UTTARAKHAND TECHNICAL UNIVERSITY

# Program: B. Tech- AEI/IC/AIE

Year: Session: 2011 – 2012

**Scheme and Evaluation Pattern**

| S.No | Course No. | Subject | Periods | | | Evaluation | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Sessional | | | External Exam | |
| | | | | | | CT | TA | Total | | |
| Semester:5th | | | | | | | | | | |
| Theory | | | | | | | | | | |
| 1. | TEC-501 | Automatic Control Systems | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 2. | TEC – 502 | Digital Signal Processing | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 3. | TEC – 503 | VLSI Technology | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 4. | TEC – 504 | Microprocessors & Controllers | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 5. | TIC – 505 | Transducers, Sensors & Display Devices | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 6. | TCS – 507 | Concepts of Programming and OOPs | 2 | 1 | 0 | 15 | 10 | 25 | 50 | 75 |
| Practical/Design | | | | | | | | | | |
| 1. | PEC -551 | Microprocessors & Controllers Lab. | 0 | 0 | 2 | 0 | 0 | 25 | 25 | 50 |
| 2. | PCS-554 | Concepts of Programming and OOPs (C++, Java) Lab. | 0 | 0 | 2 | 0 | 0 | 0 | 25 | 25 |
| 3. | PEC-552 | DSP Lab. | 0 | 0 | 2 | 0 | 0 | 25 | 25 | 50 |
| 4. | | Discipline | 0 | 0 | 2 | 0 | 0 | 50 | 0 | 50 |
| Semester: 6th | | | | | | | | | | |
| Theory | | | | | | | | | | |
| S.No | Course No. | Subject | Periods | | | Evaluation | | | | Total Marks |
| | | | L | T | P | Sessional | | | External Exam | |
| | | | | | | CT | TA | Total | | |
| 1. | TEC – 601 | Microwave Techniques | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 2. | TIC - 601 | Digital Control Engg. | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 3. | TEC – 602 | VLSI Design | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 4. | TEC - 604 | Digital Communication | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 5. | TCS – 607 | Data Structures using C++ | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 |
| 6. | THU – 608 | Principles of Management | 2 | 1 | 0 | 15 | 10 | 25 | 50 | 75 |
| Practical/Design | | | | | | | | | | |
| 1. | PIC-651 | Control System Lab. | 0 | 0 | 2 | 0 | 0 | 25 | 25 | 50 |
| 2 | PCS-654 | Data Structure Lab. | 0 | 0 | 2 | 0 | 0 | 0 | 25 | 25 |
| 3. | PEC-652 | Microwave Lab. | 0 | 0 | 2 | 0 | 0 | 25 | 25 | 50 |
| 4. | | Discipline | 0 | 0 | 2 | 0 | 0 | 50 | 0 | 50 |

## TEC- 501 AUTOMATIC CONTROL SYSTEMS

**UNIT 1**

**INTRODUCTION TO OPEN LOOP AND CLOSED LOOP CONTROL SYSTEMS:** feedback characteristics of control systems, Mathematical Representation of physical systems Electrical, Mechanical, Hydraulic, Thermal systems, Block diagram algebra and signal flow graphs, Mason's gain formula.

**UNIT 2**

**TIME DOMAIN ANALYSIS:** Standard Test Signals, Time response of First, Second and Higher order systems, Performance Indices.

**ERROR ANALYSIS:** Static and Dynamic Error Coefficients, Effect of adding poles and zeroes to the system, response of P, PI, and PID controllers.

**UNIT 3**

**CONCEPT OF STABILITY:** Concept of stability, Asymptotic and conditional stability, Routh-Hurwitz Criterion, Root Locus technique (Concept and construction)

**FREQUENCY RESPONSE ANALYSIS:** Correlation between time and frequency response, polar and inverse polar plots, Nyquist stability criterion, Bode plots. All pass and minimum phase systems, M and N circle.

**UNIT 4**

**DESIGN THROUGH COMPENSATION TECHNIQUES:** Realization of lag, lead and lag-lead compensators, Design of closed loop control system using root locus and Bode plot Compensation

**ROBUSTNESS**. Uncertainty and performance weights. Robust stability test. Robust performance test. Loop shaping necessary and sufficient conditions.

**UNIT 5**

**STABLE VARIABLE ANALYSIS:** Introduction, State space representation, State modes of linear systems, State equations, transfer matrices, diagonalization solution of state equations, controllability and observability, effect of pole zero cancellation in transfer function.

**BASIC NON-LINEAR ANALYSIS:** Linearization, describing function and phase plane methods, stability concepts and Lyapunov functions.

**SUGGESTED BOOKS:**


1. B C Kuo, Automatic Control Systems; John Wiley (India)
2. Control System, N C Jagan, BSP, Hyderabad
3. I J Nagrath & M Gopal, Control System Engineering; New Age International publishers.
4. Dr D Ganesh Rao, Control System; Sanguine Technical Publisher, Bangalore
5. K Ogata, Modern Control Engineering; PHI.

# TEC-502 DIGITAL SIGNAL PROCESSING

**UNIT 1**

**DISCRETE FOURIER TRANSFORM:** Frequency Domain Sampling: The Discrete Fourier Transform Frequency Domain Sampling and Reconstruction of Discrete-Time Signals. The Discrete Fourier Transform (DFT). The DFT as a linear Transformation. Relationship of the DFT to Other Transforms. Properties of the DFT: Periodicity, Linearity, and Symmetry Properties. Multiplication of two DFTs and Circular Convolution. Additional DFT Properties. Frequency analysis of signals using the DFT. Introduction to MATLAB. (Coding of Implementation of LTI using DFT)

**UNIT 2**

**EFFICIENT COMPUTATION OF DFT:** Efficient Computation of the DFT: FFT Algorithms, Direct Computation of the DFT. Radix-2 FFT algorithms. Efficient computation of the DFT of two real sequences, computations, efficient computation of the DFT of 2N-Point real sequences. (Coding of FFT algorithms)

**UNIT3**

**FILTER STRUCTURES:** Direct form (I & II), LATTICE for FIR & IIR Filters.

**UNIT4**

**DESIGN OF DIGITAL IIR FILTERS**: Impulse invariant and bilinear transformation techniques for Butterworth and chebyshev filters; cascade and parallel. (Coding of Butterworth and chebyshev filters)

**DESIGN OF FIR FILTERS**:- windowing, optimum approximation of FIR filters, multistage approach to sampling rate concession. Design of Hilbert transforms. (Coding of windowing for FIR Filters)

**UNIT5**

**ADAPTIVE WIENER FILTER AND LMS ALGORITHM**: Application of adaptive filtering to echo cancellation and equalization.

**APPLICATION OF DSP AND CODING**: Audio and Video coding, MPEG coding standardization, DCT, Walsh and Hardmard Coding.

**SUGGESTED BOOKS:**


1. Proakis, J.G. & Manolakis, D.G., “Digital Signal Processing: Principles Algorithms and Applications”, Prentice Hall (India).
2. Apte, “ Digital Signal Processing”, 2nd Edition, John Wiley (India),2009.
3. Rabiner, L.R. and Gold B., “Theory and applications of DSP”, PHI.
4. Thomas J, Cavichhhi, “Digital Signal Processing”, John Wiley & Sons
5. Roman KUC, Digital Signal Processing, BSP HYderabad

**TEC-503 VLSI TECHNOLOGY**

**UNIT 1.**

**Introductin to VLSI Technology:** Classification if ICs, Scale of integration, semiconductor and hybrid ICs Features of ICs,

**CRYSTAL GROWTH:** monolithic and hybrid ICs, crystal growth**,** Czochralski technique of crystal growth, wafer preparation and specifications, testing, measurements of parameters of crystals, Fabrication steps,

**OXIDATION:** Theory of growth of Silicon di oxide layer, calculation of $SiO_2$ thickness and oxidation kinetics, Dry wet and high pressure oxidation, plasma oxidation, properties of oxidation, defects induced due to oxidation.

