# राष्ट्रीय प्रौद्योगिकी संस्थान अगरतला

# NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA

***COURSE STRUCTURE AND DETAILED SYLLABUS***

***FOR B.TECH DEGREE IN ELECTRONICS AND INSTRUMENTATION ENGINEERING (E.I.E.)***

***Introductory Session- 2011-12***

National Institute of Technology, Agartala

**Proposed Course-Structure: B. Tech. Electronics & Instrumentation Engineering**

**THIRD SEMESTER THEORY**

| 3rd Semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| 1 | Mathematics III(M-301) | 3 | 1 | 0 | 4 |
| 2 | Network Analysis and Synthesis | 3 | 1 | 0 | 4 |
| 3 | Electrical Measurement and Measuring Instruments | 3 | 1 | 0 | 4 |
| 4 | Analog Electronic Circuits | 3 | 1 | 0 | 4 |
| 5 | Programming in C | 3 | 0 | 0 | 3 |
| **Total 3rd Semester Theory Credit** | | | | | **19** |

**THIRD SEMESTER LABORATORY**

| 3rd Semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| 1 | Network Analysis and Synthesis Lab | 0 | 0 | 3 | 2 |
| 2 | Electrical Measurement and Measuring Instruments Lab | 0 | 0 | 3 | 2 |
| 3 | Analog Electronic Circuits Lab | 0 | 0 | 3 | 2 |
| 4 | Programming in C Lab | 0 | 0 | 3 | 2 |
| **Total 3rd Semester Laboratory Credit** | | | | | **8** |
| **Total 3rd Semester Theory Credit** | | | | | **19** |
| **Total 3rd Semester Credit** | | | | | **27** |

National Institute of Technology, Agartala

**Proposed Course-Structure: B. Tech. Electronics & Instrumentation Engineering**

**FOURTH SEMESTER THEORY**

| 4th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| **1** | Instrumentation Devices-I | **3** | **0** | **0** | **3** |
| **2** | Signals and Systems | **3** | **1** | **0** | **4** |
| **3** | Digital Electronics | **3** | **1** | **0** | **4** |
| **4** | Numerical Methods and Analysis | **3** | **1** | **0** | **4** |
| **5** | Electromagnetic Theory | **3** | **0** | **0** | **3** |
| **6** | Nano Electronics | **3** | **0** | **0** | **3** |
| **Total 4th Semester Theory Credit** | | | | | **21** |

**FOURTH SEMESTER LABORATORY**

| 4th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| **1** | Instrumentation Devices-I Lab | **0** | **0** | **3** | **2** |
| **2** | Digital Electronics Lab | **0** | **0** | **3** | **2** |
| **3** | Numerical Methods and Analysis Lab | **0** | **0** | **3** | **2** |
| **Total 4th Semester Laboratory Credit** | | | | | **8** |
| **Total 4th Semester Theory Credit** | | | | | **19** |
| **Total 4th Semester Credit** | | | | | **27** |

National Institute of Technology, Agartala

**Proposed Course-Structure: B. Tech. Electronics & Instrumentation Engineering**

## FIFTH SEMESTER THEORY

| 5th Semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| 1 | Instrumentation Devices-II | 3 | 1 | 0 | 4 |
| 2 | Linear Control System | 3 | 1 | 0 | 4 |
| 3 | Electronic Instrumentation and Measurement | 3 | 1 | 0 | 4 |
| 4 | Computer Organization & operating system | 3 | 0 | 0 | 3 |
| 5 | Industrial Instrumentation | 3 | 0 | 0 | 3 |
| 6 | Communication theory | 3 | 0 | 0 | 3 |
| | **Total 5th Semester Theory Credit** | | | | 21 |

## FIFTH SEMESTER LABORATORY

| 5th Semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| 1 | Linear Control System Lab | 0 | 0 | 3 | 2 |
| 2 | Electronic Instrumentation and Measurement Lab | 0 | 0 | 3 | 2 |
| 3 | Industrial Instrumentation Lab | 0 | 0 | 3 | 2 |
| **Total 5th Semester Laboratory Credit** | | | | | 6 |
| **Total 5th Semester Theory Credit** | | | | | 21 |
| **Total 5th Semester Credit** | | | | | 27 |

