Applied Electronics and Instrumentation Engineering (AI)

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

AI010 303 Network Theory

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* , 12^{th} e/d ,PHI
7. C A Desoer & E S Kuh, *Basic Circuit Theory*, TMH
8. F F Kuo, *Network Analysis and Synthesis*, Wiley

AI 010 304Solid State Devices

Teaching Scheme

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

Objectives

- *To provide students with a sound understanding of existing electronic devices, so that their studies of electronic circuits and systems will be meaningful.*
- *To develop the basic tools with which students can later learn about newly developed devices and applications.*

Module I (13 hours)

Bonding forces in solids – Energy Bands – Metals, semiconductors and insulators – Direct and indirect Semiconductors – Variation of Energy Bands with alloy composition – Charge carriers in semiconductors – Electrons and holes – Effective mass – Intrinsic and extrinsic materials.

Charge concentrations – Fermi level – Electrons and hole concentrations at equilibrium – Temperature dependence of carrier concentrations – Compensation and space charge neutrality.

Drift of carriers in electric and magnetic fields – Drift and resistance – Effects of temperature on doping and mobility – High-field effects – Hall effect.

Module II (13 hours)

Excess carriers in semiconductors – Carrier lifetime – Direct and indirect recombination – Steady state carrier generation – Quasi Fermi levels.

Diffusion of carriers – Diffusion process – Diffusion coefficient – Einstein relation – Continuity equation – Steady state carrier injection – Diffusion length.

P-N junctions – Equilibrium conditions – Contact potential – Equilibrium Fermi levels – Space charge at a junction – Forward and reverse biased conditions – Steady state conditions – Qualitative description of current flow at a junction – Carrier injection – Diode equation – Majority and minority currents through a p-n junction – V-I characteristics of a p-n junction diode.

Module III (12 hours)

Reverse breakdown in p-n junctions – Zener and avalanche mechanisms – Breakdown diodes.

Time variation of stored charge in p-n junctions – Reverse recovery transient – Switching diodes – Capacitance of p-n junctions – Varactor diodes.

Metal-semiconductor junctions – Schottky barriers – Rectifying and ohmic contacts.

Optoelectronic devices – Optical Absorption – Solar Cells – Photo detectors – Photoluminescence and electroluminescence – Light emitting diodes – Laser diodes.

Module IV (12 hours)

Bipolar Junction Transistor – Bipolar Transistor action – Basic principle of operation – Simplified current relations – Modes of operation – Majority and minority current components – Emitter injection efficiency – Base transport factor – Current transfer ratio – Current amplification factor – Amplification and switching – Base width modulation – Avalanche Breakdown – Base resistance and emitter crowding

Field Effect Transistor – Basic JFET operation – pinch off and saturation – Transconductance and amplification factor – V-I characteristics – Transfer characteristics

Basic principles of high frequency transistors – Schottky transistors; Phototransistors

Module V (10 hours)

Ideal MOS capacitor – Energy band structure in depletion, accumulation and inversion modes, C-V characteristics – Threshold voltage.

MOSFETs – Enhancement and depletion MOSFETs – Current-voltage relationship – Transconductance – Control of threshold voltage – Basic principles of CMOS.

Tunnel diodes – pnpn diodes – Introduction to SCR and IGBT.

Reference Books

1. B. G. Streetman, S. K. Banerjee, *Solid State Electronic Devices*, 6th ed., PHI Learning Pvt. Ltd., New Delhi, 2010.
2. D. A. Neamen, *Semiconductor Physics and Devices,* 3rd ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
3. M. S. Tyagi, *Introduction to Semiconductor Materials and Devices,* Wiley India Pvt. Ltd., New Delhi, 2008.
4. J. Millman, C. C. Halkias, S. Jit, *Electronic Devices and Circuits,* 3rd ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
5. M. K. Achuthan, K. N. Bhat, *Fundamentals of Semiconductor Devices,* Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
6. V. Suresh Babu, *Solid State Devices and Technology,* 3rd ed., Pearson Education, 2010.

AI010 305: ANALOG CIRCUITS – I

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

Objectives:

- *To understand applications of diodes and transistors*
- *To understand working of MOSFET*
- *To provide an insight into the working, analysis and design of basic analog circuits using BJT and MOSFET*

Module I (10)

RC Circuits: Response of high pass and low pass RC circuits to sine wave, step, pulse and square wave inputs, Tilt, Rise time. Differentiator, Integrator. Small signal diode model for low and high frequencies, clipping and clamping circuits.

Analysis of half wave, full wave and bridge rectifiers. Analysis of L, C, LC & π filters. Zener voltage regulator, transistor series (with feedback) and shunt voltage regulators, short circuit and fold back protection.

Module II (14)

DC analysis of BJTs - BJT as amplifier. Small signal equivalent circuits (Low frequency π and h models only). Transistor Biasing circuits, Stability factors, Thermal runaway. Small signal analysis of CE, CB, CC configurations using approximate hybrid π model (gain, input and output impedance)

Module III (12)

MOSFET I-V relation, load lines, small signal parameters, small signal equivalent circuits, body effect. Biasing of MOSFETs amplifiers. Analysis of single stage discrete MOSFET amplifiers – small signal voltage and current gain, input and output impedance of Basic Common Source amplifier, Common Source amplifier with and without source bypass capacitor, Source follower amplifier, Common Gate amplifier.

Module IV (12)

High frequency equivalent circuits of BJTs, MOSFETs, Miller effect, short circuit current gain, s-domain analysis, amplifier transfer function. Analysis of high frequency response of CE, CB, CC and CS, CG, CD amplifiers.

Module V (12)

Power amplifiers: Class A, B, AB and C circuits - efficiency and distortion. Biasing of class AB circuits. Transformer less power amplifiers.

Feed back amplifiers - Properties of negative feed back. The four basic feed back topologies- Series-shunt, series-series, shunt-shunt, shunt-series. Analysis and design of discrete circuits in each feedback topology - Voltage, Current, Trans conductance and Trans resistance amplifiers, loop gain, input and output impedance. Stability of feedback circuits.

References:

1. Sedra and Smith: *Microelectronic Circuits*, 4/e, Oxford University Press 1998.

2. B. Razavi , "*Fundamentals of Microelectronics*", Wiley
3. Donald A Neamen. : *Electronic Circuit Analysis and Design*, 3/e, TMH.
4. Millman and Halkias: *Integrated Electronics*, TMH, 2004.
5. Spencer & Ghausi: *Introduction to Electronic Circuit Design*, Pearson Education, 2003.
6. Roger T. Howe, Charles G. Sodini**:** *Microelectronics: An Integrated Approach*, Pearson Education, 1997.
7. R E Boylstead and L Nashelsky: *Electronic Devices and Circuit Theory*, 9/e, Pearson Education

AI010 306 COMPUTER PROGRAMMING

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.

AI010 307 ANALOG CIRCUITS LAB

L-T-P : 0-0-3 ` **Credits: 2**

Objectives

- *To provide experience on design, testing, and analysis of few basic electronic circuits using BJT and MOSFET.*
- *To provide experience on electronic circuit simulation software like SPICE .*

1. Characteristics of Diodes & Zener diodes.
2. Characteristics of Transistors (CE & CB).
3. Characteristics of MOSFET.
4. Frequency responses of RC Low pass and high pass filters. RC Integrating and Differentiating circuits.
5. Rectifiers-half wave, full wave, Bridge with and without filter- ripple factor and regulation.
6. Clipping and clamping circuits.
7. Zener Regulator with & without emitter follower.
8. RC Coupled CE amplifier - frequency response characteristics.
9. MOSFET amplifier (CS) - frequency response characteristics.
10. Feedback amplifiers (current series, voltage series) - Gain and frequency response
11. Power amplifiers (transformer less), Class B and Class AB.

Introduction to SPICE

Models of resistor, capacitor, inductor, energy sources (VCVS, CCVS, Sinusoidal source, pulse, etc) and transformer.
Models of DIODE, BJT, FET, MOSFET, etc..
Simulation of following circuits using spice (Schematic entry of circuits using standard packages).
Analysis- (transient, AC, DC, etc.):
1. Potential divider.
2. Integrator & Differentiator (I/P PULSE) – Frequency response of RC circuits.
3. Diode Characteristics.
4. BJT Characteristics.
5. FET Characteristics.
6. MOS characteristics.
7. Full wave rectifiers (Transient analysis) including filter circuits.
8. Voltage Regulators.
9. Sweep Circuits.
10. RC Coupled amplifiers - Transient analysis and Frequency response.
11. FET & MOSFET amplifiers.

AI010 308:PROGRAMMING LAB

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

EN010 402(ME): Principles of Management

(Common to CE, ME, PO, EC, AI, IT)

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.

AI010 403 Signals and Systems

(Common to EC010 403, EI010 403)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives

- *To study the methods of analysis of continuous time and discrete time signals and systems to serve as a foundation for further study on communication, signal processing and control*

Module I (12 hrs)

Classification of signals: Continuous time and Discrete time, Even and Odd , Periodic and Non-periodic , Energy and Power – Basic operations on signals: Operations performed on the dependent variable , operations on the independent variable: Shifting , Scaling – Elementary Discrete time and Continuous time signals: Exponential , Sinusoidal , Step , Impulse , Ramp – Systems: Properties of Systems: Stability, Memory, Causality, Invertibility, Time invariance, Linearity – LTI Systems: Representation of Signals in terms of impulses – Impulse response – Convolution sum and Convolution integral – Cascade and Parallel interconnections – Memory, Invertibility, Causality and Stability of LTI systems – Step response of LTI systems – Systems described by differential and difference equations (solution by conventional methods not required)

Module II (12 hrs)

Fourier analysis for continuous time signals and systems: Representation of periodic signals: Continuous Time Fourier Series – convergence of Fourier series – Gibbs phenomenon – Representation of aperiodic signals: Continuous Time Fourier Transform – The Fourier Transform for periodic signals – Properties of Fourier representations – Frequency Response of systems characterized by linear constant coefficient differential equations

Module III (12 hrs)

Fourier analysis for discrete time signals and systems: : Representation of periodic signals: Discrete Time Fourier Series – Representation of aperiodic signals: Discrete Time Fourier Transform – The Fourier Transform for periodic signals – Properties of Fourier representations – Frequency Response of systems characterized by linear constant coefficient difference equations

Module IV (12 hrs)

Filtering: Frequency domain characteristics of ideal filters – Time domain characteristics of ideal LPF – Non-ideal filters – First and Second order filters described by differential and difference equations – Approximating functions: Butterworth, Chebyshev and elliptic filters (Magnitude response only) –

Sampling: The sampling theorem – Reconstruction of a signal from its samples using interpolation – Aliasing

Module V (12 hrs)

Bilateral Laplace Transform – ROC – Inverse – Geometric evaluation of the Fourier transform from pole-zero plot – Analysis and characterization of LTI systems using Laplace Transform – The Z Transform – ROC – Inverse – Geometric evaluation of the Fourier Transform from pole-zero plot – Properties of Z transform - Analysis and characterization of LTI systems using Z-Transform

References:

1) A V Oppenheim, A S Willsky and S H Nawab, *Signals and Systems*, PHI
2) S Haykin, and B V Veen, *Signals and Systems*, Wiley
3) B P Lathi, *Signal Processing and Linear Systems*, OUP
4) E W Kamen, and B Heck, *Fundamentals of Signals and Systems using the web and Matlab*, Pearson
5) Luis F Chaparro , *Signals and Systems Using MATLAB*, Elsevier
6) R E Ziemer, and W H Tranter, *Signals and Systems*, Pearson.
7) R A Gabel and R A Roberts, *Signals and Linear Systems*, Wiley

AI010 404: DIGITAL ELECTRONICS

(Common to EC010 404,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. Anada kumar, *Fundamentals of Digital Circuits*, PHI, 2008.
10. Brain Holdesworth, *Digital Logic Design*, Elsevier, 4th edition, 2002.

AI010 405

SIGNAL COMMUNICATION

Credits: 4
3+1+0

Objectives:
Familiarize the students with theoretical aspects of signal communication.
Generate awareness in students about practical issues.
Give the students an application sense.

Module 1
An overview of electronic communication systems: block diagram of communication system, analogue versus digital, modulation multiplexing.
Basic concepts of signals: signal, signal characteristics.
Basic concepts of telemetry: signal transmission over wires using voltage, current and frequency – issues related to long distance transmission: signal attenuation, phase delays – need for wireless telemetry – types of modulations used (only introduction, details in another module).