**UNIT 2.**

**EPITAXIAL PROCESS**: Epitaxy and its concept, Growth kinetics of epitaxy, epitaxial growth, Low-temperature epitaxy, Si-epitaxy- growth chemistry of Si epitaxial layer, autodoping apparatus for epitaxial layer, apparatus for epitaxy, MBE system

**DIFFUSION PROCESS**: Diffusion models of solid, Ficks theory of diffusion, Solution of Fick`s law, diffusion parameters measurements schemes, Ion implantation- Scattering phenomenon, range theory, channeling, implantation damage, ion-implantation systems, Annealing

**UNIT 3**

**LITHOGRAPHY:** photolithography and pattern transfer, Optical and non optical lithigraphy, electron, X-ray and ion-beam lithography, contact/proximity and projection printers, alignment.

Photoresist and ETCHING:Types of photoresist, polymer and materials, Etching**-** Dry & Wet etching, basic regimes of plasma etching, reactive ion etching and its damages, lift-off, and sputter etching.

**UNIT 4**

**METALLIZATION:** Applications and choices, physical vapor deposition, patterning, problem areas.

**VLSI PROCESS INTEGRATION:** PMOS**,**NMOS and CMOS IC technology, MOS memory IC technology, bipolar IC fabrication.

**UNIT 5**

**ASSEMBLY TECHNIQUE AND PACKAGING:** Package types, packaging design consideration, VLSI assembly technologies.

**YIELD AND RELIABILITY:** Yield loss in VLSI, yield loss modeling, reliability requirements, accelerated testing.

**SUGGESTED BOOKS:**


1. S.M. Sze (Ed.) / VLSI Technology / M Hill. 1988.
2. R. K. SINGH /VLSI (Technology, Design & Basic Of Micro Elec.), Kataria & Sons
3. S.A. Campbell / The Science and Engineering of Microelectronic Fabrication / Oxford University Press
4. Microelectronic Circuits International Student Edition by Sedra / Smith

**TEC -504 MICROPROCESSORS AND CONTROLLERS**

**UNIT 1**

**8–BIT MICROPROCESSOR (8085)**: Architecture, addressing modes, Assembly Language Programming.

**16-bit Microprocessors (8086):** Architecture, Physical address, segmentation, memory, difference between 8085 & 8086, Assembler Directives.

**UNIT 2**

**DATA TRANSFER SCHEMES**: Introduction, Types of transmission, 8257 (DMA), 8255 (PPI), Serial Data transfer (USART) 8251), Keyboard-Display controller (8279), Programmable Priority Controller (8259), 8253 Timer.

**UNIT 3**

**ADVANCE MICROPROCESSORS**: Introduction to 80186, 80286, 80486, Pentium Microprocessors, Introduction to Dual core, core to Duo.

**UNIT 4**

**8051 MICRO CONTROLLER**- Architecture I/O ports, memory organization in 8051, timer, serial comm.-Addressing mode, Instruction sets, Assembly Language programming.

**UNIT 5**

**INTERFACING OF 8051 AND ITS APPLICATIONS:** LEDs:, push buttons, latch connection, keyboards, 7-segment display, LCD interfacing. Different waves generation.

**SUGGESTED BOOKS:**


1. R.S Gaonkar: Microprocessor Architecture, Programming and Applications with 8085/8080, Penram Publication
2. Y.C. Liu and G.A. Gibson: Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design, PHI 2nd Edition

## TIC-502 TRANSDUCERS, SENSORS AND DISPLAY DEVICES

**UNIT 1**

**CONCEPTS OF MEASUREMENT**: Measurements, instrumentation, errors in measurements, calibration and standard.

**TRANSDUCERS**: Classification and characteristics of transducers, transducers for measurement of pressure, flow and temperature, optical sensors, acoustic sensors, DC and AC bridges.

**UNIT 2**

**SIGNAL GENERATORS AND SIGNAL ANALYSERS:** AF generator, Pulse generator, AM/FM signal generators, Function generator, Sweep frequency generator, wave analyzer, spectrum analyzer, logic analyzer, distortion analyzer.

**UNIT 3**

**SENSORS**: Strain Gauges: Basics and Examples, Capacitive Sensors: Fundamentals, Applications, and Examples, Piezoelectric Sensors, Thermometers: Measurement Techniques and Examples, Flow Sensors, Radiation Sensors, More IR Sensors and Demo: IR Motion, Micro-machined Sensors: Design and Fabrication

**UNIT 4**

**DIGITAL INSTRUMENTS**: Digital Voltmeters and Multimeters, automation in Voltmeters, accuracy in DVM, Guarding techniques, Frequency, period, time interval and pulse width measurement.

**UNIT 5**

**DATA DISPLAY AND RECORDING SYSTEM**: CRO, Single beam, dual trace, double beam CRO, storage CRO, sampling oscilloscope, analog and digital recorders, multichannel column display oscilloscope, Magnetic disk and tape – Recorders, digital plotters and printers , LED, LCD and dot-matrix display – Data Loggers

**SUGGESTED BOOKS:**


1. Balanis," Antenna Theory: Analysis & Design" 3rd Edition, 2010, John Wiley (India).
2. Prasad, K.D./"Antenna and Wave Propagation"/ Khanna Publications.
3. Jordan Edwards C. and Balman Keith G./" Electromagnetic Waves and Radiating Systems"/PHI
4. Hayt Jr. William H./" Engineering Electromagnetics"/TMH

## TCS-507 APPLICATION OF PROGRAMMING AND OOPS

**UNIT 1**

**UTILIZATION:** Developer fundamentals such as editor, integrated programming environment, UNIX shell, modules, libraries.

**PROGRAMMING FEATURES:** Machine representation, primitive types, arrays and records, objects, expressions, control statements, iteration, procedures, functions, and basic I/O.

**APPLICATIONS:** Sample problems in engineering, science, text processing, and numerical methods.

**UNIT 2**

**PROBLEM SOLVING WITH ALGORITHMS**- Programming styles – Coding Standards and Best practices - Introduction to C Programming, Testing and Debugging. Code reviews, System Development Methodologies – Software development Models, User interface Design – introduction – The process – Elements of UI design & reports.

**UNIT 3**

**OBJECTED ORIENTED CONCEPTS** – object oriented programming, UML Class Diagrams– relationship – Inheritance – Abstract classes – polymorphism, Object Oriented Design methodology - Common Base class, Alice Tool – Application of OOC using Alice tool.

**UNIT 4**

**RDBMS- DATA PROCESSING** – the database technology – data models, ER modeling concept – notations – Extended ER features, Logical database design – normalization, SQL – DDL statements – DML statements – DCL statements, Writing Simple queries – SQL Tuning techniques – Embedded SQL – OLTP

**SUGGESTED BOOKS:**


1. Object oriented to C++, Shukla, Wiley India
2. Thinking in C++ 2nd Edition by Bruce Eckel(available online)
3. G. Dromey, How to Solve It by Computer, Prentice-Hall, Inc., Upper Saddle River, NJ, 1982.
4. Polya, G., How to Solve _It (2nd ed.), Doubleday and co. (1957).
5. Let Us C. Yashwant Kanetkar. Allied Publishers, 1998.
6. An introduction to object oriented Programming in C++, Graham Seed, BSP, Hyderabad

**PEC-551 MICROPROCESSOR & CONTROLLERS LAB**

1. To perform Addition/ Multiplication of two 8 bit numbers

2. To Find the maximum value in an array

3. To perform BCD to Hex conversion & Hex to BCD conversion

4. To Design Counter using timer

5.1. Programming with 8086 –16-bit, 32 bit multiplication/division

6. Interfacing with 8085/8086/8051 – 8255, 8253

7. Interfacing with 8085/8086/8051 – 8279,8251

8. Stepper motor interfacing, Seven Segment display interfacing using 8051

NOTE: The institution may add 2 more practical in above prescribed list.

