Instrumentation and Control Engineering (IC)

EN010301A ENGINEERING MATHEMATICS II
(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives

- *To apply standard methods and basic numerical techniques for solving problems and to know the importance of learning theories in Mathematics.*

MODULE 1 Vector differential calculus (12 hours)

Scalar and vector fields – gradient-physical meaning- directional derivative-divergence an curl - physical meaning-scalar potential conservative field- identities - simple problems

MODULE 2 Vector integral calculus (12 hours)

Line integral - work done by a force along a path-surface and volume integral-application of Greens theorem, Stokes theorem and Gauss divergence theorem

MODULE 3 Finite differences (12 hours)

Finite difference operators Δ, ∇, E, μ and δ - interpolation using Newtons forward and backward formula – problems using Stirlings formula, Lagrange's formula and Newton's divided difference formula

MODULE 4 Difference Calculus (12 hours)

Numerical differentiation using Newtons forward and backward formula – Numerical integration – Newton's – cotes formula – Trapezoidal rule – Simpsons $1/3^{rd}$ and $3/8^{th}$ rule – Difference equations – solution of difference equation

MODULE 5 **Z** transforms (12 hours)

Definition of Z transforms – transform of polynomial function and trignometric functions – shifting property , convolution property - inverse transformation – solution of 1^{st} and 2^{nd} order difference equations with constant coifficients using Z transforms.

Reference

1. Erwin Kreyszing – Advance Engg. Mathematics – Wiley Eastern Ltd.
2. B.S. Grewal – Higher Engg. Mathematics - Khanna Publishers
3. B.V. Ramana - Higher Engg. Mathematics – McGraw Hill
4. K Venkataraman- Numerical methods in science and Engg -National publishing co
5. S.S Sastry - Introductory methods of Numerical Analysis -PHI
6. T.Veerarajan and T.Ramachandran- Numerical Methods- McGraw Hill
7. Babu Ram – Engg. Mathematics -Pearson.
8. H.C.Taneja Advanced Engg. Mathematics Vol I – I.K.International

EN010 302 Economics and Communication Skills

(Common to all branches)

Teaching scheme

2hours lecture and 2 hours tutorial per week **Credits: 4(3+1)**

Objectives

- To impart a sound knowledge of the fundamentals of Economics.

Economics

Module I (7 hours)

Reserve Bank of India-functions-credit control-quantitative and qualitative techniques
Commercial banks-functions- Role of Small Industries Development Bank of India and National Bank for Agriculture and Rural Development
The stock market-functions-problems faced by the stock market in India-mutual funds

Module II (6 hours)

Multinational corporations in India-impact of MNC's in the Indian economy
Globalisation-necessity-consequences
Privatisation-reasons-disinvestment of public sector undertakings
The information technology industry in India-future prospects

Module III (6 hours)

Direct and indirect taxes- impact and incidence- merits of direct and indirect taxes-progressive and regressive taxes-canons of taxation-functions of tax system-
tax evasion-reasons for tax evasion in India-consequences-steps to control tax evasion
Deficit financing-role-problems associated with deficit financing

Module IV (5 hours)

National income-concepts-GNP, NNP, NI, PI and DPI-methods of estimating national income-difficulties in estimating national income
Inflation-demand pull and cost push-effects of inflation-government measures to control inflation

Module V (6 hours)

International trade-case for free trade-case for protectionism
Balance of payments-causes of disequilibrium in India's BOP-General Agreement on Tariffs and Trade-effect of TRIPS and TRIMS in the Indian economy-impact of WTO decisions on Indian industry

Text Books

1. Ruddar Datt, Indian Economy, S.Chand and Company Ltd.
2. K.K.Dewett, Modern Economic Theory, S.Chand and Company Ltd.

References

1. Paul Samuelson, Economics, Tata McGraw Hill
2. Terence Byres, The Indian Economy, Oxford University Press
3. S.K.Ray, The Indian economy, Prentice Hall of India
4. Campbell McConnel, Economics, Tata McGraw Hill

Communication Skills

Objectives

- To improve Language Proficiency of the Engineering students
- To enable them to express themselves fluently and appropriately in social and professional contexts
- To equip them with the components of different forms of writing

MODULE – 1 (15 hours)

INTRODUCTION TO COMMUNICATION

Communication nature and process, Types of communication - Verbal and Non verbal, Communication Flow-Upward, Downward and Horizontal, Importance of communication skills in society, Listening skills, Reading comprehension, Presentation Techniques, Group Discussion, Interview skills, Soft skills

MODULE – II (15 hours)

TECHNICAL COMMUNICATION

Technical writing skills- Vocabulary enhancement-synonyms, Word Formation-suffix, affix, prefix, Business letters, Emails, Job Application, Curriculum Vitae, Report writing-Types of reports

Note: No university examination for communication skills. There will be internal evaluation for 1 credit.

REFERENCES

1. The functional aspects of communication skills, P.Prasad and Rajendra K. Sharma, S.K. Kataria and sons, 2007
2. Communication skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning private limited, 2010
3. Professional Communication, Kumkum Bhardwaj, I.K. International (P) House limited, 2008
4. English for technical Communication, Aysha Viswamohan, Tata Mc Graw Publishing company limited, 2008

IC010 303 Network Theory

(Common to EC,AI,EI,IC010 303)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives

- *To study time domain, phasor and Laplace transform methods of linear circuit analysis*

Module I (12 hrs)

Reference directions for two terminal elements - Kirchhoff's Laws - Independent and Dependent Sources – Resistance Networks: Node and Mesh analysis of resistance networks containing both voltage and current independent and dependent sources – Source Transformations – Superposition, Thevenin, Norton and Maximum Power Transfer Theorems applied to resistance networks

Module II (12 hrs)

Capacitors and Inductors – Current-voltage relationships – Step and Impulse functions – Waveshapes for Capacitor and Inductor – Series and Parallel combinations – Coupled coils – Mutual Inductance – First order Circuits: Excitation by initial conditions – Zero input response – Excitation by sources – Zero state response – Step and impulse response of RL and RC circuits - Excitation by sources and initial conditions – Complete response with switched dc sources

Module III (12 hrs)

Sinusoidal Steady State Analysis: Review of complex numbers – Rectangular and Polar forms – Phasors and the sinusoidal steady state response - Phasor relationships for R, L and C – Impedance and Admittance – Node and Mesh analysis, Superposition, Source transformation, Thevenin and Norton's theorems applied to Phasor circuits – Sinusoidal Steady State power – Average Power – Maximum power transfer theorem – Phasor analysis of Magnetically coupled circuits

Module IV (12 hrs)

Laplace Transform: Definition of Unilateral Laplace Transform- Properties –Laplace Transform of common time functions – Inverse Laplace Transform by Partial Fraction Expansion – Initial value and Final value theorems –Solution of network differential equations - Transformation of a circuit into s-domain – Transformed equivalent of resistance, capacitance, inductance and mutual inductance – Impedance and Admittance in the transform domain – Node and Mesh analysis of the transformed circuit - Network theorems applied to the transformed circuit – Network Functions: Driving point and Transfer functions - Poles and zeros

Module V (12 hrs)

Frequency Response: Network functions in the sinusoidal steady state with $s = j\omega$ – Magnitude and Phase response - Magnitude and Phase response of First order Low pass and High pass RC circuits –- Bode Plots – First order and Second order factors.
Two port networks: Characterization in terms of Impedance, Admittance, Hybrid and Transmission parameters – Interrelationships among parameter sets - Reciprocity theorem – Interconnection of two port networks- series, parallel and cascade.

References

1. W H. Hayt, Kemmerly and S M Durbin, *Engineering Circuit Analysis*, TMH
2. DeCarlo, Lin, *Linear Circuit Analysis*, OUP
3. B Carlson, *Circuits*, Ceneage Learning
4. M E. Van Valkenburg, *Network Analysis*, PHI
5. L P .Huelsman, *Basic Circuit Theory*, PHI
6. Robert L.Boylestad , *Introductory Circuit Analysis* , 12th e/d ,PHI
7. C A Desoer & E S Kuh, *Basic Circuit Theory*, TMH
8. F F Kuo, *Network Analysis and Synthesis*, Wiley

IC 010 304: ANALOG DEVICES & CIRCUITS

Teaching Scheme **Credits: 4**

3 Hours lecture and 1 Hour tutorial per week

Aim: To introduce the concept of realizing circuits using active and passive devices for signal generation and amplification.

Objectives

- *To know about the special purpose diodes with some of its application.*
- *To expose the students to study the different biasing and some transistors applications.*
- *To get introduce with the FET's & Small Signal Analysis.*
- *To study the Feedback Amplifiers and Power Amplifiers.*
- *To learn the wave shaping and wave generating circuits.*

Module-I: Diode Applications

PN Diode applications: Half wave, Full wave and Bridge Rectifier, voltage equations, Analysis and design, Voltage Multiplier Circuits. Capacitor filters analysis. RC Filter: DC Operation, AC Operation. Special purpose diodes: Zener diode – Volt-Ampere characteristics –Varactor diode, photodiode: detection principle.

Module-II: BJT

DC Biasing of BJT'S: Operating Point, Fixed, self and Voltage Divider bias circuit.
Bias Stabilization: bias stability- definition of stability factors – derivation of stability factors for I_{co} variation – bias compensation –compensation for I_{CO} and $V_{BE.}$
Applications of BJT: Relay Driver, Transistor Switch, Constant Current Source.
RC coupled amplifier: working, analysis and design – phase and frequency response
Small Signal Analysis of CE, CC & Common source amplifier.

Module-III: FET

Field Effect Transistors: Construction & Characteristics of JFET's, Transfer Characteristics. Types of FET's: MOSFET- Depletion and Enhancement type MOSFET, Operation and Characteristics. FET Biasing.

Module-IV: Power Amplifiers & Oscillators

Power Amplifiers: Class-A, B & AB amplifiers, Push Pull Amplifiers.
Feed back in amplifier circuits: Characteristics of negative feedback amplifiers – Voltage / current, series/shunt feedback – Theory of sinusoidal oscillators – Phase shift and Wien bridge oscillators – Colpitts, Hartley and crystal oscillators.

Module-V: Wave Shaping Circuits and Wave Generation Circuits

Wave shaping circuits: clipping –clamping – RC integration – RC differentiation – transistor as a switch – astable multivibrator – working and design –Regulated power supplies: Series and Shunt- design of regulated power supplies for specified output conditions- current limiting- short circuit protection- IC regulated power supply

Text Books:

(i)"Electronic Devices and Circuit Theory" – Boylestad, Nashelsky. Prentice Hall India.

(ii)David A. Bell, 'Electronic Devices & Circuits', Prentice Hall of India/Pearson Education, IV Edition, Eighth printing, 2003.

Reference Books:

(i)Jacob Millman & Christos.C.Halkias, 'Integrated Electronics: Analog and Digital Circuits and System', Tata McGraw Hill, 1991.

(ii)Donald L.Schilling and Charles Belove, 'Electronic Circuits', 3rd Edition, Tata McGraw Hill, 2003.

IC010305:BASIC INSTRUMENTATION & MEASUREMENTS ENGINEERING

Teaching Scheme **Credits:4**

3 Hours lecture and 1 Hour tutorial per week

Aim: To provide adequate knowledge in electrical measurements and instrumentation.

Objectives:

- *To make the students to gain a clear knowledge of the basic laws governing the operation of electrical instruments and the measurement techniques.*
- *To study the concepts of Basic Instrumentation.*
- *To Emphasis laid on the measurement of voltage and current.*
- *To have an adequate knowledge in the measurement of power and energy.*
- *To study the potentiometer & instrument transformers.*
- *To know the various methods for measurement of resistances and impedance.*

Module-I: Basic Instrumentation

Measurements- Significance of measurements- Methods of measurement- Direct methods, Indirect methods- Mechanical, Electrical and electronics instruments- Classification of instruments- Deflection and Null type instruments- Analog and digital modes of operation- functions of instruments and measurements systems- application of measurement systems- Type of instrument systems, information and signal processing- Elements of generalized measurement system- Primary sensing element, variable conversion element, data presentation element- Input output configuration of measuring instruments and measurement systems- Desired inputs, interfering inputs, modifying inputs, methods of correction for interfering and modifying inputs.

Module-II: Measurement Of Voltage And Current

Galvanometers – Ballistic, D'Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

Module-III: Measurement Of Power And Energy

Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter – Phantom loading – Induction type KWH meter – Calibration of wattmeter, energy meter.

Module-IV: Potentiometers & Instrument Transformers

DC potentiometer – Basic circuit, standardization – Laboratory type (Crompton's) – ACpotentiometer – Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – C.T and V.T construction, theory, operation, phasor diagram, characteristics, testing, error elimination – Applications.

Module-V: Resistance & Impedance Measurement

Measurement of low, medium & high resistance – Ammeter, voltmeter method –Wheatstone bridge – Kelvin double bridge – High resistance measurement – Megger –methods — Earth

resistance measurement. A.C bridges – Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Hay's bridge – Schering Bridge – Anderson Bridge.

Text Books

1. E.W.Golding & F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler & Co, 1994.
2. A.K. Sawhney, 'Electrical & Electronic Measurements and Instrumentation', Dhanpath Rai & Co (P) Ltd, 2004.

Reference Books

1. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K. Kataria & Sons, Delhi, 2003.
2. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2003.
3. H.S.Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 1995.
4. Martia U. Reissland, 'Electrical Measurement', New Age International (P) Ltd., 2001.

IC010 306 COMPUTER PROGRAMMING
(COMMON TO EC,AI,EI,IC010 306)

Teaching Scheme

L T P : 3 1 0 **4 credits**

Objectives

- *To develop the programming skill using C*

Module 1 (12 hrs)

Problem solving with digital Computer - Steps in Computer programming - Features of a good program, Algorithms – Flowchart.

Introduction to C: C fundamentals - The character set - identifiers and keywords - Data types - constants - variables and arrays - declarations - expressions - statements - symbolic constants- arithmetic operators - Relational and Logical operators - The conditional operator - Library functions - Data input and output - getchar – putchar, scanf, printf - gets and puts functions - interactive programming.

Module 2 (12 hrs)

Control Statements: While - do while - for - nested loops -if else switch- break - continue - The comma operator - go to statement, Functions - a brief overview - defining a function - accessing a function - passing arguments to a function - specifying argument - data types - function prototypes - Recursion.

Module 3 (12 hrs)

Program structure: storage classes - Automatic variables - external variables - multi file programs. Arrays: defining an array - processing an array - passing arrays in a function – multi dimensional arrays - array and strings. Structures and unions: defining a structure - processing a structure - user defined data types - passing structure to a function – self referential structures - unions.

Module 4 (12hrs)

Pointers: Fundamentals - pointer declaration - passing pointers to a function - pointers and one dimensional arrays - operations on pointers - pointers and multi dimensional arrays – passing functions to other functions.

Module 5 (12 hrs)

Data files: Opening and closing of a data file - creating a data file - processing a data file, low level programming - register variables – bit wise operation - bit fields - enumeration - command line parameters - macros - the C pre-processor.

References

1. Byron Gottfried, *Programming with C, Schaum's Outlines* ,Tata Mc.Graw Hill.
2. Kernighan & Ritchie , *"The C programming language:"*, PHI.

3. Venkateshmurthy , "*Programming Techniques through* C":, Pearson Education.
4. Al Kelley, Ira Pohl , "*A book on C*" , Pearson Education.
5. Balaguruswamy , "*Programming in C*" , Tata Mc Graw Hill.
6. Ashok N Kanthane , "*Programming with ANSI and Turbo C*", Pearson Education.
7. Stephen C. Kochan , "*Programming in C*" , CBS publishers.

IC010 307: BASIC ELECTRONICS LABORATORY

Teaching Scheme **Credits:2**
3 Hours Practical per week

Aim: To study the characteristics of various solid state devices

Experiments:
Diode Experiments

1. Forward characteristic curve (1N 4000 series).
2. Forward & reverse characteristic curves of a zener diode.
3. Voltage regulation using a zener diode.
    a) line regulation
    b) load regulation

Wave Shaping Circuits

4. Clipping Circuits
    a) series clipping
    b) biased series clipping
    c) shunt clipping
    d) biased shunt clipping
5. Clamping Circuits
    a) basic clamping
    b) biased clamping
6. Half wave & full wave rectifier circuits with and without capacitive filters.

Bipolar Transistor Experiments (BC107 A/B/C, BC547 B/C)

7. Common base characteristic curves.
    a) Input curve
    b) Output curve
    c) To determine the common base current gain (α) from the output curve
8. Common emitter characteristic curves.
    a) Input curve
    b) Output curve
    c) To determine the common emitter current gain (β) from the output curve

9. Common collector characteristic curves.
    a) Input curve
    b) Output curve

Field Effect Transistors (N channel depletion JFET)

10. Drain characteristic curve (I_D vs V_{DS}).
    a) To determine the pinch off voltage from the above curve.
11. Transfer characteristic curve (I_D vs V_{GS}).

Transistor Biasing Experiments

12. Fixed bias circuit
    a. Draw the load line.
    b. Locate the Q points for different transistors to ascertain the circuit stability.
13. Emitter feedback bias circuit
    c. Draw the load line.
    d. Locate the Q points for different transistors to ascertain the circuit stability.
14. Emitter current bias circuit (dual supply)
    a) Draw the load line.
    b) Locate the Q points for different transistors to ascertain the circuit stability.
15. Voltage divider bias circuit
    a) Draw the load line.
    b) Locate the Q points for different transistors to ascertain the circuit stability.
16. Frequency response of a RC coupled common emitter amplifier.
17. Design and implementation of a series voltage regulator.
18. Design and implementation of an astable multivibrator.
19. Photo diode & photo transistor characteristics.

IC010 308:PROGRAMMING LAB
(COMMON TO EC,AI,EI,IC010 308)

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To familiarize with computer hardware, operating systems and commonly used software packages*
- *To learn computer programming and debugging*

Part 1

1. Computer hardware familiarization.
2. Familiarization/installation of common operating systems and application software.

Part 2

Programming Experiments in C/C++: Programming experiments in C/C++ to cover control structures, functions, arrays, structures, pointers and files.

EN010401 Engineering Mathematics III

(Common to all branches)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Apply standard methods of mathematical &statistical analysis*

MODULE 1 Fourier series (12 hours)

Dirichlet conditions – Fourier series with period 2 π and 2l – Half range sine and cosine series – Harmonic Analysis – r.m.s Value

MODULE 2 Fourier Transform (12 hours)

Statement of Fourier integral theorem – Fourier transforms – derivative of transforms- convolution theorem (no proof) – Parsevals identity

MODULE 3 Partial differential equations (12 hours)

Formation by eliminating arbitrary constants and arbitrary functions – solution of Lagrange's equation – Charpits method –solution of Homogeneous partical differential equations with constant coefficients

MODULE 4 Probability distribution (12 hours)

Concept of random variable , probability distribution – Bernoulli's trial – Discrete distribution – Binomial distribution – its mean and variance- fitting of Binominal distribution – Poisson distribution as a limiting case of Binominal distribution – its mean and variance – fitting of Poisson distribution – continuous distribution- Uniform distribution – exponential distribution – its mean and variance – Normal distribution – Standard normal curve- its properties

MODULE 5 Testing of hypothesis (12 hours)

Populations and Samples – Hypothesis – level of significance – type I and type II error – Large samples tests – test of significance for single proportion, difference of proportion, single mean, difference of mean – chi –square test for variance- F test for equality of variances for small samples

References

1. Bali& Iyengar – A text books of Engg. Mathematics – Laxmi Publications Ltd.
2. M.K. Venkataraman – Engg. Mathematics vol II 3rd year part A & B – National Publishing Co.
3. I.N. Sneddon – Elements of partial differential equations – Mc Graw Hill
4. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
5. Richard A Johnson – Miller Fread's probability & Statistics for Engineers- Pearson/ PHI

6. T. Veerarajan – Engg. Mathematics – Mc Graw Hill
7. G. Haribaskaran – Probability, Queueing theory and reliability Engg. – Laxmi Publications
8. V. Sundarapandian - probability ,Statistics and Queueing theory – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International
10. A.K.Mukhopadhyay-Mathematical Methods For Engineers and Physicists-I.K.International

IC010 402: Principles of Management

(Common with EC,AI,EI,IC010 402)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To develop an understanding of different functional areas of management.*
- *To understand the functions and duties an individual should perform in an organisation.*

Module I (12 hours)

Management Concepts: Vision, Mission, Goals and Objectives of management-MBO-Scientific management- Functions of management- Planning- Organizing- Staffing-Directing- Motivating- Communicating- Coordinating- Controlling- Authority and Responsibility- Delegation- Span of control- Organizational structure- Line, Line and staff and Functional relationship.