National Institute of Technology, Agartala

**Proposed Course-Structure: B. Tech. Electronics & Instrumentation Engineering**

**SIXTH SEMESTER THEORY**

| 6th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| **1** | Process Control – I | **3** | **1** | **0** | **4** |
| **2** | Power Electronics | **3** | **1** | **0** | **4** |
| **3** | Biomedical instrumentation | **3** | **1** | **0** | **4** |
| **4** | Microprocessor and microcontroller | **3** | **1** | **0** | **4** |
| **5** | Data Communication and Network | **3** | **0** | **0** | **3** |
| | **Total 6th Semester theory Credit** | | | | **19** |

**SIXTH SEMESTER LABORATORY**

| 6th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| **1** | Process Control – I Lab | **0** | **0** | **3** | **2** |
| **2** | Power Electronics Lab | **0** | **0** | **3** | **2** |
| **3** | Microprocessor and microcontroller Lab | **0** | **0** | **3** | **2** |
| 4 | Group Discussion & Seminar | **0** | **0** | **3** | **2** |
| **Total 6th Semester Laboratory Credit** | | | | | **8** |
| **Total 6th Semester theory Credit** | | | | | **19** |
| **Total 6th Semester Credit** | | | | | **27** |

National Institute of Technology, Agartala

**Proposed Course-Structure: B. Tech. Electronics & Instrumentation Engineering**

**SEVENTH SEMESTER THEORY**

| 7th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| **1** | Process Control – II | **3** | **1** | **0** | **4** |
| **2** | Optoelectronic & Instrumentation | **3** | **0** | **0** | **3** |
| **3** | Digital Signal Processing | **3** | **1** | **0** | **4** |
| **4** | Engineering Economics and Costing | **3** | **0** | **0** | **3** |
| **5** | Elective-I | **3** | **0** | **0** | **3** |
| **Total 7th Semester Theory Credit** | | | | | **17** |

National Institute of Technology, Agartala

**Proposed Course-Structure: B. Tech. Electronics & Instrumentation Engineering**

**SEVENTH SEMESTER LABORATORY**

| 7th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| **1** | Process Control – I I Lab | 0 | 0 | 3 | 2 |
| **2** | Digital Signal Processing Lab | 0 | 0 | 3 | 2 |
| **3** | Project Phase-I | 0 | 0 | 6 | 4 |
| **Total 7th Semester Laboratory Credit** | | | | | **8** |
| **Total 7th Semester theory Credit** | | | | | **17** |
| **Total 7th Semester Credit** | | | | | **25** |

National Institute of Technology, Agartala

**Proposed Course-Structure: B. Tech. Electronics & Instrumentation Engineering**

## EIGHTH SEMESTER THEORY

| 8th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| 1 | Industrial Management | 3 | 0 | 0 | 3 |
| 2 | Telemetry & Remote Control | 3 | 0 | 0 | 3 |
| 3 | Analytical Instrumentation | 3 | 0 | 0 | 3 |
| 4 | Elective 2 | 3 | 0 | 0 | 3 |
| Total 8th Semester Theory Credit | | | | | 12 |

## EIGHTH SEMESTER LABORATORY

| 8th semester | Subject Name | L | T | P | Total CR |
|---|---|---|---|---|---|
| 1 | Telemetry & Remote Control Lab | 0 | 0 | 3 | 2 |
| 2 | Grand Viva | 0 | 0 | 0 | 4 |
| 3 | Project Phase-II | 0 | 0 | 9 | 6 |
| Total 8th Semester Laboratory Credit | | | | | 12 |
| Total 8th Semester Theory Credit | | | | | 12 |
| Total 8th Semester Credit | | | | | 24 |

## Total Course Credit

| | |
|---|---|
| **Total credit :** 3rd semester to 8th semester | 157 |
| **Total credit :** 1St semester to 2nd semester (Common to all existing branches of NIT, Agartala) | 65 |
| **Total Course credit :** 1St semester to 8th semester | 222 |