**PCS-557 CONCEPT OF PROGRAMMING & OOPs LAB.**

Students should implement the following during Practical hours: (illustrative only)

1. Programs using C & OOPs Language
2. Queries using MY-SQL
3. Using Alice Tool :
    a. Write a method for an Alice object
    b. Condition Construct
    c. Repetition Construct
4. Group Project

| Sl. No | Course | S/W on Students Machine | Remarks |
|---|---|---|---|
| 1. | Programming Fundamentals | Visual Studio .NET (2003), Turbo C | Alternate: Visual Studio 6 |
| 2. | RDBMS | My-SQL | Alternate: Oracle 9i Client |

The purpose of 1hour(s) tutorial per week is to help slow learning students bring upto speed all the students. The assignments for CHSSC, Programming Fundamentals, and Relational Data base Management System will be given by the instructor which is to be completed as a part of Tutorial.

## PEC-552 DIGITAL SIGNAL PROCESSING LAB

1. Sampling & Waveform Generation, Quantization
2. PCM Encoding
3. Delta Modulation
4. Digital Modulation Schemes (ASK, PSK, FSK)
5. DFT Computation.
6. Fast Fourier Transform.
7. FIR Filter implementation, IIR Filter implementation.
8. Computational Experiments with Digital Filters
9. Echo Cancellation generation and Filters implementation
10. NOTE: The institution may add 2 more practical in above prescribed list.

## TEC-601 MICROWAVE TECHNIQUES

**UNIT 1**

**ELEMENTS OF MICROWAVE/MILLIMETER WAVE INTEGRATED CIRCUITS**: classification of Transmission lines: Planar, quasi- planar and 3D structure and their properties, field distribution and range of application, Transverse transmission the techniques for multi-dielectric planar structure, Analysis of discontinuities in planar and non-planar transition line.

**UNIT 2**

**PROPAGATION THROUGH WAVEGUIDES**: Rectangular and circular waveguides solution of wave equation for TE & TM modes, degenerate and dominant modes, power transmission power loss, Excitation of wave guides , Non existence of TEM mode in waveguide, Introduction to stripline and Microstrip-line.

**UNIT 3**

**MICROWAVE CAVITY RESONATORS**: Rectangular and cylindrical cavities, Quality factor and Excitation of cavities. Microwave Components: Waveguide couplings, bends and tourists, Design and circuit realization of filters, couplers, phase shifters, E-plane, H-plane and hybrid Tees, Hybrid ring wave meters: Isolators and circulators, tunable detectors, slotted line carriage, VSWR meter.

**UNIT 4**

**MICROWAVE MEASUREMENTS**: measurement of frequency, wave length, VSWR, impedance, Attenuation Low and high power radiation patterns. Limitation of Conventional active devices at microwave frequency.

**UNIT 5**

**MICROWAVE TUBES**: Klystron, Reflex klystron, magnetron, TWT, BWO: principle of operation and its performance characteristic and application.

**SUGGESTED BOOKS:**


1. Pozar « Microwave Engineering » 3rd edition, John Wiley (India).
2. Microwave Engg. , Radhakrishna, BSP Publication

3. Collin, R.E. Foundations for Microwave Engineering; TMH 2nd Ed.
4. Rizzi, Microwave Engineering: Passive Circuits; PHI.

**TIC-601 DIGITAL CONTROL ENGG.**

**UNIT 1**

**INTRODUCTION**: Basics of z transform theory -inverse z transform, convolution, recursion relation, realisability

**SAMPLING AND RECONSTRUCTION OF SIGNALS**- zero order hold/D-A conversion, Shannon's sampling theorem; aliasing and folding, choice of the sampling period in sampled-data control systems, pulse transfer function and analysis of control systems, mapping of poles and zeroes

**UNIT 2**

**CASE STUDY**: PID digital control

**CONTINUOUS-TIME STATE-SPACE SYSTEMS AND THEIR DISCRETIZATION**: controllability and observability, under discretization, intersample behaviour

**UNIT 3**

**REALIZATION THEORY**- canonical forms , minimality , internal- and BIBO-stability and relation between the two

**CONTROLLER DESIGN VIA POLE PLACEMENT** - continuous-time-based design techniques, deadbeat control

**UNIT 4**

root-locus based digital control design and its case study (from reference 1).

**UNIT 5**

**OBSERVERS AND THEIR USE IN STATE-FEEDBACK LOOPS**- Observer-based controllers, the separation principle

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**Referenc**


1. **Digital control, K.M. Moudgalya, Wiley India**
2. **Digital Control Engg, M Gopal, TMH**
3. **Modern Control System, Richard C Dorf, Pearson**

**TEC-602 VLSI DESIGN**

**UNIT 1**

**REVIEW:** Current conduction in MOSFET, Electrical Properties of MOS and BiCMOS, The Pass Transistor, CMOS.

**UNIT 2**

**CMOS Inverter:** Static CMOS inverter, layout, switching threshold and noise margin concepts and their evaluation, dynamic behavior, power consumption.

NMOS MOS pass transistor inverter.

**COMBINATIONAL LOGIC:** Static CMOS design, rationed logic, pass transistor logic, dynamic logic, cascading dynamic gates, CMOS transmission gate logic.

**UNIT 3**

**SEQUENTIAL LOGIC:** Static latches and registers, bi-stability principle, MUX based latches, static SR flip-flops, master-slave edge-triggered register, dynamic latches and registers, concept of pipelining, Timing issues.

**UNIT 4**

**MEMORY AND ARRAY STRUCTURE:** ROM, RAM, peripheral circuitry, memory reliability and yield, SRAM and DRAM design, flash memory, PLA,PAL, FPGA.

**UNIT 5**

**DESIGN FOR TESTABILITY**: Logic Testing, sequential Logic Testing, Guidelines to be adopted in Design for Test, Scan Designing Techniques, Built-In self Test (BIST)Techniques.

**SUGGESTED BOOKS:**


1. Basic VLSI Design by D.A. Pucknell & Eshraghian (PHI)
2. Modern VLSI Design Systems on Silicon by Wayne Wolf (Pearson Pub.)
3. R. K. Singh « VLSI DESIGN (With VHDL), Kataria & Sons » , 2nd Edition, 2010.

## TEC-604 DIGITAL COMMUNICATION

**UNIT 1**

**ELEMENTS OF DIGITAL COMMUNICATION AND INFORMATION THEORY:** Model of a Digital Communication, System, Probability Theory, Entropy and Information Rate, Conditional Entropy and Redundancy, Source Coding, Fixed and Variable Length Code Words, Source Coding Theorem, Prefix free code and, Kraft Inequality, Shannon-Fano and Huffman Coding.

**UNIT 2**

**DIGITAL BASE BAND TRANSMISSION**

PCM Coding, DM, DPCM, ADCM, Data Transfer Rate, Line Coding and Its Properties, NRZ & RZ Types, Signalling Format For Unipolar, Polar, Bipolar(AMI) & Manchester Coding Matched Filter Receiver, Derivation of Its Impulse Response and Peak Pulse Signal to noise ratio, ISI, Rectangular**,** sync & Raised cosine pulse comparison

**UNIT 3**

**DIGITAL MODULATION TECHNIQUES**

Gram-Schmidt Orthogonalization Procedure, Hilbert transform, Types of Digital Modulation, correlation receiver, Waveforms for Amplitude, Frequency and Phase Shift Keying, Method of Generation and Detection of Coherent & Non-Coherent Binary ASK, FSK & PSK & PSD derivation for Coherent & Non-Coherent Binary ASK, FSK & PSK. Differential Phase Shift Keying, bit error rate comparison of Digital modulation techniques

**UNIT 4**

**ADVANCED MODULATION TECHNIQUES**

Introduction to M-ary modulation techniques 16 PSK, QPSK , QAM , Continuous phase shift keying , MSK, GMSK. Direct sequence spread spectrum, processing gain Frequency hop Spread spectrum.