Module 2
Basic concepts of noise:, noise, noise spectrum, noise figure and noise temperature;
Bandwidth requirements, effect of limiting bandwidth; signal attenuation and transmission distance; considerations of filter selection for suppression of noise: bandwidth, amplitude response, phase response.
Emi and related issues: grounding – shielding – twisted pair – twisted shielded pair - ground loop – guarding techniques.

Module 3
Introduction to digital communication: components of digital transmission system – advantages of digital transmission – analogue and discrete sinusoids – A/D conversion – sampling – sampling theorem- sampling in practical situations involving a range of frequencies and noise – aliasing error - filter order to minimize aliasing error - D/A conversion – channel capacity; Pulse Modulation concept and basic scheme: PAM, PWM, PPM, PCM, Delta modulation.
FDM and telemetry- IRIG standards for telemetry.

Module 4
Introduction to fibre optic communication: Light propagation in glass fibres; optical communication system: system components, transmitters – fibre channel – light detectors; transmitter concepts: sources, optical switches, modulation;
optical fibres: step index fibre, graded index fibre, single mode and multi mode fibres - fibre power loss terms; channel multiplexing: TDM, FDM: modulation formats; optical receivers: detectors, optical isolators.

Module 5

Introduction to satellite communication: basic concepts: satellite orbits, block diagram of satellite communication system, transponders, up linking, down linking, satellite system parameters, satellite system link equation and link budget, frequency bands for satellite communication.

References:

1. Wayne Tomasi, Advanced Electronic Communication Systems, PHI.
2. NIIT, Communication System, PHI.
3. K.N. Hari Bhatt, Analogue Communication, Sanguine Technical Publishers.
4. Gautam Saha, Principles of Communication System, Tata McGraw Hill.
5. David Bailey, Edwin Wright, Practical Fibre Optics, Elsevier Publications.
6. Govind P. Agrawal, Fibre Optic Communication system, John Wiley
7. Joseph C. Palais, Fibre Optic Communication, P Education.
8. D. Patranabis, Telemetry Principle, Tata McGraw Hill.
9. Cardon, Frank, Telemetry System Design, ARTEC.

AI010 406 : ANALOG CIRCUITS – II
(Common to EC010 406)

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

Objectives:

- *To understand differential amplifiers using BJT and MOSFET*
- *To understand operational amplifier and its applications.*

Module I (12)

Differential Amplifiers - BJT differential pair, large signal and small signal analysis of differential amplifiers, Input resistance, voltage gain, CMRR, non ideal characteristics of differential amplifier. Frequency response of differential amplifiers. MOS differential amplifiers, Current sources, Active load, cascode load, current mirror circuits, Wilson current mirror circuits. Small signal equivalent circuits, multistage differential amplifiers.

Module II (12)

Simplified internal circuit of 741 op-amp. DC analysis, Gain and frequency response. MOS Operational Amplifiers, single stage- cascode and folded cascode, two stage op-amp, op-amp with output buffer, frequency compensation and slew rate in two stage Op-amps. Ideal op-amp parameters, Non ideal op-amp. Effect of finite open loop gain, bandwidth and slew rate on circuit performance.

Module III (12)

Opamp applications: Inverting and non-inverting amplifier, summing amplifier, integrator, differentiator, Differential amplifiers, Instrumentation amplifiers, V to I and I to V converters, Comparators, Schmitt Trigger, Square and triangular waveform generator, Oscillators – RC Phase-shift and Wein-Bridge, Multivibrators – Astable and Monostable, Precision rectifiers, Programmable gain Amplifier

Module IV (12)

Filters: I^{st} order Low pass, high pass and all pass filters - Bandpass and band elimination filters Biquadratic filters (single op-amp with finite gain non inverting Sallen-Key of Low pass, High pass, Band pass and Band elimination filters. Switched capacitor Resistor, switched capacitor Integrator, I^{st} order SC filter

Module V (12)

D/A converters: DAC characteristics- resolution, output input equations, weighted resistor, R-2R network. A/D converter: ADC characteristics, Types - Dual slope, Counter ramp, Successive approximation, flash ADC, oversampling and delta sigma ADC.

Waveform generators – grounded capacitor VCO and emitter coupled VCO. Basic PLL topology and principle, transient response of PLL, Linear model of PLL, Major building blocks of PLL – analog and digital phase detector, VCO, filter. Applications of PLL. Monolithic PLL - IC LM565 and CD4046 CMOS PLL. 555 Timer Astable Multi vibrator and Monostable Multi vibrator using 555.

References:

1. Sergio Franco: *Design with Operational Amplifiers and Analog Integrated Circuits*, 3/e,TMH.
2. Behzad Razavi : *Design of Analog CMOS IC*, TMH, 2003.
3. Gayakwad : *Op-Amps and Linear Integrated Circuits* , 4/e, PHI.
4. David A.Johns, Ken Martin: *Analog Integrated Circuit Design*, Wiley India, 2008
5. Gray, Hurst, Lewis and Meyer *Analysis and Design of Analog Integrated Circuits*, Wiley
6. Baker R Jacob: *CMOS Circuit Design, Layout and Simulation*, PHI,2005

AI010 407 ANALOG CIRCUITS-II LAB
(Common to EC010 407)

L-T-P : 0-0-3 ` **Credits: 2**

Objectives

- *To provide experience on design, testing, and analysis of few electronic circuits.*
- *To provide experience on design ,testing and analysis of op-amp circuits .*

LIST OF EXPERIMENTS

1. Differential amplifiers (using BJT and MOSFETs) - Measurement of CMRR
2. Cascade amplifiers - Frequency response.
3. Cascode amplifiers (using BJT and MOSFETs) - Frequency response.

4. Familiarization of Operational amplifiers- Inverting and Non inverting amplifiers, frequency response, Adder, Integrator, comparator and voltage level detector.
5. Measurement of Op-Amp. parameters.
6. Difference Amplifier and Instrumentation amplifier.
7. Astable, Monostable and Schmitt trigger circuit using Op -Amps.
8. Triangular and square wave generators using Op- Amplifier.
9. Wien bridge oscillator using op-amplifier with amplitude stabilization and amplitude control, RC Phase shift Oscillator.
10. Study of 555 and Astable, Monostable multivibrator using 555.
11. Active second order filters using Op-Amp (LPF, HPF, BPF and BSF)
12. . A/D converters- counter ramp and flash type.
13. D/A Converters- ladder circuit.

AI010 408(P)

DIGITAL IC LAB

(Common to IC010 408(P))

Credits 2
0+0+3

Objectives:

To familiarize the application of Digital IC's
To equip the students with the design of digital circuits.
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

AI010 502

INDUSTRIAL ELECTRONICS AND APPLICATIONS

(Common to EI010 502, IC010 502)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

1) To give the fundamental concept of Power semiconductor devices
2) To get an adequate knowledge about converters and inverters.
3) To get an exposure in control circuits for power electronics

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

AI010 503

BASIC INSTRUMENTATION & RECORDING SYSTEM

Credits: 4
3+1+0

Objectives:

To help the students to

1. have knowledge of the basics of instrumentation,
2. have an exposure to different types of bridge measurements, recorders and meters

Module 1

Generalized configuration of Instrumentation system- Definition of measurement parameters – Calibration - Static and dynamic characteristics- Standards of measurements-Measurements errors- Accuracy-Precision- Sensitivity- Resolution, Significant figures .

Module 2

Bridge measurement: Wheatstone, Kelvin, Wien, Hay, Maxell, Anderson and Schering bridges; Q meter – Potential transformer - current transformers – KVA meters – Power factor meter – Megger.

Module 3

DC and AC voltmeters, differential voltmeters, AC current measurements – multimeters –vector impedance meter - power meter: Wave analyzer – harmonic distortion analyzer - spectrum analyzer.

Module 4

Digital instruments: Digital voltmeter - dual slope- successive approximation types; Digital measurement of time interval, phase, period, frequency, ratio of two Frequencies; Digital LCR meter; Digital alpha numeric display.

Module 5

General purpose oscilloscope : CRT screen characteristics – vertical and horizontal amplifiers –delay line – time base and sweep trigger circuits –synchronization- typical measurements using CRO ; Sampling oscilloscope ; digital storage oscilloscope ; Recorders: moving coil recorders - XY plotters - UV recorders- Thermal recording.

Text Book:

1. Doeblin, Measurement Systems-Application and Design, Mc Graw Hill, N.Y.1990.
2. Cooper, W.D., and Helfrick, A.D., Electronic Instrumentation and Measurement Techniques, Third Edition, Prentice Hall of India, 1991
3. D.A.Bell, Electronic Instrumentation and Measurements, Englewood Cliffs, N.J., 1994
4. Kalsi, G.C., Electronic Instrumentation TMH, 1998.

Reference Books:

1. Sawhney, K.A., A Course in Electrical & Electronics Measurement & Instrumentation, Dhanpat Rai & Sons.
2. Cidwell, W., Electrical Instruments and Measurements, TMH, 1969.
3. Woolvert, G.A., Transducers in Digital Systems, Peter peregrinvs Ltd., England, 1988.
4. Bouwens, A.J., Digital Instrumentation, McGraw Hill, 1986.

AI010 504

DATA ACQUISITION SYSTEM

Credits 4
3+1+0

Objectives:

1. To help students get an awareness of modern data acquisition systems.
2. To help students understand different types of sensors / transducers.
3. To help students understand the elements of data acquisition system, and their selection.
4. To help students understand how to do error budgeting.

Module 1

An overview of data acquisition systems: Need for data acquisition - types of signals and signal information - advantage of handling digital data in comparison with analogue data; simplified block diagram: elements of a typical data acquisition system.

Module 2

Sensors: response parameters – selection criteria including functional specifications, environmental specifications and physical specifications – resistive, capacitive, and inductive sensors; temperature sensors; position sensors, displacement sensors, speed sensors; force sensors pressure sensors; vibration sensors, acceleration sensors; proximity sensors; flow sensors, flow-rate sensors; liquid-level sensors, humidity sensors.

Module 3

Signal conditioning units: functions including gain, excitation for sensors, linearization and filtering– single-ended and differential measurements - charge to voltage conversion – programmability of gain – selection of filters based on amplitude response and phase response requirements – shielding and guarding –

Module 4

Analogue to digital and digital to analogue converters: need for A/D converters – sampling rate and aliasing error- anti aliasing filter requirements - error estimation considering filter order - principle and features of digital ramp ADC, successive approximation ADC, flash ADC.

Module 5

Multiplexing and demultiplexing: basic concepts of time division multiplexing of analogue and digital data: conventional time division multiplexing, bit interleaved and byte interleaved multiplexing.
Error budgeting and apportioning: rss error – rms error – system error estimate – error budgeting and apportioning total error among system elements.

Text Books:

1. Joseph J. Carr, Data acquisition and control: microcomputer applications for scientists and engineers, Tab Professional and Reference Books.

2. V.U.Bakshi U.A.Bakshi, Measurements And Instrumentation**,** Technical Publications.

References:

3. H. Rosemary Taylor, Data Acquisition for Sensor Systems, Chapman & Hall.

4. John Park, Steve Mackay, Data Acquisition for Instrumentation and Control Systems; Elsevier

5. Paul Horowitz and Hill, The Art of Electronics, Cambridge.

AI010 505

CONTROL ENGINEERING I

(Common to EI010 505)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

1) To give the fundamental concept of the analysis and design techniques of control systems by transfer function approach.

2) To get an adequate knowledge in the time response of systems and steady state error analysis.

3) To learn the concept of stability of control system and methods of stability analysis.

4) To study the three ways of designing compensation for a control system.

5) To get an exposure to MAT lab programs for control system analysis.

Module 1 (12 Hours)

System modeling - Transfer function approach :
Introduction to control system – Classification of control systems. Principles of automatic control- Feed back systems –Practical examples – Transfer function – Transfer function of electrical, mechanical and electromechanical system – Block diagram – Signal flow graph – Mason's gain formula.

Module 2 (12 Hours)

Time domain analysis :
Standard test signals - Response of systems to standard test signals – Step response of second order systems in detail – Time domain specifications – Steady state response – Steady state error- Static & Dynamic error coefficients- MAT lab programs for time domain analysis.

Module 3 (12 Hours)

Stability of linear systems in time domain – Routh's criterion of stability. Root locus - Construction of root locus – Effect of addition of poles and zeros on root locus-MAT lab programs for stability analysis.

Module 4 (12 Hours)

Frequency domain analysis :
Frequency response – Frequency domain specifications – Stability in the frequency domain - Nyquist stability criterion – Stability from polar and Bode plots - Relative stability – Gain margin and phase margin – M & N circles – Nichol's chart – MAT lab programs for frequency domain analysis.

