective: To introduce the concepts and techniques used in the area of computer networks and issues related to networking technologies.

Course Outcomes:

Students will be able to,

1. Explain the fundamental principles of computer networking.
2. Analyze data transmission theory and key transmission technologies used in computer networks.
3. Discuss and build the skills of sub-netting and routing mechanisms.
4. Discuss the protocols used for reliable and efficient communication between machines.
5. Determine appropriate method to design, install, configure and operate local area networks and wide area networks.

Introduction: Uses of computer networks, network hardware, network software, reference models, example networks, network standardization. **06 Hrs**

The physical layer: Theoretical basis for data communication guide transmission media, wireless transmission, communication satellites, public switched telephone network, mobile telephone system. **07 Hrs**

The data link layer: Data link layer design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols. **06 Hrs**

The medium access control sub layer: The channel allocation problem multiple access protocols, Ethernet, wireless LANs, broadband wireless. **04 Hrs**

The network layer: Network layer design issues, routing algorithms-the optimality principle, shortest path routing, flooding, distance vector routing, congestion control algorithms, internet:working, the network layer in the Internet. **07 Hrs**

The transport layer: The transport service, elements of transport protocol, the internet transport protocol (TCP and UDP), performance issues. **05 Hrs**

The application layer: domain name system (DNS), electronic mail, worldwide web, multimedia. **04 Hrs**

TEXT BOOK:

1. **Computer Networks**, Andrews S. Tanenbaum, 5th Edition, Pearson Education.

REFERENCE BOOKS:

1. **Data communication and Networking** . Behrouz A. Forouzan, , 4th Edition, Tata McGraw – Hill, 2011.
2. **Computer Networks: A Systems Approach** Larry L. Peterson, Bruce S. Davie, Fifth Edition, Morgan Kaufmann Publishers, 2011.
3. **ATM Protocols concepts**, Hondel and Fluber, AdditionWesley,.....
4. **Data and Computer Networks**, W Stallings 5th Edition Prentice Hall of India 1998

LEARNING MATERIAL:

<http://nptel.ac.in/downloads/106105080/>

ARTIFICIAL INTELLIGENCE

Sub code: EI654

Credit Pattern: 3:0:0

Total Hours: 39 Hrs

Contact Hours: 03 Hrs/Week

Pre-requisite: Programming in C

Course Objective: To introduce AI concepts and algorithms to solve real-world problems.

Course Outcomes:

Students will be able to,

1. Illustrate the fundamentals of knowledge representation, inference and theorem proving.
2. Analyze simple knowledge based systems.
3. Design various AI Search algorithms
4. Apply working knowledge of reasoning in the presence of incomplete and /or uncertain information.
5. Explain knowledge representation, reasoning, and machine learning techniques to real-world problems.

Introduction: Introduction to Agents and environment; Rationality; the nature of environment; the structure of agents. Problem solving: Problem-solving agents; Example problems; Searching for solution; uninformed search strategies. Informed Search and Exploration: Informed search strategies; Heuristic functions; Constraint Satisfaction: Backtracking search for CSPs. **10 Hrs**

Knowledge and Reasoning: Logical Agents: Knowledge-based agents; The wumpus world as an example world; Logic; Propositional logic; Reasoning patterns in propositional logic; First-Order Logic, Inference in First-Order Logic – 1: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic; Knowledge engineering in first-order logic. **Inference in First-Order Logic – 2:** Propositional versus first-order inference; Unification and lifting forward chaining; backward chaining; Resolution. **9 Hrs**

Knowledge Representation: Ontological engineering; Categories and objects; Actions, situations, and events; Mental events and mental objects; The Internet shopping world; Reasoning systems for categories; Reasoning with default information.

6 Hrs

Planning: The problem; Planning with state-space approach; planning graphs; Planning with propositional logic. Uncertainty: Acting under certainty; Inference using full joint distributions; Independence; Bayes' rule and its use. Probabilistic Reasoning: Representing knowledge in an

uncertain domain; the semantics of Bayesian networks; efficient representation of conditional distributions; exact inference in Bayesian networks. **09 Hrs**

Learning: Learning from Observations: Forms of Learning; Inductive learning; Learning decision trees; Ensemble learning; Computational learning theory.AI: Present and Future:Agent components; Agent architectures; Are we going in the right direction? What if AI does succeed? **05 Hrs**

LEARNING MATERIALS:

<http://nptel.ac.in/courses/106105077/>

TEXT BOOK:

1. **Artificial Intelligence A Modern Approach:** Stuart Russel and Peter Norvig, 2nd Edition, Pearson Education, 2003.