**UNIT 5**

**ERROR CONTROL CODING**

Error Free Communication Over a Noise Channel, Hamming code, Relation Between Minimum Distance and Minimum Distance Error Correcting & detection Capability, Linear Block Codes, Encoding and Syndrome Decoding, Cyclic Codes, , Encoder and Decoder For Cyclic Codes, Convolution Coding & Viterbi decoding, introduction to burst error correction codes

**SUGGESTED BOOKS:**


1. Tele communication switching system and networks - Thyagarajan Viswanath, PHI, 2000.
2. Digital telephony - J. Bellamy, John Wiley, 2nd edition, 2001.
3. Data Communications & Networks - Achyut. S.Godbole, TMH, 2004.
4. Principles of Communication Systems – H. Taub & D. Schilling , TMH, 2nd Edition, 2003.
5. Telecommunication switching, Traffic and Networks - J E Flood, Pearson Education, 2002

**TCS-607 DATA STRUCTURES USING C++**

**UNIT 1**

**COMPLEXITY ANALYSIS:** Time and Space complexity of algorithms, asymptotic analysis, big O and other notations, importance of efficient algorithms, program performance measurement, data structures and algorithms.

**LINEAR LISTS:** Abstract data type, sequential and linked representations, comparison of insertion, deletion and search operations for sequential and linked lists, list and chain classes, exception and iterator classes for lists, doubly linked lists, circular lists, linked lists through simulated pointers, lists in STL, skip lists, applications of lists in bin sort, radix sort, sparse tables.

**UNIT 2**

**STACKS AND QUEUES: A**bstract data types, sequential and linked implementations, exception handling in classes, representative applications such as parenthesis matching, towers of Hanoi, wire routing in a circuit, finding path in a maze, simulation of queuing systems, equivalence problem.

**UNIT 3**

**HASHING:** Search efficiency in lists and skip lists, hashing as a search structure, hash table, collision avoidance, linear open addressing, chains, uses of hash tables in text compression, LZW algorithm.

**UNIT 4**

**TREES:** Binary trees and their properties, terminology, sequential and linked implementations, tree traversal methods and algorithms, heaps as priority queues, heap implementation, insertion and deletion operations, heapsort, heaps in Huffman coding, leftist trees, tournament trees, use of winner trees in mergesort as an external sorting algorithm, bin packing.

**UNIT 5**

**GRAPHS:** Definition, terminology, directed and undirected graphs, properties, connectivity in graphs, applications, implementation – adjacency matrix and linked adjacency chains, graph traversal – breadth first and depth first, spanning trees.

**SUGGESTED BOOKS:**

1. M. T. Goodrich and R. Tamassia, *Algorithm Design: Foundations, Analysis and Internet Examples*, John Wiley & Sons, 2001.
2. Drozdek, A., “Data Structures and Algorithms in C++”, Vikas Publishing House. 2002
3. Wirth, N., “Algorithms and Data Structures”, Prentice-Hall of India. 1985
4. Lafore, R., “Data Structures and Algorithms in Java”, 2nd Ed., Dorling Kindersley. 2007
5. Datastructure using C, Bandopadhyaya, “Data Structures, Algorithms, and Applications in Java”, WCB/McGraw-Hill. 2001
6. C and datastructure, Padnabham, BSP, Hyderabad

## THU-608 PRINCIPLES OF MANAGEMENT

**UNIT 1**

**INTRODUCTION TO MANAGEMENT:** Theories of management: Traditional behavioral, contingency and systems approach. Organization as a system.

**UNIT 2**

**MANAGEMENT INFORMATION:** Interaction with external environment. Managerial decision making and MIS.

**UNIT 3**

**PLANNING APPROACH TO ORGANIZATIONAL ANALYSIS:** design of organization structure; job design and enrichment; job evaluation and merit rating.

**UNIT 4**

**MOTIVATION AND PRODUCTIVITY**: Theories of motivation, leadership styles and managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control. Japanese management techniques. Case studies.

- Minor Project: submission of 15 pages of Case studies on above.

**SUGGESTED BOOKS**


1. Peter Drucker, Harper and Row: The Practice of Management.
2. Schemerhorn" introduction to Management" 10th edition, John Wiley (India).
3. Staner: Management, PHI Learning.
4. Daft: Principles of Management, Cengage Learning.


## PIC 651 CONTROL SYSTEM LAB.

**List of Experiments:**

Experiments to be done on MAT LAB

1. Discrete Time LTI model
2. Discrete pole locations & transients response

Small damping (e= 0.1 Wn= 4p/5T)

Medium damping (e= 0.4 Wn= 11p/5T)

Large damping (e= 0.8 Wn= p/4T)
3. Digital Dc motor Speed control with PID controller
4. Designing Lead & Lag Compensators
5. Kalman Filter design
**6.** State space design for the Inverted pendulum
7. Closed loop control of level process.
8. Closed loop control of Thermal Process.
9. Closed loop control of Pressure process.
10. Inherent and Installed characteristic study of linear, equal percentage and quick opening valves.
NOTE: The institution may add 2 more practical in above prescribed list.

**PCS-657 DATA STRUCTURE USING C++ LAB.**

Problems in **"C++ "** using **Data Structures** involving arrays, stacks, queues, strings, linked lists, trees, graphs.

1) Using STACK to check matching left and right characters such as parantheses, curly braces and square brackets in a given string.
2) Single server queuing system and gathering statistics.
3) Operations on Stacks.
4) Sparse Matrices
5) Linear linked list implementation
6) Operations on Doubly Linked List and Circular List with a test application
7) Operations on Ordered Binary Trees.
8) Graph Traversal Techniques
9) Implementation of Quicksort, Mergesort and Heapsort
10) Operations on Binary Trees
11) Shortest Path Problem

**PEC-652 MICROWAVE LAB**

1. Study of various microwave components and instruments like frequency meter, attenuator, detector & VSWR meter.
2. Draw V-I characteristics of microwave source like Gunn diode / Reflex Klystron.

3. Measurement of frequency and wavelength in a rectangular waveguide.
4. Measurement of VSWR (small as well as large values) & reflection coefficient.
5. Measure an unknown impedance with smith chart.
6. Draw the following characteristics of Gunn Diode
(i) Output power and frequency as a function of voltage
(ii) Square wave modulation by PIN diode.
7. Drawing polar pattern of Horn antenna.
8. To observe the action of directional coupler and its use in separating incident & reflected wave.

- NOTE: The institution may add 2 more practical in above prescribed list.

**UTTARAKHAND TECHNICAL UNIVERSITY**

## Program: B. Tech- AEI/IC/AIE

**Year: Session: 2012 – 2013**

**Scheme and Evaluation Pattern**

| | | | L | T | P | Sessional | | | External Exam | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CT | TA | Total | | |
| **Semester:7th** | | | | | | | | | | |
| **Theory** | | | | | | | | | | |
| **1.** | **TEC-701** | **Optical Fibre Communication Systems** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| **2.** | **TEE – 702** | **Artificial Neural Networks and Fuzzy Logic** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| **3.** | **TIC – 701** | **Biomedical Instrumentation** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| **4.** | **TIC-01X** | **ELECTIVE-I** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| **5.** | **TOE-XX** | **Open Elective** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| | | | | | | | | | | |
| **Practical/Design** | | | | | | | | | | |
| **1.** | **PIC -751** | **Project** | **0** | **0** | **4** | **0** | **0** | **50** | **50** | **100** |
| **2.** | **PIC-752** | **Industrial Interaction** | **0** | **0** | **2** | **0** | **0** | **25** | **25** | **50** |
| **3.** | **PIC-753** | **Biomedical Instrumentation Lab.** | **0** | **0** | **2** | **0** | **0** | **25** | **25** | **50** |
| **4.** | | **Seminar** | **0** | **0** | **2** | **0** | **0** | **50** | **0** | **50** |
| **Semester: 8th** | | | | | | | | | | |
| **Theory** | | | | | | | | | | |
| **S.No** | **Course No.** | **Subject** | **Periods** | | | **Evaluation** | | | | **Total Marks** |
| | | | **L** | **T** | **P** | **Sessional** | | | **External Exam** | |
| | | | | | | **CT** | **TA** | **Total** | | |
| **1.** | **TIC - 801** | **PLC and Distributed Control System** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| **2.** | **TIC-802** | **Process & Optimal Control** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| **3.** | **TIC-02X** | **ELECTIVE-II** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| **4.** | **TIC-03X** | **ELECTIVE-III** | **3** | **1** | **0** | **30** | **20** | **50** | **100** | **150** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Practical/Design** | | | | | | | | | | |
| **1.** | **PIC-851** | **Project** | **0** | **0** | **6** | **0** | **0** | **100** | **200** | **300** |
| **2** | **PIC-852** | **PLC & DCS Lab.** | **0** | **0** | **2** | **0** | **0** | **25** | **25** | **50** |
| **3.** | | **Discipline** | **0** | **0** | **2** | **0** | **0** | **50** | **0** | **50** |