Module II (12 hours)

Personnel Management: Definition and concept- Objectives of personnel management-Manpower planning- Recruitment and Selection of manpower- Training and development of manpower- Labour welfare- Labour turnover- Quality circle- Industrial fatigue- Industrial disputes-Method of settling disputes- Trade unions.

Module III (12 hours)

Production management: Objectives and scope of production management- Functions of production department- production management frame work- product life cycle-Types of production- Production procedure- Project planning with CPM and PERT- Basic concepts in network.

Module IV (12 hours)

Financial Management: Objectives and Functions of Financial Management- Types of Capital- Factors affecting working capital- Methods of financing.
Cost Management: Elements of cost- Components of cost- Selling Price of a product.

Module V (12 hours)

Sales and Marketing Management: Sales management- Concept- Functions of sales department- Duties of sales engineer- Selling concept and Marketing concept- Marketing-Definition and principles of marketing- Marketing management and its functions- Sales forecasting- Pricing- Advertising- Sales promotion- Channels of distribution- Market research.

Text Books

1. Koontz and Weihrich, *Essentials of Management*, Tata McGraw Hill.
2. Mahajan M., *Industrial Engineering and Production Management*, Dhanpat Rai and Co.
3. Kemthose and Deepak, *Industrial Engineering an Management*, Prentice Hall of India.

Reference Books

1. Martand Telsang, *Industrial Engineering and Production Management.*
2. Khanna O.P., *Industrial Engineering and Management*, Dhanpat Rai and Co.
3. Philip Kotler, *Marketing Management*, Prentice Hall of India.
4. Sharma S. C. & Banga T. R., *Industrial Organisation and Engineering Economics*, Khanna Publishers.
5. Prasanna Chandra, *Financial Management*, Tata McGraw Hill.

IC010 403: TRANSDUCER ENGINEERING

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To provide adequate knowledge in sensors & transducers**.**

Objective:

- *To impart knowledge about the principles and analysis of sensors.*
- *To know about the classification and characteristics of transducers.*
- *To have an adequate knowledge in resistance and inductance transducers.*
- *Basic knowledge in capacitance and piezoelectric transducers.*
- *Pressure, Digital and other miscellaneous sensors*

Module-I: Science of Measurement
Measurement systems – Significance of Measurements, Characteristics of Instruments – Static and Dynamic, Loading Effects, Types of errors, Error analysis, Units and Standards. Calibration and Standards: Process of calibration, classification of standards, standards for calibration.

Module- II: Classification and Characteristics of Transducer
Transducer – Definition, Classification of Transducer – analog and digital transducer- primary and secondary transducer- active and passive transducer-Inverse transducer, Characteristics and choice of transducer, Factors influencing choice of transducer.

Module-III: Resistance and Inductance Transducer
Resistance Transducer-Basic principle, Potentiometer – Loading effects, Resolution, Linearity, Non-linear Potentiometer, Noise in potentiometer, Resistance strain gauge – Types, Resistance thermometer, thermistors – characteristics, thermocouple – Compensation circuits – junction and lead compensation, merits and demerits.
Inductance Transducer:- Basic principle, Linear variable differential transformer (LVDT), Rotary Variable Differential Transformer (RVDT), Synchros, Induction potentiometer, variable reluctance accelerometer, Microsyn.

Module- IV: Capacitance and Piezoelectric Transducer
Capacitance Transducer – Basic principle, transducers using change in - area of plates distance between plates- variation of dielectric constants, frequency response, Merits, demerits and uses. Piezoelectric transducer- Basic principle, Mode of operation, properties of piezoelectric crystals, loading effects, frequency response and impulse response uses.

Module-V: Pressure, Digital and other miscellaneous sensors
Pressure sensors – bourdon tube, bellows, Pitot tube, diaphragm.
Digital Transducer – shaft encoder, optical encoder, digital speed transducer.
Hall Effect transducer, sound sensors, vibration sensors – seismic transducer, chemical sensor – pH sensor, velocity transducer,
Introduction to smart sensors, micro sensor.

Text Books

1. A.K. Sawhney “A Course in Electrical and Electronics Measurements and Instrumentation” – Dhanpat Rai & Co., (Pvt) Ltd., 2000.
2. S.Renganathan “Transducer Engineering” – Allied publishers Limited, 1999.

Reference Books

1. Ernest O. Doeblin “Measurement Systems – Application & Design” McGraw – Hill Publishing company, 1990.
2. Woolvert, G.A., “Transducer in Digital Systems” Peter Peregrinus Ltd., England, 1998.

IC010 404: DIGITAL ELECTRONICS
(Common with EC,AI,IC,EI010 404)

Teaching scheme **Credits: 4**
L T P : 3 1 0

Objectives

- *To Work with a variety of number systems and numeric representations, including signed and unsigned binary, hexadecimal, 2's complement.*
- *To introduce basic postulates of Boolean algebra and show the correlation between Boolean expression.*
- *To introduce the methods for simplifying Boolean expressions.*
- *To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits.*

Module I (12hours)

Positional Number System: Binary, Octal, Decimal, Hexadecimal number system, Number base conversions, complements - signed magnitude binary numbers - Binary Arithmetic- addition, subtraction - Binary codes- Weighted, BCD, 8421, Gray code, Excess 3 code, ASCII, Error detecting and correcting code, parity, hamming code.
Boolean postulates and laws with proof, De-Morgan's Theorems, Principle of Duality, Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Canonical forms, Karnaugh map Minimization, Don't care conditions

Module II (12 hours)

Digital Circuits: Positive and Negative logic, Transistor transistor logic, TTL with totem pole, open collector and tri state output, Emitter coupled logic – basic ECL inverter, NMOS NOR gate, CMOS inverter, NAND and NOR, Gate performance parameters – fan in, fan out, propagation delay, noise margin, power dissipation for each logic, characteristics of TTL and CMOS, subfamilies of TTL and CMOS.

Module III (12 hours)

Introduction to Combinational Circuits: Basic logic gates, Universal gates, Realization of Boolean functions using universal gates, Realization of combinational functions: addition – half and full adder – n bit adder – carry look ahead adder, subtraction, comparison, code conversion, and decoder, encoder, multiplexer, demultiplexer, parity checkers, and parity generator.
Introduction to Sequential Circuits: latches, timing, Flip Flops, types, characteristic equations, excitation tables, Realization of one flip flop using other flip flops.

Module IV (12 hours)

Application of flip flops as bounce elimination switch, register, counter and RAM, Binary ripple counter, synchronous binary counter, Design of modulo 'n' synchronous counter, up/down counters,
Shift registers – SISO, SIPO, PISO, PIPO, bidirectional shift register and universal register, counters based on shift registers

Module V (12 hours)

Hazards in combinational circuits: Static hazard, dynamic hazard, essential hazards, hazard free combinational circuits.

Introduction to programmable logic devices: PLA- block diagram, PAL – block diagram, registered PAL, Configurable PAL, GAL - architecture, CPLD – classification internal architecture, FPGA - architecture, ASIC – categories , full custom and semi custom.

Reference Books

1. Donald D Givone, *Digital Principles and Design*, Tata McGraw Hill, 2003.
2. G K Kharate, *Digital Electronics*, Oxford university press, 2010
3. Ronald J Tocci, *Digital Systems*, Pearson Education, 10th edition 2009.
4. Thomas L Floyd, *Digital Fundamentals*, Pearson Education, 8th edition, 2003.
5. Donald P Leach, Albert Paul Malvino, *Digital Principles and Applications*, Tata McGraw Hill 6th edition, 2006.
6. Charles H.Roth, *Fundamentals of Logic Design*, Thomson Publication Company 5th edition, 2004.
7. Milos Ercegovac, *Introduction to Digital Systems*, Wiley India, 2010
8. Moris Mano, *Digital Design*, PHI, 3rd edition, 2002.
9. Ananda Kumar, *Fundamentals of Digital Circuits*, PHI, 2008.
10. Brain Holdesworth, *Digital Logic Design*, Elsevier, 4th edition, 2002.

IC010 405: ELECTRICAL ENGINEERING

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To expose the concepts of various electrical machines and its construction.

Objectives:

- *To study the principle of operation and performance of DC generators*
- *To study the principle of operation, performance and starting of DC motor.*
- *To impart the knowledge on constructional details, principle of operation and performance of transformers.*
- *To impart the knowledge on constructional details, principle of operation and performance of synchronous and induction machines.*
- *To study about single phase induction motors and special machines.*

Module-I: D.C Generator
Emf generated in armature, commutation process, armature reaction, compensating winding – O.CC – condition for self excitation – Field critical resistance, critical speed – Load characteristic of generators – Losses – power flow diagram – efficiency –condition for maximum efficiency – applications.

Module-II: D.C Motors
Back emf – speed equation – starters – 3 point and 4 point starters –Torque equation –speed torque characteristics of shunt, series, and compound motors – Losses –Efficiency – Brake test – Swinburne's test – Speed control – field control –armature control –series parallel control – applications.

Module-III: Transformer
Ideal transformer – constructional features – emf equation – vector diagram – equivalent circuit – regulation – losses and efficiency- O.C and S,C test –Applications – Auto transformers – working principle and saving of copper. Basic idea of current and potential transformers.

Module-IV: A.C Machines
3 phase Induction Motors- Constructional features- principle of operation – vector diagram and equivalent circuits. Torque equation – slip – torque, slip characteristics. Starting of 3 phase induction motors – starters – phase wound motor – rotor resistance starters.
Synchronous Machines – Constructional features – Principle of operation of alternator – emf equation – regulation by emf and mmf method – principle of operation of synchronous motors – starting synchronous motor.

Module-V: Single phase Induction motors

Prinicple of operation – production of rotating field – starting – split phase –capacitor start – two value capacitor motor – permanent split capacitor motor – shaded pole motor –single phase series motor –Universal motor – stepper motor.

Reference Books:

1. P.S.Bimbra -Electrical Machinery -Khanna Publishers
2. S.L.Uppal -Electrical Power -Khanna Publishers
3. Ashfaq Hussain -Fundamentals of Electrical Engg.-Dhanpat Rai&Co.Delhi.
4. B.L Theraja, A.K Theraja- Electrical Technology

IC010 406: MECHANICAL ENGINEERING

Teaching Scheme **Credits:4**

3 Hours lecture and 1 Hour tutorial per week

Aim: To impart the knowledge on the basic mechanical engineering

Objectives:

- *This module introduces the fundamental concepts of fluid flow and measurements related to fluid flow.*
- *This module explains the rudiments of steam generation and its allied equipments and safety precautions to be used while operating steam generators.*
- *This module explains the construction and working of steam engines and steam steam turbines and measurements made on steam turbines and engines.*
- *This module introduces the construction and working principles of pumps and compressors. Efficiency tests on pumps and compressors.*
- *This module introduces the various materials used in the engineering applications and manufacture of composite materials.*

Module-I

Laws of fluid motion-continuity, momentum and energy equations-Bernoulli's equation and its application in flow and velocity measuring devices-turbulent flow through pipes- fluid friction losses in pipe fittings-loss of head due to sudden enlargement& contraction

Module-II

Steam generators: properties of steam, classification and construction of boilers-fire tube and water tube boilers- Modern high pressure boilers.

Boiler mountings and accessories: boiler mountings, water gauge and water level indicator-pressure gauge-steam stop valve-feed check valve-blow down cock-fusible plug-spring loaded safety valve-dead weight safety valve-high steam and low water safety valve.

Accessories: pressure reducing valve-steam traps-steam separator-economizer-feed pump injector.

Module-III

Steam engine and turbines: classification of steam engines-working indicator diagram-work done, Steam turbines-classification steam turbines-simple impulse turbine-compounding of impulse turbines-advantages of steam turbines over steam engines. Introduction to condensers and cooling towers.

Module-IV

Introduction to pumps-centrifugal, rotary and reciprocating pumps-classification of centrifugal pumps and applications, Manometric head-net positive suction head efficiency-reciprocating pumps-indicator diagrams, slip-theory of air vessels (description only).

Air compressors – Reciprocating type, single stage and multistage compressors, intercooling and its effects.

Module-V

Classification of engineering materials, material classification, Engineering requirements of materials, properties of engineering materials – physical, mechanical and thermal properties. Selection of materials, ferrous and non ferrous materials. Applications of ferrous matals and

alloys. Ceramics, refractories and polymers - composition and application of composite materials and their construction.

References:

1. A text book of Fluid Mechanics-Dr R K Bansal
2. Thermal Engineering-R K Rajput
3. Engineering Fluid Mechanics-K L Kumar
4. Material Science and Metallurgy-O P Khanna
5. Metallurgy and Material Science-William D Calluster
6. Elements of Mechanical Engineering-Domkundwar & Domkundwar

IC010 407: ELECTRICAL MACHINES LABORATORY

Teaching Scheme **Credits:2**
3 Hours Practical per week

Aim: To expose the students to the basic operation of electrical machines and helps them to develop experimental skills.

Experiments:

1. Galvanometers –extension of range
2. Calibration of DC ammeters, voltmeters and wattmeter using precision potentiometers
3. Calibration of energy meters at different power factors using 3 phase 400v supply
4. Measurement of resistance using DC bridges
5. Use of universal LCR bridges, Digital LCR meter for measurement of inductance, capacitance and resistance. Principle of measurements of capacitance and inductance.
6. BH curve of a given specimen using method of reversals.
7. OC and SC test on a single-phase transformer.
8. Load test on a single-phase transformer.
9. O.C.C of a DC shunt machine.
10. Load test on DC shunt motor
11. Load test on a DC series motor.
12. Swinburn's test.
13. No load and blocked rotor test on 3 phase induction motor.
14. Load test on induction motor.
15. Study of alternators.
16. Use of instrument transformer for measurement of voltage and current.

AI010 408(P)

DIGITAL IC LAB

(Common to AI, IC010 408)

Credits 2
0+0+3

Objectives:

(i) To familiarize the application of Digital IC's
(ii) To equip the students with the design of digital circuits.
(iii) To introduce the basic concept of digital system design.

1. TTL and CMOS characteristics.
2. Interfacing of TTL and electromagnetic relay using transistor, optocoupler (4N33) and Darlington Arrays ULN 2803
3. Logic family Inter connection [TTL to CMOS and CMOS to TTL]
4. Design of Half Adder and Full Adder using Gates.
5. Design and testing of ripple and synchronous counter.
6. Johnson and Ring Counter using Shift registers.
7. Study of counter using (a) flip-flop (b) IC's[7490,7493,74910]
8. Design of Astable and Monostable Multivibrators using (a) Gates (b) 555
9. Study of ADC [at least one]
10. Study of Multiplexer, Demultiplexer, Decoder and Encoder.
11. Study of Adders/ Subtractors using IC's.
12. Study of 7 segment display circuit static/dynamic.[7447, FND542]
13. Static RAM
14. Sequence Detector circuit.[Mealy, Moore]
15. Simulation using VHDL [Internal Valuation Only].-Logic Gates, Decoders, Encoders, Half Adders, Full Adders, Flip flops, counters.

EN010501A ENGINEERING MATHEMATICS IV

(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Use basic numerical techniques to solve problems and provide scientific techniques to decision making problems.*

MODULE 1 Function of Complex variable (12 hours)

Analytic functions – Derivation of C.R. equations in cartision co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal mapping of z^2 , $\frac{1}{z}$ - Bilinear transformation – cross ratio – invariant property (no proof) – simple problems

MODULE 2 Complex integration (12 hours)

Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's series- Laurent's series – Zeros and singularities – types of singularities – Residues – Residue theorem – evaluation of real integrals in unit circle – contour integral in semi circle when poles lie on imaginary axis.

MODULE 3 Numerical solution of algebraic and transcendental equations (10 hours)

Successive bisection method – Regula –falsi method – Newton –Raphson method - Secant method – solution of system of linear equation by Gauss – Seidel method

MODULE 4 Numerical solution of Ordinary differential equations (10 hours)

Taylor's series method – Euler's method – modified Euler's method – Runge – Kutta method (IV order) - Milnes predictor – corrector method

MODULE 5 Linear programming problem (16 hours)

Definition of L.P.P., solution, optimal solution, degenerate solution – graphical solution –solution using simplex method (non degenerate case only) Big -M method – Duality in L.P.P. – Transportation problem –Balanced T.P. – initial solution using Vogel's approximation method - modi method (non degenerate case only)

References

1. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
2. M.R.Spicgel , S.Lipschutz , John J. Schiller, D.Spellman – Complex variables, schanm's outline series - Mc Graw Hill
3. S.Bathul – text book of Engg.Mathematics – Special functions and complex variables –PHI
4. B.S. Grewal – Numerical methods in Engg. and science - Khanna Publishers
5. Dr.M.K Venkataraman- Numerical methods in science and Engg -National publishing co

6. S.S Sastry - Introductory methods of Numerical Analysis -PHI
7. P.K.Gupta and D.S. Hira – Operations Research – S.Chand
8. Panneer Selvam– Operations Research – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International

IC010 502 Industrial Electronics and Applications

(Common to AI010 502 and IC010 502)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Module 1

Power semiconductor Devices-ratings and specification -Power diodes – power transistor – power MOSFET - characteristics of SCR, Triac–IGBT – MCT – LASCR – SCR turn on, turn off characteristics — thyristor protection circuits – series and parallel operations of SCR- Thyristor trigger circuits – R ,RL,RC triggering.

Module 2

AC to DC converters – single phase – three phase – half controlled and fully controlled rectifiers – free wheeling diodes -free wheeling effect - effect of source and load inductance – power factor improvement methods for phase controlled rectifiers- PWM chips:SG3524 and TL 494- dual converters – cyclo converters.

Module 3

Inverters and voltage source inverters – series, parallel and bridge inverters – current source inverters – PWM inverters – D.C. chopper – step up and step down chopper – AC chopper: AC converters: – uninterrupted power supply (UPS) – (circuit diagram approach), rectifier — inverter – static transfer switch.
DC to DC converters: choppers: SMPS, battery charger circuits

Module 4

D.C Motor control: phase control, Single phase SCR drive – Three phase SCR drive – speed control of dc series motor – Chopper controlled dc drives – PLL control of dc motor, A.C. Motor control : controlled – slip system – slip power recovery system - stepper motor drive - synchronous motor control.

Module 5

Control circuits for power electronics: basic schemes for pulse generation using analog and digital ICs. Single, double and four quadrant systems. Series and parallel operations of thyristor, cable firing, isolation etc.

Text Books

1. P.S.Bimbhra, 'Power Electronics', Khanna Publishers, New Delhi, 2002
2 G.K.Dubey, Doradia, S.R. Joshi and R.M.Sinha, Thyristorised Power Controllers, New Age International Publishers, New Delhi, 1996.

References

1. M.H.Rashid, Power Electronics – circuits, devices and applications, PHI, New Delhi, 1995.
2. Joseph Vithyathi, Power Electronics, McGraw Hill, USA, 1995.
3. Mohan, Undeland and Robbins, Power Electronics, John Wiley and Sons, New York, 1995.