## LIST OF PROPOSED ELECTIVE SUBJECTS:

| SL. NO. | SUBJECTS | L | T | P | CREDIT |
|---|---|---|---|---|---|
| 1 | Mobile Communication | 3 | 0 | 0 | 3 |
| 2 | Advanced Control System | 3 | 0 | 0 | 3 |
| 3 | Optimization Techniques | 3 | 0 | 0 | 3 |
| 4 | Digital Image Processing | 3 | 0 | 0 | 3 |
| 5 | Data Structure and Algorithm | 3 | 0 | 0 | 3 |
| 6 | Fuzzy Logic and Neural Network | 3 | 0 | 0 | 3 |
| 7 | Advanced Microprocessors and Microcontrollers | 3 | 0 | 0 | 3 |
| 8 | VLSI Technology | 3 | 0 | 0 | 3 |
| 9 | Embedded systems | 3 | 0 | 0 | 3 |
| 10 | Antenna & Wave propagation Engineering | 3 | 0 | 0 | 3 |
| 11 | Industrial Automation & Control | 3 | 0 | 0 | 3 |
| 12 | Nonlinear control | 3 | 0 | 0 | 3 |
| 13 | AI & Soft computing | 3 | 0 | 0 | 3 |
| 14 | Fuzzy set and fuzzy logic | 3 | 0 | 0 | 3 |
| 15 | Artificial Intelligence and Robotics | 3 | 0 | 0 | 3 |
| 16 | Advance Mathematics | 3 | 0 | 0 | 3 |
| 17 | Computational Electrodynamics | 3 | 0 | 0 | 3 |
| 18 | Operational research | 3 | 0 | 0 | 3 |
| 19 | Advance Solid State Devices | 3 | 0 | 0 | 3 |
| 20 | Laser and Nonlinear Optics | 3 | 0 | 0 | 3 |
| 21 | Advanced Optoelectronics and Photonics | 3 | 0 | 0 | 3 |
| 22 | Elements of computer graphics | 3 | 0 | 0 | 3 |

# DETAILED SYLLABUS FOR 3rd, 4th, 5th, 6th, 7th & 8th SEMESTERS

## 2nd Year 3rd Sem

## Mathematics III

**Probability and Statistics:**

Classical and Axiomatic definition of Probability, Conditional Probability, Independent Events, Random Variables, Probability mass function and Probability density function, Distribution function, Function of Random Variables. Standard univariate discrete and continuous distribution and their properties, Mathematical Expectation, Moments, Moments Generating Function, correlation and regression.

**Fourier series:**

Fourier series, half range series, Fourier sine series and Fourier cosine series.

**Function of Several Variables:**

Partial Derivatives, Chain Rule, Differentiation of Implicit functions, Exact Differentials, Tangent planes and Normal planes, Maxima, Minima and Saddle points, Simple problems in extrema of functions with constraints, Method of Lagrangian Multipliers.

**Multiple Integrals:**

Double and Triple Integrals, Jacobians and transformation of co-ordinates, Application to areas, volumes center of pressure.

**Improper Integrals:**

Test of convergence, Beta and Gamma function, principle value.

**Vector Calculus:**

Vector differentiation and Integrations, gradient, divergence and curl-Application.

**Function of a Complex Variable:**

Limit, continuity and differentiation, Analytic function, Cauchy-Riemann equations, Conjugate functions, Application to two dimensional problems, Cauchy's Integral theorem, Taylor's and Laurent's expansions, Brach points, zeros, poles, residues, simple problems on Contour Integration.

**Reference Books**

1. Advanced Engineering Mathematics: E. Kreyszig.
2. Advanced Engineering Mathematics: H.K.Dass.
3. A Textbook of Engineering Mathematics: N.P.Bali & Manish Goyal.
4. Advanced Engineering Mathematics: B.S.Grewal.
5. Statistical Methods: Gupta & Kapoor/Kapoor & Sexena.
6. Vector Calculas: M.L.Khanna.
7. Integral Calculas: Maity & Ghosh.

# Network Analysis and Synthesis

**Unit 1:** **Introduction**

Introduction to circuit element, types of network, Review of network theorems

**Unit 2:** **Transient Response**

**First Order systems**: Introduction, natural response, initial conditions, complete response of first order system, Application of Lap lace Transform

**Higher order systems**: Natural response, over damped system, critically damped system and under damped system, Network excited by external energy sources.

**Transform of other signal wave form**: Shifted Unit step function, Ramp and Impulse function, wave form synthesis, Initial and final value of f(t) and F(s)

**Unit 3:** **Properties of Network**

**Impedance functions and network theorem:** Concept of complex frequency, transform impedances and transform circuit and application of network theorem

**Network Function Poles and Zeros**

Concept of poles and zeros, Network functions for one port and two port network, Restrictions of poles and zeros location for driving point function and transfer function. Time domain behavior for the poles and zero plots. Passive filters.