## ELECTIVE-I

**TIC 011 Fiber Optics and LASER Instrumentation**

**TIC 012 Analytical Instrumentation**

**TIC 013 Industrial Electronics**

**TIC 014 Optical Instrumentation**

**ELECTIVE-II**

**TIC 021 Power Plant Engineering**

**TIC 022 Computer Control Process**

**TEC 024 Digital Image Processing**

**TIC 023 System Design Using Microcontroller**

**ELECTIVE-III**

**TIC 031 Adaptive Control System**

**TIC 032 Industrial Safety and Management**

**TIC 033 Process Control System Components**

**TIC 034 Robotics & Automation**

## TEC-701 OPTICAL FIBRE COMMUNICATION SYSTEMS

**UNIT 1**

**INTRODUCTION:** Demand of Information Age, Block Diagram of Optical fiber Communication System, Technology used in OFC System, Structure and types of Fiber, modes and Configuration**,** mode theory for circular guide modal equation, modes in optical fiber, linearly polarized modes, attenuation factors, pulse broadening in optical fiber, single mode fiber, mode field diameter, single distortion in single mode fiber, Derivation of material dispersion and waveguide dispersion.

Attenuation, Signal Degradation in Optical Waveguides, Pulse Broadening in Graded index fiber Waveguides, Mode Coupling.

**UNIT 2**

**OPTICAL SOURCES:**

**LED:** Visible LED, Infrared LED, LED structure and configuration, Loss mechanism, Application of LED, operating Characteristics materials for Visible LED.

**LASER:** Principle of LASER Action, Efficiency of LASER Diode, principles and structures, index guided and gains guided lasers, mode separation, quantum well laser, laser modulation.

**UNIT 3**

**OPTICAL DETECTORS**: Optical Absorption in semiconductors, Types of Photo Diodes, Principle of photo detection, working and structures of p-i-n and APD photo detectors, noises in photo detectors, SNR, detector response time effects, comparison of various photo detectors.

**UNIT 4**

**ANALYSIS AND PERFORMANCE OF OPTICAL RECEIVER**: Receiver Sensitivity, Photodiode for optical receiver, Optical Receiver Design, recent receiver circuits, System configuration and power budget.

**UNIT 5**

**OPTICAL NETWORKS:** WDM concepts and principles, passive components, SONET/SDH networks, performance of WDM.

**SUGGESTED BOOKS**


1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 3rd Edition, 2000.
2. Optical Communication- R. K. Singh, Katson books, 2004.
3. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.


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## TEE-702 ARTIFICIAL NEURAL NETWOKS AND FUZZY LOGIC

**Unit-I**

**Neural Networks-1(Introduction & Architecture):** Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory

**Unit-II**

**Neural Networks-II (Back propagation networks):** Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propogation algorithm, factors affecting back propagation training, applications.

**Unit-III**

**Fuzzy Logic-I (Introduction) :** Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory versus probability theory, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

**Unit-IV**

**Fuzzy Logic –II (Fuzzy Membership, Rules) :** Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzifications, Fuzzy Controller,

**Unit-V**

**Application of Neural Network and Fuzzy logic:** Application of neural network, case study, Inverted pendulum, Image processing. Introduction to neuro & fuzzy logic controller.

**SUGGESTED BOOKS:**


1. Jacek M. Zurada, 'Introduction to Artificial Neural Systems', Jaico Publishing home, 2002.
2 . Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', 2nd John Wiley (India), 1997.


## TIC-701 BIOMEDICAL INSTRUMENTATION

**UNIT 1**

**ELECTRO PHYSIOLOGY:** Review of Physiology and anatomy – sources of Bioelectric Potentials – Resting and Action Potentials – Propagation of Action Potentials –Electrodes theory – Bio potential electrodes – Bio chemical transducers – Transducers forBio Medical applications.

**UNIT 2**

**BIOMEDICAL RECORDERS AND CARDIOVASCULAR MEASUREMENT:** Physiology of cardiovascular and nervous system – ECE-EEE-EME – Foetal ECEP hono-cardiography – Vector Cardiography – Holtel monitoring – BP – Blood flow – cardiac output – ICCU – Bedside unit and central monitoring unit.

**UNIT 3**

**PULMONARY MEASUREMENT AND BIO TELEMETRY:** Physiology of respiratory system – Respiratory rate measurement – wine and wireless Biotelemetry – Telemetering multiple information – implanted transmitters – sauces of electrical hazards and safety techniques.

**UNIT 4**

**MEDICAL IMAGING SYSTEM:** Ultrasound scanner – Echo cardiography – Coloar Doppler system – CAT and CT scan – MRI Imaging – Cine angiogram – LASER Imaging –Endoscope.

**UNIT 5**

**THERAPEUTIC UNITS:** Physiotheraphy and Electrotheraphy - Short ware, Microwave diathermy – Defibrillators – Cardio vector – Hearing aid – dialysis machine.

**REFERENCES:**

1. R.S. Khandpar, “Hand Book of Biomedical Instrumentation and measurement”, McGraw Hill publishing Co., 1990.
2. Aston, “Principles of Biomedical Instrumentation and measurements”, McGraw Hill publishing Co., 1990.
3. M. Arumugam, “Biomedical Instrumentation”, Anuradha Agencies Publishers, Vidayal Karuppar, 612 606, Kumbakonam, R.M.S: 1992.

## PIC 753 BIOMEDICAL INSTRUMENTATION LAB.

**List of Experiments:**

1. Study of different biomedical transducers.
2. Study of cardiovascular systems
3. Study of ECG machine
4. Study of EEG simulator.
5. Study of EMG simulator.
6. Study of blood sugar meter.
7. Measurement of heartbeats using heart beat monitor.

8. Measurement of lung capacity using spirometer.
9. Demonstration of defibrillator.
10. Measurement of blood pressure by indirect method.
11. Electrical safety measures in hospitals.

NOTE: The institution may add 2 more practical in above prescribed list.

## TIC 011 FIBRE OPTICS AND LASER INSTRUMENTATION

**UNIT 1**

**OPTICAL FIBRES AND THEIR PROPERTIES** Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors & splicers – Fibre termination – Optical sources – Optical detectors.

**UNIT 2**

**INDUSTRIAL APPLICATION OF OPTICAL FIBRES** Fibre optic sensors–Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

**UNIT 3**

**LASER FUNDAMENTALS** Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

**UNIT 4**

**INDUSTRIAL APPLICATION OF LASERS** Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

**UNIT 5**

**HOLOGRAM**

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components.

## TIC-012 ANALYTICAL INSTRUMENTATION

**UNIT 1**

**ELECTROMAGNETIC RADIATION** – different regions, their wavelengths, frequencies and energies - interaction of EM radiations with matter – atomic, molecular, electronic interaction - Basic principles of spectroscopy – emission and absorption of radiations – resonance - radiation sources – dispersing and resolving techniques – detectors - typical atomic emission and absorption spectrographs in the UV and visible region.