4. P.C.Sen, Modern Power Electronics, Wheeler publishers, New Delhi, 1998
5. M.D.Singh, K.B. Khanchandani: Power Electronics, TMH, 1998

IC010 503: ELECTRONIC INSTRUMENTATION

Teaching Scheme **Credits: 4**

3 Hours lecture and 1 Hour tutorial per week

Aim: To expose the students to the concepts of various types of electronic instruments and its uses.

Objective:

- Emphasis is laid on analog meters and digital voltmeters
- Emphasis is laid on analog and digital instruments.
- Elaborate discussion about signal generators, wave analyzer and harmonic distortion.
- To study the working of an CRO
- To study the construction, working of various recorders

Module-I: Electronic Analog Meters & Digital Voltmeters

Electronic analog meters: DC voltmeter- Loading –Transfer voltmeter – chopper type – DC amplifier voltmeter – Solid state voltmeter – Differential voltmeter – AC voltmeter using Rectifiers – Average responding voltmeter – peak responding voltmeter – True RMS voltmeter – True RMS meter – considerations in choosing analog voltmeter, Calibration of DC instrument.

Digital voltmeter – introduction- Ramp technique- Dual slope integrating type DVM – Integrating type DVM – Successive type approximation s type DVM – Continuous balance DVM or servo balancing potentiometer type DVM – 3 ½ digit – Resolution and sensitivity of digital meters – General specifications of a DVM – Microprocessor based Ramp type DVM.

Module-II: Analog & Digital Instruments

Analog instruments – Introduction – output power meters – field strength meter – stroboscope- phase meter – vector impedance meter – Q meter – LCR Bridge – Rx meters – Automatic bridges – Transistor tester – analog PH meter. Digital Instruments- Introduction – Digital multimeter – Digital frequency meter – Digital measurement of time – universal counter – Decade Counter – Electronic counter – Digital measurement of frequency – Digital Tachometer – Digital PH meter – Automation in Digital instrument – Digital phase meter – Digital capacitance meter – Microprocessor based instruments –IEEE488 BUS.

Module-III: Signal Generators, Wave analyzers and Harmonic Distortion

Signal generators – Introduction – fixed frequency AF oscillator – variable AF oscillator – Basic standard. Signal generator – Standard signal generator – Modern Laboratory signal generator – AF sine and square wave generator – Function generator – square and pulse generator – random noise generator – sweep generator – TV sweep generator – Marker generator – sweep marker generator – Wobbluscope – Video pattern generator – Colour bar generator – Vectroscope –Beat Frequency oscillator(BFO) – Standard specifications of a signal generator.

Wave analyzers and Harmonic Distortion – Introduction – Basic wave analyzer – frequency selective wave analyzer- Heterodyne wave analyzer- Harmonic distortion analyzer- spectrum analyzer – spectrum analyzer – digital Fourier analyzer – practical FET spectrum analysis using wave form processing software.

Module-IV: Cathode Ray Oscilloscope

CRO-block diagram-CRT circuit-vertical deflection system-delay line-multiple trace-horizontal deflection system-oscilloscope probes and transducers-oscilloscope techniques-storage oscilloscope-sampling oscilloscope basic principles only

Module-V: **Recorders**

Introduction strip chart recorders – Galvanometer type recorder – Null type recorder – Circular chart recorder – X-Y Recorder – U-V Recorder- Magnetic Recorder – Frequency modulation (FM) recording- Digital data recording – Digital memory wave form recorder(DWR) – Interfacing and screening – Electrostatic and electromagnetic Interference –Grounding.

Text Books:

H.S.KALSI, Electronic Instrumentation, Tata McGraw Hill

References:

1. Albert D.Helfrick, William O.Cooper : Modern Electronic Instrumentation and Measurement techniques, Prentice Hall of India.
2. David Buchla, Wayne Melachlan : Applied Electronic Instrumentation and Measurement, Prentice Hall
3. A.J.Bouwens : Digital Instrumentation, Tata Mc Graw Hill

IC010 504 LINEAR INTEGRATED CIRCUITS

Teaching Scheme **Credits: 4**

3 Hours lecture and 1 Hour tutorial per week

Aim: To introduce the concepts for realizing functional building blocks in ICs & application of ICs.

Objective:

- *To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.*
- *To study the applications of Op-amp*
- *To implement the various filters using Op-Amp*
- *To design the wave shaping circuits using Op-amp and to study about the regulators.*
- *To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADCs*

Module I: Operational amplifiers

Introduction to operational amplifiers-Basic differential amplifier-dual input balanced output and unbalanced output-Internal block schematic of op amp- Pin identification-power supply requirements-typical data sheet-Opamp parameters-ideal op amp
-transfer curve- equivalent circuit-open loop configurations-Frequency response of op amps-compensating networks-slew rate and its effect.

Module II : Applications of Opamp

Difference amplifier-instrumentation amplifier-inverting and non inverting amplifier-integrator and differentiator- summer-subtractor-voltage follower-Comparator-zero crossing detector-Sample and hold circuit-precision rectifiers-Peak detector-log amplifier-antilog amplifier-multiplier using log and antilog amplifier

Module III : Filters

Active and passive filters-Low pass filters-high pass filters-Band pass filters-Notch filters and all pass filters-First and second order filters-Higher order filters-Design of these filters.

Module IV: Wave Shaping Circuits

Oscillators-RC Phase shift oscillators-Wien bridge oscillators-Square wave generator-Triangular wave generator-Saw tooth wave generator-Schmitt trigger.

Regulators: Monolithic regulators–switched mode power supplies-principles and applications-switching regulators.

Module V : Timers

555 timer-Functional block diagram-Astable multivibrator, Monostable multivibrator and its application. Phase locked loop PLL-capture and lock range-functional block diagram-565PLL-PLL applications; frequency multiplications and division –AM demodulation-FM detection-FSK Demodulation.

Text Books

1. Op amp and linear integrated circuits – Coughlin and Driseoll

References

1 Op amp and linear integrated circuits -Ramakand Gaykwad
2. Linear integrated circuits-Roy choudhary and Jain
3. Integrated Electronics-Millman and Halkias

IC 010 505: LINEAR CONTROL SYSTEM

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To provide sound knowledge in the basic concepts of linear control theory and design of control system.

Objective:

- *To understand the methods of representation of systems and getting their transfer function models.*
- *To provide adequate knowledge in the time response of systems and steady state error analysis.*
- *To give basic knowledge is obtaining the open loop and closed–loop frequency responses of systems.*
- *To understand the concept of stability of control system and methods of stability analysis.*
- *To provide the adequate knowledge on state space analysis.*

Module-I:
Open loop and closed loop control systems, Laplace transforms to linear systems, Transfer function, Impulse response and transfer function, Mathematical modeling of simple electrical ,mechanical, electromechanical, hydraulic and pneumatic systems, Analogous systems: Force-voltage analogy and Force-current analogy, Control system components: Servo motors and stepper motors, Block diagram algebra, Signal flow graphs, Mason's gain formula.

Module-II: Time domain analysis:
Time response, Standard test signals, Time response of first order and second order systems to unit step input, Time domain specifications, Type number of a system, Steady state error, Static and dynamic error coefficient, Correlation between static and dynamic error coefficients, Effect of adding zero and pole to a transfer function, P-PI-PD and PID modes of feed back control.

Module-III: Frequency domain analysis:
Frequency response, Advantages of frequency response analysis, Frequency domain specifications, Expressions for frequency domain specifications, Correlation between time and frequency response, Frequency response plots: Bode plot, Polar plot, Nichols plot, Closed loop response from open loop response: M and N circles, Nichol's chart.

Module-IV: Concepts of stability:
Definitions of stability, Absolute and Relative stability, Location of roots in s-plane for stability, Routh-Hurwitz Criterion, Root Locus method, Construction of Root Loci, Effects of poles and zeros and their location on the root locus, Nyquist stability criterion, Gain margin and Phase margin.

Module-V: State Space Analysis:
State space formulation, State model of linear systems, State model for linear continuous time systems, state variable representation for continuous time systems by using physical-phase and canonical variables, Solution of differential equation, Computation of state transition matrix, Decomposition of Transfer function: Direct, cascade and parallel decomposition techniques, Diagonalization, Controllability and Observability.

Text Books

1. I.J.Nagrath and M.Gopal,Control system engineering, New Age International

References:

1.Ogata K., Modern control engineering, Prentice Hall
2.Kuo B.C. ,Automatic control systems, Prentice Hall
3.A. Nagoor Kani, Control systems, RBA Publications
4.A. Nagoor Kani, Advanced control Theory, RBA Publications

IC010 506 Microprocessors & Microcontrollers
(Common to AI010 506 and IC010 506)

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

1. *To Create an exposure to basic microprocessors, peripherals and its programming.*
2. *To impart the basic concepts of advanced microprocessors.*
3. *To have an adequate knowledge in 8-bit microcontrollers.*
4. *To provide the basic concepts of programming in 8051.*
5. *To provide basic knowledge in RISC.*

Module 1

Introduction to microprocessors and microcomputers: Function of microprocessors- architecture of 8085. Intel 8086 Microprocessor - Internal architecture – Block diagram –8086 memory organization – even and odd memory banks – segment registers – logical and physical address.
Minimum and maximum mode operation – Interrupt and Interrupt applications –peripherals– programmable DMA controller-8257 – 8087 math coprocessor-Programmable interrupt controller-8259

Module 2

Addressing modes used in 80x86 family - Data addressing modes, Program memory addressing modes, Stack memory addressing modes. Instruction sets of 8086-programming. Architectures of Intel 80286 Microprocessor, 80386 Microprocessor Advanced Intel Microprocessors – 80486 Pentium.

Module 3

Atmel AT89C51 microcontroller – features - pin configurations - internal block
Schematic. Port structures .Idle & power down mode - power control register - program protection modes – flash programming & verification.
Memory organization - program memory - data memory .Program status word - registers banks. External program & data memory timing diagrams- I/O port timings – and operation –Direct & indirect addressing area - Addressing modes.

Module 4

8051 Programming-Machine cycle-Instruction set – arithmetic - logical and data transfer instructions – Boolean instructions - program branching instructions - Programming examples Timer0 & Timer1 - TMOD SFR - mode0, mode1, mode2, mode3 – TCON-Programming examples.

Module 5

Serial interface - SCON SFR - mode0, mode1, mode2, mode3- block schematics baud
rates- power on reset circuit- ONCE mode- on chip oscillator interrupts - interrupt sources - interrupt enable register -interrupt priority - interrupt control system - interrupt handling ,single step operation. Programming examples
Introduction to RISC processors-Microchip PIC16 family – PIC16F873 processor – features – architecture

References:

1. The 8051 Microcontroller: Muhammad Ali Mazidi, Pearson Education.
2. The 8051 Microcontroller: Kenneth J Ayala, Penram International
3. Microprocessors and Architecture: Ramesh S Goankar
4. Microcomputers and Microprocessors: John Uffenbeck, PHI
5. Web site of Atmel - www.atmel.com
6. The Microprocessors 6th Edition Barry B. Brey Pearson Edu.
7. Microprocessor and Interfacing 2nd Edition Douglous V. Hall TMH
8. The 80x 86 families John Uffenbeck
9. Microchip semiconductor web site – www.microchip.com
10. Design with PIC micro-controllers: John B Peatman, Pearson Education.

IC010 507 MICROPROCESSORS& MICROCONTROLLER LAB

Teaching Scheme

Credits:2

3 Hours Practical per week

Aim: To have an adequate knowledge of handling processors and interfacing.

1. Programming experiments using 8086(MASM)
    - Mathematical Manipulations
    - Logical Instructions
    - String Instructions
2. Procedures and Macros
3. Modular Programming
4. DOS and BIOS Interrupts
5. ADC and DAC Interfacing
6. Stepper Motor Interfacing
7. Waveform generation
8. Display (LED, Seven Segment, LCD) interface
9. Programming experiments using 8051 Microcontroller (Software)
10. Hardware exercise in Microcontroller kits.

IC010 508: Linear Integrated circuits lab

Teaching scheme **Credits: 2**
3 hours practical per week

Aim: To study the OP-AMP parameters, characteristics and application.

Experiments:

1. Measurement of opamp parameters.
    - Input Bias Curreent
    - CMRR .
    - Slew rate.
    - Open loop gain.
    - Input and output impedances.
2. Inverting and non inverting amplifiers
    - Gain and frequency response.
3. Integrators and differentiators
4. Instrumentation amplifiers
    - Gain.
    - CMRR.
    - Input impedance.
5. LPF and HPF, Sallen-Key configuration
    - 1^{st} order & 2^{nd} order for a given frequency band.
6. Narrow band filter- Delyiannis configuration for a given frequency.
7. Active notch filter realization using opamps for a given frequency.
8. Wien Bridge oscillator with frequency and amplitude stabilization.
9. Astable and monostable multivibrators using opamps for a pulse width of ‘x’ms.
10. Square, Triangular and ramp generation using opamps for a given frequency.

11. Voltage regulation using IC723.

- Line.
- Load

12. Astable and monostable multivibrators using IC555 for a pulse width of ‘x’ms.

13. Design of PLL for given lock and capture ranges and frequency multiplication.

14. Precision limiters using opamps.

15. Multipliers using opamps-1,2 and 4 quadrant multipliers.

IC010 601 Process Control Instrumentation

(Common to AI010 601 and IC010 601)

Teaching scheme **Credits**: 4

3 hours lecture and 1 hour tutorial per week

Objectives

1. *To study the basics of process control*
2. *To study about the various controller modes and methods of tuning of controllers*
3. *To give an idea about the construction , characteristics and applications of control valves*
4. *To have a case study of distillation column control.*

Module 1 (12 hours)

Process Control System: Need for process control, classification of process variables, Process characteristics: Process equation, degrees of freedom, modeling of simple systems – thermal, gas, liquid systems. Process lag, load disturbance and their effect on processes. Self-regulating processes, interacting and non interacting processes, Regulator and servo control. Piping and Instrumentation diagram- instrument terms and symbols.

Module 2 (12 hours)

Controller modes: Basic control action, two position (ON-OFF), multi-position, floating control modes. Continuous controller modes: Proportional, Integral, Derivative. Composite controller modes: P-I, P-D, P-I-D. response of controllers for different types of test inputs, electronic controllers to realize various control actions, selection of control mode for different processes, Integral wind-up and prevention. Auto/Manual transfer, Bumpless transfer.

Module 3 (12 hours)

Optimum Controller Settings: Controller tuning Methods- Process reaction curve method, Ziegler Nichols method, damped oscillation method, ¼ decay ratio. Evaluation criteria - IAE, ISE, ITAE. Response of controllers for different test inputs. Selection of control modes for processes like level, pressure, temperature and flow.

Module 4 (12 hours)

Final control elements: I/P and P/I converter, Pneumatic and Electric actuators. Pneumatic control valves, classification, construction details (Globe, butterfly and ball valve types), various plug characteristics. Valve sizing, inherent and installed valve characteristics. Cavitation and flashing in control valves. Valve actuators and positioners. Selection of control valves.

Module 5 (12 hours)

Advanced control schemes: Cascade control, ratio control, feed forward control, Adaptive and Inferential control, split range and averaging control. Multivariable process control, interaction of control loops. Case Studies: Steam boiler – control of heat exchangers, drum level control and combustion. Distillation column – Control of top and bottom product compositions – Reflux ratio, control schemes in distillation column.

Text Books:

1. George Stephenopoulos: *Chemical Process Control,*

2. Donald P. Eckman, *Automatic Process Control*
3. Peter Harriot : *Process Control*,TMH,1985.
4. D R Coughanowr: *Process Systems Analysis and Control*, McGraw Hill.

References:

1. Patranabis D: *Principles of Process Control*, TMH, 1981.
2. B.G Liptak, *Process Control*, Chilton Book Company

IC010 602: PRINCIPLES OF TELEMETRY AND COMMUNICATON

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To introduce the fundamental techniques of telemetry and communication.

Objectives:

- *To understand the basic signals, analog modulation and demodulation.*
- *To understand the types of radio receivers.*
- *To explain the different types of modulation and the fundamental concepts of telemetry.*
- *To provide adequate knowledge on various telemetry principles.*
- *To learn the basics of optical telemetry.*

Module I: Introduction
Communication systems: Modulation - need for modulation- bandwidth- Amplitude modulation - theory- mathematical representation- frequency spectrum - USB & LSB- power relation- Frequency modulation - theory- mathematical representation- frequency spectrum- Phase modulation- comparison of AM- FM- PM.

Module II: Radio receivers
Tuned radio frequency receiver- super heterodyne receiver - block schematic- AM receivers - schematic explanation - RF amplifiers - circuit explanation - simple diode detector - Automatic gain control circuit - simple and delayed AGC - FM receivers - block schematic explanation FM demodulators: slope detectors- phase discriminator- ratio detectors.

Module III: Modulation Techniques & Telemetry
RF Modulation and Demodulation- PCM, FSK, delta and adaptive modulation-multiplexing and demultiplexing-digital encoding. Fundamental concepts-functional blocks of telemetry and telecontrol systems-methods of telemetry-electrical, pneumatic and optical telemetry

Module IV: Types of Telemetry
Telemetry Standards-landline telemetry-electrical telemetry-current, voltage, synchro and position-radio telemetry-transmission and radio receiving techniques

Module V: Optical Telemetry
Optical telemetry-optical Fibers for signal transmission-source for fiber optic transmission-optical detectors-trends in fiber optic device development-examples of optical telemetry systems

References:

1. Grenburg E I-Handbook of Telemetry and Remote Control-McGraw Hill
2. Young R E-Telemetry Engineering-Little Book
3. Swoboda G-Telecontrol methods and applications of Telemetry and Remote Control-Reinhold Publishing Company
4. Rajangam R.K-Industrial Telemetry-Lecture notes
5. Electronic communication Systems: Wayne Tomasi- Pearson Edn.
6. Electronic communication: Roody and Coolen- PHI.
7. Electronic Communication systems: George Kennedy- Mc Graw Hill

IC 010 603 Industrial Instrumentation I

(Common to AI010 603 and IC010 603)

Teaching scheme **Credits**: 4

3 hours lecture and 1 hour tutorial per week

Objectives

1. *To provide exposure to various measuring techniques for force, torque velocity, acceleration, vibration, density, pressure and temperature.*
2. *At the end of the course the student will have an indepth knowlwdge in units, different techniques, and significance of measuring devices.*

Module 1 (12 hours)

Measurement of Force, Torque, Velocity :-
Basic methods of measurement of force (weight) :scales and balances- mechanical balances- electro magnetic balance – Different types of load cells : hydraulic load cells - pneumatic loadcell - magneto elastic (pressductor)- strain gauge loadcell - proving ring.
Different methods of torque measurement: Strain gauge, Relative regular twist-measurement of torque with spur gears – and proximity sensors.
Speed and velocity measurement: Revelution counter- Capacitive tachometer -Drag cup type tacho meter- D.C and A.C tacho generators – Stroboscope- translational velocity transducers. Velocity measurement using variable reluctance proximity pickup. Calibration methods.

Module 2 (12 hours)

Measurement of acceleration, vibration and density :-
Accelerometers – potentiometric type – LVDT- Piezo-electric, capacitive - Strain gauge and variable reluctance type accelerometers.
Mechanical type vibration instruments – Seismic instrument as an accelerometer and vibrometer – measurement of relative motion - Calibration of vibration pick ups
Units of density, specific gravity and viscosity used in industries – Baume scale API scale – hydro meter- density measurement using LVDT- differential pressure method- pressure head type densitometer – float type densitometer – Ultrasonic densitometer – Bridge type gas densitometer- coriolis densitometer. .

Module 3 (12 hours)

Pressure measurement : - Units of pressure – different types of pressure- Manometers – Different types –errors in manometers- Elastic type pressure gauges – Bourden tube - Bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – potentiometric pressure transducers- Capacitive type pressure gauge –Piezo electric pressure sensor –Resonator pressure sensor – optical pressure transducers- pressure switches- Measurement of vacuum – McLeod gauge – Thermal vacuum gauges – Ionization gauge -Testing and calibration of pressure gauges – Dead weight tester- Bulk gauge(high pressure measurement).