**Unit 4:** **Two Port Network**

Concept of two port network, Impedance parameter, Admittance parameter, transmission parameter, inverse transmission parameter, hybrid parameter, inverse hybrid parameter, Relation between parameter set, interconnection of two networks, Network functions for general networks

**Unit 5:** **Graph Theory**

Graph of a network, Trees, co-trees, loops, Incidence matrix, Cut-set, tie-set matrix, number of possible trees of a graph.

**Unit 6:** **Coupled inductors**

Introduction to coupled inductors, mutual inductance, dot convention, co-efficient of coupling, series and parallel combination of coupled circuit.

**Unit 7:** **Fourier series**

Introduction to Fourier series, Evaluation of Fourier coefficient, Waveform symmetries, Exponential form of Fourier series, Introduction to Fourier transform.

**Unit 8:** **Network synthesis**

Elements of Two element network synthesis, Positive real function and their properties, Driving point and transfer impedance function, LC network, RC, RL, LCR, Theory of approximation, terminated network.

**Books**

1. An active network synthesis by A Budak
2. Sudhakar:Circuits & Networks:Analysis & Synthesis 2/e TMH New Delhi
3. Valkenburg M. E. Van, "Network Analysis", Prentice Hall./Pearson Education
4. A, Chakraborty: Networks, Filters & Transmission Lines
5. D.Chattopadhyay and P.C.Rakshit: Electrical Circuits
6. A.V. Oppenheimer and A.S.Wilsky: Signals & Systems, PHI/Pearson
7. R.V.Jalgaonkar.: Network Analysis & Synthasis.EPH.
8. Sivandam- Electric Circuits and Analysis, Vikas
9. Electric circuits by Balbanaan
10. V.K. Chandna, A Text Book of Network Theory & Circuit Analysis, Cyber Tech

**Reference Books:**

1. Reza F. M. and Seely S., "Modern Network Analysis", Mc.Graw Hill Book Company
2. Roy Choudhury D., "Networks and Systems", New Age International Publishers.
3. Kuo F. F., "Network Analysis & Synthesis", John Wiley & Sons.

# Electrical Measurement and Measuring Instruments

**Module I**

Classification of electrical measuring instruments, general features of indicating type instruments - controlling, damping and balancing of moving systems; static and dynamic performance characteristics. Principles of permanent-magnet moving coil, moving iron, rectifier, electrodynamic and induction type instruments. Extension of instruments range - shunt, multipliers, C.T and P.T.,

**Module II**

Measurement of low, medium and high resistances, Kelvins double bridge, multimeters, megger, localization of cable faults using Murray and Varley loop methods.

**Module III**

D.C. and A.C. potentiometers, Measurement of high voltage, Electrostatic instruments, measurement of inductances, capacitance and frequency by A.C. Bridges – Maxwell, Schering, Anderson, De-Sauty, Wien.

**Module IV**

Concept of polyphase circuit, Three phase voltage, current, and power, Balanced and unbalanced three phase circuits, Measurement of active power in polyphase circuits, various wattmeter connections. A.C. and D.C. energy meters.

.

**Reference Books:**

1. Golding E.W. & Wides F.C. : Electrical Measuring Instruments & Measurements ; Wheeler
2. Harris, F. K. – Electrical Measurements, Wiley.
3. Modern Electronic Instrumentation and Measurement Techniques by Helfrick & Cooper (ISBN: 81-203-1626-6), Pub: Prentice Hall
4. Introduction to instrumentation &control : Arun K. Gosh. (ISBN: 81-203-0752-6), Pub: Prentice Hall
5. Electrical and electronics Measurement: R.K.Rajput ;S.Chand
6 Shawney A.K: A course in Electrical & Electronic Measurements, Dhanpat Rai & Sons.

# Analog Electronic Circuits

Transistor Biasing and Stability: Self Bias-CE, CC, Compensation techniques. h-parameter low frequency model of transistor: Voltage, current, transresistance & transconductance amplifier,. High frequency model of transistor.

Power amplifiers – Class A, B, AB, C, Tuned amplifier.

Different stages of Operational Amplifier: Differential Amplifier, Constant current source (current mirror etc.), level shifter, Ideal and practical OpAmp. Comparator, Schmitt Trigger. Instrumentation Amplifier, Log & Anti-log amplifiers, Trans-conductance multiplier, Precision Rectifier

Feedback amplifier: General theory of feedback, Barkhausen criteria, stability of feedback amplifier, different feedback topologies, and Different RC and LC oscillators.

Multivibrator – Monostable, Bistable, Astable. Timer. Monostable and astable operation using 555 timer.