**UNIT 2**

**MOLECULAR SPECTRA** – electronic, vibrational and rotational energies and spectra characteristic bands of radicals, OH, CH, CO, etc., - IR absorption – spectroscopy – single and double beam spectrophotometers - instrumentation techniques for analyzing solid, liquid and gaseous samples – sample handling techniques.

**UNIT 3**

**MICROWAVE SPECTROSCOPY** – NMR, ESR and EPR spectroscopy – basic principles – instrumentation techniques and applications - principles of ion optics – ion sources – single focusing and double focusing mass spectrometers – principles and application

**UNIT 4**

**PRINCIPLES OF X-RAY FLUORESCENCE SPECTROMETRY AND FLAME PHOTOMETRY** – detection of X-rays and nuclear radiations – ionization chamber - proportional counter – GM counter - scintillation counter - solid state detector - gamma ray spectrometers – isotope dilution and tracer techniques for quantitative estimation and analysis.

**UNIT 5**

**ELECTROCHEMICAL METHODS** – electrical conductivity of liquids conductivity and water purity – practical measurements and application – sulphur dioxide monitor – determination of pH – oxygen analyzers. Principles of gas and liquid chromatography – process chromatography – operation of typical process chromatography.

**REFERENCE BOOKS**

1. H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Settle, Instrumental methods of Analysis, 6th edition - CBS Publishers and Distributers, 1986.
2. B.E.Noltingk (Edtr,) Jone's Instrument Technology, Vol. 2, Fourth Edition, Butterworths, 1986 (chapters 4 &5 for unit 5)
3. D.A. Skoog and D.M. West, Principles of Instrumental Analysis, 2 nd edition, Holt-Saunders, 1980.

## TIC-013 INDUSTRIAL ELECTRONICS

**UNIT 1**

**REGULATED SUPPLIES AND SCR:** Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators, Current boosting .Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors, Classes A, B, C, D, E and F, Ratings of SCR.

**UNIT 2**

**APPLICATIONS OF SCR-I:** Static circuit breaker, Protection of SCR, Inverters, Classification, Single Phase inverters, Converters , single phase Half wave and Full wave.Chopper circuits, Principle, methods and Configurations, Diac and Triac, Triacs, Triggering modes, Firing Circuits, Commutation

**UNIT 3**

**APPLICATIONS OF SCR-II** Voltage compensator – solid state DC voltage regulation – DC shunt motor – armature control and field control of motor speed – electronic control of DC motor – speed regulator action – full wave motor speed regulation by one SCR

**UNIT 4**

**INDUSTRIAL TIMERS :** Industrial timers -Classification, types, Electronic Timers, Classification, RC and Digital timers, Time base Generators. Electric Welding , Classification, types and methods of Resistance and ARC wielding

**UNIT 5**

**INDUSTRIAL HEATING APPLICATIONS :** High Frequency heating, principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating, principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications.Ultrasonics, Generation and Applications.

**TEXTBOOKS**

1. Industrial and Power Electronics, G.K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.

**REFERENCES**

1. Thyristors and applications, M. Rammurthy, East-West Press, 1977.
2. Industrial electronics and control, S.K. Bhattacharya and S.chatterjee, Tata Me Graw Hill, 1995
3. Frank D. Petruzella, Industrial Electronics, McGraw Hill International Editions, 1996

## TIC-014 OPTICAL INSTRUMENTATION

**Unit 1**

**LIGHT SOURCING, TRANSMITTING AND RECEIVING:** Concept of Light, Classification of different phenomenon based on theories of light, Basic light sources and its Characterization, Polarization , Coherent and Incoherent sources, Grating theory ,Application of diffraction grating, Electro-optic effect, Acoustooptic effect and Magneto-optic effect

**Unit 2**

**OPTO –ELECTRONIC DEVICES AND OPTICAL COMPONENTS:** Photo diode, PIN, Photo-Conductors, Solar cells, ,Phototransistors, Materials used to fabricate LEDs and Lasers Design of LED for Optical communication, Response times of LEDs ,LED drive circuitry, Lasers Classification :Ruby lasers, Neodymium Lasers, He- Ne Lasers,CO2 Lasers, Dye Lasers, Semiconductors Lasers ,Lasers Applications.

**Unit 3**

**INTERFEROMETRY:** Interference effect, Radio- metry, types of interference phenomenon and its Application, Michelson's Interferometer and its application Fabry-perot interferometer, Refractometer, Rayleigh's interferometers, Spectrographs and Monochromators, Spectrophotometers, Calorimeters, Medical Optical Instruments

**Unit 4**

**HOLOGRAPHY:** Principle of Holography, On-axis and Off axis Holography, Application of Holography,Optical data storage,

**OPTICAL FIBER SENSORS:** Active and passive optical fiber sensor, Intensity modulated, displacement type sensors, Multimode active optical fiber sensor (Microbend sensor)Single Mode fiber sensor-Phase Modulates and polarization sensors

**Unit 5**

**FIBER OPTIC FUNDAMENTALS AND MEASUREMENTS:** Fundamental of Fibers, Fiber Optic Communication system, Optical Time domain Reflectometer (OTDR),Time domain dispersion measurement, Frequency Domain dispersion measurement, Laser Doppler velocimeter,

**Reference BOOK:**

1- J.Wilson &J F B Hawkes,Opto Electronics:An Introduction PHI,Edition
2-Wave Optics and its Application, Rajpal S.Sirohi
3-A Yariv / Optical Electronics/C.B.S. Collage Publishing, New York, 1985.
4-Fundamentals of OPTOELECTRONICS by Pollock

**TIC-801 PLC AND DISTRIBUTED CONTROL SYSTEM**

**UNIT 1**

PLC Fundamentals – Discrete state Vs continuous state control-Evolution of modern day, PLCs building blocks of PLCs-Communication in PLCs.

**UNIT 2**

PLC Applications-Programming methods- Relay & logic ladder diagrams-Boolean logic-High level languages-Graphical representation- programming examples – Comparative study of industrial PLCs.

**UNIT 3**

Elements of DCS –Evolution of DCS - Building blocks- Detailed descriptions and functions of field control units-Operator stations and data highways-Redundancy concepts.

**UNIT 4**

Case studies in DCS-Comparative study of industrial DCS-Reliability calculations -intrinsically safe instrumentation –Case studies

**UNIT 5**

Communications in DCS - Basics of Computer networks - Special requirements of network used for control - Communication protocols-link access mechanism- Manufactures automation protocols - Field bus and Smart transmitters.

**REFERENCE BOOKS**

1. Moore, Digital control devices, ISA press, 1986.
2. Tanaenbaum A.S., Computer networks, Prentice Hall, 1998.
1. Lukcas M.P., Distributed control systems, Van Nostrand Reinhold co., Newyork,1986.
2. Huges T, Programmable Logic Controllers, ISA press,1994.

## TIC-802 PROCESS & OPTIMAL CONTROL

**UNIT 1**

**PROCESS CHARACTERISTICS:** Terms and Objectives, Incentives for process Control – design aspects of a Process Control System- Classification of variables.

Process Equation, Process variables, Degrees of freedom. Characteristics of liquid system, gas system, thermal system. Mathematical modelling of processes. Self regulating-Servo and Regulatory, Interacting and Non-Interacting process – Inverse response.

**UNIT 2**

**PROCESS CONTROL ELEMENTS:** Signal conversion - I/P, P/I Converters, Pneumatic and Electric actuators, Valve Positioner-Control Valve – Characteristics of Control Valves-Types of control valves- Control valve sizing- cavitation and flashing. Dynamics of batch and Continuous process.

**UNIT 3**

**CONTROLLER: -** Basic control actions – Discontinuous control mode, Continuous control mode-Proportional, Single speed floating, Integral and Derivative– Composite control modes – P+I, P+D and P+I+D control modes. Response of controller for different types of test inputs – Integral windup – Auto manual transfer. Selection of control mode for different processes – Typical control schemes for level flow, pressure and temperature.