Module 4 (12 hours)

Temperature measurement :- Definitions and standards – Primary and secondary fixed points – Calibration of thermometers - Different types of filled in system thermometer – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – Electrical methods of temperature measurement – resistance thermometers-3 lead and 4 lead RTDs - Thermistors – Linearization techniques.

Module 5 (12 hours)

Thermocouples –thermocouple junctions- Law of thermocouple – Fabrication of industrial thermocouples– Signal conditioning of thermocouple output — Commercial circuits for cold junction compensation — Special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement –Radiation fundamentals – Total radiation pyrometers – Optical pyrometer – infra red pyrometers- Two colour radiation pyrometer.- IC temperature sensors- fiber optic temperature measurement- calibration of temperature transducers.

Text Books

1. A.K.Sawhney, A course in mechanical measurements and Instrumentation–Dhanpat Rai and Sons, New Delhi, 1999.
2. R. K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.

References

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
2. B.C.Nakra and K.K.Chaudary, Instrumentation Measurement and Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1985.
3. S.K.singh, industrial instrumentation and control, Tata McGraw Hill Publishing Ltd., New Delhi, 2006

IC010 604 SIGNALS AND SYSTEMS WITH PROCESSING

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain.

Objectives:

- *To classify signals and systems & their mathematical representation.*
- *To analyse the discrete time systems.*
- *To study various transformation techniques & their computation.*
- *To study about filters and their design for digital implementation.*
- *To study about a programmable digital signal processor & quantization effects.*

Module-I: Introduction
Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation, analog to digital conversion.

Module-II: Discrete Time System Analysis
Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response –Convolution – Fourier transform of discrete sequence – Discrete Fourier series.

Module-III: Discrete Fourier Transform & Computation
DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure.

Module-IV: Design Of Digital Filters
FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design - Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping - Frequency transformation.

Module-V: Programmable DSP Chips
Architecture and features of TMS 320C54 signal processing chip – Quantisation effects in designing digital filters.

Text Books:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2003 / PHI.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill, New Delhi, 2001.

Reference Books:

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, 'Discrete – Time Signal Processing', Pearson Education, New Delhi, 2003.
2. B. Venkataramani, M. Bhaskar, 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw Hill, New Delhi, 2003.
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, 'Digital Signal Processing', Tata McGraw Hill, New Delhi, 2003.
4. Texas TMS 320C54X user manual (website).

IC 010 605 ADVANCED CONTROL SYSTEM

Teaching Scheme **Credits:4**

3 Hours lecture and 1 Hour tutorial per week

Aim: To obtain comprehensive knowledge in design of compensators, nonlinear control theory and design of digital controllers for nonlinear systems.

Objectives:

- *To design a compensators for the continuous system.*
- *To get introduced with discrete control system.*
- *Elaborate study on state space and design of discrete systems.*
- *To study the features of linear and non-linear systems and expose the students to the physical non-linearity.*
- *To analyze the stability of the systems using Liapunov's approach.*

Module-I: **Introduction to Design**

Design of controllers, Types of compensation, Cascade compensation in frequency and time domain (lead, lag and lead-lag compensators), Design of PI -PD and PID controllers, Feed back compensation, Design via pole placement.

Module-II:Introduction to discrete time control systems:

Introduction to Digital control systems, Quantizing and quantization error, Data acquisition, conversion and distribution systems, Spectrum analysis of sampling process, Signal reconstruction (zero order and first order hold circuits), Difference equation model, Z (Pulse) transfer function, Response of linear discrete systems, Z and S domain relationship, Jury's stability test, Bilinear transformation.

Module-III:State space and Design of Discrete systems:

State space representation of discrete time systems, Solution of discrete time state equation using Z-transform, Computation of state transition matrix, Design of discrete data system using frequency response and root locus methods.

Module-IV:Non linear systems:

Characteristics of non linear systems, Types of nonlinearities, Describing function analysis common non linearities, Phase plane analysis, Singular points, Classification of singular points, Phase trajectory, Construction of phase trajectory by Isocline method and Delta method, Stability analysis using phase trajectory.

Module-V:Liapunov's stability:

Liapunov functions, Stability in the sense of Liapunov and methods, Liapunov theorems on stability and asymptotic stability, Liapunov stability analysis of linear time invariant continuous time and discrete time systems, Generation of Liapunov function linear systems-discrete systems and non linear systems.

Reference Books:

1. Ogata. K, “Discrete Time Control systems”, Prentice Hall
2. Nagarath & Gopal, “Control System Engineering.” New Age Publications.
3. A. Nagoor Kani, “Advanced Control Theory”, RBA Publications.
4. Ogata. K, “Modern control engineering.” Prentice Hall

IC010 606L01-MECHATRONICS

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To gain comprehensive knowledge on Mechatronics.

Objectives:

- *To study the relevant historical back ground of Mechatronics and its scope.*
- *To study the fundamentals of CNC machines and its parts.*
- *To study the various programming concepts in CNC.*
- *To study the various parts of robots and fields of robotics*
- *To study the various sensors in the field of Robotics.*

Module-I: Introduction
Introduction to mechatronics- Mechatronics in manufacturing- mechatronics in production- scope of mechatronics- fundamental of numerical control- advantages of NC systems- point to point and contouring systems- NC and CNC – Incremental and absolute systems- open loop and closed loop systems- features of NC machine tools- methods of improving machine accuracy and productivity- special tool holders

Module-II: System devices
System devices- system drives – hydraulic systems- DC motors- Stepping motors- AC motors- feedback devices encoders- pulse digitizers- resolvers – inductosyn- tachometer- counting devices- flip flops- counters- decoders- digital to analog converters – interpolation – linear interpolator- circular interpolator- CNC software- interpolator – flow of data in NC machines

Module-III:NC Machines
NC part programming – manual programming – concepts – tape formats – tab sequential- fixed block word address and variable block formats – part programming examples- point to point programming and simple contour programming – computer aided programming concepts- post processor programming languages – APT programming – part programming examples

Module-IV: Introduction to MEMS
Introduction: Historical background of Micro-Electro Mechanical system (MEMS), Mechatronic system, And Functional components of Mechatronics, Scope of Mechatronics, Material processing and device fabrication: Lithography, Ion implantation, Etching, Wafer bonding.

Module-V:Introduction to nanotechnology
History of nanoscale science,Principles of nanotechnology, chemistry fundamentals,fabrication of nanomaterial-nanolithoghraphy,thin film processors,tools-electron microscope,scanning electron microscope,Xray diffraction,practical applications,carrier opportunities

Reference Books:

1 Yoram Koren “Computer Control of Manufacturing Systems” Mc Graw Hill
2 Groover M.P “Industrial Robots- Technology Programming and application
3. Banks H T, Smith R C and Wang Y: Smart material structures-Modelling, Estimation and control, John Wiley & sons.
4. Mechatronics ,Edited by HMT,TMH.
5.Written notes on nanotechnology.

IC010 606 L02- COMPUTER NETWORKS & PROTOCOLS

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To illustrate the concept of networking of computers and protocols

Objectives:

- *To provide fundamental knowledge about computer networks.*
- *To provide comprehensive knowledge about the methods of internetworking.*
- *To study the detection and correction of errors, link control and link protocols of data link Layer.*
- *To study the access method, electrical specification and implementation of different networks, types of switching.*
- *To study about the standardized data interface and it's working principle.*

Module-I: Data Network Fundamentals
Network hierarchy and switching – Open system interconnection model of ISO – Datalink control protocol – BISYNC – SLDC – HLDC – Media access protocol – Command– Token passing – CSMA/CD, TCP/IP.

Module-II: Internet Working
Bridges –Routers – Gateways – Open system with bridge configuration – Open system with gateway configuration – Standard ETHERNET and ARCNET configuration –Special requirement for networks used for control.

Module-III: Error Control And Data Link Protocols
Error detection and correction: Types of errors – Detection – Vertical Redundancy Check(VRC) – Longitudinal Redundancy Check (LRC) – Cyclic Redundancy Check (CRC) –Check sum – Error correction.Data link control: Line discipline – Flow control – Error control. Data link protocols: Asynchronous protocols – Synchronous protocols – Character oriented protocols – BIT oriented protocols – Link access procedures.

Module-IV: Networks And Switching
LAN: Project 802 – Ethernet – Token bus – Token ring – FDDI.
MAN: IEEE 802.6 (DQDB) – SMDS.
Switching: Circuit switching – Packet switching – Message switching.

Module-V: X.25, Frame Relay, Atm And Sonet/ Sdh
X.25: X.25 Layers.Frame relay: Introduction – Frame relay operation – Frame relay layers – Congestion control – Leaky bucket algorithm – Traffic control.ATM: Design goals – ATM architecture – ATM layers – ATM applications.SONET / SDH: Synchronous transport signals – Physical configuration – SONET layers– Applications.

Text Books:

1. Behrouz A.Forouzan, 'Data Communication and Networking', Second Edition, Tata McGraw Hill, 2000.
2. A.S. Tanenbaum, 'Computer Networks', 3rd Edition, Pearson Education, 1996 / PHI.

Reference Books:

1. William Stallings, 'Data and Computer Communication', 8th Edition, Prentice Hall of India/Pearson Education, 2003.
2. S. Andrew Tannenbaum, 'Computer Networks', Prentice Hall of India/Pearson Education, 4th Edition, 2003.

IC010 606L03: ADVANCED MICRO-CONTROLLERS

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To impart the knowledge on advanced microcontrollers.

Objectives:

- *To get introduced with the the ATMEL family architecture.*
- *To study about the TIMERS, ADC and PWM features.*
- *To get introduced with the COP8 family.*
- *To study about the various fetaures of COP8 family.*
- *To study about the features of PIC16 Microcontroller.*

Module I:
Low pin count controllers – Atmel AVR family – ATTiny15L controller - architecture – pin descriptions – features – addressing modes – I/O space – reset and interrupt handling – reset sources - Tunable internal oscillator.

Module II
Timers – Watch dog timer – EEPROM – preventing data corruption – Analog comparator – A/D converter – conversion timing – ADC noise reduction – PortB – alternate functions – memory programming – fuse bits – high voltage serial programming – algorithm.

Module III
National semiconductor COP8 family - COP8CBR9 processor – features – electrical characteristics – pin descriptions – memory organization –EEPROM - security – brownout reset – in system programming – boot ROM. Idle timer – Timer1, Timer2, Timer3 -operating modes – PWM mode – event capture mode

Module IV
Power saving modes – Dual clock operation – Multi input wake up – USART – framing formats – baud rate generation – A/D conversion – operating modes – prescaler – Interrupts – interrupt vector table – Watch dog – service window – Micro-wire interface waveforms.

Module V
Microchip PIC16 family – PIC16F873 processor – features – architecture – memory organization - register file map – I/O ports – PORTA - PORTB – PORTC – Data EEPROM and flash program memory – Asynchronous serial port – SPI mode – I2C mode.

Reference Books:

1. Design with PIC micro-controllers: John B Peatman, Pearson Education.
2. DS101374: National Semiconductor reference manual.
3. National semiconductor web site – www.national.com
4. 1187D: Atmel semiconductor reference manual.
5. Atmel semiconductor web site – www.atmel.com
6. DS30292B: Microchip reference manual.
7. Microchip semiconductor web site – www.microchip.com

IC010 606L04 – EMBEDDED SYSTEM DESIGN

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To introduce to the functional building blocks of an embedded system for developing a real time system application.

Objectives:

- *Introduce to features that build an embedded system.*
- *To help the understanding of the interaction that the various components within an embedded system have with each other.*
- *Techniques of inter facing between processors & peripheral device related to embedded processing.*
- *To enable writing of efficient programs on any dedicated processor.*
- *To present in lucid manner the basic concepts of systems programming like operating system, assembler compliers etc and to understand the management task needed for developing embedded system.*

Module-I:Introduction To Embedded System
Introduction to functional building blocks of embedded systems – Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each categories.

Module-II:Processor And Memory Organization
Structural units in a processor; selection of processor & memory devices; shared memory; DMA; interfacing processor, memory and I/O units; memory management – Cache mapping techniques, dynamic allocation - Fragmentation.

Module-III:Devices & Buses For Devices Network
I/O devices; timer & counting devices; serial communication using I2C, CAN, USB buses; parallel communication using ISA, PCI, PCI/X buses, arm bus; interfacing with devices/ports, device drivers in a system – Serial port & parallel port.

Module-IV:I/O Programming Schedule Mechanism
Intel I/O instruction – Transfer rate, latency; interrupt driven I/O - Non-maskable interrupts; software interrupts, writing interrupt service routine in C & assembly languages; preventing interrupt overrun; disability interrupts. Multi threaded programming – Context switching, premature & non-premature multitasking, semaphores. Scheduling – Thread states, pending threads, context switching, round robin scheduling priority based scheduling, assigning priorities, deadlock, watch dog timers.

Module-V:Real Time Operating System (RTOS)
Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools.

Text Books:

1. Rajkamal, ‘Embedded System – Architecture, Programming, Design’, Tata McGraw Hill, 2003.
2. Daniel W. Lewis ‘Fundamentals of Embedded Software’, Prentice Hall of India, 2004.

Reference Books:

1. David E. Simon, ‘An Embedded Software Primer’, Pearson Education, 2004.
2. Frank Vahid, ‘Embedded System Design – A Unified hardware & Software Introduction’, John Wiley, 2002.
3. Sriram V. Iyer, Pankaj Gupte, ‘Embedded Real Time Systems Programming’, Tata McGraw Hill, 2004.
9. Steve Heath, ‘Embedded System Design’, II edition, Elsevier, 2003.

IC010 606 L05-DIGITAL SYSTEM DESIGN

Teaching Scheme **Credits:4**
3 Hours lecture and 1 Hour tutorial per week

Aim: To impart the knowledge on the concepts of digital system design.

Objective:

- *To expose the students to study the concepts of combinational circuits*
- *To expose the students to study the concepts of sequential circuits*
- *To study and analyze the hazards in sequential circuits.*
- *To have an adequate knowledge in the VHDL basics*
- *An exposure is given to the students on VHDL codes & PLD*

Module-I :Combinational Circuits:
Combinational Circuits design**:** Review of combinational circuits design, CMOS realization of basic gates and simple Boolean expressions. Minimisation of Boolean functions with 5 and 6 varaibles using Karnauph map.
Combinational circuit building blocks: Review of multiplexers- synthesis of logic functions using multiplexers, multiplexer synthesis using Shannon's expansion. Review of decoders and encoders- Binary encoders, Priority encoders.

Module- II :Sequential Circuits:
Sequential circuit design: Finite state machine- Moore and Mealy machines. One-hot encoding. Design and implementation of synchronous sequential circuits with D-Flip Flops (Counters, sequence generators, sequence detectors, serial adder).

Module-III:Hazards In Sequential Circuits:
Logic design issues- Hazards in combinational networks- Hazards in sequential networks- Synchronous design method- Clock skew- Synchronous inputs- Synchroniser failure and metastability

.

Module- IV:VHDL Basics
VHDL- Behavior modeling- Transport Vs inertial delay- Simulation deltas- Sequential processing- Process statement- Signal assignment Vs variable assignment- Sequential statements. VHDL codes for Boolean expressions, multiplexers, Binary decoders, Priority encoders, Comparators.VHDL: Data types- Subprograms and packages

Module- V:VHDL Codes & Programmable Logic Devices:
VHDL codes for flip-flops, registers, counters and finite state machines.
VHDL: Predefined attributes- Configurations- Subprogram overloading- VHDL
synthesis. Programmable Logic Devices: Programmable Logic Array, Programmable Array Logic Complex
Programmable Logic Devices, Field Programmable Logic Devices.

Text Books:

1.Stephen Brown & Zvonko Vranesic- Fundamentals of Digital Logic with VHDL design- Tata McGraw Hill.

2.Perry D.L, VHDL- McGraw Hill.

Reference Books :

1.John F Wakerly, Digital design principles & practices, Pearson Education.

2.M. Morris Mano, Digital logic and Computer design, PHI.

3.Roth C.H.Jr.- Digital system Design using VHDL, PWS Pub.co

4.Sudhakar Yalamanchili, Introductory VHDL from simulation to synthesis, Pearson Education.

5.Bhasker J- A VHDL Primer, Addison Wesly.

IC010 606L06- DATA STRUCTURES AND ALGORITHMS

Teaching Scheme **Credits:4**

3 Hours lecture and 1 Hour tutorial per week

Aim: To present the concept of arrays, recursion, stack, queue, linked list, trees and graph data structures.

Objectives:

- *To introduce the concept of arrays, structures, pointers and recursion.*
- *To study stack, queue and linked list concepts.*
- *To study trees, representation of trees, tree traversal and basic operations on trees.*
- *To study some of the sorting and searching techniques.*
- *To study the concept of graphs, traversal techniques and minimum spanning tree.*

Module-I:Introduction To Data Structures

Abstract data types - Sequences as value definitions - Data types in C - Pointers in C - Data structures and C - Arrays in C - Array as ADT - One dimensional array - Implementing one dimensional array - Array as parameters - Two dimensional array - Structures in C - Implementing structures - Unions in C - Implementation of unions - Structure parameters - Allocation of storage and scope of variables.Recursive definition and processes: Factorial function - Fibonacci sequence – Recursion in C - Efficiency of recursion.

Module-II:Stack, Queue And Linked List

Stack definition and examples – Primitive operations – Example - Representing stacks in C - Push and pop operation implementation.Queue as ADT - C Implementation of queues - Insert operation - Priority queue - Arrayimplementation of priority queue.Inserting and removing nodes from a list-linked implementation of stack, queue andpriority queue - Other list structures - Circular lists: Stack and queue as circular list -Primitive operations on circular lists. Header nodes - Doubly linked lists - Addition oflong positive integers on circular and doubly linked list.

Module-III:Trees

Binary trees: Operations on binary trees - Applications of binary trees - Binary tree representation - Node representation of binary trees - Implicit array representation of binary tree – Binary tree traversal in C - Threaded binary tree - Representing list as binary tree - Finding the Kth element - Deleting an element.Trees and their applications: C representation of trees - Tree traversals - Evaluating an expression tree - Constructing a tree.

Module-IV:Sorting And Searching

General background of sorting: Efficiency considerations, Notations, Efficiency of sorting. Exchange sorts; Bubble sort; Quick sort; Selection sort; Binary tree sort; Heap sort. Heap as a priority queue - Sorting using a heap-heap sort procedure - Insertion sorts: Simple insertion - Shell sort - Address calculation sort - Merge sort -Radix sort. Sequential search: Indexed sequential search - Binary search - Interpolation search.

Module-V:Graphs

Application of graph - C representation of graphs - Transitive closure - Warshall's algorithm – Shortest path algorithm - Linked representation of graphs - Dijkstra's algorithm - Graph traversal - Traversal methods for graphs - Spanning forests -Undirected graph and their traversals - Depth first traversal - Application of depth first traversal - Efficiency of depth first traversal - Breadth first traversal - Minimum spanning tree - Kruskal's algorithm - Round robin algorithm.

Text Books:

1. Aaron M. Tenenbaum, Yeedidyah Langsam, Moshe J. Augenstein, 'Data Structures Using C', Pearson Education, 2004 / PHI.

Reference Books:

1. E.Balagurusamy, 'Programming in Ansi C', Second Edition, Tata McGraw Hill Publication, 2003.
2. Robert L. Kruse, Bruce P. Leung Clovis L.Tondo, 'Data Structures and Program Design in C', Pearson Education, 2000 / PHI.

IC010 607: INDUSTRIAL INSTRUMENTATION LABORATORY

Teaching scheme **Credits: 2**

3 hours practical per week

Aim: To study the characteristics of various physical phenomenons.