Linear voltage regulator: series and shunt. Switched mode power supply.

Wave shapers-I, I-V, V-F & F-V converters.

**Text Book:**


1. Millman & Halkias – Integrated El;ectronics, Tata McGraw Hill.
2. Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e,TMH
3. Schilling & Belone—Electronic Circuit:Discrete & Integrated , 3/e ,TMH
4. Gayakwad R.A -- OpAmps and Linear IC's, PHI
5. Coughlin and Drisscol – Operational Amplifier and Linear Integrated Circuits – Pearson Education Asia.
6. Microelectronic Circuits – Sedra and Smith (Fifth Edition) (Oxford)
7. Microelectronics – Analysis and Design – Sundaram Natarajan (TMH)


**Reference Books:**


1. Electronic Circuits – D.L. Schilting and C. Belove (TMH)
2. Sergio Franco – Operational Amplifier (JMH)
3 R. A. Gackward – PHI/Pearson Education
4. Electronic Devices and Circuit theory – Boylestead and Nashesky – PHI/Pearson Education
5. Malvino—Electronic Principles , 6/e ,TMH
6. Millman & Taub- Pulse, Digital & switching waveforms- TMH
7. Horowitz & Hill- The Art of Electronics; Cambridge University Press.
8. Hayes & Horowitz- Student Manual for The Analog Electronics; Cambridge University Press.
9. Boyle'stead & Nashelsky: Electronic Devices & Circuit theory, PHI.
10. Tobey & Grame – Operational Amplifier: Design and Applications, Mc Graw Hill.
11. Tushar Jadhab – Linear Integrated Circuits, Everest Publishing House.

# Programming in C

**UNIT I.** Introduction
A. History of C
B. Why use C
C. Compilers
D. Memory models

**UNIT II.** Program Structure
A. Header and body
B. Use of comments
C. Construction of the program
1. /* Comments */
2. { Body } braces
3. File names
4. Standard compiler library

**UNIT III.** Data Concepts
A. Interactive programs
B. Variables, constants, and data types
C. Declaring words, bytes, and bits
D. Key and reserve words

**UNIT IV.** Simple Input / Output Operations
A. Character strings
1. printf ()
2. scanf ()
B. Single characters
1. getchar ()
2. Putchar ()

**UNIT V.** Statements and Operators
A. Expressions
B. Conversions and typecasting

**UNIT VI**. Decision Making Abilities
A. Relational operators
B. Relational expressions
C. Logical operators

**UNIT VII.** Loops and Controls
A. Control statements for decision making
B. Branching and jumps (if statement)
C. While loop
D. Do while for loop

**UNIT VIII.** Input/Output and Redirection
A. Buffers
B. Redirection and files

**UNIT IX.** Storage Classes
A. Automatic Variables
B. External Variables
C. Scope and Functions

**UNIT X.** Functions and Arguments
A. Global and local variables
B. Recursion
C. Altering variables in calling programs

**UNIT XI.** Strings and Arrays
A. Dimensions and initialization of arrays
B. String functions
C. Pointers & pointer operations
D. Pointers and multidimensional arrays
E. Pointers and strings

**UNIT XII.** Dynamic Memory allocation
A. Malloc( )
B. Calloc ( )

**UNIT XIII.** Input, Output, and Disk Files
A. Streams and Files
1. Text Streams
2. Binary Streams
B. Standard I/O
1. fopen () and fclose () function
2 fprint (), fscanf (), fgets (), and fputs ()
3. Random access: fseek () and ftell ()

**UNIT XIV.**
A. Structures
B. Pointers to Structures
C. Union

**UNIT XV.** Advanced Topics
Basic Graphic Programming in C

## Reference Books:


1. Introduction To Computing (TMH WBUT Series), E. Balagurusamy,TMH
2. Kerninghan, B.W. The Elements of Programming Style
3. Yourdon, E. Techniques of Program Structures and Design
4. Schied F.S. Theory and Problems of Computers and Programming
5. Gottfried Programming with C Schaum
6. Kerninghan B.W. & Ritchie D.M. The C Programming Language
7. Rajaraman V. Fundamental of Computers
8. Balaguruswamy Programming in C
9. Kanetkar Y. Let us C
10. M.M.Oka Computer Fundamentals,EPH
11. Xavier C. C Language & Numerical Methods, New Age Inter.
12. Dutta N. Computer Programming & Numerical Analysis, Universities Press

# 2nd Year 4th Sem

## Instrumentation Devices I

Definition, principles of sensing and transduction, classification

**Mechanical and Electromechanical sensors:**
Resistive (potentiometric) type, Forms, materials.

Strain Gauges: theory, types, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesives, rosettes.