**CONTROLLER TUNING: –** Zeigler and Nichols open and Closed loop methods, Performance indices –Based on evaluation criteria – ISE, IAE, ITAE.

**UNIT 4**

**INTRODUCTION TO OPTIMAL CONTROL:** Statement of optimal control problem – Problem formulation and forms of optimal control – Performance measures for optimal control – Selection of performance measure – Various methods of optimization – Linear programming – Nonlinear programming – Dynamic programming.

**UNIT 5**

**DYNAMIC PROGRAMMING :** Principle of optimality – Recurrent relation of dynamic programming for optimal control problem – Computational procedure for solving optimal control problems – Characteristics of dynamic programming solution – Hamilton Jacobi Bellman equation – Application to a continuous linear regulator problem.

**REFERENCES:**

1. D.P. Eckman, “Automatic Process Control”, Wiley Eastern Ltd., 1972.
2. D.R. Coughanowr, “Process System Analysis and Control”, Second Edition, McGraw Hill 1991.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall of India, 1982.
1. Donald E. Kirk, ‘Optimal Control Theory – An introduction ‘, Pearson Education, 1970.

**PIC852: PLC & DCS Lab.**

**List of Experiments:**

1. Study of basic programming of PLC
2. Analog operation in PLC
3. Arithmetic operation, Timer, Counter operation using PLC
4. Annunciator design using PLC
5. Application using PLC PC based programming (Level control, Temperature control, Speed Control)

6. Study and Demonstration of DCS
7. Developing control logic using DCS
8. Application of DCS(Level control, Pressure control)
9. Application of DCS(Boiler Control, Distillation column control)
10. Virtual DCS

NOTE: The institution may add 2 more practical in above prescribed list.

## TIC-021 POWER PLANT ENGINEERING

**UNIT 1**

**INTRODUCTION :** Piping and instrumentation diagram of a thermal power plant, basic process on a boiler, Fuel measurement- review of pressure and temperature measurement steam and water flow measurement – instrument applications in power stations: review of indicating and recording instrument applications in power stations: review of indicating and recording instruments, water level gauge for boiler drums, closed circuit television instrument, gas analysis meters, smoke instruments, dust monitor-measurement of impurities in feed water and steam

generator coolant controls and instruments, instrument maintenance aspects.

**UNIT 2**

**BOILER CONTROL-I:** Boiler control objectives-combustion of fuels (gaseous liquid, and solid), excess air, combustion chemistry and products of combustion, requirement for excess combustion, air-circulation of efficiency of boiler: input/output method-stream temperature control systems super heaters and de-superheaters.

**UNIT 3**

**BOILER CONTROL-II:** Feed water supply and boiler water circulation system-drum level control systems-boiler draft systems-measurement and control of furnace draft measurement and control of combustion-draft and air flow control related functions.

**UNIT 4**

**FLUE GAS ANALYSIS TRIMMING OF COMBUSTION CONTROL SYSTEMS :**

Combustion control for liquid and gaseous fuel boilers coal or solid fuel strokes combustion control for stoker-fired boilers- pulverised coal-fired boilers. Turbine monitoring and control: speed, vibration, shell temperature monitoring.

**UNIT 5**

**NUCLEAR POWER PLANT INSTRUMENTATION**: Piping and instrumentation diagram of different types of nuclear power plants-radiation detection instruments process sensors for nuclear power plants-spectrum analyzers-nuclear reactor control systems and allied instrumentation.

**REFERENCE BOOKS:**

1. B.G.Liptak, Instrumentation in process industries, Vol. I and II, Chilton books co, 1973.
2. Sam G. Dukelow. The control of boilers, Instrument Society of America press.
3. A.Sherryet. Al. (Editors), Modern power station practice, Vol.6 (Instrumentation controls and testing), Pergamon Press, 1971.

## TIC-022 COMPUTER CONTROL OF PROCESS

**UNIT 1**

**ANALYSIS OF SAMPLED DATA CONTROL SYSTEM**: Continuous and discrete systems sample data system- Z transform –inverse Z transform- selection of sampling period – mathematical representation of sampler- transfer function of zero order hold and first order hold device-Pulse transfer function – –open loop and closed response of linear sample data control system for step input – stability analysis: Jury's test and bilinear transformation-State space representation of sample data systems

**UNIT 2**

**DIGITAL CONTROL ALGORITHMS** – Deadbeat Algorithm – Dahlin's method – ringing – Kalman's approach – discrete equivalent to an analog Controller – design for load changes. PID Algorithms – tuning techniques. Selection of sampling time. Dead time Compensation – Smith Predictor Algorithm.

**UNIT 3**

**SYSTEM MODELING AND IDENTIFICATION** – Mathematical model for processes – first order. Second order processes without and with pure delay higher order systems – process modeling form step test data – pulse testing for process identification – time – domain identification – linear least square algorithm.

**UNIT 4**

**ROBUST CONTROL, INTELLIGENT CONTROLLERS, OPTIMAL CONTROL**

**UNIT 5**

**ADAPTIVE CONTROL:** Introduction- types- MFA control- single loop MFA controlmultivariable MFA control-model reference adaptive control.

**MODEL PREDICTIVE CONTROL:** Introduction- optimization problems- dynamic matrix control-DMC for first order process **–** quadratic DMC.

**REFERENCES BOOK:**

1. P.B. Deshpande and RH. Ash, "Elements of Computer Process Control", Instrument Society of America. 1981.
1. B.W.Bequette. "Process control" Prentice Hall Inc. 2006(unit IV)
2. C.L. Smith, "Digital Computer Process Control", Intext Educational Publishers, 1972.
3. Vance Vandoren" Techniques for Adaptive Control" BH publishers.,2003 (unit –V)

## TIC-023 SYSTEM DESIGN USING MICROCONTROLLERS

**UNIT 1**

**REVIEW OF MICROCONTROLLERS:** Features of Typical Microcontroller – on Board peripherals – Processor Selection criteria – Microcontroller Design Specifications – Word length – Performance Issues - Power consumption – Package Types – Electrical requirements – Reset Hardware – oscillator Design – power Consideration - Development Tools –Firmware Development options – Assembly Language Vs High level Language Programming.

**UNIT 2**

**MCS51 MICROCONTROLLER AND INTERFACING:** Intel MCS51 Architecture – Derivatives - Special Function Registers (SFR), I/O pins, ports and circuits, Instruction set, Addressing Modes, Assembly Language Programming, Timer and Counter Programming, Serial Communication, Connection to RS 232, Interrupts Programming, External Memory interfacing , Introduction to 16 bit Microcontroller

**UNIT 3**

**PIC MICROCONTROLLER AND INTERFACING:** Introduction, CPU architecture, registers, instruction sets addressing modes Loop timing, timers, Interrupts, Interrupt timing, I/o Expansion, I 2C Bus Operation Serial EEPROM, Analog to digital converter, UART-Baud Rate-Data Handling-Initialization, Special Features - serial Programming- Parallel Slave Port.

**UNIT 4**

**SOFTWARE DEVELOPMENT AND TOOLS:** Embedded system evolution trends. Round - Robin, robin with Interrupts, function-One-Scheduling Architecture, Algorithms. Introduction to-assembler-compiler-cross compilers and Integrated Development Environment (IDE). Object Oriented Interfacing, Recursion, Debugging strategies, Simulators.

**UNIT 5**

**REAL TIME OPERATING SYSTEMS:** Task and Task States, tasks and data, semaphores and shared Data Operating system Services-Message queues-Timer Function-Events-Memory Management, Interrupt Routines in an RTOS environment, basic design Using RTOS. System Design Issues – Design of Industrial Control System.

**REFERENCES:**

1. Burns, Alan and Wellings, Andy, " Real-Time Systems and Programming Languages ", Second Edition. Harlow: Addison-Wesley-Longman, 1997.
2. Raymond J.A. Bhur and Donald L.Bialey, " An Introduction to real time systems: Design to networking with C/C++ ", Prentice Hall Inc. New Jersey, 1999.
3. Grehan Moore, and Cyliax, " Real time Programming: A guide to 32 Bit Embedded Development. Reading " Addison-Wesley-Longman, 1998.
4. Heath, Steve, " Embedded Systems Design ", Newnes 1997.