Module 5 (12 Hours)

Design of compensators:

Introduction to design – compensation techniques – Lead, Lag and Lead -Lag compensation using RC network --Design of Lead, Lag and Lead-Lag compensators using bode plots.

References

1. Modern control engineering – Katsuhiko Ogata, Pearson Edn.
2. Control systems principles and design: M. Gopal, TMH.
3. Automatic control system – B.C. Kuo, PHI.
4. Control system design: Graham C Goodwin, PHI.
5. Modern Control Systems: Dorf, Pearson Education.

AI010 506

Microprocessors and microcontrollers

(Common to EI010 506, 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.

AI010 507(P)

Industrial Electronics Lab

0+0+3
Credit : 2

Objectives:

1. To familiarise different power semiconductor devices.
2. To design the circuit for the devices.
3. To introduce power converters**.**

1. Study of V-I characteristic of SCRS, TRIAC.
2. Study of BJT, IGBT, GTO & MOSFET.
3. R, RC and UJT firing circuits for the control of SCRs.
4. Design and implementation of Ramp-Comparator and digital firing scheme for simple SCR circuits.
5. Automatic lighting control with SCRs and optoelectronic components.
6. AC phase control using SCR and TRIAC.
7. Speed control of DC motor using choppers and converters.
8. Generation and study the PWM control signal for Single phase dc to ac inverter.
9. Study and use of the single phase half controlled & fully controlled AC to DC Converter and effect of firing angle control on load voltage & wave Forms.
10. Study and use of back to back connected SCR/ TRIAC Controlled AC Voltage controller and its wave forms with Variation of firing angle.
11. Study & use chopper circuit for the control of DC Voltage using (1) Pulse width control (2) Frequency Control.
12. Study of Single Phase inverter and its wave form.
13. Study of Three Phase firing circuit with synchronisation, and testing with three phase AC to DC bridge converter. Testing of wave forms of digital firing modules.
14. Study and Testing of a Three Phase bridge inverter with different types of loads.
15. Simulation of gating circuits and simple converter circuits.

AI010 508(P)

MEASUREMENTS LAB

0+0+3
Credit : 2

Objectives:
To familiarize signal conditioning circuits using Op-amps
To familiarize various measuring devices
To study various transducers and measurements

1. Op-amp ADC & DAC. (2expts).
2. Filters using Op-amps: determine frequency response and phase response.
3. Instrumentation amplifier
4. Determination of impact of filter on rise time and fall time of pulses.
5. Characterisation of simple measuring instruments like ammeter and voltmeter.
6. Measurement of resistance using Kelvin's double bridge and Wheatstone bridge.
7. Measurement of inductance using Maxwell's bridge and Hay's bridge.
8. Measurement of capacitance using Schering bridge.
9. Measurement using transducers:
   (i). Measurement of temperature using forward drop of diode.
   (ii). Measurement of displacement using LVDT.
   (iii). Evaluation of coefficients of thermocouple.
   (iv). Evaluation of coefficients of RTD.
   (v). Calibration of pressure transducer using dead weight calibrator.

AI010 601

PROCESS CONTROL INSTRUMENTATION

(Common to EI010 601, 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.

AI010 602 DIGITAL SIGNAL PROCESSING

(COMMON TO EC010 602)

Teaching scheme **Credits**: 4

2 hours lecture and 2 hours tutorial per week

Objectives

- *To study the fundamentals of discrete-time system analysis, digital filter design and the DFT*

Module I (12 hrs)

Advantages of DSP – Review of discrete time signals and systems – Discrete time LTI systems – Review of DTFT – Existence – Symmetry properties – DTFT theorems – Frequency response- Review of Z transform – ROC – Properties

Sampling of Continuous time signals – Frequency domain representation of sampling – Aliasing - Reconstruction of the analog signal from its samples – Discrete time processing of continuous time signals – Impulse invariance – Changing the sampling rate using discrete time processing – Sampling rate reduction by an integer factor – Compressor – Time and frequency domain relations – Sampling rate increase by an integer factor – Expander – Time and frequency domain relations – Changing the sampling rate by a rational factor.

Module II (12 hrs)

Transform analysis of LTI systems – Phase and group delay – Frequency response for rational system functions – Frequency response of a single zero and pole – Multiple poles and zeros - Relationship between magnitude and phase – All pass systems – Minimum phase systems – Linear phase systems – Generalised linear phase – 4 types – Location of zeros.

Module III (12 hrs)

Structures for discrete time systems – IIR and FIR systems – Block diagram and SFG representation of difference equations – Basic structures for IIR systems – Direct form - Cascade form - Parallel form - Transposed forms – Structures for FIR systems – Direct and Cascade forms - Structures for Linear phase systems – Overview of finite precision numerical effects in implementing systems

Analog filter design: Filter specification – Butterworth approximation – Pole locations – Design of analog low pass Butterworth filters – Chebyshev Type 1 approximation – pole locations – Analog to analog transformations for designing high pass, band pass and band stop filters.

Module IV (12 hrs)

Digital filter design: Filter specification – Low pass IIR filter design – Impulse invariant and Bilinear transformation methods – Butterworth and Chebyshev – Design of high pass, band pass

and band stop IIR digital filters – Design of FIR filters by windowing – Properties of commonly used windows – Rectangular, Bartlett, Hanning, Hamming and Kaiser.

Module V (12 hrs)

The Discrete Fourier Transform - Relation with DTFT – Properties of DFT – Linearity – Circular shift – Duality – Symmetry properties – Circular convolution – Linear convolution using the DFT – Linear convolution of two finite length sequences – Linear convolution of a finite length sequence with an infinite length sequence – Overlap add and overlap save – Computation of the DFT – Decimation in time and decimation in frequency FFT – Fourier analysis of signals using the DFT – Effect of windowing – Resolution and leakage – Effect of spectral sampling.

References

1. A V Oppenheim, R W Schaffer, *Discrete Time Signal Processing* , 2nd Edition Pearson Education.
2. S K Mitra, *Digital Signal Processing: A Computer Based Approach* ,TMH
3. J G Proakis, D G Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, PHI.
4. L C Ludeman, *Fundamentals of Digital Signal Processing*, Wiley
5. J R Johnson, *Introduction to Digital Signal Processing*, PHI

AI010 603

INDUSTRIAL INSTRUMENTATION I

(Common to EI010 603, 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

AI010 604

MICROCONTROLLER BASED SYSTEM DESIGN

3+1+0
Credits: **4**

Objectives:

1. To give an idea about micro controllers and its interfacing techniques.
2. To get an exposure in microcontroller programming

Module 1

Various logic families – features – comparison – PLA – PAL- GAL -comparison – combinational PAL – PAL with flip-flops – study of 16L8, 22V10 GAL – dual port RAM – FIFO – FPGA – gate arrays.

Module 2

Embedded C compiler – advantages – memory models – interrupt functions – code optimization – 89C2051 micro-controller- architecture-comparison with 89C51- design of a simple trainer circuit using 89C51/89C2051 µC. Introduction to latest micro controllers (ARM Processor/ PIC microcontrollers) - introduction, architecture (block diagram explanation only), Memory organization etc.

Module 3

Analog to digital converters- single slope, dual slope, successive approximation, sigma delta, flash – comparison – typical ICs – A/D interface – digital to analog converters – different types – D/A interface – optically isolated TRIAC interface- design of a temperature control system- sensors - opto isolator -interfacing programs using C and assembly language-.

Module 4

Serial Communication :Serial bus standards – I2C bus, SPI bus – operation – timing diagrams – 2 wire serial EEPROM – 24C04 – 3wire serial EEPROM – 93C46 – interfacing – serial communication standards – RS232, RS422, RS485 – comparison – MAX232 line driver/ receiver – interfacing — universal serial bus – PCI bus - interfacing programs using C and assembly language – low voltage differential signaling – PC printer port – registers – interfacing.

Module 5

Real World Interfacing**:** Matrix key board interface – AT keyboard – commands – keyboard response codes – watch dog timers – DS1232 watch dog timer – real time

clocks – DS1302 RTC – interfacing – measurement of frequency – phase angle – power factor – stepper motor interface – dc motor speed control – L293 motor driver – design of a position control system — interfacing of DIP switch, LED, 7 segment display, alphanumeric LCD – relay interface – design of a traffic light control system – interfacing programs using C and assembly language.

References

1. The 8051 Microcontroller: Muhammad Ali Mazidi, Pearson Education.
2. The 8051 Microcontroller: Kenneth J Ayala, Penram International.
3. Digital fundamentals: Floyd, Pearson Education.
4. Programming and customizing the 8051 µC: Myke Predko, TMH
5. Programming with ANSI C and turbo C: Kamthane, Pearson Education.
6. Microcomputers and Microprocessors: John Uffenbeck, PHI.
7. Web site of Atmel semiconductors – www.atmel.com
8. PIC 16F877 data book

AI010 605

Control Engineering II
(Common to EI010 605)

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

Objectives

1. *To study the modeling of the systems using State Space methods*
2. *To learn State variable analysis and design of continuous time systems*
3. *To get an exposure to digital control systems.*
4. *To understand the basic concepts of nonlinear systems*

Module 1 (12 Hours)

System modeling using state variable approach -Limitation of Conventional Control Theory. Concepts of state variables and state model - State model for linear time invariant systems.-State space representation of dynamic systems – Nonuniqueness of state model- Block diagram representations- State diagrams- Lagrange's equations .

Module 2 (12 Hours)

Transformation of state variables- State space representations of transfer functions- Solution of differential equations in state space form- Interpretation and properties of the state transition matrix - Solution by the Laplace transform - The resolvent - Transfer function from state model.

Module 3 (12 Hours)

State variable analysis - controllability and observability. Gilber test and Kalman's tests. Design of regulators for single input single output systems, Bass- gura pole placement formula. Linear observers: Need of observers, Structure and properties of observers, Pole placement for single output systems.

Module 4 (12 Hours)

Discrete time systems- Introduction to digital control system –Review of Z-transform and properties.- inverse z transform- z transform method for solving difference equations- Impulse sampling and data hold circuits -Zero order and First order hold – signal reconstruction –Practical aspects of the choice of sampling rate-Pulse transfer function - The Z and S domain relationships -Stability analysis - Jury's test-Bilinear transformation .

Module 5 (12 Hours)

Nonlinear systems- Behaviour of nonlinear systems-Common physical nonlinearities-The phase plane method- basic concepts- Singular points- Describing function method – Basic concepts-- Describing functions of saturation and dead zone nonlinearities. – Stability of nonlinear systems- limit cycles.
(Detailed analysis not required).

Text Books

1. K. Ogata , Modern Control Engineering , Prentice Hall of India
2. K. Ogata , Discrete Time Control Systems ,Prentice Hall Of India.
3. M. Gopal , Digital Controls and State Variable Methods ,TMH Pub. Com.
4. B. C. Kuo , Automatic Control Systems, Prentice Hall of India.
5. J. Nagrath & M. Gopal ,Control System Engineering , New Age Int. (P) Ltd
6. B.Friedland, Control System Design- An Introduction to state space methods- Mc Graw Hill, Inc.N Y.

AI010 606 L01

MECHATRONICS (ELECTIVE-1)

3+1+0
Credits: 4

Objectives:
1. To introduce the concept of integration of mechanical, electronic and computer system to achieve high precision and quality.
2. To help the students develop knowledge and skills that allow them to adopt interdisciplinary and integrated approach to engineering design.
3. To help the students understand modern integrated approach to development of precision mechanisms and machineries.

Module 1
Introduction to mechatronics: What is mechatronics – advantage of integrating electronics to mechanical devices;
Introduction to basic elements of mechatronics: mechanical systems, control systems, electronics systems and computer systems; generalised block schematic of mechatronics.

Module 2
Signal conditioning: requirements – basic approach – filters – multiplexing – data acquisition – role of micro processors and micro controllers

Module 3
Actuation systems: pneumatic and hydraulic systems - directional control valves - pressure control valves - process control valves - rotary actuators - electro-mechanical actuators - electrical switches - mechanical Switches - solid-state switches - dc motors - stepper motors - piezoelectric actuators.

Module 4
Introduction to MEMS: what are MEMS – microsystems and nano technology;
Typical MEMS applications: pressure sensors – accelerometers - micro pumps - ink jet printers.

Module 5
Modeling Electromechanical Systems- Mathematical models of mechanical system building blocks, Electrical system building blocks, Thermal system building blocks, Fluid Power systems.