REFERENCE BOOKS:

1. **Artificial Intelligence:** Elaine Rich, Kevin Knight, 3rd Edition, Tata McGraw Hill, 2009.
2. **Principles of Artificial Intelligence:**Nils J. Nilsson, Elsevier, 1980.

DIGITAL IMAGE PROCESSING

Sub code: EI661

Credit Pattern: 3:0:0

Total number of hours: 39 Hrs

Contact hours: 03Hrs /Week

Pre-requisites: Signals and systems, Digital signal processing.

Course Objective: To introduce the fundamentals of digital image processing, image enhancement, compression, restoration and edge detection techniques.

Course Outcomes:

Students will be able to,

1. Explain the basic concepts of digital image processing
2. Make use of spatial domain and frequency domain techniques for improving image quality.
3. Analyze the images in spatial domain and frequency domain.
4. Choose suitable techniques for reducing image data size.
5. Test different methods for extracting useful information from the image.

Fundamentals: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing fundamentals and models. **5 Hrs**

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothing linear filters, order statistics filters, Sharpening spatial filters – Foundation, The Laplacian, The Gradient, **8Hrs**

Image Enhancement in Frequency Domain: Background, discrete Fourier transform and its properties, discrete cosine transform and its properties, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal lowpass filters, Butterworth lowpass filters, Gaussian lowpass filters, Sharpening frequency domain filters – Ideal highpass filters, Butterworth highpass filters, Gaussian highpass filters, Homomorphic filtering, **8Hrs**

Image Restoration: Image degradation/restoration model, Noise models, Restoration using spatial filtering – Mean filters, Geometric mean filters, Harmonic mean filters, Median filter, Max & min filters, Midpoint filter, Noise filtering by frequency domain filtering – Band reject

filters, Band pass filters, Notch filters, Inverse filtering, Minimum mean square error (Wiener) filtering. **6Hrs**

Image Compression: Fundamentals, Variable length coding, LZW coding, Bit plane coding, Run length coding, Lossless predictive coding, Lossy predictive coding, transform coding. **6 Hrs**

Image Segmentation: Introduction, Thresholding – Threshold detection methods, Optimal thresholding, Multi-spectral thresholding, Edge-based segmentation – Edge image thresholding, Border tracing, Hough transform, Region-based segmentation – Region merging, Region splitting, Splitting & merging. **6 Hrs**

LEARNING MATERIALS:

<http://www.nptelvideos.com/course.php?id=541>

TEXT BOOK:

1. **Digital Image Processing**, Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc.

REFERENCE BOOKS:

1. **Digital Image Processing with Matlab&Labview**, Vipula Singh, Reed Elsevier India Pvt. Ltd.
2. **Fundamentals of Digital Image Processing**. Anil K. Jain, Prentice Hall of India.
3. **Image Processing, Analysis and Machine Vision**, Milan Sonka, Vaclav Hlavac& Roger Boyle, Second Edition, Thomson Publication.

PHOTOVOLTAIC THEORY AND DESIGN

Sub code: EI662

Credit Pattern: 3:0:0

Total number of hours: 39Hrs

Contact hours: 03Hrs/Week

Pre-requisite: Basic Electronics

Course Objective: To expose fundamentals of semiconductor materials, principle of solar cells, design of solar cells and Photo Voltaic (PV) modules.

Course Outcomes:

Students will be able to,

1. Explain the fundamentals of solar energy.
2. Discuss the basic principles & configuration of solar cell
3. Construct photovoltaic cell using series and parallel connections
4. Analyze the solar cell parameters and its losses
5. Design of solar PV module for required specifications

Introduction to Solar Cells: Basics of semiconductors, Introduction to P-N junction equilibrium condition, non-equilibrium condition, P-N junction under illumination: solar cell **6 Hrs**

Design of Solar Cells: Upper limits of Cell Parameters, losses in solar cells, solar cell design, Design of High I_{sc} , V_{oc} and FF. analytical techniques. **8 Hrs**

Solar photovoltaic modules: Solar PV modules from solar cells, mismatch in series connection, mismatching in parallel connection, PV module power plants. **7Hrs**

Balance of Solar PV systems: Basics of electromechanical cell, factors affecting battery performance, batteries for PV systems, DC to DC converters, Charge controllers, DC to Ac converter, MPPT **09Hrs**

Photovoltaic system design and applications: introduction to Solar PV systems, design methodology of PV systems, Hybrid PV systems, grid-connected PV systems, simple playback period, life cycle costing. **09Hrs**

TEXT BOOK:

1. **Solar Photovoltaics, Fundamentals, technologies and applications**, Chetan Singh Solanki, second edition, PHI 2011.