Experiments:

1. Measurement of Viscosity
    - Plot the characteristics- temperature versus viscosity.
2. Measurement of Temperature
    - RTD – Temperature versus Resistance.
3. Measurement of pH.
4. Measurement of pressure
    - Strain gauge – input versus output and sensitivity.
5. Measurement of level.
6. Measurement of flow
    - Flow in pipe line.
    - Error analysis.
7. Dynamic response of first order system.
8. Dynamic response of second order system.
9. Pressure to current converter.
    - Plot the characteristics.
10. Current to Pressure converters
    - Plot the characteristics.
11. Use of LDR for measurement of physical variations.
    - Light intensity versus resistance.
12. Measurement of Strain/Force.
    - Resistance versus strain.
    - Error analysis.
13. Measurement of Speed- Open loop and closed loop.
14. Calibration of instruments.
    - Pressure gauge.

IC 010 608 Mini Project
(Common to AI010 608)

Teaching Scheme
3 hours practical per week **2 credits**

The mini project will involve the design, construction, and debugging of an electronic system product approved by the department. The schematic and PCB design should be done using any of the standard schematic capture & PCB design software. Each student may choose to buy, for his convenience, his own components and accessories. Each student must keep a project notebook. The notebooks will be checked periodically throughout the semester, as part of the project grade. The student should submit the report at the end of the semester. A demonstration and oral examination on the mini project also should be done at the end of the semester.

IC010 701: COMPUTER CONTROL OF INDUSTRIAL PROCESS

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

AIM:

To provide sound knowledge on the principal of digital control system, PLC and SCADA

Objectives:

(i) To give an introductory knowledge of about PLC Programming languages.

(ii) To give basic knowledge in the architecture and local control unit of distributed control system.

(iii) To give basic knowledge about HART (Highway Addressable Remote Transducer), field bus technology and some BUSES.

(iv) To study the importance of optimal control problem and regulator problem.

(v) To emphasis on design techniques that are applicable when the model of the system is partially known.

Module-I: PROGRAMMABLE LOGIC CONTROLLER AND SCADA

Instrumentation to CCP- data acquisition system- data loggers- annunciators- smart transducers and transmitters- an introduction to real time Operating system- Discrete state process control- event sequencing – programmable logic controllers – functional block description of PLC- different type of PLC languages- development of ladder logic diagrams for simple application- project execution- PLC installation- introduction to SCADA systems.

Module-II: DISTRIBUTED CONTROL SYSTEM AND LOCAL UNITS

Distributed Control Systems- PLC versus DCS- DCS configuration – the control console equipment- relay rack mounted equipments- local control units- communication between components- Data highways – field buses- multiplexers.

Module-III: BUSES AND PROTOCOLS

Remote terminal units – MAP/TOP- MOD BUS- PROFI BUS- FIP BUS- man machine interface- integration with PLC- integration with computers- integration with direct I/O serial linkages- network linkages – links between networks-HARTCommunication modes- HART networks- FIELD BUS-Introduction and Architecture.

Module-IV: DESIGN OF DIGITAL CONTROL SYSTEM

Formulation of optimal control problem- optimal state regulators- finite state regulators – infinite state regulators – output regulator problem- accommodation of external disturbances- Eigen value assignment by state feedback- Dead beat Control- State observers- stochastic optimal estimation – Kalman Filter.

Module-V: SELF-TUNING CONTROL

Self tuning control- the identification problem – the principles of least squares – recursive least square algorithms- Self tuning Regulator- Case Study: Microprocessor based Position Control System

REFERENCE BOOKS:

1. Instrument Engineer's Hand Book-Process Control (1st and 2nd module) -Liptak.B.G. -Butterworth Heinemann.
2. Andrews W.G: “Applied Instrumentation in process industries”
3. Jones “Instrument Technology Vol 5”
4. Computer Control of Process (1st and 2nd module) -M.Chidambaran -Narosa Publishing House
5. Chemical Process Control (3rd Module) -George Stephanopoulos -Prentice Hall of India.
6. Digital control and State Variable Methods (3rd and 4th module) -M.Gopal-Tata McGraw-Hill.
7. P.B. Deshpande and R.H. Ash, ‘Computer Process Control’, ISA Publication, USA, 1995.
8. Michael P. Lukas, ‘Distributed Control System’, Van Nostrand Reinhold Co., Canada, 1986.

IC010 702 OPTICAL AND OPTO ELECTRONIC INSTRUMENTATION

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

AIM

To contribute to the knowledge of Fibre optics and Laser Instrumentation and its application.

Objectives

(i) To provide an adequate knowledge about an interferometers.
(ii) To acquaint the students with the working of some optical devices.
(iii) To expose the students to the laser fundamentals.
(iv) To provide adequate knowledge about Industrial application of lasers.
(v) To provide adequate knowledge about the Industrial applications of optical fibres and to measure fiber characteristics.

Module-I: INTERFEROMETERS

Interferometers- Fabry Perot and Michelson interferometers- MachZehnder interferometers- Interference filters- interferometric methods in metrology and testing of optical components – optical spectrum analyser- modulation of light

Module-II: OPTICAL DEVICES

Electro optic effect- Kerr Modulators- Magneto optic devices- acoustic optic modulators- display devices- light emitting diodes – plasma displays- liquid crystal displays- pin diodes – photo detectors- optocouplers

Module-III: LASER FUNDAMENTALS

Optical materials and coating – moiré fringes- photo elasticity- lasers- principles of operation- Einstein relations- population inversion- optical feedback- laser modes- classes of lasers- solid state- gas and liquid dye lasers – semiconductor lasers – Q-switching and mode locking- properties of laser light.

Module-IV: APPLICATION OF LASERS

Application of lasers- laser gyro- laser Doppler anemometry (LDA)- holographic interferometry- distance measurement- holography- principles and application –optical fibers- light guidance through fibers- step index fibers – multi mode and single mode fibers- fiber fabrication

Module-V: FIBER CHARACTERISTICS & FIBER APPLICATION

Measurement of fiber characteristics- attenuation- dispersion and refractive index profile measurement- OTDR- fiber optic components- couplers, splicers and connectors- application of optical fibers- optical fiber sensors- recent trends.

REFERENCES BOOKS:

1 Cock W.E “Engineering application of lasers and holography” Plenum Press

2 Cheo P.K “Fiber optic devices and laser systems” PHI

3 Jain R.K “ Engineering metrology” Khanna publishers

IC010 703: BIOMEDICAL INSTRUMENTATION

(COMMON TO AI010 703 AND EI010 703)

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

Course objectives:

1. To help students learn the basics of instrumentation related to biomedical systems.
2. To help students get overall knowledge of the medical equipments for diagnosis and therapy.
3. To help students understand the relative electrical safety measures and standards.
4. To help students know general concepts of imaging system.
5. To bring out the importance of modern methods of imaging techniques.

Module 1: Physiology and Transducers

Introduction to BMI: general perspective including objectives– an overview of safety requirements, biometrics, biomedical instruments, parameters, man-machine interface and components.

Bioelectric potentials: human cell- action potential, generation and propagation of bio electric action potential, resting potential- relative refractory period, absolute refractory period.

Electrodes: electrode theory- types of electrodes- biopotential electrodes- polarizable and nonpolarizable electrodes- equivalent circuit of electrode-skin interface.

Transducers: transducers for biological applications: pressure, flow, pulse, respiration; chemical sensor- implantable transducer.

Module 2: Electro-Physiological Measurements

Cardio vascular system: electrical activity of heart- ECG- typical ECG and characteristics- ECG as a diagnostic tool- monitoring scheme- lead system- introduction to ECG machine.

Phonocardiography- principle and clinical applications.

Biopotential Recording- noise, motion artifacts and other considerations.

Module 3: Nervous and Respiratory Measurements

Nervous system: EEG- typical EEG and characteristics- significance- lead system, clinical applications, evoked potentials, introduction to EEG machine.

Respiratory system: respiratory measurements - lung volume and capacities- spirometer

EMG-working principle and clinical applications.

Module 4: Safety and Therapeutic Equipment

Electrical safety– physiological effects of electricity, micro and macro shock hazards, electrical safety codes and standards- patient safety considerations in power distribution and equipment design.

Therapeutic Equipment: pacemaker, defibrillator, dialysis machine, ventilators.

Operation theatre equipment: surgical diathermy equipment- diathermic equipment using microwaves, short waves and ultra sound.

Module 5: Imaging Techniques

Medical Imaging: computed tomography- basic principle- data accumulation scanning motions– X ray tubes- collimators- detectors- image reconstruction algorithms- display.

Nuclear Magnetic Resonance: nuclear structure and angular momentum- magnetic dipole moment- resonance- RF magnetic field- Larmor frequency- free induction decay- an overview of NMR instrumentation and imaging system.

Text Books:

1. Leslie Cromwell, Fred J. Weibell and Erich A Pferffer - Biomedical Instrumentation and Measurements - Prentice Hall of India, 1990
2. R.S Khandpur - Handbook of Biomedical Instrumentation - Tata Mc Graw – Hill

References:

1. John G. Webster - Medical Instrumentation - Application and Design - Houghton mifflin company, Boston
2. John C. Cobbold - Tranducers for Biomedical measurements - John wiley & Sons
3. Jacob Kline- Hand book of Biomedical Engineering - Academic Press INC

IC010 704: ANALYTICAL INSTRUMENTATION

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

Objectives

a. *To impart a basic knowledge about analytical instruments, its concepts, and its technique.*
b. *To give a vast knowledge about different types of spectroscopic analysis.*
c. *To study about the NMR, Mass and Electron Spin Resonance Spectrometer.*
d. *To provide the knowledege on PH meters and dissolved component analysers.*
e. *To study about the different Chromatographic techniques.*

Module 1: Fundamentals and Spectroscopy

Introduction to Analytical Instrumentation: Fundamentals of analytical instruments: Elements of an analytical instrument – PC based analytical instruments –Classification of instrumental techniques . Electro magnetic radiation- Electromagnetic spectrum- Laws relating to absorption of radiation. Absorption spectroscopy: Absorption instruments – Radiation sources- Optical filters- Monochromators- Detectors.

Ultra violet and visible absorption spectroscopy- Colorimeters/ photometers: Single beam and double beam filter photometer – Spectro photometers: Single beam and double beam spectro photo meters- Infra red spectroscopy: Basic components- Radiation sources- Monochromators- Detectors.

Module 2: Photometry and Various Spectrometers

Flame Photometry: Principle and constructional details of flame photometer- Emission system – Optical system – Detectors . Atomic absorption spectrophotometers: Theoretical concepts, Instrumentation: Radiation sources - Burners and flames - Plasma excitation sources - Optical and electronic system .

Fluorescence spectroscopy: Principle of fluorescence – Measurement of fluorescence – Single beam and double beam filter fluorimeter- Ratio fluorimeter. Spectro fluorimeters.

Raman spectrometer- Basic theory-Photo acoustic spectroscopy- Photo thermal spectroscopy .

Module 3: Mass, NMR and Electron Spin Resonance Spectrometer

Mass spectrometer: Principle of operation- Magnetic deflection mass spectrometers- Components of a mass spectrometer – Inductively coupled plasma mass spectrometer.

Nuclear Magnetic Resonance spectroscopy: Basic principle – Constructional details of NMR spectrometer – Nuclear radiation detectors .

Electron Spin Resonance spectrometer: Basic ESR spectrometer – Electron spectroscopy: Instrumentation for electron spectroscopy.. X- Ray spectrometers: X – ray spectrum – Instrumentation for x –ray spectrometry. X-ray diffractometers- X-ray absorption meters- X- ray fluorescence spectrometry.

Module 4: PH Meters and Dissolved Component Analysers

Industrial Gas analyzers- pH meters- Conductivity meters - Dissolved oxygen meters- Sodium analyser – Gas analysers- Paramagnetic oxygen analyser – CO analysers – Flue gas analysers- Blood PH measurement – Thin film technology for gas sensors- Basic concepts. Measurement

techniques and application of gas sensors. Thermal Sensors:- Radiation Sensors, Mechanical Sensors and Bio-Chemical Sensors.

Module 5: Chromatography

Chromatography: Chromatographic process – Classification- Terms in chromatography- Gas chromatography: Block diagram- Principle - Constructional details – Column details- GC detectors.

Liquid Chromatography: Types of liquid chromatography- High pressure Liquid Chromatography (HPLC): Principle- Constructional details.

Textbooks:

1. Instrumental Methods of Analysis, Willard, Merritt, Dean, Settle, CBS Publishers & Distributors, New Delhi, Seventh edition.
2. Handbook of Analytical Instruments, R. S. Khandpur, Tata McGraw–Hill Publications, 3rd edition
3. Principles of Instrumental Analysis, Skoog, Holler, Nieman, Thomson books-cole publications, 5th edition.

Reference books:

1. Instrumental Methods of Chemical Analysis, Galen W. Ewing, McGraw-Hill Book Company, Fifth edition.

2. Introduction to Instrumental Analysis, Robert D. Braun, McGraw-Hill Book Company

IC010 705: INDUSTRIAL INSTRUMENTATION -II

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

AIM:
To equip the students with relevant knowledge to suit the industrial requirement.

Objectives:

a. *To provide exposure to various measuring techniques for flow, level, ph, humidity, viscosity, moisture , dimension, sound and thermal conductivity.*
b. *At the end of the course the student will have an indepth knowlwdge in units, different techniques, and significance of measuring devices.*

Module 1: FLOW MEASUREMENT
Measurement of flow: Flow characteristics- Flow measuring techniques - Classification of flow meters- Variable head flow meters for incompressible fluids- : Venturi tubes- Square root relationship - Flow nozzle- Orifice plates - Dall tube – Wiers and flumes - Pitot tube. Variable meters for compressible fluids. Installation of flow meters. Quantity flow meters: Positive displacement flow meters- Nutating disc, Rotary vane, Reciprocating piston, Oval gear, Helix type. Mass flow meters: Angular momentum type, Impeller turbine, Twin turbine, Coriollis , Thermal , Radiation type mass flow meters.

Module 2: AREA AND ELECTRICAL TYPE FLOW METERS
Inferential type : Variable area flow meters (Rotameters) – Turbine flow meters - Target flow meters- Electrical type flow meters- Electro magnetic type- Comparison of DC and AC excitations- Ultrasonic flow meters - Laser Doppler Anemometer (LDA) - Hot wire anemometer - Other flow meters: Purge flow regulators- Flow meters for solid flow – Vortex flow meters – Calibration of flow meters. Dynamic weighing method – Master meter method- Bell prover system . Factors to be considered for flow meter selection.

Module 3: LEVEL MEASUREMENT
Level measurement :- Methods of liquid level measurement –Classification of liquid level detectors – Direct method- Hook type, Sight glass technique– Float type level indication — Float level switches - Rope method- Level measurement using displacer and torque tube – Indirect methods : Hydrostatic pressure type- Pressure gauge method- Air bellows- Air purge system. Boiler drum level measurement – Thermal level sensors – Differential pressure method –Electrical types of level gauges using Resistance, Capacitance, Nuclear radiation and Ultrasonic sensors – Laser level sensors- Microwave level switches – Fibre optic level detectors- Calibration of level detectors.

Module 4: PH MEASUREMENT
Measurement of pH, Viscosity, Humidity and Moisture : - Need for pH measurement - pH electrodes- Viscosity terms – Capillary viscometer- Say bolt viscometer – Rotameter type viscometer- red wood type viscometer. – Humidity terms – Dry and wet bulb psychrometers – Hot wire electrode type hygrometer – Dew cell – Electrolysis type hygrometer – Commercial

type dew point meter –Different methods of moisture measurement –Application of moisture measurement.
Smart sensors: block diagram- Smart transmitter. Recent trends in sensor technology – Semiconductor sensors–Film sensors – MEMS - Nanosensors.

Module 5: MEASUREMENT OF DIMENSION
Measurement of Dimension, Sound and Thermal conductivity : Thickness measurement- Contact type thickness gauge- Inductive methods , Capacitive methods . Non contact type - Radiation type- Laser based thickness gauges- Measurement of coating thickness- Laser based length measurement- Width measurement – Diameter measurement. Measurement of sound using microphones, Measurement of thermal conductivity of solids, liquids and gases.

TEXT BOOKS

1. D. Patranabis, Principles of Industrial Instrumentation Tata McGraw Hill Publishing Co., New Delhi, 1999
2. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi 1999.
3. A.K.Sawhney, A course in Mechanical Measurements and Instrumentation – Dhanpat Rai and Sons, New Delhi, 1999.

REFERENCES

1. Ernest O. Doebelin, Measurement systems application and design international student Edition, Tata McGraw Hill Publishing Co., New Delhi, 1999.
2. Eckman D.P.Industrial Instrumentation – Wiley Eastern Limited, 1990.
3. Liptak B.G. Instrument Engineers Handbook (Measurement), Chilton Book Co., 1994.
4. Padmanabhan T R, Industrial Instrumentation Principles and Design, Springer International

IC010 706L01 ARTIFICIAL INTELLIGENT & EXPERT SYSTEMS

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

Objectives:

(i)To study the idea of intelligent agents and search methods.
(ii). To study about representing knowledge.
(iii). To study the reasoning and decision making in uncertain world.
(iv). To construct plans and methods for generating knowledge.
(v). To study the concepts of expert systems.

MODULE-I : INTRODUCTION

Introduction to AI: Intelligent agents – Perception – Natural language processing –Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.

MODULE-II: KNOWLEDGE AND REASONING

Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents: Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.

MODULE-III: UNCERTAIN KNOWLEDGE AND REASONING

Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – Probabilistic reasoning – Making simple decisions.

MODULE-IV: PLANNING AND LEARNING

Planning: Planning problem – Partial order planning – Planning and acting in nondeterministicdomains – Learning: Learning decision trees – Knowledge in learning –Neural networks – Reinforcement learning – Passive and active.

MODULE-V: EXPERT SYSTEMS

Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.

TEXT BOOKS

1. Stuart Russel and Peter Norvig, 'Artificial Intelligence - A Modern Approach', Second

Edition, Pearson Education, 2003 / PHI.

2. Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education.

REFERENCE BOOKS

1. George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem

Solving', Fourth Edition, Pearson Education, 2002.
2. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995.
3. Janakiraman, K. Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science.
4. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003.

IC010 706L02 ROBOTICS & AUTOMATION

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

Objectives:
i. To study the various parts of robots and fields of robotics.
ii. To study the various kinematics and inverse kinematics of robots.
iii. To study the Euler, Lagrangian formulation of Robot dynamics.
iv. To study the trajectory planning for robot.
v. To study the control of robots for some specific applications.

MODULE-I: INTRODUCTION TO ROBOTICS
History of Robots – Classifications – Various fields of Robotics – Actuators – Sensors – Manipulators – End effectors – Application areas – Robot programming languages.

MODULE-II: ROBOT KINEMATICS
Matrix representation – Homogeneous transformation – DH representation of standard robots – Inverse kinematics.

MODULE-III: ROBOT DYNAMICS
Velocity kinematics – Jacobian and inverse Jacobian – Lagrangian formulation – Eulers Lagrangian formulation – Robot equation of motion.

MODULE-IV: TRAJECTORY PLANNING
Introduction – Path Vs trajectory – Joint-space Vs Cartesian-space descriptions – Basics of trajectory planning – Joint-space trajectory planning – Cartesian-space trajectories.

MODULE-V: CONTROL AND APPLICATION OF ROBOTICS
Linear control of robot manipulation – Second-order systems – trajectory following control Modeling and control of single joint – Architecture of industrial robotic controllers – Robot applications.

TEXT BOOKS
1. Saced B. Niku, ‘ Introduction to Robotics Analysis, Systems, Applications’, Prentice Hall of India/Pearson Education, Asia, 2001.
2. Craig, ‘Introduction to Robotics Mechanics and Control’, Second edition, Pearson Education, Asia, 2004.