Text Books:

1. Mechatronics - Electronic Control systems in Mechanical and Electrical Engineerng, -W. Bolton, 2 Ed. Addison Wesley Longman, Pub, 1999 (Delhi)
2. "Introduction to Mechatronics and Measurement systems",David G. Alciatore and Michael B.Histand, 2nd edition Tata McGraw-Hill, 2003.

3. Mechatronics: Integrated Mechanical Electronic Systems With Cd by K.P. Ramachandran, G.K. Vijayaraghavan, M.S.Balasundaram : ISBN 9788126518371

Reference Books:

4. Mechatronics - Dan S. Necsulescu, Prentice Hall, 2002, (311 p.). ISBN: 0-201-44491-7
5. Mechatronics: Electronics in Products and Processes, Dawson, D et.al, Nelson Thornes, ISBN: 0-7487-5742-2,
6. Mechatronics , Shanmugam, Anuradha Agencies, 2001, ISBN 81-87721-21-9
7. Analytical Robotics and Mechatronics - Wolfram Stadler, McGraw-Hill ISBN 0-07-060608-0.

AI010 606 L02

MICROELECTRONICS (ELECTIVE-1)

3+1+0
Credits: 4

Objectives:

1. To introduce various IC technologies and their fabrication techniques
2. To outline the procedures for the fabrication of IC's like ion implantation and Lithography techniques

Module 1

Introduction to Microelectronics**:** Monolithic and hybrid Ics- Bipolar & MOS Technology- Fabrication of active and passive components, bonding, packaging, - Concepts of SSI, LSI, VLSI. Introduction to thick film and thin film Technology – resistors- capacitors- comparison.

Module 2

Cleanroom Technology - Clean room concept – Growth of single crystal Si, surface contamination, cleaning & etching. (Laboratory Practices: Cleaning of p-type & n-type Si-wafer by solvent method & RCA cleaning)

Module 3

Oxidation – Growth mechanism and kinetic oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, charactrisation of oxide films, Use of thermal oxide and CVD oxide; growth and properties of dry and wet oxide, dopant distribution, oxide quality; (Laboratory Practices : Fabrication of MOS capacitor)

Module 4

Solid State Diffusion – Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon di-oxide diffusion systems.

Module 5

Ion Implantation – Range theory, Equipments, annealing, shallow junction, high energy implementation.
Lithography – Optical lithography, Some Advanced lithographic techniques.

Text books:

Millman & Grabel, Microelectronics, Tata McGraw Hill, 2nd edition

References:

1. Horstian , Micro Electronics, Prentice-Hall India, 3rd edition
2. Sedra & Smith, Microelectronic circuit, Oxford University Press, 3rd edition
3. Semiconductor Devices Physics and Technology, Author: Sze, S.M.; Notes: Wiley, 1985

4. An Introduction to Semiconductor Microtechnology, Author: Morgan, D.V., and Board, K
5. The National Technology Roadmap for Semiconductors, Notes: Semiconductors Industry Association, SIA, 1994
6. Electrical and Electronic Engineering Series VLSI Technology, Author: Sze, S.M. Notes: Mcgraw-Hill International Editions

AI010 606 L03

DIGITAL SYSTEM DESIGN (ELECTIVE-1)

3+1+0
Credits: 4

Objectives:
To introduce various memory devices, digital buses and finite state machines.
To give an introduction to VHDL

Module I
Memories: ROM, PROM, EPROM, PLA, PLD, CPLD,FPGA

Module II
RS 232, RS 485, RS 422, ISA, PCI and IIC bus characteristics, Bus interface ICs

Module III
Finite state machine design - the concept of state machine - timing in state machine - FSM design procedure - ASM notation - Moore and Mealy machine design - examples of Moore and Mealy machines.

Module IV
Introduction to HDLs, Design Flow, Synthesis, VHDL Basics, Data types, Operators, Concurrent coding, Structural and Behavioural Modelling, Design of Adder, Substractor, Decoder, encoder, Code converter, Multiplexer, VHDL for Combinational Circuits, Blocks, Generate Statements.

Module V
Sequential Code, Control Structure, Attributes, VHDL for Flip Flops, Design of Shift Registers & Counters using VHDL, Design of memory using VHDL, Signals and Variable.

References
1. Milos D Ercegovac,Tomaslang,digital system and hardware/firmware algothim,john wiley
2. V.A.Pedroni,”circuit design with vhdl”, phi, 2005
3. J.bhaskar,”a vhdl synthesis primer”, bsp, 2006
4. d.j.smith,”hdl smith design”,don publisher,2005

AI 010 606 L04

INDUSTRIAL SAFETY ENGINEERING (ELECTIVE-1)

3+1+0
Credits: 4

Objectives:

1. To generate safety awareness among students.
2. To help the students learn the fundamentals of science and engineering of safety.
3. To help the students acquire attitude towards safety.

Module 1

Types of industries: light, heavy, high tech – manufacturing (iron and steel), process (oil refinery), service (hospital); Overview of a typical modern industry: activity flow, machineries, operations, parameters which could lead to accidents; ranges of temperatures and pressures, working media like fluids and gases, safety concerns (over pressure, gas leaks, etc.); Areas of industrial safety: process safety, personnel safety, instrument safety, facility safety, environment safety.

Module 2

Static electricity and safety: Basic concepts of static electricity: accumulation of charge leading to high potential and discharge – break down of insulation and discharge processes – earthing - human body as a source of charge and simple methods to discharge – lightning protection of industrial areas.
Accidents: categories, system analysis for safety/failure prediction, steps for prevention, need for post accident analysis (analysis techniques not included).

Module 3

Introduction to special components, tools and instruments: Safety relays – safety gate switch and interlock - gas detectors; Instrument design and development concept for safety: Building in safety: failsafe design- ergonomics in design/layout/ with simple examples – redundancy - factor of safety-selection of materials-device etc- importance of screening, testing. Special tools and gadgets for safety: helmet-gloves– non sparking tools -safe ohm meter - hydraulic tools - hydraulic press – applicable standards.

Module 4

Quality management and safety: Importance of QM in safety – quality assurance versus quality control – total quality management - quality control methods: FMECA/FMEA – screening and testing - fault tree analysis – quality implementation methods like documented procedure, and periodic calibration of tools and other equipment - applicable standards.

Module 5

Safety Management: visible and latent hazards - human factors and safety - OSHA-safety audit - industrial fatigue- role of industrial psychology- risk analysis - safety training - accident and near miss investigations- promotional measures to avoid accidents - human reliability - safety management characteristics-industrial safety policies and implementation.

References:

1. Patrick D. T. O' Connor, Practical Reliability Engineering, JW
2. R.P.Blake, Industrial Safety, PHI.
3. Brown D.B, "System Analysis and Design for safety", Prentice Hall, New Jercy.
4. Laird Wilson, Industrial Safety and Risk Management, University of Alberto.
5. L.M. Deshmukh, Industrial Safety Management, Tata McGrawHill.
6. Anil Mital (Ed), Advances in Industrial Ergonomics and Safety, Vol 1, Taylor and Francis.
7. Robin Garside, William Calder, Intrinsically Safe Instrumentation, Instrument Society of America.
8. Jain R K, Industrial Safety Health And Environment Management Systems ,Khanna.
9. Deshmukh L M , Industrial Safety Management, Tata McGrawHill.

AI010 606 L05

RELIABILITY ENGINEERING (ELECTIVE I)

3+1+0
Credits: 4

Objectives:

1. To induce in students an attitude towards reliability which will ensure that they look out for steps to avoid failures to achieve success in all assignments they take up. That will help them become true engineers.
2. To generate in students an awareness of the importance of statistical concepts, and to make them realise that engineering is also largely statistics based.

Module1

Basic concepts of reliability: meaning of reliability – meaning of failure – statistical nature of failure – general reasons for failure - reliability growth testing and failure data table - reparable and nonreparable failures – component failure versus system failure. Measures of reliability: failure rate - MTTF – MTBF - MTTR – maintainability – availability.

Module 2

Failure pattern: Statistical nature of failure - BT curve for electronic and mechanical components.
Hazard rate models: importance of mathematical models - constant hazard rate model – linearly increasing hazard rate model – Weibull model.– reparable system availability analysis – failure modes – common mode failure – system reliability analysis using reliability block diagram.

Module 3

Quality and Reliability:
concept of quality - broad causes for lack of quality – quality management concepts - QMS –prototype development and testing - trilogy of quality – QP, QA and QC- role of standards in achieving quality – quality circles; statistical process control for manufacture of components: basic concept of statistical process control – introduction to control charts - the Taguchi methodology – concept of robust design - process capability indices – six sigma approach -

Module 4

Reliability design and design management: system reliability models and estimation of reliability - apportioning reliability among subsystems - series reliability model – active redundancy – 'm out of n' redundancy – standby redundancy – FMECA – design reviews –reliability enhancement through reengineering.

Module 5

Reliability testing: environmental stress screening - development test – qualification test – accelerated life testing, ALT and HALT: basic concept – reliability assessment based on ALT data -

Text Books:

1. Patrick D. T. O'Connor, Practical Reliability Engineering, JW.
2. E. Balaguruswamy, Reliability Engineering, Tata McGraw Hill.

References:

1. E.E. Lewis, Introduction to Reliability Engineering, JW.
2. NVR Naidu, et al, Total Quality Management, New Age International Publishers.
3. J.M. Juran and Frank M. Gryna, Quality Planning and Analysis, Tata McGraw Hill.
4. Charles E. Ebeling, Reliability and Maintainability Engineering, Tata McGraw Hill.

AI010 606 L06

ENERGY MANAGEMENT (ELECTIVE I)

3+1+0
Credits: 4

Objectives:

- Generate awareness among students about the relation ship between development of the society and energy consumption.
- Help the students understand the serious consequences of impact on environment.
- Help the students develop an attitude towards conserving energy for future.
- Help the students to become aware of, and hence to contribute to, the world wide efforts to save Mother Earth through proper energy management efforts.

Module 1
Introduction to energy: forms of energy – radiation, mechanical, chemical, electrical, nuclear; types of energy: potential, kinetic; concept of energy conversion;
Laws of thermodynamics: laws – entropy – relevance of the concept of entropy to human society; energy versus power; units of energy and power; household energy consumption estimation; approach to energy management at home.

Module 2
Use of electrical energy: role of energy in the development of human society; energy needs of growing economy; comparison of energy use in industrialized and developing countries – trends in global energy consumption.
India's current energy scenario: major sources – hydro electric stations, thermal stations, nuclear stations; – problems with current patterns of energy use in India: supply and demand gap – over dependence on import of oil.
Distribution of major sources of nonrenewable sources over the globe and over India - Comparison of consumption in industrial, domestic and agricultural sectors in India.

Module 3
Major issues related to production and distribution of electrical energy: widespread inefficiency in power generation, transmission, management; - major loss parameters in production and distribution of energy – steps to reduce loss, and constraints – need for non conventional forms of energy.

Module 4
Role of energy management in the march towards self reliant India: long term energy scenario –Integrated Energy Policy for India.
Introduction to renewable energy sources - significance of renewable energy sources – Energy sources and environmental impact: solar energy – wind energy – wave energy - tidal energy – mini hydro electric projects.

Module 5

Basic concepts on environmental impact: social and economic impacts – impact on ozone layer and climate – issue of global warming - United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol.

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Text Books:

1. Centre for Environment Education, Energy, Oxford and IBH Publishing Co.
2. S.A. Abbasi and Naseema Abbasi, Renewable Energy Sources and Their Energy Impact, PHI.
3. B. Muzumdar, A Text Book of Energy Technology: Both Conventional & Renewable Source of Energy, APH.

References:

4. India Energy Portal
5. Wayne C. Turner, Energy management handbook, John Wiley and Sons.
6. Cape Hart, Guide to Energy Management, Turner and Kennedy

AI010 607(P)

Microprocessors & microcontrollers lab

(Common to EI010 607)

Teaching scheme **Credits: 2**

3 hours practical per week

Objectives

1. To provide experience on programming and testing of few electronic circuits using 8086

2. To provide experience on programming and testing of few electronic circuits using 8051simulator.

3. To understand basic interfacing concepts between trainer kit and personal computers.

A. Programming experiments using 8086 (MASM)

1. Sum of N Numbers.
2. Display message on screen using code and data segment.
3. Sorting, factorial of a number
4. Addition /Subtraction of 32 bit numbers.
5. Concatenation of two strings.
6. Square, Square root, & Fibonacci series.

B. Programming experiments using 8051 simulator (KEIL).

1. Addition and subtraction.
2. Multiplication and division.
3. Sorting, Factorial of a number.
4. Multiplication by shift and add method.
5. Matrix addition.
6. Square, Square root, & Fibonacci series.