Inductive sensors: common types- reluctance change type, mutual inductance change type, transformer action type, magnetostrictive type brief discussion with respect to materials, construction and input output variables, Ferromagnetic plunger type-short analysis.

LVDT: Construction, materials, output-input relationship, I/O curve, discussion.
Proximity sensor.

**Capacitive sensors:**
Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities Stretched Diaphragm type: microphones, response characteristics ultrasonic sensors

**Thermal sensors:**
Material expansion type: solid, liquid, gas and vapour

Resistance change type: RTD, materials, construction, tip sensitive and stem sensitive type, Thermister materials, shapes, ranges, accuracy specifications.

Thermoemf sensors: types, thermoelectric powers, general consideration Junction semiconductor type IC and PTAT type

Radiation sensors: types, characteristics and comparisons Pyroelectric type

**Magnetic sensors:**
Sensors based on Villari effect for assessment of force, torque, proximity; Wiedemann effect for yoke coil sensors, Thomson effect. Hall effect and Hall drive, performance characteristics

**Reference Books:**

1. Golding E.W. & Wides F.C. : Electrical Measuring Instruments & Measurements ; Wheeler
2. Harris, F. K. – Electrical Measurements, Wiley.
3. E. A. Doebelin, Measurement Systems: Application and Design Mc Graw Hill, New York
4. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta
5. D Patranabis, Sensors and Transducers, PHI, 2nd ed.

# Signals and Systems

**Signals:** Introduction, Types of signals, Continuous-time and discrete time signals. Energy and Power, Transformations of the independent variable, Exponential and sinusoidal signals, Unit impulse and Unit sample signals, Continuous-time and Discrete time systems and Basic system properties.

**Linear time-invariant systems:** Discrete and Continuous time systems, convolution sum, convolution Integral, Properties, causal LTI systems described by difference equations, singularity function.

**Representation of aperiodic signals by Fourier Transform:** Continuous-time and discrete-time signals, Properties, System characterized by linear constant coefficient differential equation.

**Z-transform:** The region of Convergence, Inverse z-transform, pole zero plot, Properties of z-transform, Analysis and characterization of LTI system using z-Transform.

**Sampling:** representation of Continuous-time signals by its samples, sampling theorem, Impulse train sampling, Sampling with zero order hold, Reconstruction of signal from its samples using interpolation, Aliasing, Discrete time processing of continuous time signals, Digital differentiator, half sample delay, Sampling of Discrete-time signals, Decimation and interpolation.

**Random signals:** review of probability theory, Random variable: Continuous and Discrete, Description of Continuous Random variable, Statistical averages, Description of Discrete Random variable, Statistical averages, Random processes: definition, properties and types.

**Reference Books:**

1. Signals and Systems, A. V. Oppenheim, A. S Willsky, and S. H. Nawab, Prentice-Hall, Englewood Clieffs.
2. Probability, random variables, and stochastic Processes, A. Papoulis, McGraw-Hill
3. Signals and Systems, B. P. Lathi
4. Signals and Systems, M. J. Roberts McGraw-Hill

# Digital Electronics

Number systems and codes; Boolean algebra, logic gates, tristate logic, Minimization using Karnaugh map. NAND and NOR gate implementation.

Combinational Systems : Combinational Logic Circuit Design, code converters BCD to Seven Segment decoder, full adder, half adder, 4-bit magnitude Comparator, Encoders, Decoders.

Design of the circuits using Decoders, MUX and DEMUX, Design of the circuits using multiplexers,

Sequential Systems: R-S Latch, Master-Slave and edge/level- triggered flip-flops, conversion design of flip-flops, shift registers, serial and parallel loading.

Design of synchronous counters, Mod-k or Divide-by-k counters, Decade counter, BCD Counter, Ring counters, The Johnson or Twisted-ring counter, Counter Application.

Memory: ROM, PROM, EPROM, EEPROM, RAM, Introduction to memory organization.

PAL PLA, HDL and introduction to VHDL Designs.

Logic families: RTL, DTL, TTL, ECL, MOS and CMOS, Calculation of noise margins, fan in and fan-out.