REFERENCE BOOKS
1. K.S. Fu & Co., ‘Robotics Control, Sensing, Vision and Intelligence’, McGraw Hill International Editions, Industrial Engineering Series, 1991.
2. Klafter R.D., Chimielewski T.A. and Negin M., ‘Robotic Engineering – An integrated Approach’, Prentice Hall of India, New Delhi, 1994.
8. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, ‘Industrial Robotics Technology Programming and Application’, McGraw Hill book company, 1986.

IC010 706L03 EMBEDDED INSTRUMENTATION SYSTEM

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

Objectives:
i. To study the various parts of robots and fields of robotics.
ii. To study the various kinematics and inverse kinematics of robots.
iii. To study the Euler, Lagrangian formulation of Robot dynamics.
iv. To study the trajectory planning for robot.
v. To study the control of robots for some specific applications.

MODULE-I : INTRODDUCTION
Embedded system evolution trends - basic real time concepts - real time design issues - 68HC11 Microcontrollers -architecture - instruction set -interrupt handling –integrating interrupts in a system -examples -the shared data problem -software architecture.

MODULE-II: REAL TIME OPERATING SYSTEMS
Real time specifications – real time kernels – inter-task communications and synchronizations – real time memory management.

MODULE-III: SYSTEM PERFORMANCE, ANALYSIS AND OPTIMIZATION
Response – time calculation – interrupt latency – time loading and its measurement –scheduling – reducing response times and time loading – analysis of memory requirements –reducing memory loading – input – output performance.

MODULE-IV: DEBUGGING TECHNIQUES AND DEVELOPMENT TOOLS
Faults, failures, bugs and effects – reliability – testing – fault tolerance – host and target machines – linker / locators for embedded software – getting embedded software into target system.

MODULE-V: REAL TIME APPLICATION
Real time system as complex systems – real time databases – real time image processing – real time Unix – building real time applications with real time programming languages
An example : The tank monitoring systems

Text Books
1. Philip A. Laplante, “Real Time Systems Design and Analysis: An Engineer’s Handbook”, edition, Prentice Hall of India, New Delhi, 2000
2. David E. Simon, “An Embedded Software Primer”, Addision Wesley, New Delhi, 2000

Reference Books
1. Raymond J.A. Bhur and Donald L. Bialey, “An Introduction to Real Time Systems: From Design to Networking with C/C++”, Prentice Hall of Inc., New Jersey, 1999

2. John B.Peatman, “Design with Microcontrollers”, McGraw Hill Book Co., New york, 1988
3. Jonathan W. Valvano, “Embedded Micro Computer System: Real Time Interfacing”, Brooks/Cole, USA, 2000
4. C.M. Krishnan and Kang G. Shin “ Real Time Systems”, McGraw Hill, New Delhi 1997

IC010 706L04 ULTRASONIC INSTRUMENTATION

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

***Objectives*:**

(i) To study the basic properties of ultrasonic waves.
(ii) To study the different methods to generate the ultrasonic waves.
(iii) To study the different ultrasonic test methods.
(iv) To study about the measure of the variables using ultrasonic methods.
(v) To study about the ultrasonic applications in various field.

Module-I: Ultrasonic Properties

Ultrasonic waves-principles and propagation of various waves-characterisation of ultrasonic transmission-reflection and transmission co-efficients-intensity and attenuation of sound beam-power level-medium parameters

Module-II: Generation of Ultrasonic Waves

Generation of ultrasonic waves-magnetosrictive and piezo-electric effects-search unit types-construction and characteristics

Module-III: Test methods

Ultrasonic test methods-pulse, echo, transit time, resonance, direct contact and immersion type-ultrasonic methods of flaw detection

Module-IV: Variables measurement

Ultrasonic methods of measuring thickness, depth and flow – variables affecting ultrasonic testing in various applications.

Module-V: Applications

Ultrasonic application in medical diagnosis and therapy – acoustical holography.

References:

1 . Krauthkumar J . & Krauthkumar H : Ultrasonic Testing of Materials , Narosa Publishing House , New Delhi , 1993 .

2 . Wells N . T : Biomedical Ultrasonics , Academic Press , London , 1977 .

3 . Bray B . E and Mcbride D . Non destructive testing techniques , John Wiley & sons , 1992 .

IC010 706L05 VLSI DESIGN

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

Objectives:
i. To introduce MOS theory / Manufacturing Technology.
ii. To study inverter / counter logic / stick / machine diagram / sequential circuits.
iii. To study address / memory / arithmetic circuits.
iv. To introduce FPGA architecture / principles / system design.
v. To get familiarized with VHDL programming behavioral/Structural/concurrent/ process.

Module-I: BASIC MOS TRANSISTOR
Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – Second order effects – MOS Transistor Model.

Module-II: NMOS & CMOS INVERTER AND GATES
NMOS & CMOS inverter – Determination of pull up / pull down ratios – Stick diagram – lamda based rules – Super buffers – BiCMOS & steering logic.

Module-III: SUB SYSTEM DESIGN & LAYOUT 9
Structured design of combinational circuits – Dynamic CMOS & clocking – Tally circuits – (NAND-NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

Module-IV: DESIGN OF COMBINATIONAL ELEMENTS & REGULAR ARRAY LOGIC
NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA.

Module-V:VHDL PROGRAMMING
RTL Design – Combinational logic – Types – Operators – Packages – Sequential circuit – sub programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / Demltiplexers).

TEXT BOOKS
1. D.A.Pucknell, K.Eshraghian, ‘Basic VLSI Design’, 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Eugene D.Fabricius, ‘Introduction to VLSI Design’, Tata McGraw Hill, 1990.

REFERENCE BOOKS
1. N.H.Weste, ‘Principles of CMOS VLSI Design’, Pearson Education, India, 2002.
2. Charles H.Roth, ‘Fundamentals of Logic Design’, Jaico Publishing House, 1992.
3. Zainalatsedin Navabi, ‘VHDL Analysis and Modelling of Digital Systems’, 2nd Edition, Tata McGraw Hill, 1998.
4. Douglas Perry, ‘VHDL Programming by example’, Tata McGraw Hill, 3rd Edition, 2003.

IC010 706L06 VIRTUAL INSTRUMENTATION

Teaching Scheme: 3 Hours lecture and 1 Hour tutorial per week **Credits:4**

OBJECTIVES

i. To know about the fundamentals of virtual instrumentation.
ii. To study the basic building blocks of virtual instrumentation.
iii. To study the various techniques of interfacing of external instruments of PC.
iv. To study the various graphical programming environment in virtual instrumentation.
v. To study a few applications in virtual instrumentation.

MODULE-I: REVIEW OF DIGITAL INSTRUMENTATION

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

MODULE-II: DATA ACQUSITION IN VI

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

MODULE-III: CLUSTER OF INSTRUMENTS IN VI SYSTEM

Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards – IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.

MODUL-IV: GRAPHICAL PROGRAMMING ENVIRONMENT IN VI

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes –Local and global variables – String and file I/O.

MODULE-V: ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI

Fourier transform - Power spectrum - Correlation – Windowing and filtering tools –Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation -Simulation of a simple second order system – Generation of HTML page.

TEXT BOOKS

1. S. Gupta and J.P Gupta, ‘PC Interfacing for Data Acquisition and Process Control’, Instrument society of America, 1994.
2. Peter W. Gofton, ‘Understanding Serial Communications’, Sybex International.
3. Robert H. Bishop, ‘Learning with Lab-view’, Prentice Hall, 2003.

REFERENCE BOOKS

1. Kevin James, ‘PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control’, Newness, 2000.
2. Gary W. Johnson, Richard Jennings, ‘Lab-view Graphical Programming’, McGraw Hill Professional Publishing, 2001.

IC010 707 PROCESS CONTROL LAB

Teaching Scheme: 3 hours practical per week **2 credits**

Experiments:

1. Study of interacting and non-interacting systems.
2. Response of different order processes with and without transportation lag.
3. Response of P+I+D controller.
4. Characteristics of control valve with and without positioner.
5. Closed loop response of flow control loop.
6. Closed loop response of level control loop.
7. Closed loop response of temperature control loop.
8. Closed loop response of pressure control loop.
9. Tuning of PID controller.
10. Response of cascade control system & ratio control system.

Detailed Syllabus

1. Study of interacting and non- interacting systems

Aim

To study the operation of interacting and non- interacting systems

Exercise

1. Connect the two tank system (Level process) in series (as non- interacting system)
2. Check whether level in tank is affected due to changes made in the second tank.
3. Connect the two tank system in series (as interfacing as system).
4. Check whether level in tank 1 is affected due to changes made in the second tank.
5. Determine the transfer function of individual and overall system.

Equipment

1. Two tank system with provision for making them as interfacing and non interfacing. – 1 No
2. Level transmitters – 1 No
3. Recorder – 1 No

2. Response of different order processes with and without transportation delay

Aim

To determine the transient response of a first order process with and without transportation delay and second order process with and without transportation delay to step change in input.

Exercise

1. Record the transient response to a step change of first order process and second order process (Level or thermal (or) any process) with and without transportation lag.
2. Calculate the process gain, time constant and dead time of the process from the step response.

Equipment

1. Two tank system with provision for transportation delay (Non – interacting process)
2. Level transmitter – 1 No

3. Recorder – 1 No

3. Response of P+I+D controller

Aim

To investigate the operation of an electronic controllers with P, P+I and P+I+D action.

Exercise

1. Plot the response of P, P+I, P+D and P+I+D controllers to step and ramp inputs.
2. Determine the calibration of the proportional, Integral and derivative adjustments.

Equipment

1. Electronic PID controller – 1 No
2. Source for generating step and ramp inputs – 1 No
3. Recorder – 1 No
4. Digital Multimeter – 1 No

4. Characteristics of control valve with and without valve positioner

Aim

To determine the flow – lift characteristics (Internet / Installed) of a control valve equipped with and without valve positioner.

Exercise

1. Plot the flow – lift characteristics of the given valve without positioner keeping
(i) Constant ΔP
(ii) Variable Δ P
2. Compute the valve gain at different operating points.
3. Plot the flow – lift characteristics of the given with positioner keeping.
i. Constant ΔP
ii. Variable ΔP
4. Compute the valve gain at different operating points.

Equipment

1. Control valve trainer (with position for varying ΔP across the valve) - 1 No
2. Flowmeter - 1 No

5. Closed loop response of flow control loop

Aim

To obtain the closed loop response of flow control loop for servo and regulator operation.

Exercise

1. Closed – loop connection is made in the flow process station.
2. The flow controller (P+I) is tuned using any one of the tuning techniques.
3. The response of the control loop is obtained for changes in the set point.
4. The response of the control loop is obtained for changes in the load variable.
5. The step 3 and 4 are repeated for different controller modes and settings.

Equipment

1. Flow process station with all accessories - 1 No
2. Analog / Digital PID controller - 1 No
3. Recorder - 1 No

6. Closed loop response of level control loop

Aim

To obtain the closed loop response of level control loop for servo and regulator

operation.

Exercise

1. Closed loop connection is made in the level process station.
2. The level controller (P+I) is tuned using any one of the tuning techniques.
3. The response of the control loop is obtained for changes in the set point.
4. The response of the control loop is obtained for changes in the load variable.
5. The step 3 and step 4 are repeated for different controller modes and settings.

Equipment

1. Level process station with all accessories - 1 No
2. Analog / Digital PID controller - 1 No
3. Recorder - 1 No

7. Closed loop response of temperature control loop

Aim

To obtain the closed loop response of temperature control loop for servo and regulator operation.

Exercise

1. Closed-loop connection is made in the temperature process station.
2. The temperature controller (P+I+D) is tuned using any one of the tuning techniques.
3. The response of the control loop is obtained for changes in the set point.
4. The response of the control loop is obtained for changes in the load variable.
5. The step 3 and 4 are repeated for different controller modes and settings.

Equipment

1. Temperature process station with all accessories - 1 No
2. Analog / Digital PID controller - 1 No
3. Recorder - 1 No

8. Closed loop response of pressure control loop

Aim

To obtain the closed loop response of pressure control loop for servo and regulator operation.

Exercise

1. Closed – loop connection is made in the pressure process station.
2. The pressure controller (P+I) is tuned using any one of the tuning techniques.
3. The response of the control loop is obtained for changes in the set point.
4. The response of the control loop is obtained for changes in the load variable.
5. The step 3 and 4 are repeated for different controller modes and settings.

Equipment

1. Pressure process station with all accessories - 1 No
2. Analog / Digital PID controller - 1 No
3. Recorder - 1 No

9. Tuning of PID controller

Aim

To determine the controller settings of a given process using two popular tuning techniques.

Exercise

1. Plot the process reaction curve for the given process (higher order process)
2. From the reaction curve, calculate the process gain, time constant and dead time

using the above process parameters calculate the Kc, Ti, Td valves using the appropriate thumb rules.
3. Conduct the closed loop test as per Z-N method [continuous cycling method] and determine the ultimate gain (Ku) and ultimate period (Pu), calculate the controller parameters (Kc, Ti, Td) using Ziegler Nichol's closed loop tuning approach.

Equipment

1. Process control trainer / real time process (level / thermal process) - 1 No
2. Recorder - 1 No
3. PID controller - 1 No

10. Response of cascade control system & Ratio Control System

Aim

(i) To determine the closed loop performance of a cascade control system and compare it with that of conventional control system.
(ii).To determine the closed response of the ratio control system.

Exercise

1. The secondary and primary controllers are tuned using any one of the tuning techniques.
2. Obtain the closed loop response of cascade control system with the load variable entering the inner loop.
3. Obtain the closed loop regulating response with conventional control system.
4. Compare the performance of conventional control system and cascade control system internal of peak overshoot, setting time, I&E etc
5. Set the level in the reference tank & obtain the response of the process tank level.

Equipment

1. Cascade control system with flow as inner variable and liquid level as outer variable with following accessories.
2. Level transmitter - 1 No
3. Flow transmitter - 1 No
4. Control valve - 1 No
5. Analog / Digital PID controller - 1 No
6. Recorder - 1 No

IC010 708 MECHANICAL MEASUREMENTS LAB

Teaching Scheme: 3 hours practical per week **2 credits**

Experiments:

1. **Measurement of linear and angular dimensions:** calibrations & use of micrometer, vernier calipers, dial gauges, vernier height gauges, feeler gauges, screw pitch gauges, wire/plate gauges, angle gauges, bevel protractor, sine bar, autocollimator, slip gauges, gear tooth calipers.
2. **Measurement of flow**: Measurement of air flow-calibration and use of wind velocity recorders. Hot wire anemometer Pitot static tube-Measurement of water flow-calibration and use of use of flow measuring devices in closed pipes and open channels like venturimeter. Orifice meter, Notches (Rectangular /triangular)
3. **Measurement of speed**: Calibration and use of mechanical tachometer, RPM counters, stroboscopes
4. **Measurement of area**: Calibration and use of polar planimeter
5. **Measurement of vibration**: Calibration and use of vibration meter, accelerometer, vibration indicator, shock pulse meter, bearing analyzers.Free and forced vibration measurements
6. **Acoustic measurements**: Calibration and use of precision sound leave meter, octave band filter, preparation of noise contours.
7. **Measurement of psychometric of air**: calibration and use of wet and dry bulb thermometers Barometers, Human air hygrometers preparation of psychometric chart.
8. **Measurement and analysis of automobile exhaust gases**: Calibration and use of exhaust gas analyzers (both petrol and diesel engines) Orsat apparatus-Engine indicator, air flow indicator diagram preparation –Air intake measurement performance analysis (volumetric efficiency, Brakemann effective pressure and efficiency) of internal combustion engine

IC 010 709 Seminar

Teaching scheme **credits: 2**

2 hours practical per week

The seminar power point presentation shall be fundamentals oriented and advanced topics in the appropriate branch of engineering with references of minimum seven latest international journal papers having high impact factor.

Each presentation is to be planned for duration of 25 minutes including a question answer session of five to ten minutes.

The student's internal marks for seminar will be out of 50. The marks will be awarded based on the presentation of the seminar by the students before an evaluation committee consists of a minimum of 4 faculty members. Apportioning of the marks towards various aspects of seminar (extent of literature survey, presentation skill, communication skill, etc.) may be decided by the seminar evaluation committee.

A bona fide report on seminar shall be submitted at the end of the semester. This report shall include, in addition to the presentation materials, all relevant supplementary materials along with detailed answers to all the questions asked/clarifications sought during presentation. All references must be given toward the end of the report. The seminar report should also be submitted for the viva-voce examination at the end of eighth semester.

For Seminar, the minimum for a pass shall be 50% of the total marks assigned to the seminar.

IC 010 710 Project Work

Teaching scheme **credits: 1**

1 hour practical per week

Project work, in general, means design and development of a system with clearly specified objectives. The project is intended to be a challenge to intellectual and innovative abilities and to give students the opportunity to synthesize and apply the knowledge and analytical skills learned in the different disciplines.

The project shall be a prototype; backed by analysis and simulation etc. No project can be deemed to be complete without having an assessment of the extent to which the objectives are met. This is to be done through proper test and evaluation, in the case of developmental work, or through proper reviews in the case of experimental investigations.

- The project work has to be started in the seventh semester and to be continued on to eighth semester.
- Project work is to be done by student groups. Maximum of four students only are permitted in any one group.
- Projects are expected to be proposed by the students. They may also be proposed by faculty member (Guide) or jointly by student and faculty member.
- Students are expected to finalise project themes/titles with the assistance of an identified faculty member as project guide during the first week of the seventh semester.

The progress from concept to final implementation and testing, through problem definition and the selection of alternative solutions is monitored. Students build self confidence, demonstrate independence, and develop professionalism by successfully completing the project.

Each student shall maintain a project work book. At the beginning of the project, students are required to submit a project plan in the project book. The plan should not exceed 600 words but should cover the following matters.

- ❖ Relevance of the project proposed
- ❖ Literature survey
- ❖ Objectives
- ❖ Statement of how the objectives are to be tackled

- Time schedule
- Cost estimate

These proposals are to be screened by the evaluation committee (EC- minimum of 3 faculty members including the guide) constituted by the head of department, which will include a Chairman and the EC will evaluates the suitability and feasibility of the project proposal. The EC can accept, accept with modification, request a resubmission, or reject a project proposal.

Every activity done as part of project work is to be recorded in the project book, as and when it is done. Project guide shall go through these records periodically, and give suggestions/comments in writing in the same book.

The students have to submit an interim report, along with project work book showing details of the work carried out by him/her and a power point presentation at the end of the 7^{th} semester to EC. The EC can accept, accept with modification, request a resubmission, or extension of the project.

The student's internal marks for project will be out of 50, in which 30 marks will be based on day to day performance assessed by the guide. Balance 20 marks will be awarded based on the presentation of the project by the students before an evaluation committee consists of a minimum of 3 faculty members including the guide.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.

IC010 801 INSTRUMENTATION SYSTEM DESIGN

(Common to AI010 801 and EI010 801)

Teaching scheme **Credits:** 4

3 hours lecture and 2 hours tutorial per week

Objectives:

To help the students get basic understanding of the following:

- *Design of instrumentation systems for various applications.*
- *Design of electronic and pneumatic controllers.*
- *Piping and instrumentation diagrams.*
- *Procedures for the preparation of an instrumentation project.*
- *Noise and noise reduction techniques in measurement.*

Module I: Design of signal conditioning circuits for sensors

Sensing element : Elastic sensing elements - Cantilever and torque elements, Pillar load cell, Strain gauge accelerometer- Inductive push pull displacement sensor -Capacitive level sensor .

Signal conditioning element :Design of resistive and reactive bridges for sensors. Design of the bridge Circuit for RTD- Design of reference junction compensation for thermocouple.- Linearising techniques for thermocouple and thermistor- Design of charge amplifier-Instrumentation amplifier. A.C. carrier systems.- Lock in amplifier.