C. Interface experiments using Trainer kit / Direct down loading the programs from Personal computer.

1. ADC / DAC interface.
2. Stepper motor interface.
3. Display (LED, Seven segments, LCD) interface.
4. Frequency measurement.
5. Wave form generation.
6. Relay interface.

AI010 608(P)

Mini Project

(Common to EI010 608,IC 010 608)

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.

AI010 701 VLSI

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

- *To impart knowledge of the VLSI Design and , scaling of devices*
- *To make an awareness on the various processes involved in the fabrication of different devices*

Module 1

Processes in IC fabrication: Overview of the VLSI fabrication process – Elemental semiconductors and compound semiconductors –Crystal growth: –Czochralski process – Wafer preparation – wafer cleaning – Epitaxial growth: – Chemical vapour deposition(CVD) – Molecular beam epitaxi(MBE) - Sputtering – Oxidation :– dry oxidation and wet oxidation -Lithography:- photolithography – fine line lithography – X-Ray lithography – electron beam lithography –photo mask fabrication –Etching:- wet etching and reactive plasma etching –Doping:- diffusion – mechanism - Fick's laws - impurity profiles – ion implantation and annealing – metallization: – physical vapour deposition –patterning –wire bonding and packaging

Module 2

VLSI Design: Circuit design – scaling of device structure – scaling factors - effects of miniaturization – VLSI Design cycle: –system specification – architectural design functional design – logic design – circuit design - physical design – fabrication –packaging testing and debugging new trends in design cycle – physical design cycle: - partitioning floor planning and placement – routing – compaction extraction and verification –
design styles:–full custom- standard cell - gate arrays - field programmable gate array – sea of gates-Stick diagram – Mask lay out –design rules - Design of simple logic circuits: inverter, NAND gate, NOR gate, CMOS logic system, BiCMOS Circuits – Sub system design process : design of a 4 bit shift register – Basics of Hard ware description languages : VHDL and Verilog

Module 3

VLSI process integration :Silicon Technology: Monolithic component fabrication – BJT fabrication – buried layer – impurity profile – parasitic effects – diodes – Schottky diode and transistor – FET –JFET– monolithic resistors sheet resistance and design – resistors in diffused region — Monolithic capacitor – junction capacitor– Isolation of components – junction isolation - dielectric isolation – IC crossovers - vias

Module 4

Silicon MOS Technology: MOSFET fabrication – NMOS – PMOS –Si gate technology - control of threshold voltage- Metal gate CMOS – Sillicon Gate CMOS – Twin well process – Latch up –BiCMOS technology - MOS resistance- MOS capacitor

Module 5

Compound semiconductor technology: GaAs Technology – Crystal structure – doping process – Channeling effect – MESFET –Fabrication - device modeling - Strained Si technology, Si-Ge,

References

1. VLSI Technology : S M Sze ,Tata McGraw Hill pub
2. VLSI Fabrication Principles: Sorab K Gandhi, John Wiley & sons
3. Basic VLSI Design : Douglas Pucknel, PHI
4. Integrated Circuits K R Botkar, Khanna pub
5. Algorithms for VLSI Physical design Automation : NaveedSherwani ,Springer
6. ULSI Technology :Chang, SM Sze,Tata McGraw Hill pub,
7. Principles of CMOS VLSI design :H E Weste , Pearson Edn
8. Modern VLSI Design : Wayne Wolf, Pearson Edn
9. VHDL primer, J Bhaskar

AI010 702

Computerised Process Control
(Common to EI010 702)

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

Objective:

- *To provide a detailed view of the implementation of SCADA in process industry.*
- *To give an insight about Instrumented Safety Systems and Programmable Logic controllers with applications using ladder programming.*
- *To teach about different digital controllers using z transforms.*
- *To impart knowledge about Distributed Control System and its architecture.*
- *To have an insight into Electrical Safety and Process Safety Management.*

Module 1

Introduction to computer control of process- need for computers in control system –block diagram of a computer control system- multi channel data acquisition system(DAS)
Supervisory Control and Data Acquisition System (SCADA) :Concepts- SCADA development from Telemetry, SCADA System Hardware, Remote Terminal Units (RTUs), Master Terminal Units, Communication philosophies, Communication Interface and Communication Protocols, Configuring Simple applications, Operator Interfacing and Applications of SCADA.

Module 2

Programmable Logic Controllers: Introduction to Instrumented Safety Systems and Safety Integrity Levels, Sequential and Combinational Control, Microprocessor Based Programmable Logic Controllers - Architecture, I/O Modules, Isolators, PLC Programming Languages, PLC ladder programming : Programming On-Off inputs to produce on – off outputs, Concept of Redundancy and Triple Modular Redundant PLCs, PLC Installation and Testing.

Module 3

Digital controllers: Design of Control algorithms using Z transforms – Dead beat algorithm – Dahlin's method –Ringing – Kalman's approach – Digital PID algorithms – Position and velocity form . Modified Z transforms to system with dead time –Smith predictor algorithm. Internal model control using Z transform.

Module 4

DCS Basic Packages: Introduction to Centralized & De-centralized Control, Direct Digital Control and Distributed Process Control, DCS Architecture, Local Control Units, DCS Configuration with associated accessories, I/O Hardware, Multiplexers, A/D and D/A Converters, Set Point Stations, DCS Flow sheet Symbols. Redundancy Concepts, Data Highways,Field Buses, CRT Displays, Man Machine Interface, Operator Stations, Engineer' Stations, System Integration with PLC, SCADA and Computers, OPC Connectivity.

Module 5

Electrical safety: NEMA standards, grounding and shielding – standards , power grounding, concept of shielding, electro static instrument shielding . Process safety management: elements of process safety management- process safety information – process hazard analysis .

Reference Books

1. Stuart A.Boyer "Supervisory **Control and Data Acquisition**
2. Jeff Weigunt. "Creating HMI/ SCADA Industrial Applications using Microsoft Access", ISA.
3. RJ.Willam, "Hand book of SCADA System for the Oil and Gas Industry", Mold Clwyd.
4. Considine, Applications of Computers in Process Control
5. Krishnakanth, Computerised Based Industrial Controls
6. B.G Liptak - Handbook of Process Control - 1996
7. Jon Stenerson "Fundamentals of Programmable Logic Controllers, Sensors and Communications", Prentice Hall of India.
8. John webb: Programmable logic controllers, PHI
9. Deshpande, P.B. and Ash R.H., Elements of Computer Process Control, Instruments Society of America, 1981
10. C.L.Smith, Digital Computer Process Control, Intext Educational Publications 1972
11. M.P.Lukas, Distributed Control System, Van Nostrand Rainhold Compony 1986.
12. Frank D Petruzella, Programmable Logic Controllers (Mc Graw Hill)
13. Dobrivoje Popovic and Vijay P. Bhatkar - Distributed Computer Control for Industrial Automation - Marcel Dekker, INC, 1990.
14. LIPTAK, Instrument engineers hand book: Process software and digital networks , third edition.
15. LIPTAK, Instrument engineers hand book: Process measurement and analysis, fourth edition.

AI 010703

Biomedical Instrumentation

(Common to EI010 703 and IC010 703)

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

Objectives:

- *To help students learn the basics of instrumentation related to biomedical systems.*
- *To help students get overall knowledge of the medical equipments for diagnosis and therapy.*
- *To help students understand the relative electrical safety measures and standards.*
- *To help students know general concepts of imaging system.*

Module 1

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

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 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

Module 4

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

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

AI 010 704

Analytical Instrumentation

(Common to EI010 704 and IC010 704)

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Objectives

- *To impart a basic knowledge about analytical instruments, its concepts, and its technique.*
- *To give a vast knowledge about different types of spectroscopic analysis.*
- *To study about different types of chromatographic analysis.*

Module 1

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

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 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

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: 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

AI010 705

Industrial Instrumentation II

(Common to EI010 705 and IC010 705)

Teaching scheme **Credits: 3**

2 hours lecture and 1 hour tutorial per week

Objectives

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

Module 1

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

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 :- 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

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, 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 – DhanpatRai 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

AI010 706L01

Robotics

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

- *To familiarize the students with the fundamental concepts of robotics and automation.*
- *To introduce basic elements and subsystems of robots.*
- *To generate an awareness of various applications of robots.*

Module1

Robot Organization

Introduction to robotics: Evolution of robots, laws of robotics, progressive advancements in robots, robot anatomy. Links, joints, degrees of freedom, arm configuration, wrist configuration, end effectors, manipulation and control. Coordinate frames: description of objects in space, transformation of vectors, inverting a homogeneous transform, fundamental rotation matrices, Euler angle representations.

Forward kinematics: mechanical structure and notations, description of links and joints, kinematic modeling of the manipulator, Denavit-Hartenberg notation, kinematic relationship between adjacent links manipulator transformation matrix

Inverse kinematics: Manipulator workspace, solvability of inverse kinematic model.

Module 2

Robot hardware

Robot sensors: proximity sensors ,range sensors, tactile sensors, , position sensors, velocity sensors Visual Sensors and auditory sensors.Robot Manipulators introduction: wrists, robot gripper, manipulator control

Dynamic modeling (proofs not required): Lagrangian mechanics, two degree freedom manipulator, Lagrange Euler formulation, velocity of a point on the manipulator.

Module 3

Introduction to robot control

Control of manipulators: linear control schemes, partitioned PD control scheme,PID control scheme, computed torque control,force control of robotic manipulators,hybrid position force control,impedance force torque control,adaptive control.

Module 4

Robot and Artificial Intelligence

Principles of all basics of Learning, planning movement,basics of knowledge representation, robot programming languages,trajectory planning (only a brief introduction required) and remote manipulation.

Module 5
Robotic Vision Systems
Principles of edge detection, determination of optical flow and shape, image segmentation, pattern recognition, model director sense analysis.

Textbooks

1. R K Mittal , I J Nagrath, Robotics and control,Tata McGraw Hill
2. M.P .Groover,Mitchell Weiss, Roger N.Nagel, Nicholas G Odrey, Industrial Robotics, Tata McGraw Hill.
3. Lee, Gonzalez aqnd Fu “Robotics (11 Ed)”, IEEE Press, 1986

References

1. Hall and Hall” Robotics – A User Friendly Introduction”, Saunders Publishing Company, 1985
2. Vokobravotic “Introduction to Robotics”, Springer 1988
3. Charniakand, Mcdermott, “Roboty Technology ande Applications”, Springer 1985
4. Charniac & Mcdermott, “Introduction to Artificial Intelligence”, Mc Graw Hill, 1986
5. P Janaki Raman, “Robotics”, Tata Mcgraw Hill

AI010 706L02

Real Time Systems

Teaching scheme **Credits:**4

2 hours lecture and 2 hours tutorial per week

Objectives

- *Introduce the concept and principles of real time systems design.*
- *Introduce the working principles of hard real systems.*
- *Also covers topics on reliability of real time systems.*

Module 1

Introduction to Real Time Systems: structure of real time systems, real time computer, task classes – periodic, aperiodic, critical, noncritical, definition of real time systems – real time systems, embedded systems - hard real time systems, soft real time systems, real time design issues; real time kernel: polled loop systems, co-routines, interrupt driven systems, round robin systems, task control block model.

Module 2

Characterizing real time systems: performance measures for real time systems, performability, cost functions and hard dead lines; Estimating program run times. Task assignment and scheduling: uni-processor scheduling: rate monotonic algorithm, EDF algorithm, multiprocessor scheduling: utilization balancing algorithm, next-fit, bin-packing assignment algorithm for EDF.

Module 3

Communication: communication media, message sending topologies, network architecture issues, contention based and token based protocols, stop and go,multihop, polled bus, hierarchal, round robin, fault tolerant routing. Clocks and synchronization: fault tolerant synchronization in hardware, synchronization in
software.

Module 4

Fault tolerance – definition, cause of failure, fault types, fault detection and containment, redundancy – hardware, software, time, information, integrated failure handling – reliability – parameter values – series – parallel systems, NMR clusters, combinational model, master chain model, fault latency, transient faults,software error models.

Module 5

Programming Languages – Desired language characteristics, Real time databases characteristics, main memory databases, Transaction, Disk schedule algorithms, Databases for hard real time systems, maintaining serialization constituency.