REFERENCE BOOKS:

1. **Applied Photo voltaics**, Stuart R Wenhem, earth scan, 2007.
2. **Solar electric hand book, Photo voltaic fundamentals and applications**, Solar energy international.

LEARNING MATERIAL:

<http://nptel.ac.in/courses/117108141/>

FUZZY LOGIC AND APPLICATIONS

Sub code: EI663

Credit Pattern: 3:0:0

Total number of hours: 39 Hrs

Contact hours: 03Hrs /Week

Pre-requisite: Engineering Mathematics, Logic Design

Course Objective: To introduce the importance of fuzzy sets, fuzzy relations and fuzzy measures and its applications in engineering and biomedical field.

Course Outcomes:

Students will be able to,

1. Define crisp sets and fuzzy sets.
2. Discuss the different operations performed on fuzzy sets.
3. Explain the different operations performed on fuzzy relations.
4. Explain the different operations performed on fuzzy measures.
5. Apply knowledge of fuzzy in engineering and medical applications.

Crisp sets and fuzzy sets: Introduction, crisp sets, the notion of fuzzy sets, Basic concepts of fuzzy sets, classical logic, fuzzy logic. **5Hrs**

Operations on fuzzy sets: General discussion, fuzzy complement, fuzzy union, fuzzy intersection, and combinations of operations **5Hrs**

Fuzzy relations: Crisp and fuzzy relations, Binary relation, Binary relations on a single set, equivalence and similarity relations, compatibility or tolerance relations, ordering morphism, fuzzy relations equations. **10Hrs**

Fuzzy measures: General discussion, Belief and plausibility measures, probability measures, possibility and necessity measures, relationship among classes of fuzzy measures. **10Hrs**

Applications: General discussion, natural life and social sciences, engineering, medicine, management and decision-making, computer science and systems science **09Hrs**

TEXT BOOKS:

1. **Fuzzy sets, Uncertainty and information**, Klein and Folger, Prentice Hall, 1987.
2. **Fuzzy logic with engineering applications**, Timothy. J. Ross, McGraw Hill International edition, 1997.

LEARNING MATERIALS:

1. <http://nptel.ac.in/courses/106105173/2>
2. <https://www.youtube.com/watch?v=H9SikB7HbSU>

MEDICAL IMAGING

Sub code: EI664

Credit Pattern: 3:0:0

Total number of hours: 39 Hrs

Contact hours: 03Hrs /Week

Pre-requisite: Engineering physics, Engineering Mathematics.

Course Objective: To introduce the concept of different medical imaging modalities, reconstruction algorithms and applications.

Course Outcomes:

Students will be able to,

1. Explain the concepts related to medical imaging system sources (X-Ray, CT, Gamma ray, ultrasound).
2. Explain the technology behind instrumentation used in medical imaging systems.
3. Discuss the different modes of operation and algorithms used in medical imaging machines.
4. List the advantages and limitations of available equipment and systems to provide a safe radiographic examination.
5. Illustrate the applications of the different imaging modalities.

X-Rays: Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers, X-Ray detectors, Conventional X-Ray radiography, Fluoroscopy, Angiography, Digital radiography, Dynamic spatial reconstructor, X-Ray image characteristics, Biological effects of ionizing radiation. **08Hrs**

Computed Tomography: Conventional tomography, Computed tomography principle, Projection function Generations of CT machines, Electron beam CT, Reconstruction algorithms, Helical CT. **06 Hrs**

Ultrasound Imaging: Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging. **06Hrs**

Magnetic Resonance Imaging: Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, Free induction decay, Relaxation times, Pulse sequences, Block of a magnetic resonance imager, Slice selection, Frequency encoding, Phase encoding, Spin-Echo imaging, Gradient-Echo imaging, Imaging safety. **10Hrs**

Radionuclide Imaging: Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, nuclear radiation detectors, rectilinear scanner, scintillation camera, SPECT, PET. **05Hrs**

Thermal Imaging: Medical thermography, Infrared detectors, Thermographic equipment, Pyroelectric vision camera. **04Hrs**

TEXT BOOKS:

1. **Principles of Medical Imaging**, Kirk shung, Academic Press,1992
2. **Medical Imaging Signals and Systems**, Jerry L Prince and Jonathan M Links, Pearson Prentice Hall Bioengineering, 2nd edition 2014.

REFERENCE BOOKS:

1. **Handbook of Biomedical Instrumentation**,Khandpur, Tata McGraw-Hill Publishing Company Ltd., Second edition, 2003.
2. **Fundamentals of medical Imaging**, Zhong Hicho and Manbirsingh, John Wiley1993.

LEARNING MATERIALS:

1. <http://nptel.ac.in/courses/108105091/2>
2. <https://www.mooc-list.com/course/introduction-biomedical-imaging-edx>