Module II: Transmitters Design

Current transmitters-Concept of 2 and 4 wire transmitters with 4-20mA output- Open loop and closed loop current transmitters. Smart transmitters- Future trends in intelligent devices- Design of pneumatic and electronic PID controllers-Design of ON-OFF controllers with neutral zone -Design of instrumentation servo mechanism- Design of annunciators - Low level and high level annunciators.- Enunciators

Module III: Flow Meter Design

Orifice meter- Design of orifice for a given flow condition for compressible and incompressible fluids -Design of rotameter- Design of venturi meter- Bourdon gauges- Factors affecting sensitivity- Design of bourdon tubes- Design of square root extractors for variable head flow meters.

Module IV:Piping and Instrumentation Diagram and Procedures

Piping and instrumentation diagrams – ISA symbols – Process and instrumentation (PI)diagram of typical process plant – Preparation of instrumentation project – Documents to be produced- Process flow sheet – mechanical flow sheets- Instrument index sheet – Instrument specification sheet – Process information required- process

information – Bid documents – project procedures – Project schedule – Vendor drawings – Work coordination – Project manager – process engineer – Equipment engineer – Job execution – planning hints- scheduling- Project checklist – equipment delivery - Conclusion Instrument specification sheet for pressure – Choice of temperature – flow – level – analytical instruments and control panels.

Module V: Noises in Instrument System

Signals and noise in instrument systems – Statistical representation – pdf – psd – Auto correlation function – Effects of noise and interference – Series and common mode – Noise sources and coupling mechanisms – Multiple earths – Methods of reduction of noise – Shielding – Screening – Filtering – Modulation – Averaging – Auto correlation .

Reference Books:

1. John P. Bentley : Principles of measurement systems, Longman 1983
2. Johnson C.D: Process control instrumentation technology, 4/e, PHI, 1995
3. D.Patranabis : Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd. New Delhi, 1999
4. Sheingold D. H.: Transducer interfacing hand book – a guide to analog signal conditioning, analog devices Inc masschusetts, 1980.
5. Anderson N A : Instrumentation for process measurement and control :Chilton book company 1980.
6. Andrew w: Applied Instrumentation in process Industries; Vol. II. Gulf publications, 1990.
7. Doebelin.E.O. Measurement systems applications and design, McGraw Hill, 1975.
8. Tattamangalam R. Padmanabhan : Industrial Instrumentation Principles and Design, Springer International
9. E. Radhakrishnan : Instrumentation, measurements and Experiments in Fluids, Boca Raton, FL : CRC Press

IC010 802 POWER PLANT INSTRUMENTATION

Teaching scheme: 2 hours lecture and 2 hours tutorial per week **Credits:** 4

Objectives:

i) To provide an overview of different power generation methods.
ii) To bring out the various measurements involved in power generation plants.
iii) Emphasis laid on the nuclear reactor and instrumentation symbols
iv) To impart knowledge about the different types of controls and control loops.
v) To provide knowledge about the different treatment methods in tne power plants.

Module-I: OVERVIEW OF POWER PLANT GENERATION

Introduction to power plant process-types of fuels-Principle types of power plants-classification of power plant cycles-rankine, reheat, regenerative, carnot and brayton cycles-boilers-water tube, once through and fluidized types –types of condenses –steam combines cooling water system – types of hydro turbines–gas turbines–combined cycle power plant–power generating and distributing system

Module-II: MEASUREMENTS IN POWER PLANT

Measurement and analysis in power plant –electrical measurement, current, voltage, power, and frequency-flow measurements- feed water, fuel flow, and airflow correction for temperature and pressure mmts –Level mmts-Smoke density mmts-Chromatography-PH METER-conductivity meter-TDS Meter-Flame scanners-Measurement of silica –dissolved Oxygen Monitoring System

Module-III: NUCLEAR REACTOR AND DIAGRAMS

Introduction to nuclear reactor-essential components, power of nuclear reactor –classification-PWR/BWR/FBR/GCR - pollution from power plants

Reading and drawing of Instrumentation diagrams-Flow Sheets symbols-ANSIC Symbols for 1.lines2.valves3.Heat transfer 4.dryer 5.material handling equipments 6.Storage vessel 7.Turbine-compressor 8.Flow sheet codes and lines 9.Graphical symbols for pipe fittings, valves and piping-instrumentation symbols-standards-specifications one line diagram of typical mmts And control schemes-for flow, temperature, pressure, and other process variables-one line diagram of typical pneumatic hydraulic and electrical instrumentation systems.

Module-IV: TYPES OF CONTROLS

Combustion control main pressure air/fuel ratio, Furnace draft and excess air control-drum level control-Two element and Three element control-Main and reheat stem temperature control-Burner tilting and Bypass damper–Super Heater-Spray and gas recirculation control-BFT Recirculation control –Hot well and de-aerator level control—interlocks-Turbine monitoring and control-condenser vacuum control- exhaust steam pressure control-speed monitoring ,vibration monitoring –shell temperature monitoring-Lubricant oil temperature control-H2 Generator cooling system.-H2 purity monitoring -control and safety instrumentation and reliability aspects

Module-V: TREATMENT IN POWER PLANT

Auxiliaries in power plant –Instrument air –Common impurities in feed water-different methods of treatment-Air preheating type-soot blowers. Mechanical and electrical precipitators-us e of computer in power plant-DAS Graphics/bar chart/alarms/start up and shutdown log-load dispatching computer generation station computer-simulators in power plant

References:

1. Rajput,"Power plant Engineering"
2. CEGB Engineers, "Modern power station practice"volume6, pergamon
3. Kallen, "power plant instrumentation"
4. Andrews &Williams, "Applied instrumentation in process industries"
5. Mcculough C.R.,"Safety aspects of nuclear reactors".Van

IC010 803 INSTRUMENTATION & CONTROL IN PETRO CHEMICAL INDUSTRIES

Teaching scheme: 2 hours lecture and 2 hours tutorial per week **Credits:** 4

Objectives:

(i) Petroleum Geology and Scope
(ii) Instrumentation and control in chemical reactors.
(iii) Instrumentation and control in dryers.
(iv) Control of Pumps.
(v) Instrumentation and control in evaporators.

Module-I: PETROLEUM GEOLOGY & SCOPE

Origin of Petroleum (emphasis on both techniques and geo chemistry), oil and gas traps. Physical and chemical characteristics of crude oil, source rock and maturation. Migration of oil-mechanism pattern and barriers, Reservoir rocks and cap rocks, Entrapment of oil-types and mechanism.Application of remote sensing in petroleum resource development, Basin and exploration strategies. The model approach to exploration strategty, Basin mapping methds, Depositional systems such as marine, non-marine, coastal, shelf, carbonate evaporates, Basin evolution, Sedimentation and Plate techtonics, Basin evalution, factors governing hydrocarbon potential.

Module-II: INSTRUMENTATION AND CONTROL IN CHEMICAL REACTORS

Temperature and pressure control in batch reactors. Instrumentation and control in distillation columns: Distillation equipment – Variables and degrees of freedom – Measurement and control of column pressure – Liquid distillate – Vapour distillate and inserts – Control of feed in reboiler and refelx – Use of Gas Chromatography – Cascade and feed forward controls – PH control system in Chemical Industries.

Module-III: INSTRUMENTATION AND CONTROL IN DRYERS

Batch dryers and Continous dryers. Instrumentation and control in heat excahngers: Variables and degrees of freedom – Liquid to Liquid heat exchangers – Steam heaters – Condensers – Reboilers and vaporizers – use of cascade and feed forward control.

Module-IV: CONTROL OF PUMPS

Centrifugal pumps – Rotary Pumps – Reciprocating pumps – Throttling control – On-off control. Absolute pressure control schemes for compressors with special reference to surge control.Effulent and water treatment.

Module-V: INSTRUMENTATION AND CONTROL IN EVAPORATORS

Types of Evaporators – Steady state Model – Process dynamics – feedback trim – steam entalpy – product density measurement - Measurement and control of absolute pressure, conductivity, differential pressure, and flow.

Reference Books:

1. Kellen " Power Plant Instrumentation"
2. Andrews & William "Applied Instrumentation in Process Industries" Vol:2
3. Liptak B.G "Instrumentation and Processing Industries" Chiller Book Co.
4. Bradely H B "Petroleum Engineering Handbook", SPE
5. Berger B D, Anderson K E, "Modern Petroleum" Pennwell Books

IC010 804L01: INTELLIGENT CONTROL SYSTEM

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

(i) To learn about the biological background and various learning process of neural networks.
(ii) To learn about the probabilistic approach machine and some application.
(iii) To provide adequate knowledge about fuzzy set theory.
(iv) To provide adequate knowledge of application of fuzzy logic control to real time system.
(v) To learn about the fundamentals of Genetic algorithm.

Module-I: Artificial Neuron and its learning

Introduction to Artificial Neural Networks- Biological Prototypes- McCulloch & Pitts models of neurons- Types of Activation functions- Network Architecture- Training of Neural Networks- Knowledge representation- Learning process- Error Correction Learning-Supervised Learning- Unsupervised Learning- Perceptron- Perceptron Convergence Theorem (without proof)- Linear Separability- Multilayer Perception-Back Propagation Algorithms

Module-II: Feedback & Feed forward Neurons

Recurring Neural Networks- Hopfield Networks- Energy Functions- Simulated Annealing- Boltzmann Machine- Boltzmann Learning Rule- Mean Field Theory Machine-Mean Field Theory Learning Algorithm.

Application of Neural Network- Process identification- Neuro Controller for Inverted Pendulum

Module-III: Fuzzy Systems

Introduction to Fuzzy Logic- Review of Crisp Set Theory- Basic concepts of Fuzzy Sets- Properties- Operations on Fuzzy Sets- Fuzzy relations- Membership Functions- Fuzzification and Defuzzification- Fuzzy logic control principles-Fuzzy controllers-Mamdani and TSK types

Module-IV: Fuzzy Logic Control

Adaptive Fuzzy Systems-Generation of membership function of Fuzzy Logic Controllers using Neural Networks-Fuzzy Neuron-Design of Fuzzy Logic Controller for controlling temperature, speed, chemical process and truck& trailer

Module-V: Genetic Algorithm

Introduction to Genetic Algorithms and Hybrid Systems- Genetic algorithms-Natural Evolution-Properties--GA Features-Coding-Selection-Reproduction-Crossover and Mutation operators-

Basic GA structure-Hybrid Systems-Classification-Basic concept of Neurogenetic, Neuro genetic and Fuzzy genetic systems

References:

1. Simon Haykins, “Neural Networks- A Comprehensive Foundation” , Macmillan College, Proc. ,Con, Inc
2. James A. Freeman and David M. Skapura, “ Neural Networks- Algorithms ,Applications and Programming Techniques” , Pearson Education Asia,Inc
3. Zurada J.M, “Introduction to Artificial Neural Systems”,Jaico publishers
4. P.D.Wasserman, “Neural Computing Theory and Practice” , Van Nortrand Reinhld, New York
5. T.J Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill
6. John Yen& Reza Langari, “ Fuzzy Logic- Intelligence, Control and Information”
7. George J. Klir and Tina A Folger, “Fuzzy Sets Uncertainty and Information”, Prentice Hall India
8. Drainkov D, Hellendoorn and Reinfrank M, “An Introduction to Fuzzy Control” , Norosa
9. Goldgerg D.E., “ Genetic Algorithms in Search Optimisation and Machine Learning”, Addison Wesley
10. S.Rajasekharan, G.A Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms-Synthesis and Applications”

IC010 804L02 AUTOMOTIVE INSTRUMENTATION

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

(i) To acquaint the students with construction and design of the various automobile panel meters.
(ii) To study the designing of various indicating instruments.
(iii) To study about the various warning and alarm instruments.
(iv) To provide adequate knowledge in dash board amenities.
(v) To have an adequate knowledge in switches & controls.

Module: I - Automobile Panel Meters and Sensor Design

Ergonomics – Panel Meters – Controllers – Sensor for Fuel Level in Tank, Engine Cooling Water Temperature Sensors Design, Engine Oil Pressure Sensor Design, Speed Sensor, Vehicle Speed Sensor Design, Air Pressure Sensors, Engine Oil Temperature Sensor.

Module: II – Indicating Instrumentation Design

Moving Coil Instrument Design, Moving Iron Instruments, Balancing Coil Indicator Design, Ammeter and voltmeter – Odometer and Taximeter Design, Design of Alphanumeric Display for Board Instruments

Module: III – Warning and Alarm Instruments

Brake Actuation Warning System, Traficators, Flash System, Oil Pressure Warning System, Engine Overheat Warning System, Air Pressure Warning System, Speed Warning System, Door Lock Indicators, Gear Neutral Indicator, Horn Design, Permanent Magnet Horn, Air Horn, Music Horns.

Module: IV – Dash Board Amenities

Car Radio Stereo, Courtesy Lamp, Timepiece, Cigar Lamp, Car Fan, Windshield Wiper, Window Washer, Instrument Wiring System and Electromagnetic Interference Suppression, Wiring Circuits for Instruments, Electronic Instruments, Dash Board Illumination

Module: V - Switches and Controls

Horn Switches, Dipper Switches, Pull and Push Switches, Flush Switches, Toggle Switches, Limit Switches, Ignition Key, Ignition Lock, Relay and Solenoid, Non – contact Switches

Text Books:

1. Walter E, Billiet and Leslie .F, Foings, ‘Automotive Electric Systems’, American Technical Society, Chicago, 1971.
2. Judge .A.W., ‘ Modern Electric Equipments for Automobiles’, Chapman and Hall, London, 1975.

IC010 804L03 INSTRUMENTATION AND CONTROL IN PAPER INDUSTRIES

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

(i) To expose the students the paper making process and important terms of paper manufacturing.
(ii) To impart the knowledge on various properties of paper.
(iii) To get introduced with the wet end instrumentation in paper industries.
(iv) To get introduced with the dry end instrumentation in paper industries.
(v) To study the control philosipies in the paper industry.

Module-I: PAPER MAKING PROCESS

Paper making process – Raw materials – Pulp preparation – Screening – Bleaching – Cooking – Chemical addition – Instrumentation needs – Energy conservation and quality control.

Module-II: PROPERTIES OF PAPER

Physical, Electrical, Optical and Chemical properties of paper – Basis weight, Thickness, density, Porosity, smoothness, softness, hardness and compressibilty - Stress-strain relationship; Tensile strength; Bursting Strength; Tearing Strength; Folding Strength; Folding endurance, Stiffness and impact strength- Dielectric constant, Dielectric strength, Dielectric loss and properties of electrical insulating papers- Brigthness, colour, gloss and capacity – Copper number; Viscosity ; Ash content; Rosin size and content; Starch content; Acidity and PH

Module-III: WET END INSTRUMENTATION

Wet End Instrumentation – Conventional measurements at wet end – Consistency measurement – High-low PH, ORP; Digester – Rotary and Batch – Bleaching at wet end.

Module-IV: DRY END INSTRUMENTATION

Dry end Instrumentation- Conventional measurements – Moisture ; Basics weight; capilipre, Coat thickness , Brightness and colour; Tensile Strength- Calendring – Modern Instrumentation Techniques.

Module-V: CONTROL IN PAPER INDUSTRIES

Control Aspects – Consistency, Moisture and Basics weight control- Machine and cross directional cotrol techniques –Modern distributor control system (DCS) and Mill wide control.

Reference Books:

1. Sankaranarayanan P.E: Pulp and Paper Industry – Technology & Instrumentation. Kothari's Desk Book series 1995
2. James P. Casey: Pulp and Paper Chemistry and Chemical Technology, John Wiley & Sons, 1981
3. Richard E. Mark: Handbook of Physical and Mechanical Testing of Paper and Paperboard, Marcel Dekker, 1983.
4. Britt K.W : Handbook of Pulp and Paper Technology, van Nostrand Reinhold Company, 1970
5. Liptak B.G. : Instrumentation in the processing industries, Ghilton Book Co.,1973

IC010 804L04 DIGITAL IMAGE PROCESSING TECHNIQUES

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objective:

(i) Digital Image Fundamentals
(ii) Enhancement and Restoration
(iii) Segmentation & Representation
(iv) Recognition & Interpretation.
(v) Image Compression and some application.

Module-I: DIGITAL IMAGE FUNDAMENTALS

Image acquisition – Storage – Digital image representation, quantization and sampling, Imaging geometry, discrete image transforms – Properties and applications.

Module-II: ENHANCEMENT AND RESTORATION

Image enhancement techniques – Spatial domain methods histogram modification techniques, spatial filtering, enhancement in the frequency domain, image restoration – Degradation model – Inverse filter – Wiener filter constraint. Least squares restoration, restoration in spatial domain.

Module-III: SEGMENTATION & REPRESENTATION

Edge linking, boundary detection, threshold, region oriented, segmentation, representation schemes

Module-IV: RECOGNITION & INTERPRETATION

Decision theoretic methods, structural methods, interpretation – Knowledge based systems, logical systems, expert systems.

Module-V: IMAGE COMPRESSION

Image compression models, elements of information theory, transform coding –Video coding, coding standards.

TEXT BOOKS

1. R.C. Gonzalez, & R.E. Woods, 'Digital Image Processing', Addison Wesley, 1998.
2. A.K. Jain, 'Fundamentals of Digital Image Processing', Pearson Education, 1989 PHI.

REFERENCE BOOKS

1. A. Rosenfield & A.C. Kak, 'Digital Picture Processing', II edition, Academic Press New York 1982.
2. W.K. Pratt, 'Digital Image Processing', II Edition, John Wiley 1991.
a. K.R. Rao, J.J.Hwang, 'Techniques and Standards for Image Video and Audio Coding', Prentice Hall, N.J. 1996.

IC010 804L05 INSTRUMENTATION AND CONTROL IN AEROSPACE AND NAVIGATION

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

(i) Basics of Aircraft and Aircraft Instruments.
(ii) Air Data Instruments and Directional Systems
(iii) Gyroscopic and Advanced Flight Instruments.
(iv) Engine Instruments and Indicators.
(v) Aircraft Navigation Systems.

Module-I : BASICS OF AIRCRAFT AND AIRCRAFT INSTRUMENTS

Basics of Aircraft: Introduction, Control Surfaces, Forces, Moments and Angle of Attack (AOA) Engines, Avionics, Modern Aircraft System.

Aircraft Instruments and their Layout, Aircraft Display types, Instrument Grouping, Glass Cockpits of Modern Aircraft, Electronic Flight Instrument System (EFIS).

Module-II:AIR DATA INSTRUMENTS, DIRECTIONAL SYSTEMS

Introduction to Air Data Instruments, Types of Air data Instruments, International Standard Atmosphere (ISA), Air Data Instruments – Directional Systems : Magnetic Compass, Earth Magnetic Field.

Module-III: GYROSCOPIC AND ADVANCED FLIGHT INSTRUMENTS

Introduction – Types of Gyro – Basic Mechanical Gyro and its properties – Directional Gyro – Gyro Horizon – Turn and Bank Indicator – Turn coordinator – Standby Attitude Director Indicator (ADI) – Gyro Stabilised Direction Indicating Systems – Advanced Direction indicators.

Module-IV: ENGINE INSTRUMENTS, INDICATORS

Introduction- Engine Speed Measurements (RPM) – Torque Measurements – Pressure Measurements.

Engine Fuel Indicators : Fuel Quantity Indicator – Fuel Flow Rate Indicator.

Module-V : AIRCRAFT NAVIGATION SYSTEMS

Introduction – Radio Navigation Aids – Radio Navigation Systems – VHF Omnidirectional Range (VOR) System/DME/ILS/INS/GPS. Distance Measuring Equipment (DME), Instrument Landing Systems, Inertial Navigation System, Attitude and Heading Reference System (AHRS), Strap Down INS, Doppler Navigation System (DNS), Area Navigation, Global Positioning system (GPS)

Text Book:

1. “Aircraft Instrumentation and Systems” S.Nagabhushana, L.K.Sudha. I.K International Publishing House Pvt. Ltd.