Text Book

1. C.M Krishna, Kang G. Shini ,Real Time Systems, McGraw Hill
2. Philip Laplante,Real Time Systems, Design & Analysis ,PHI

Reference

1. Krishna, Real Time Systems, Tata McGraw Hill

AI010 706L03

Optimization Techniques

(Common to EC010 706L01, EI010 706L01)

Teaching Schemes **Credits: 4**

2 hours lecture and 1 hour tutorial per week.

Objectives:

Understand the need and origin of the optimization methods. Get a broad picture of the various applications of optimization methods used in engineering. Define an optimization problem and its various components.

Module I (12 hrs)

One Dimensional Unconstrained Minimization techniques, single variable minimization, unimodality, bracketing the minimum, necessary and sufficient conditions for optimality, convexity, steepest descent method.

Module II (12hrs)

Linear programming, introduction, linear programming problem, linear programming problems involving LE (≤) constraints, simplex method, optimality conditions, artificial starting solutions, the M method.

Module III (12hrs)

Transportation models, definition, non traditional models, transportation algorithm, East West corner method, Vogel approximation method. Assignment model, Introduction, Hungarian method.

Module IV (12hrs)

Forecasting Models, moving average technique, regression method, exponential smoothing. Game Theory, two persons zero sum games, mixed strategy games- graphical method.

Module V (12hrs)

Queuing models, elements of queuing model, pure birth and death model, specialized Poisson queues, single server models. Multiple server models, self service model.

References:

1. Ashok D Belegundu, Tirupathi R Chandrupatla, “Optimization concepts and Application in Engineering”, Pearson Education.
2. Kalynamoy Deb, “Optimization for Engineering Design, Alogorithms and Examples”, Prentice Hall,
3. Hamdy A Taha, “Operations Research – An introduction”, Pearson Education,
4. Hillier / Lieberman, “Introduction to Operations Research”, Tata McGraw Hill Publishing company Ltd,
5. Singiresu S Rao, “Engineering optimization Theory and Practice”, New Age International,

6. Mik Misniewski, “Quantitative Methods for Decision makers”, MacMillian Press Ltd.,

AI010 706L04

Fuzzy Logic

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

- *To teach about the concept of fuzziness involved in various systems.*
- *To provide adequate knowledge about fuzzy set theory. .*
- *To provide adequate knowledge of application of fuzzy logic control to real time systems*.

Module 1

Introduction to Fuzzy sets and systems. Basics of fuzzy sets membership function, support of a fuzzy set, height - normalized fuzzy set, α - cuts (decomposition of a fuzzy set), set theoretic definitions on fuzzy sets, complement, intersection and union equality, subset hood - basic definition based on membership functions. The law of the excluded middle and law of contradiction on fuzzy sets. Properties of fuzzy sets operations (logical proof only). Extension of fuzzy sets concepts - type-2 and level 2 fuzzy sets - examples.

Module 2

Operations on fuzzy sets - intersection, algebraic sum - product, bounded sum - product, drastic sum product, t-norms and t-conorms(s - norms) on fuzzy sets, typical parameterized t - norms and s-norms (with simplified proof). Extension principle and its applications.

Module 3

Fuzzy relation. Resolution form of a binary fuzzy relation. Operations on fuzzy relations - projection, max-min. and min and max, compositions cylindrical extension. Similarity relations - reflexivity, symmetry, transitivity.

Module 4

Further operations on fuzzy sets and proposed by Zadeh - concentration dilation, contrast Intensification, a linguistic hedges, computation of the meaning of values of a linguistic variable, fuzzy algorithms, fuzzy engineering - applications of fuzzy controls, case studies. Fuzzy pattern recognition-feature analysis, partitions, identification, multifeature recognition.

Module 5

Logical operations on fuzzy sets – Negation – Conjunction, disjunction, implication, fuzzy inference. Block diagram of a fuzzy logic system. Fuzzy rule base – simplification of compound rule base – fuzzy inference – max. –min, man product, man drastic product, man bounded product. Defuzzification – Centre of gravity, center of sums, weighted

average etc (Defuzzification methods) Simple controllers, General controllers, Stability, Models, Inverted pendulam, Aircraft landing control, Aircondioner control.

References

1. C.T Lin & C S George Lee. Neural Fuzzy Systems, Prentice Hall.
2. Earl Cox. Fuzzy Systems Handbook, Associated Press
3. Klir and Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall of India.
4. IEEE Trans on Systems, Man & Cybernetics, vol. SMC - 3, No.1, January 1973, pp 28-44
5. Bart Kosko. Fuzzy Engineering, Prentice Hall.
6. Ahamad M. Ibrahim : *Introduction to Applied Fuzzy Electronics*, PHI. (Module 3)
7. S. Rajasekharan, G A Vijayalakshmi Pai *: Neural Networks, Fuzzy logic and Genetic Algorithms*, PHI.
8. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 2/e, McGraw Hill.

Mahatma Gandhi University

AI010 706L05

Digital Image Processing

(Common to EI010 706L03)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives:

- *To study the fundamentals of image processing*
- *To study various transforms*
- *To get an exposure to image enhancement and restoration*
- *To learn the details of coding techniques*
- *To understand the concept of segmentation*

Module 1

Digital image fundamentals: Two dimensional systems and mathematical preliminaries- Elements of digital image processing system- Structure of the human eye - Image formation and contrast sensitivity – Gray scale and Colour Images-Sampling and Quantization -Image processing applications

Module 2

Image Transforms: Introduction to Fourier transform - Discrete Fourier transform - Properties of two dimensional FT – Separability, Translation, Periodicity, Rotation, Average Value – DFT,FFT,DCT, DST, Walsh, Hadamard, KL transforms and their properties.

Module 3

Image Enhancement: Point Operations - Spatial domain methods - Frequency domain methods -
Histogram Equalization technique - Neighbourhood averaging Median filtering - Low pass filtering
Averaging of multiple Images - Image sharpening by differentiation - High pass filtering.
Image Restoration: Degradation model for continuous functions - Discrete formulation - Diagonalization of circulant and Block-circulant matrices - Effects of Diagonalization - Unconstrained and constrained Restorations - Inverse Filtering - Wiener Filter - Constrained least - square Restoration.

Module 4

Image Compression: Coding and Inter-pixel redundancies - Fidelity criteria - Image Compressions

Models - Elements of Information theory - Variable length coding - Bit plane coding - Lossless
Predictive coding - Lossy predictive coding - Transform coding techniques.

Module 5

Image Segmentation and Representation: The detection of discontinuities - Point, Line and Edge
detections - Gradient operators - combined detection - Thresholding - Representation schemes: chain codes - Polygon approximation - Boundary descriptors: Simple descriptors - Shape numbers Fourier descriptor's - Introduction to recognition and Interpretation.

Text books:

1. Rafael C Gonzalez and Richard E.woods, ―Digital Image Processing ,3/e,Addition – Wesley.
2. Anil K Jain, ―Fundamentals of Digital Image Processing , PHI, New Delhi, 1995
3. S Jayaraman,S Esakkirajan,T Veerakumar, Digital Image Processing ,TMH,2009

References:

1. Kenneth R Castleman, ―Digital Image Processing , PHI, 1995.
2. William K Pratt, ―Digital Image Processing , Wiley India 2/e.
3. Sid Ahmed M A, ―Image Processing Theory, Algorithm and Architectures , McGraw-Hill, 1995.
4. Rafael C Gonzalez and Richard E.woods, ―Digital Image Processing Using MATLAB , Addition - Wesley, 2004.
5. R.M. Haralick, and L.G. Shapiro, Computer and Robot Vision, Vol-1, Addison

AI010 706L06

Advanced Microcontrollers

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 1

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 2

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 3

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 4

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 5

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

AI010 707

Industrial Instrumentation Lab

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

Objective:
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.

AI010 708

DIGITAL SIGNAL PROCESSING(DSP) LAB

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

Objectives:

- *To familiarise with real time signal processing.*
- *To familiarize with signal procesing tools like, Matlab/Octave and TMS 320C 6713 DSP Processor.*
- *Study of charecteristics of analog and digital signals and systems.*
- *Study of practical dificulties in designing a digital system.*

List of Experiments:

1. Introduction to Matlab/Octave for signal processing.

2. Architecture of DSP chips-TMS 320C 6713 DSP Processor.

3. Generation of Test Discrete-Time Signals in the Time Domain- Impulse, step, triangular, sinusoidal, damped sinusoidal, etc.

4. Discrete-Time Systems in the Time Domain- Discrete time system as mathematical operation and analysing for linearity, impulse response, step response.

5. Discrete-Time Signals in the Frequency Domain- Analysis of various signals in frequency domain using Fourier basis using Fourier series, Foureir Transform, DFS DTFT and N-point FFT algorithm.

6. Discrete-Time Systems in the Frequency Domain- Analysis of system in frequency domain and study the frequency response and phase response of a system.

7. Digital Processing of Continuous-Time signals: Sampling Theorem and anti-aliasing filters- Study of sampling theorem by sampling an analog signal and reconstruction for various sampling rate. Design of a signal pre-processing(anti-aliasing filter) system to sample a signal from a transducer.

8. Digital Filter Structures: Realisation of FIR and IIR system and their implementation in direct, cascade, parallel, lattice and lattice-ladder forms and study the finite length effects in various realization.

9. Digital Filter Design -FIR filters using windows and effects of various windows on transition width and maximum attenuation obtained.

10. Digital Filter Design -IIR filters by pole-zero placements and approximation of analog filters like Butterworth, Chebyshev, elliptic filters and comparing their phase charecteristics, magnitude response for various orders.

References:

1. Digital Signal Processing: Laboratory Experiments Using C and the TMS320C31 DSK:Rulph Chassaing

2. DIGITALS IGNALP ROCESSING USING MATLAB by Vinay K. Lngle, John G. Proakis.
3. Digital Signal Processing Laboratory Using MATLABby Sanjit K Mitra.

AI 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.

AI 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.

AI 010 801

Instrumentation System Design

(common to EI010 801 and IC 010 801)

Teaching scheme **Credits:** 4

3 hours lecture and 2 hours tutorial per week

Objective

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 1

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 2

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 3

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 4

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 5

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 .

Text 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

AI 010 802

Instrumentation in Process Industries

(common to EI010 802)

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

Objectives:

- *To give a basic knowledge about unit operations.*
- *To provide exposure to the process and instrumentation applications in different industries.*

MODULE 1

Basic concepts and principles of commonly used unit operations – Reactors – batch reactors – distillation towers – refrigeration units – steam boilers – furnaces – dryers – crystallizers – centrifuges – heat exchangers – pumps – compressors – evaporators – extruders.

MODULE 2

Instrumentaion in the Food industry : Description of the process – Measurment hardware in the food industries – Analyzers in the food industry – Valves and feeders in the food industry – Controllers and displays in the food industry – Computer applications in the food industry – Typical control systems in the food industry

MODULE 3

Instrumentation in the iron and steel industry: Description of the process – Measurment hardware – analyzers – valves - Controllers and displays in the iron and steel industry – Computer applications in the iron and steel industry – Typical control systems in the iron and steel industry

MODULE 4

Instrumentaion in the Paper industry : Description of the process – Measurment hardware in the Paper industry – Analyzers in the Paper industry – Valves and feeders in the Paper industry – Controllers and displays in the Paper industry – Computer applications in the Paper industry – Typical control systems in the Paper industry.

Instrumentation in the Nuclear industy: Description of the process- Measurement hardware in the nuclear industry – Analysers in the nuclear industry – Valves and control rodes in the nuclear industry – Control panels and displays – Computer applications – Typical control system.

MODULE 5

Instrumentaion in the pharmaceutical industry : Description of the process – Measurment hardware in the pharmaceutical industry – Analyzers in the pharmaceutical industry – Valves and

feeders in the pharmaceutical industry – Controllers and displays in the pharmaceutical industry – Computer applications in the pharmaceutical industry – Typical control systems in the pharmaceutical industry.

Text Book:

1. Instrumentation in the Processing Industries , Bela G Liptak (ed.), Chilton Book Company

Reference Books:

1. Unit operation in chemical Engg. McCabe Smith 4/e Mcgrans Hill
2. Outline Chemical Technology M Gopal Rao &M Sitting 3/E East West 1973
3. Chemical Engineering Hand book Peiry,McGrans Hill
4. Chemical reaction Engineering O leven spielJ.Wiley & sons

AI010 803

Computer Networks

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives:

- *To develop basic knowledge on the mode of operation of different types of computer networks that are used to interconnect a distributed community of computers and various interfacing standards and protocols.*

Module I

Network requirements, Network Architecture –layering and protocol, OSI Architecture, Internet Architecture, Performance-bandwidth and latency , Delay x bandwidth product, high speed networks .