## TEC 024 DIGITAL IMAGE PROCESSING

**UNIT 1**

**INTRODUCTION**: Fundamental steps in DIP, elements of DIP, Simple image model, Sampling & quantization, basic relationships between Pixels, Color image model.

**UNIT 2**

**IMAGE TRANSFORMS**: One-dimensional & Two-dimensional DFT, Cosine, Sine, Hadamard, Haar, and Slant & KL transforms

**IMAGE ENHANCEMENT**: Introduction, Point operations, Histogram modeling, spatial operations, Transform operations

**UNIT 3**

**IMAGE RESTORATION**: Introduction, Image observation models, Inverse & Wiener filtering, difference between enhancement & restoration Restoration-spatial filtering, Noise reduction in frequency domain.

**UNIT 4**

**IMAGE COMPRESSION**: Introduction, Pixel coding, Predictive coding, Transform coding, Inter-frame coding.

**UNIT 5**

**IMAGE SEGMENTATION**: Introduction, Spatial feature extraction, Transforms features, Edge detection, Boundary extraction, Segmentation techniques.

**SUGGESTED BOOKS:**


1. Digital Image Processing, Rafael C. Conzalez Richard E Woods, 2nd Ed.
2. Fundamentals of Digital Image Processing, Anil K Jain.


## TIC-031 ADAPTIVE CONTROL SYSTEMS

**UNIT 1**

**Mathematical Model:** Mathematical Model for process of I order, II order – I order with pure delay & higher order system. Discretization techniques and computer solution of differential equations – simulation of process dynamics – state models.

**UNIT 2**

**Identification of Methods:** Conventional techniques of identification, Identification of systems with dead time Discrete Systems, ARMA process, discrete state model – least squares techniques – recursive least squares – generalized recursive least squares algorithms – fixed memory

algorithm, Minimum variance method.

**UNIT 3**

**Adaptive Control of Deterministic Systems:** Gain scheduling, MRAC, STC, Minimum variance controller – Predictive control, Minimum prediction error adaptive controls – adaptive control algorithms for closed loop pole assignment – adaptive control of time varying systems.

**UNIT 4**

**Adaptive Control of Stochastic Systems:** Stochastic processes, Stochastic minimum prediction error adaptive controller – adaptive pole placement – adaptive optimal controllers.

**UNIT 5**

**State Estimation and Observers:** Parameter estimation and state estimation, Luenberger, Asymptotic observers – adaptive observer – Extended Recursive least squares, FM and Kalman filter.

**REFERENCES:**

1. Goodwin G.C. and Sin K.S. Jersey,, "Adaptive filtering, prediction and control", Prentice Hall, inc., 1984.
2. Mendel J.M., Marcel, Dekker, "Discrete techniques of parameter estimation", New York, 1994.
3. Hsia T.C.H.A., "System Identification", Lexington books, 1974.
4. Harris C.J. and Billings S.A. Peter ,"Self Tuning and Adaptive control", Peregnius Ltd., 1984.

## TIC 032 INDUSTRIAL SAFETY AND MANAGEMENT

**UNIT 1**

**ENERGY CONVERSION** – world fossil fuel reserves – world energy consumption – historical lives of fossil fuels – global energy and environmental management – environmental aspects of fossil, nuclear, hydro and biomass energy conversion – gaseous emissions – solid waste – liquid waste.

**UNIT 2**

**ENERGY MANAGEMENT** – need for energy conservation – energy auditing – conducting real time continuous energy audits – data collection – automated data acquisition – data analysis – role of

energy manager – energy audit instruments – gas analyzer – energy conservation in industries: boilers, pumps, fans, compressed air systems, refrigeration and air conditioning systems, DG sets, electrical motors, variable speed motors.

**UNIT 3**

**AIR POLLUTANTS AND GLOBAL CLIMATE** – air pollutant effects. Pollution control laws and regulation – national and international – role of environmental monitoring in environmental management systems – continuous emissions monitoring systems. Pollution control – review of pollution control methods in thermal power plants – industrial – nuclear – automobiles – disposal/treatment of solid and liquid wastes – alternate fuels.

**UNIT 4**

**SAFETY AND PRODUCTIVITY** – causes of accidents in industries – accidents reporting and investigation – measuring safety performance – workman compensation rules.

**UNIT 5**

**SAFETY CODES AND STANDARDS** – general safety considerations in power plants, pressure vessels and pressurized pipe lines – operation and inspection of extinguishers – preventing the spread of fire – emergency exit facilities.

**TEXT BOOKS:**

1. Blake Roland. P, "Industrial safety", Prentice Hall of India, 1973.
2. Callaghan. P. O, "Energy Management", McGraw Hill Book Co., 1993.

**REFERENCES:**

1. Culp. A. W, "Principles of Energy Conservation", McGraw Hill Book Co., 1991.
2. Noel de Nervers, "Air Pollution Control Engineering", McGraw Hill Book Co., 2000.

## TIC-033 PROCESS CONTROL SYSTEM COMPONENTS

**UNIT 1**

**ORIFICE METER** – design of orifice for given flow condition – design of rotameter – design of RTD measuring circuit – design of cold junction compensation circuit for thermocouple using RTD – Transmitters – Zero and span adjustment in D/P transmitters and temperature transmitters.

**UNIT 2**

**BOURDON GAUGES** – factors affecting sensitivity – design of Bourdon tube – Design of Air purge system for level measurement. Electronic P+I+D controllers – design – adjustment of setpoint, bias and controller settings.

**UNIT 3**

**CONTROL VALVES** – design of actuators and positioners – types for valve bodies – valve characteristics – materials for body, and trim – sizing of control valves – selection of body, materials and characteristics of control valves for typical applications.

**UNIT 4**

**TYPES OF PUMPS** – pump – performance – pipe work calculation – characteristics of different pumps – pump operation maintenance – instruments used in pumping practice pump noise and vibration – selection of pumps.

**UNIT 5**

Design of logic circuits for alarm and annunciator circuits, interlocks – design of microprocessor based P+I+D controller.

**TEXT BOOKS:**

1. N.A. Anderson, "Instrumentation for Process Measurement and Control", Chillton Company, 1980.
2. D.M. Considine, "Process Instruments and Controls Handbook", McGraw Hill Book Co. 1985.

**REFERENCES:**

1. R.H. Warring, "Pumping Manual", Gulf Publishing Co., 1984.
2. C.D. Johnson, "Process Control Instrumentation Technology", Prentice Hall Inc.

## TIC-034 ROBOTICS AND AUTOMATION

**UNIT 1**

**INTRODUCTION:** Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator- DC motor horse power calculation, magnetostrictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors –ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems – Image processing and analysis – image data

reduction – segmentation feature extraction – Object recognition.

**UNIT 2**

**ROBOT CONTROL:** Control of robot manipulators- state equations-constatnt solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control- Impedance control .

**UNIT 3**

**END EFFECTORS:** End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope-workspace fixtures-pick and place operation- continous path motioninterpolated motion-straight line motion.

**UNIT 4**

**ROBOT MOTION ANALYSIS:** Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates- Homogeneous transformations and rotations and Robot dynamics.

**UNIT 5**

**ROBOT APPLICATIONS:** Industrial and Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

**TEXT BOOKS:**

1. Mikel P. Grover , et. Al. “Industrial Robots – Technology Programming and Applications”, McGraw Hill, 1980.
2. Robert J.Schilling, Fundamentals of Robotics-Analysis and Control, PHI,2007.( Unit 2 and Unit 3)

**REFERENCE:**

1. K.S.Fu, R.C.Gonzalez, CSG. Lee, Robotics, control sensing vision and Intelligence, Tata Mcgraw-Hill, 2008