IC010 804L06 TELECOMMUNICATION & SWITCHING NETWORKS

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

OBJECTIVES:

1. To introduce the concepts of Frequency and Time division multiplexing.
2. To introduce digital multiplexing and digital hierarchy namely SONET / SDH
3. To introduce the concepts of space switching, time switching and combination switching, example of a switch namely No.4 ESS Toll switch.
4. To introduce the need for network synchronization and study synchronization issues. To outline network control and management issues.
5. To study the enhanced local loop systems in digital environment. To introduce ISDN, DSL / ADSL, and fiber optic systems in subscriber loop.
6. To introduce statistical modeling of telephone traffic. To study blocking system characteristics and queuing system characteristics.
7. To characterize blocking probability holding service time distributions for in speech and data networks.

Module-I: MULTIPLEXING

Transmission Systems, FDM Multiplexing and modulation, Time Division Multiplexing, Digital Transmission and Multiplexing : Pulse Transmission, Line Coding, Binary NZero Substitution, Digital Biphase, Differential Encoding, Time Division Multiplexing, Time Division Multiplex Loops and Rings.

SONET/SDH : SONET Multiplexing Overview, SONET Frame Formats, SONET Operations, Administration and Maintenance, Payload Framing and Frequency Justification, Virtual Tributaries, DS3 Payload Mapping, E4 Payload Mapping, SONET Optical Standards, SONET Networks. SONET Rings: Unidirectional Path-Switched Ring, Bidirectional Line-Switched Ring.

Module-II: DIGITAL SWITCHING

Switching Functions, Space Division Switching, Time Division Switching, two dimensional Switching: STS Switching, TST Switching, No.4 ESS Toll Switch, Digital Cross-Connect Systems, Digital Switching in an Analog Environment. Elements of SSN07 signaling.

Module-III: NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT

Timing: Timing Recovery: Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.

Module-IV: DIGITAL SUBSCRIBER ACCESS

ISDN: ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. High-Data-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL. Digital

Loop Carrier Systems: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems, Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber Coax Systems, Voice band Modems: PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.

Module-V: TRAFFIC ANALYSIS

Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues.

TEXT BOOKS

1. Bellamy John, “Digital Telephony”, John Wily & Sons, Inc. 3rd edn. 2000.

REFERENCES BOOKS

1. Viswanathan. T., “Telecommunication Switching System and Networks”, Prentice Hall of India Ltd., 1994.

IC010 805G01 TEST ENGINEERING

(Common to EC010 805G01 and EI010 805G01)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives

1. *To provide an insight into multi-disciplinary approach to test engineering including test economics and management.*
2. *To understand practical, concise descriptions of the methods and technologies in modern mechanical, electronics and software testing.*
3. *To provide an insight into the developing interface between modern design analysis methods and testing practice.*
4. *To understand why products and systems fail, which testing methods are appropriate to each stage of the product life cycle and how testing can reduce failures.*
5. *To provide an overview of international testing regulations and standards.*

Module 1 (12 hrs)

Introduction: need for test, analysis and simulation, good and bad testing, test economics, managing the test programme

Stress, Strength and Failure of Materials: mechanical stress and fracture, temperature effects, wear corrosion, humidity and condensation, materials and component selection

Electrical and Electronics Stress, Strength and Failure: stress effects, component types and failure mechanisms, circuit and system aspects

Module 2 (12 hrs)

Variation and Reliability: variation in engineering, load-strength interference, time-dependent variation, multiple variations and statistical experiments, discrete variations, confidence and significance, reliability

Design Analysis: Quality Function Deployment, design analysis methods, analysis methods for reliability and safety, design analysis for processes, software for design analysis, limitations of design analysis, using analysis results for test planning

Module 3 (12 hrs)

Development Testing Principles: functional testing, testing for reliability and durability, testing for variation, process testing, ‘Beta’ testing

Materials and Systems Testing: materials, assemblies and systems, system aspects, data collection and analysis, standard test methods, test centres

Testing Electronics: circuit test principles, test equipment, test data acquisition, design for test, electronic component test, EMI / EMC testing

Module 4 (12 hrs)

Software: software in engineering systems, software errors, preventing errors, analysis of software system design, data reliability, managing software testing

Manufacturing Test: manufacturing test principles, manufacturing test economics, inspection and measurement, test methods, stress screening, electronics manufacturing test options and economics, testing electronic components, statistical process control and acceptance sampling

Testing in Service: in-service test economics, test schedules, mechanical and systems, electronic and electrical, sotaftware, reliability centred maintenance, stress screening of repaired items, calibration

Module 5 (12 hrs)

Data Collection and Analysis: FRACAS, acceptance sampling, probability and hazard plotting, time series analysis, software for data collection and analysis, reliability demonstration and growth measurement, sources of data

Laws, Regulations and Standards: safety and product liability, main regulatory agencies in USA, Europe and Asia, International standards, BIS, ISO standards, industry / technology standards

Management: organization and responsibilities, procedures for test, development test programme, project test plan, training and education for test, future of test.

References:

1. Patrick D. T. O'connor, "A Concise Guide to Cost-effective Design, Development and Manufacture", John Wiley & Sons, 2001
2. Patrick D. T. O'connor, "Practical Reliability Engineering", Wiley India, 2008
3. Naikan V. N. A., "Reliabilty Engineering and Life Testing", PHI Learning, 2008
4. Kapur K. C., Lamberson L. R., "Reliability in Engineering Design", Wiley India, 2009
5. Srinath L. S., "Reliability Engineering", East West Press, 2005

IC010 805G02 MULTIMEDIA SYSTEMS

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

i. *To understand the basics of Multimedia technology.*

ii. *To create an awareness on the image compression techniques and its standards.*

iii. *To study about the representation of audio,compression and decompression techniques.*

iv. *To study about the video and its compression techniques.*

v. *To introduce about the virtual reality and applications*

MODULE-I:BASICS OF MULTIMEDIA TECHNOLOGY

Computers, communication and entertainment; multimedia an introduction; framework for multimedia systems; multimedia devices; CD- Audio, CD-ROM, CD-I, presentation devices and the user interface; multimedia presentation and authoring; professional development tools; LANs and multimedia; internet, World Wide Web & multimedia distribution network-ATM & ADSL; multimedia servers & databases; vector graphics; 3D graphics programs; animation techniques; shading; anti aliasing; morphing; video on demand.

MODULE-II: IMAGE COMPRESSION & STANDARDS

Making still images; editing and capturing images; scanning images; computer color models; color palettes; vector drawing; 3D drawing and rendering; JPEG-objectives and architecture; JPEG-DCT encoding and quantization, JPEG statistical coding, JPEG predictive lossless coding; JPEG performance; overview of other image file formats as GIF, TIFF, BMP, PNG etc.

MODULE-III: AUDIO

Digital representation of sound; time domain sampled representation; method of encoding the analog signals; subband coding; fourier method; transmission of digital sound; digital audio signal processing; stereophonic & quadraphonic signal processing; editing sampled sound; MPEG Audio; audio compression & decompression; brief survey of speech recognition and generation; audio synthesis; musical instrument digital interface;

MODULE-IV: VIDEO

Digital video and image compression; MPEG motion video compression standard; DVI technology; time base media representation and delivery.

MODULE-V: VIRTUAL REALITY

Applications of multimedia, intelligent multimedia system, desktop virtual reality, VR operating system, virtual environment displays and orientation making; visually coupled system requirements; intelligent VR software systems. Applications of environment in various fields.

TEXT BOOKS:

1. Multimedia:An Introduction :Villamil and Molina; Mc Milan, 1997
2 Multimedia: Making it work (fifth edition) : Vaughan; TMH,1994

REFERENCE BOOKS:

1. Multimedia: Production, planning and delivery : Villamil and Molina; Que,1997
2. Multimedia on the PC: Sinclair; BPB
3. Multimedia in Action : James E Shuman; Wadsworth Publ., 1997
4. Multimedia in Practice : Jeff coate Judith; PHI, 1995
5. Multimedia Systems : Koegel; AWL
6. Multimedia Making it Work : Vaughar; etl.
7. Multimedia Systems : John .F. Koegel; Buford,2001
8. Multimedia Communications by Halsall & Fred, AW, 2001
9. Lozano, multimedia: Sound and Video; PHI, 1997, (Que)

IC010 805G03 TOTAL QUALITY MANAGEMENT

(Common to EI010 805G02 and AI010 805G01)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

i. To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.
ii. To understand the statistical approach for quality control.
iii. To create an awareness about the ISO and QS certification process and its need for the industries.

Module I: INTRODUCTION

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

Module II: TQM PRINCIPLES

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

Module III: STATISTICAL PROCESS CONTROL (SPC)

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

Module IV: TQM TOOLS

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

Module V: QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS9000, ISO 14000 – Concept, Requirements and Benefits.

TEXT BOOK

1. Dale H.Besterfiled, et al., Total Quality Management, Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCE BOOKS

1. James R.Evans & William M.Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. “Total Quality Management, McGraw Hill, 1991.
3. Oakland.J.S. “Total Quality Management Butterworth – Hcinemann Ltd., Oxford. 1989.
4. Narayana V. and Sreenivasan, N.S. Quality Management – Concepts and Tasks, New Age International 1996.
5. Zeiri. “Total Quality Management for Engineers Wood Head Publishers, 1991.

IC010 805G04 BIO INFORMATICS

(Common to EC010 805G04 and EI010 805G04)

Teaching Schemes **Credits: 4**

2 hours lecture and 2 hours tutorial per week.

Objective: To cater the needs of students who want a comprehensive study of the principle and techniques of bioinformatics..

Module 1 (12 hrs)

Nature and scope of life science, Various branches of life sciences, Organization of life at various levels, Overview of molecular biology, The cell as basic unit of life-Prokaryotic cell and Eukaryotic cell - Central Dogma: DNA-RNA-Protein, Introduction to DNA and Protein sequencing, Human Genome Project, SNP, **Bioinformatics databases**, - Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, GeneBank, DDBJ; Secondary nucleotide sequence databases Protein sequence databases- SwissProt. Protein Data Bank

Module 2 (12 hrs)

Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues. Scoring matrices- PAM and BLOSUM matrices, Pairwise sequence alignments: Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments. BLAST and FASTA. Multiple sequence alignments (MSA)- CLUSTALW.

Module 3 (12 hrs)

Phylogeny: Basic concepts of phylogeny; molecular evolution; Definition and description of phylogenetic trees. Phylogenetic analysis algorithms - Maximum Parsimony, UPGMA and Neighbour-Joining. Evaluation of phylogenetic trees-reliability and significance; Boot strapping; Jackknifing

Module 4 (12 hrs)

Computational approaches for bio-sequence analysis - Mapping bio-sequences to digital signals – various approaches – indicator sequences – distance signals – use of clustering to reduce symbols in amino acid sequences - analysis of bio-sequence signals – case study of spectral analysis for exon location.

Module 5 (12 hrs)

Systems Biology: System Concept- Properties of Biological systems, Self organization, emergence, chaos in dynamical systems, linear stability, bifurcation analysis, limit cycles, attractors, stochastic and deterministic processes, continuous and discrete systems, modularity and abstraction, feedback, control analysis, Mathematical modeling; Biological Networks- Signaling pathway, GRN, PPIN, Flux Balance Analysis, Systems biology v/s synthetic biology

References.

1. Claverie & Notredame, “Bioinformatics - A Beginners Guide”, Wiley-Dreamtech India Pvt.
2. Uri Alon, “An Introduction to Systems Biology Design Principles of Biological Circuits”, Chapman & Hall/CRC.
3. Marketa Zvelebil and Jeremy O. Baum, “Understanding Bioinformatics”, Garland Science.
4. Bryan Bergeron, “Bioinformatics Computing, Pearson Education”, Inc., Publication.
5. D. Mount, “Bioinformatics: Sequence & Genome Analysis”, Cold spring Harbor press.
6. Charles Semple, Richard A. Caplan and Mike Steel, “Phylogenetics”, Oxford University Press.
7. C. A. Orengo, D.T. Jones and J. M. Thornton, “Bioinformatics- Genes, Proteins and Computers”, Taylor & Francis Publishers.
8. Achuthsankar S. Nair et al. “Applying DSP to Genome Sequence Analysis: The State of the Art, CSI Communications”, vol. 30, no. 10, pp. 26-29, Jan. 2007.
9. Resources at web sites of NCBI, EBI, SANGER, PDB etc

IC010 805G05 INTELLECTUAL PROPERTY RIGHTS

(Common to EC010 805G05 and EI010 805G05)

Teaching scheme **Credits:4**

2 hour lecture and 2 hour tutorial

Objectives

1. *To appreciate the concept of Intellectual Property and recognize different kinds of Intellectual Property*
2. *To appreciate the rationale behind IP and underlying premises*
3. *To know the position of IP under the constitution of India*

Module 1(12 Hours)

Concept of intellectual property – different types of IP-Rationale behind Intellectual property-Balancing the rights of the owner of the IP and the society – Enforcement of IPRs – IP and constitution of India.

Module 2 (12 Hours)

World intellectual Property Organization (WIPO) – WTO/TRIPS Agreement – India and the TRIPS Agreement – Patent law in India –Interpretation and implementations – Transitional period.

Module 3 (12 Hours)

Patent system – Patentable Invention – Procedure for obtaining patent – Rights of a patentee – Limitations on Particular's Rights – Revocation of patent for Non – working Transfer of patent – Infringement of patent.

Module 4 (12 Hours)

Indian Designs Law – Meaning of Design Registration and Prohibitions – Copyright in Designs – Piraiy of Design and Penalities – Steps for foling an Application – Copyright law in India – Owner of the copyright – Rights of Broad Casters and Performers – Registration of Copyright – Assignment, Licensing and Transmission – Infringement – International Copyright and Copyright Societies

Module 5 (12 Hours)

Trade Mark Law in India – Functions of a Trade Mark – Registration of Trade Mark Exploiting Trade Mark – Infringement –Offenses and Penalties – Indian Trade Mark Act 1999; salient features. Geographical Indications – Registration of Geographical Indication – Term and Implication of Registration – Reciprocity and Prohibition on Registration.

Text books

1. Jayasree Watal **-Intellectual Property Rights:** In the WTO and Developing Countries - Oxford University Press
2. V.Sarkar-Intellectual Property Rights and Copyright- ESS publications

References

1. R..Anita Rao and Bhanoji Rao - Intellectual Property Rights –Eastern Book Company

2. Arthur R Miller and Michael H Davis – Intellectual Property in a Nutshell: marks patents, Trade and Copy Right

3. Richard Stim - Intellectual Property marks patents, Trade and Copy Right – Cangage Learning
4. Christopher May and Susan K Sell - Intellectual Property Rights –A critical History - Viva Books

IC010 805G06 PROFESSIONAL ETHICS

(Common to EC010 805G06 and EI 010 805G06)

Teaching Schemes **Credit: 4**

2 hours lecture and 2 hours tutorial per week.

Objectives:

- *To create awareness on professional ethics for engineers*
- *To instil human values and integrity*
- *To respect the rights of others and develop a global perspective*

Module 1 (12 hrs)

Understanding Professional Ethics and Human Values Current scenario – contradictions – dilemmas – need for value education and self esteem – Human values – morals – values – integrity – civic virtues - work ethics – respect for others – living peacefully – caring – honesty – courage – valuing time – co operation – commitment – empathy – self confidence - character

Module 2 (12 hrs)

Ethics for Engineers Ethics – its importance – code of ethics – person and virtues – habits and morals – 4 main virtues – ethical theories – Kohlberg's theory – Gilligan's theory – towards a comprehensive approach to moral behaviour – truth – approach to knowledge in technology

Module 3 (12 hrs)

Environmental Ethics and sustainability problems of environmental ethics in engineering - engineering as people serving profession – engineer's responsibility to environment – principles of sustainability - industrial, economic, environmental, agricultural and urban sustainability - Sustainable development.

Module 4 (12 hrs)

Social Experimentation, Responsibility and Rights Engineers as responsible experiments – safety and risk – confidentiality – knowledge gained confidentiality – experimental nature of engineering – Intellectual Property Rights – professional rights – employee rights – occupational crime

Module 5 (12 hrs)

Global Issues Globalisation – unethical behaviour – computer ethics – weapons development – engineers as expert witness and advisors – moral leadership

Reference

1. Mike W Martin, Roland Schinzinger, " Ethics in Engineering", Tata McGraw -Hill, 2003
2. Govindarajan M, Natarajan S, Senthil Kumar V S, "Engineering Ethics" PHI India, 2004
3. P Aarne Vesblind, Alastair S Gunn, " Engineering Ethics and the Enviornment"
4. Edmund G Seebauer, Robert L Barry, " Fundamentals of Ethics for scientists and engineers" Oxford University Press 2001
5. R RGaur, R Sangal, G P Bagaria, " A foundation course in value education and professional ethics"

IC010 806 SYSTEM SIMULATION LABORATORY

Teaching scheme: 3 hours practical **Credits:** 2

Experiments:

1. Study of Programmable Logic Controller

Exercises:

(i) Implementation of the AND / OR gate using PLC.
(ii) Implementation of proportional (P) control system.
(iii) A program which sounds an alarm when a preset count value is reached.
(iv) A program sounds an alarm after a time delay.
(v) A program which illustrates the use of flags and the flag instructions.

2. Study of Supervisory Control- SCADA Package

3. Study of Distributed Control System

Exercises:

(i) Using graphic and text features design different types of operator interaction pages, to suit different process stations available in process control lab.
(ii) Implement the various control actions like ON-OFF, Proportional, Proportional + Integral, Proportional +Derivative, Proportional + Derivative+Integral on different process stations available in process control lab.
(iii) Analyse the responses for set point and disturbance changes.

4. Study of MATLAB Control System Tool Box

Exercises:

(i) Study of basic commands in MATLAB
(ii) Time domain, Frequency domain, State Space, Stability of systems using MATLAB.
(iii) Design of Lead and Lag Compensators using MATLAB

5. Simulation studies of PID controller for motor drives and process control system using MATLAB-SIMULINK under various disturbances

6. Design of Deadbeat/ Dahlins algorithms

7. Labview Programming

Exercises:

(i) Programming using loops, case and sequence structures and arrays.

8. Data Acquisition using Labview, C, Matlab.

IC010 807 Project Work

Teaching scheme **credits: 4**

6 hours practical per week

The progress in the project work is to be presented by the middle of eighth semester before the evaluation committee. By this time, the students will be in a position to publish a paper in international/ national journals/conferences. The EC can accept, accept with modification, and request a resubmission.

The progress of project work is found unsatisfactory by the EC during the middle of the eighth semester presentation, such students has to present again to the EC at the end of the semester and if it is also found unsatisfactory an extension of the project work can be given to the students.

Project report: To be prepared in proper format decided by the concerned department. The report shall record all aspects of the work, highlighting all the problems faced and the approach/method employed to solve such problems. Members of a project group shall prepare and submit **separate** reports. Report of each member shall give details of the work carried out by him/her, and only summarise other members' work.

The student's sessional marks for project will be out of 100, in which 60 marks will be based on day to day performance assessed by the guide. Balance 40 marks will be awarded based on the presentation of the project by the students before an evaluation committee.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.

IC010 808 Viva -Voce

Teaching scheme **credits: 2**

A comprehensive oral Viva-voce examination will be conducted to assess the student's intellectual achievement, depth of understanding in the specified field of engineering and papers published / accepted for publication etc. At the time of viva-voce, certified bound reports of seminar and project work are to be presented for evaluation. The certified bound report(s) of educational tour/industrial training/ industrial visit shall also be brought during the final Viva-Voce.

An internal and external examiner is appointed by the University for the Conduct of viva voce University examination.

For Viva-voce, the minimum for a pass shall be 50% of the total marks assigned to the Viva-voce.

Note: If a candidate has passed all examinations of B.Tech. course (at the time of publication of results of eighth semester) except Viva-Voce in the eighth semester, a re-examination for the Viva-Voce should be conducted within one month after the publication of results. Each candidate should apply for this 'Save a Semester examination' within one week after the publication of eighth semester results.