Module 2

Direct Link Network, Hardware Building Block, Framing-Byte Oriented Protocol, Bit Oriented Protocol , Clock Based Framing, Reliable Transmission-Stop and Wait, Sliding Window, Ethernet(802.3)-Physical properties, Access protocol, Wireless-Bluetooth, WiFi, Wimax

Module 3

Packet Switching-Switching and Forwarding- Datagram, virtual circuit switching, Source routing Bridges and LAN Switches-Learning Bridges, Spanning tree Algorithms ,Broadcast and Multicast, Limitations of bridges, Simple Internetworking-Service Model, Global Address, Datagram Forwarding in IP, address translation, Routing-network as graph, distance vector, link state, matrix

Module 4

End to End Protocol, Simple de-multiplexer, Reliable Byte stream, TCP-Issues, segment format, connection establishment and termination sliding window revisited, triggering transmission, adaptive retransmission, RPC-fundamentals ,TCP Congestion control – additive increase, slow start, fast retransmit and fast recovery, congestion avoidance mechanism, DEC bit, Random Early Detection bit, Source Based Congestion avoidance

Module 5

Applications -WWW, E-mail, Name Service, Network Management, Web Services Custom Application protocol, Generic Application Protocol ,Overlay Networks-Peer to Peer Networks.

Reference Books

1. Computer Networks A Systems Approach-Larry L.Peterson and Bruce S.Davie,4th Edition .Morgan Kaufman
2. Introduction to data communication and networking Behrouz Forozan TMH.

3. Computer networks ,Andrew S Tanenbaum ,PHI
4. Data communication, computer networks and open systems, Halsall F ,Addison Wesley.

AI010 804L01

NEURAL NETWORKS

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

Objectives:

- to present an overview of the theory and applications of artificial neural networks to engineering applications.
- to create an understanding of various neural network system models and the applications of these models to solve engineering problems

Module 1

Fundamentals of Neural Networks – Human Brain – Model of an artificial neuron - activation functions – Typical architectures – Training and learning methods – Perceptron - Linear separability – XOR problem- Perceptron convergence theorem - Adaline and Madaline Network – Applications of ANNs.

Module 2

Back Propagation – The Single layer ANNs – Multi layered feed forward ANNs – Back propagation network architecture and algorithm – Method of steepest descent – local and global minima - Effect of learning rate – Adding a momentum term - Applications.

Module 3

Associative Memory – Auto associative memory – Storage capacity- Hetero associative memory – Kosko's discrete BAM –- Recurrent networks – Discrete Hopfield network stability - Adaptive resonance theory – Vector quantization – ART1 and ART2 architecture.

Module 4

Competitive Networks – Kohonen's self organizing maps – architecture and algorithm – LVQ – architecture and algorithm - Counter Propagation networks: - Full CPN – Forward only CPN.

Module 5

Simulated Annealing - Boltzmann's Machine - Applications to traveling salesman problem.
Simulating ANN using Matlab/Labview – Simple neuron model using hardware, Neural network hardware and VLSI implementation.

Text Books

1. *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications* - S. Rajasekaran, G. A. Vijayalakshmi Pai, PHI Learning Pvt. Ltd.
2. *Fundamentals of Neural Networks: Architectures, Algorithms and Applications* - Laurene Fausett, Pearson Education Inc.

3. *Neural Networks: A Classroom Approach* – Satish Kumar, TMH Education Pvt. Ltd.

References

1. *Neural Networks*: *A Comprehensive Foundation* - Simon Haykins, Prentice Hall
2. *Introduction to Artificial Neural Systems* - J.M. Zurada, Jaico Publishing House.
3. *Artificial Neural Networks* - Robert J. Schalkoff, McGraw Hill
4. *Artificial Neural Networks* - B.Yegnanarayana, Prentice Hall India
5. *Neural Computing: Theory & Practice* - Philip D. Wasserman.

AI010 804 L02

Advanced Digital Signal Processing

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

Objective :

- To give a basic foundation to some advanced topics in digital signal processing.
- The students who take this course will be well prepared for pursuing graduate level (masters level) programme in Signal Processing.

Module 1

Vector Spaces :- Complex Numbers, Definition of Vector Space, Properties of Vector Spaces, Subspaces, Sums and Direct Sums, Span and Linear Independence, Bases, Dimension
Inner-Product Spaces :- Inner Products, Norms, Orthonormal Bases, Orthogonal Projections and Minimization Problems
Linear Maps :- Definitions and Examples, Null Spaces and Ranges, The Matrix of a Linear Map, Invertibility, Eigenvalues and Eigenvectors

Module 2

Probability space: Introduction to probability, Sample space, field, σ-field, Borel set, Probability space, Definition of random variable,
Random Vector: - Definition of random vector, joint statistics, independent events and conditional probability, Conditional distributions, Expectation, variance, moments, covariance and correlation, conditional expectation, Fundamental Theorem of expectation.
Random process: - Definition of random process, IID process, statement of weak and strong law of large numbers, Convergence of random sequences- almost sure convergence, convergence in probability, convergence in the mean square sense. [Only notion of convergence is expected, no proofs related to convergence]
Stationarity: - Stationary and ergodic process

Module 3

Introduction to Multi-rate Digital Signal Processing – Sample rate reduction -decimation by integer factors- sampling rate increase – interpolation by integer factor - Design of practical sampling rate converters: Filter Specification- filter requirement for individual stages - Determining the number of stages and decimation factors - Sampling rate conversion using poly-phase filter structure – poly-phase implementation of interpolators.

Module 4

Adaptive Signal Processing – Adaptive filters – Concepts- Adaptive filter as a Noise Canceller - Other configurations of the adaptive filter - Main components of the adaptive filter – Basic Wiener filter theory – The basic LMS adaptive algorithm – Practical limitations of the basic LMS algorithm - Recursive Least Square Algorithm – Limitations - Factorization Algorithm.

Module 5

Introduction to two dimensional signal and systems - 2D impulse and its sifting property, 2D continuous fourier transform pair, 2D sampling and the 2D sampling theorem, 2D DFT Transforms and its inverse, 2D convolution theorem, Discrete Cosine Transform, Sine transform, Haar Transform, Hadamard transform, KL transform - Properties and Applications.

References

1. Sheldon Axler, Linear Algebra Done Right, Springer
2. Gilbert Strang, Linear Algebra and Its Applications, Thomson Learning.
3. Henry Stark , John W Woods, Probability and Random Processes With Application to Signal Processing, 3/e, Pearson Education India
4. Emmanuel C Ifeachor, Barrie W Jrevis, Digital Signal Processing, Pearson Education.
5. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
6. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education.

AI010 804 L03

Embedded Systems

Teaching Schemes **Credits: 4**

2 hours lecture and 2 hour tutorial per week.

Objectives

- *To introduce students to the embedded systems, its hardware and software.*
- *To introduce devices and buses used for embedded networking.*
- *To explain programming concepts and embedded programming in C.*
- *To explain real time operating systems.*

Module I (9hrs)

Introduction to Embedded System**,** Definition and Classification, Requirements of Embedded Systems, Applications of Embedded Systems in Consumer Electronics, Control System, Biomedical Systems, Handheld computers, Communication devices, Embedded Systems on a Chip (SoC).

Module II (9 hrs)

Embedded Hardware & Software Development Environment, Hardware Architecture, Embedded System Development Process, Embedded C compiler, advantages, code optimization, Programming in assembly language vs. High Level Language, C Program Elements, Macros and functions, Interfacing programs using C language.

Module III (9 hrs)

Embedded Communication System: Serial Communication, PC to PC Communication, Serial communication with the 8051 Family of Micro-controllers, I/O Devices - Device Types and Examples , synchronous and Asynchronous Communications from Serial Devices - Examples of Internal Serial-Communication Devices - UART and HDLC - Parallel Port Devices - Sophisticated interfacing features in Devices/Ports- Timer and Counting Devices - 1^2C, USB, CAN and advanced I/O Serial high speed buses- ISA, PCI, PCI-X, and advanced buses. Voice-over-IP, Embedded Applications over Mobile Network.

Module IV (9 hrs)

Matrix key board interface - AT keyboard – commands – keyboard response codes - watch dog timers - DS1232 watch dog timer – real time clocks – DS1302 RTC – interfacing - measurement of frequency - phase angle - power factor – stepper motor interface - dc motor speed control – L293 motor driver - design of a position control system - Interfacing with Displays, D/A and A/D Conversions, interfacing programs using C

Module V (9 hrs)

Definitions of process, tasks and threads – Clear cut distinction between functions – ISRs and tasks by their characteristics – Operating System Services- Goals – Structures- Kernel - Process Management – Memory Management – Device Management – File System Organisation and Implementation – I/O Subsystems – Interrupt Routines Handling in RTOS, REAL TIME OPERATING SYSTEMS : Introduction to Real – Time Operating Systems: Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment

Reference Books

1. Rajkamal, “Embedded Systems Architecture, Programming and Design”, Tata McGraw-Hill
2. Steve Heath, “Embedded Systems Design”, Newnes.
3. David E.Simon, “An Embedded Software Primer”, Pearson Education Asia.
4. Wayne Wolf, “Computers as Components; Principles of Embedded Computing System Design” Harcourt India, Morgan Kaufman Publishers.
5. Frank Vahid and Tony Givargis, “Embedded Systems Design – A unified Hardware /Software Introduction” , John Wiley
6. Kenneth J.Ayala, “The 8051 Microcontroller”, Thomson.
7. Labrosse, “Embedding system building blocks”, CMP publishers.
8. Ajay V Deshmukhi, “Micro Controllers”, Tata McHraw-Hill.

AI010 804L04

Artificial Intelligence

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

Aim
To present the concepts of intelligent agents, searching, knowledge and reasoning, planning, learning and expert systems.

Objectives
- To study the idea of intelligent agents and search methods.
- To study about representing knowledge.
- To study the reasoning and decision making in uncertain world.
- To construct plans and methods for generating knowledge.
- To study the concepts of expert systems.

Module 1
Introduction
Introduction to AI: Intelligent agents – Perception – Natural language processing –Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.

Module 2
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 3
Uncertain Knowledge And Reasoning
Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – Probabilistic reasoning – Making simple decisions.

Module 4
Planning And Learning
Planning: Planning problem – Partial order planning – Planning and acting in nondeterministic domains – Learning: Learning decision trees – Knowledge in learning –Neural networks – Reinforcement learning – Passive and active.

Module 5
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.

AI010 804L05

VHDL

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objective:

- To teach about the concept of hardware design.
- To provide adequate knowledge about different method of programming in VHDL.
- To provide knowledge about application of VHDL in digital system design

Module 1

Introduction: Hardware Abstraction- Basic Terminology- Entity Declaration- Architecture Body- Configuration Declaration- Package Declaration- Package Body- Model Analysis- Simulation- Basic Language Elements –Identifiers- Data Objects- Data Types- Operators.

Module 2

Behaviour modelling: entity declaration, architecture body, process statement, variable assignment statement, signal assignment statement, wait statement, if statement, case statement, null statement, loop statement, exit statement, next statement, assertion statement, report statement, other sequential statement, multiple process, postponed process, data flow modeling: concurrent signal assignment statement, concurrent v/s sequential signal assignment, delta delay revisited, multiple drivers, conditional signal assignment statement, selected signal assignment statement, the unaffected value block statement, concurrent assertion statement, value of a signal.-

Module 3

Dataflow Modeling: Concurrent Signal Assignment Statement- Concurrent versus Sequential Signal Assignment- Delta Delay Revisited- Multiple Drivers- Conditional Signal Assignment Statement- Selected Signal Assignment Statement- the UNAFFECTED Value- Block Statement- Concurrent Assertion Statement- Value of a Signal. Structural Modeling: Component Declaration- Component Instantiation- Resolving Signal Values - Generics and Configurations: Generics- Configurations- Configuration Specification- Configuration Declaration- Default Rules - Conversion Functions - Direct Instantiation- Incremental Binding.

Module 4

Generics, configuration specifications, configuration declaration, default rules, converstion functions, direct instantiation, incremental binding. Subprograms and Overloading: Subprograms- Subprogram Overloading- Operator Overloading- Signatures- Default Values for Parameters - Packages and Libraries: Package Declaration- Package Body-Design File- Design Libraries-Order of Analysis- Implicit Visibility- Explicit Visibility.

Module 5

Hardware modeling example: modeling entity interfaces, modeling simple elements, different styles of modeling, modeling regular structures, modeling delays, modeling conditional operations, modeling synchronous logic. State machine modeling, interacting state machines, modeling a Moore FSM, modeling a Mealy FSM, a generic priority encoder, black jack program, a clock divider, a generic binary multiplier, a pulse counter, a barrel shifter, hierarchy in design.

Text Book

1. VHDL Primer Third editions: J. Bhasker, Pearson Education Asia.

Reference

1. Introducing VHDL from simulation to synthesis: Sudhakar Yakmandhiri, Pearson Education Asia

AI010 804 L06

BioInformatics

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

AI010 805 G01

Total quality management

(Common to EI 010 805 G02 and IC 010 805 G03)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

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

Module 1

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 2

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 3

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 4

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 5

Quality Systems

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System –Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, 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.

AI010 805 G02

Human factors engineering

(Common to EI 010 805 G03)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives

- Appreciate the importance of the human factors discipline.
- Apply human factors (HF) methods and principles to the evaluation and design of systems in the world around you.
- Understand human limitations and capabilities and how they impact the design of controls, displays, and related devices.
- Appreciate how human factors can influence the effectiveness of human-system interactions.

Module 1

Introduction to the subject: common examples of human machine interactions/systems – need for engineering approach and attention to human machine systems through simple common place examples like handle positioning on doors, positioning of bath room fittings, stair case dimensions, heights of table and chair in relation, placing of alphabet keys on computer key board; definition of HF.

Module 2

Human machine systems/interfaces, HFE at work place through examples from mechanical fitting shop, electrical machine shop, assembly lines in manufacturing shops, front panels of electronic instruments.

Module 3

Anthropometric Principles: Bertillon’s observations - Bergmann's rule - Allen's rule; anthropometric division of body types - anthropometric data.

Module 4

Applied anthropometry and work space design & seating: positive and adverse effects related to work design issues – impact on worker performance and fatigue - illustration through simple examples including dimensions: safe clearances or heights, such as for doorways or walkways, safe reach distances, such as for safety cords or equipment controls, safety features including machine guards and protective shields.

Module 5

Work related health issues, safety aspects and legal aspects: work related musculoskeletal disorders, visual environment, thermal environment, auditory environment, vibrations.

Text Books:

1. McCormick, E.J., Human Factors in Engineering and Design, McGraw-Hill Book Company.
2. Eggleton, E.M. (Ed.), Ergonomic Design for People at Work: Volume 1 and 2, Van Nostrand Reinhold.

References:

1. ILO, Introduction to Work study
2. M. S. Sanders and Ernest J. McCormick, Human Factors Engineering and Design. McGraw Hill Inc.
3. Kroemer, K., H. Kroemer, and Kroemer-Elbert, K., Ergonomics: How to Design for Ease and Efficiency, Prentice Hall
4. Meister, D., Conceptual Aspects of Human Factors. Baltimore, MD, The Johns Hopkins University Press
5. Burgess, J.H., Designing for Humans: The Human Factors in Engineering, Petrocelli Books.

AI010 805G03

SYSTEM ENGINEERING

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives

- To familiarise students the modern systems approach to realise complex hardware systems.
- To help students understand the basics of reliability management of complex systems.
- To introduce to the students general concepts and generic descriptions of relevant processes, tools, and techniques.

Module 1 (12 hours)

Introduction to systems engineering (SE): concept of system - meaning of systems engineering - need/ objectives of SE.
System architecture: system, subsystem, assembly, subassembly, component/part.
General approach used in systems engineering – system development life cycle (SDLC) methodology – Introduction to different phases included in the SDLC: system/hardware requirements analysis, hardware requirements analysis, preliminary design, detailed design, fabrication, HWCI testing, system integration and testing.

Module 2 (12 hours).

Introduction to statistical analysis: Distributions of sampling statistics: sample mean – central limit theorem – distribution of sample mean – minimum sample size to use normal distribution – sample variance – joint distribution of mean and sample variance – sampling from a finite population – parameter estimation and confidence; t_ distribution and applicability; error specification in terms of standard deviation and confidence - error propagation – error budgeting.

Module 3 (15 hours)

Engineering specialties: reliability, maintainability, safety.

Introduction to reliability management: QA – QC – TQM – configuration control; system reliability: series configuration – parallel configuration – series parallel combination; designing for reliability: reliability specification and system measurements – system effectiveness; basic concepts of maintainability - economic analysis and life cycle costs – reliability allocation - redundancy concepts; failure mode evaluation and criticality analysis: identification of failure modes – determination of cause – assessment of effects – classification of severity – estimation

of probability of occurrence – computation of criticality index; system safety and fault tree analysis: error, mistake and fault – fault tree analysis.

Module 4 ((11 hours).

Systems management:
Need for documented management plan – SE management plan.
Basic concepts of organizational management: planning and control processes – review systems - strategic planning – management control – task control.
Basic concepts of project management.
Role of standards in: what are standards – need for standards – national and international agencies generating standards – examples of standards like standards for design, standards for documentation and standards for testing.

Module 5(10 hours).

System electrical integration and check out: interface design and specifications – types of connectors – types of joints like soldered and crimped joints - electrical integration related issues like ground lifting- types of failures related to integration - ensuring safety of system;
Electrical check out: continuity checks – isolation checks - functionality checks – redundancy verification checks.

Text books:

1. Sage, A.P., *Systems Engineering,* John Wiley and Sons Inc.
2. Charles E. Ebeling, Reliability and maintainability Engineering, Tata McGraw-Hill.
3. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press.

References:

1. ANSI/EIA 632, Standard, *Process for Engineering a System*, January 1999.
2. Blanchard, B.S. and Fabrycky, W.J., *Systems Engineering and Analysis*, Prentice-Hall
3. Grady, J.O., *System Integration,* CRC Press, Boca Raton, 1994.
4. Hughes Aircraft Co., *Systems Engineering Handbook*, 1994.
5. ISO/IEC 15288, *System Life Cycle Processes*, October 2002.
6. Sage, A.P. and Rouse, W.B. (Eds), *Handbook of Systems Engineering*, John Wiley & Sons, 1999.

AI 010 805 G 06

Professional Ethics

(common to EI 010805 G06 , EC 010 805 G06 and IC 010 805 G06)

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”

AI010 805G05

Industrial Pollution control

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

- To generate an awareness among students about the importance of, and need for pollution control.
- To help the students internalise concern for environment.

Module 1:

Concept of ecosystem: Structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, ecological succession, food chains and ecological pyramids, biodiversity and its conservation.

Introductory lessons on environmental pollution: Types of pollution: soil – water – air – causes - types of emissions from chemical industries - effects on environment - greenhouse gases and global warming – climate change - acid rain - ozone layer depletion - nuclear accidents and holocaust.

Module 2:

Mathematics of Growth:
Concern about future – models of population growth – exponential growth – logistic growth – logistic human population curve.
Natural resources: renewable and non-renewable resources - resource consumption - depletion of nonrenewable energy sources - Concept of sustainable development.

Module 3:

Social issues and the environment: population and pollution - consumerism and waste products - environmental ethics - social cost of pollution - 'polluter pays principle' and its relevance. Water pollution: Water resources- properties of water: density, melting point, boiling point, specific heat, dissolved oxygen; water as a solvent, the hydrogen cycle. Water pollutants: pathogens, oxygen demanding wastes, nutrients, salts, thermal pollutants, heavy metals, pesticides,volatile organic compounds.

Air pollution: Overview of emissions– criteria pollutants – toxic air pollutants –motor vehicle emission – basic ideas of influence of air pollution on meteorology - comparison of air pollution in major cities. The carbon cycle: Importance of CO_2 in climate change – green house effect and global energy balance.

Module 4:

Pollution monitoring:

Pollution monitoring devices: paper tape sampler - bubbler systems - gas analysers Basics of methods of measuring pollution: principle of sampling air /water/soil for pollution measurement; ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants; stack sampling: sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and ozone, hydrocarbons, particulate matter.

Module 5:

Principles and simple methods of pollution abatement and control: Concepts of solid waste management: source reduction – recycling – disposal. Concepts of waste water treatment methods: physical treatments – biological treatments - reuse and recycle of water and waste water. Environmental impact assessment of large scale projects. Legislation and standards for Air, Water and Soil pollution – international nature of pollution and the need for international rules and regulations - air quality regulations – clean air act.

Text Books:

1. R. Rajagopalan, Environmental Studies, Oxford IBH Pub.
2. Benny Joseph, Environmental Studies, McGraw Hill Pub.
3. Erach Bharucha, Text Book for Environmental Studies, Pub., UGC.
4. Masters, Gilbert M. Introduction to Environmental Engineering and Sciences, PHI.

Reference:

India Environmental Port, http://www.indiaenvironmentportal.org.in

Extra reading:

UNESCO, Only One Earth, 1986.

Rachel Louise Carson, Silent Spring, 1962.

AI010 805G06

Simulation and modelling

Teaching scheme: **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

- *To provide adequate knowledge to various MODELLING METHODS.*
- *To impart the basic concepts of various system simulation methods.*
- *To give a basic introduction to simulation of different types of systems.*

Module-1

Introduction to modeling and simulation: Nature of Simulation. Systems , Models and Simulation, Continuous and Discrete systems, system modeling, concept of simulation, Components of a simulation study, Principles used in modeling, Static and Dynamic physical models, Static and Dynamic Mathematical models Introduction to Static and Dynamic System simulation, Advantages, Disadvantages and pitfalls of Simulation

Module-2

System Simulation and Continuous System Simulation: Types of System Simulation, Monte Carlo Method, Comparison of analytical and Simulation methods, Numerical Computation techniques for Continuous and Discrete Models, Distributed Lag Models, Cobweb Model. Continuous System models, Analog and Hybrid computers, Digital-Analog Simulators, Continuous system simulation languages, Hybrid simulation, Real Time simulations.

Module-3

System Dynamics & Probability concepts in Simulation: Exponential growth and decay models, logistic curves ,Generalization of growth models , System dynamics diagrams, Multi segment models , Representation of Time Delays.Discrete and Continuous probability functions, Continuous Uniformly Distributed Random Numbers, Generation of a Random numbers, Generating Discrete distributions, Non-Uniform Continuously Distributed Random Numbers, Rejection Method.

Module-4

Simulation of Queuing Systems and Discrete System Simulation Poisson arrival patterns, Exponential distribution, Service times, Normal Distribution Queuing Disciplines, Simulation of single and two server queue. Application of queuing theory in computer system .Discrete Events, Generation of arrival patterns, Simulation programming tasks, Gathering statistics, Measuring occupancy and Utilization, Recording Distributions and Transit times

Module 5

Introduction to Simulation languages and Analysis of Simulation output: GPSS: Action times, Succession of events, Choice of paths, Conditional transfers ,program control statements . SIMSCRIPT: Organization of SIMSCRIPT Program, Names & Labels, SIMSCRIPT statements. Estimation methods, Relocation of Runs , Batch Means , Regenerative techniques , Time Series Analysis , Spectral Analysis and Autoregressive Processes

References:

• Gorden G., System simulation, Prentice Hall.
• Seila, Simulation Modeling, Cengage Learning
• Law .,Simulation Modeling And Analysis, McGraw Hill
• Deo, System Simulation with Digital Computer, PHI
• Harrington, Simulation Modeling methods, McGraw Hill
• Severance, " System Modeling & Simulation, Willey Pub

AI010 806

Process Control Lab

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

1. Electronic PID controller and implementation of PID algorithm using high level language
2. Performance Evaluation of Temperature process control station.
3. Performance Evaluation of Pressure process control station
4. Performance Evaluation of Flow process control station
5. Performance Evaluation of Level process control station
6. Characteristics of Differential Pressure Transmitter and Rotameter
7. Characteristics of control valve, with and without positioner
8. Characteristics of I/P and P/I converter
9. Study of process control simulator
10. Study of PLC
11. PLC programming and implementation
12. Control of bottle filling system using PLC
13. Speed controller of a DC motor using PLC
14. Liquid level control using PLC
15. Study of Distributed Control System

MATLAB

1) Experiments using MATLAB SIMULINK package for level control in realtime.
2) Experiments using MATLAB SIMULINK package for pressure control in realtime.
3) Controller tuning for a process– using Ziegler-Nichols and Cohen – Coon rule

LABVIEW

1) LabVIEW Fundamentals I – Data types, Loops, Shift Registers, Case Structures, Sequence Structures, Formula Node.
2) LabVIEW Fundamentals II – Arithmetic Operations, Arrays, Sub-VI, Boolean Operations, Comparison.
3) Development of VI for temperature measurement-with display, and visual and sound alarms
4) Development of VI for level measurement-with display, and visual and sound alarms

AI010 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.

AI010 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.