**Books:**


1. Digital Integrated Electronics - Taub and schilling
2. Microelectronics - Millman
3. Digital concept Using standard ICs – Sandige
4. M. Morris Mano: *Digital Design*. Third Edition, Prentice Hall 2002.
5. R. J. Tocci. *Digital Systems: Principles and Applications*, 4th Edition. PH, 1988.
6. Digital Elecronics- R. P. Jain
7. Fundamental of digital circuits by A.Anand Kumar (PHI)


**Reference books:**


1) Digital systems (9/e) by R.J.Tocci, N.S.Widemer,G.L.Mos (Pearson)
2) Digital Fundamentals by T.L.Floyd, R.P.Jain (Pearson)
3) 2000 solved problems in digital electronics by S.P.Bali (TMH)
4) Digital design principals and applications (6/e) by D.P.Leach, A.P.Malvino, G.Saha (TMH)
5) Digital Electronics-Bignell & Donovan,Delmer,Thompson Learning
6) Digital principals and design by D.D.Givone (TMH)
7) Digital design principles and practices by J.F.Wakerly (Pearson/PHI)

## Numerical Methods and Analysis

**Unit I:** Introduction to finite differences, difference formulae, fundamental theorem of difference calculus, the difference table, to express value of the function in terms of leading term and the leading differences of a difference table, the operator E, properties of two operators E & D, relation between operator E of finite differences and differential coefficient D of differential calculus, one or more missing terms, generalized factorial notations, methods of representing any given polynomial in factorial notation.

**Unit II:** Introduction to interpolation, interpolation with equal intervals, different interpolation methods (Newton-Gregory forward and backward difference formulae), interpolation with unequal intervals, divided differences and table, Newton's divided difference formulae, central difference interpolation formulae (Gauss, Stirling, Bessel formulae), piecewise and spline interpolation, (cubic splines) least squares approximations.

**Unit III:** Numerical differentiation based on interpolation, numerical integration, a general quadrature formula for equidistant ordinates, the trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Weddles rule, Method of undetermined coefficients, extrapolation method.

**Unit IV:** Numerical solution of ordinary differential equations of first order by Euler's and Runge – Kutta's method.

**Unit V:** Solution to Algebraic and transcendental equations by Regula-Falsi method, iteration method, Newton-Raphson method, simultaneous linear Algebraic equations by Gauss-Jordon method, Crout's method, factorization method, Gauss-Seidel iterative method, determination of eigen values.

**Reference Books:**

1. Numerical Analysis & Algorithms, Pradeep Niyogi, TMH, 1st ed.
2. C Language and Numerical Methods by C.Xavier
3. Introductory Numerical Analysis by Dutta & Jana
4. Numerical Method:Balagurusamy
5. Numerical Mathematical Analysis by J.B.Scarborough
6. Numerical Methods (Problems and Solution) by Jain, Iyengar , & Jain
7. Numerical Methods In Computer Applications – P.U.Wayse. EPH
8. Computer Oreinted Numerical Method- Dutta,N. ,Vikas
9. Numerical Methods with Programs in Basic Fortran Pascal & C++ - S.B.Rao, Universities Press
10. Computer Programming & Numerical Analysis – N.Dutta, Universities Press
11. Numerical Methods for Engineers – Gupta, New Age International
12. Numerical Solutions of Differential Equations – Jain M.K.,New Age International
13. Numerical Methods for Scientific & Engg Computation – Jain M.K.,New Age International
14. Numerical Analysis – Rao G.S.,New Age International
15. Discrete Mathematical Structures – Rao G.S., New Age International
16. Foundations of Discrete Mathematics – Joshi K.D., New Age International
17. Applied Discrete Structures – Joshi, New Age International
18. Groups, Rings & Modules with Applications – Adhikari, M.R.,Universities Press

# Electromagnetic Theory

Electrostatic field: Dielectric interface, Laplace and Poisson's equations, energy & force. Steady currents: continuity equations, Ohm's law, Joule heating, current flow in materials.

Magnetostatic field: Ampere's circuital law, scalar & vector potentials, Laplace and Poissions equations.

Electromagnetic induction: Maxwell's equations; power flow and Poynting vector. Solutions of field equations in rectangular, cylindrical and spherical coordinate system; Radiation generation; Propagation of electromagnetic waves; various boundary value problems; Principle of electromagnetic radiation & interaction with matter; Scientific and engineering applications of electromagnetic radiation.

**Books:**

1. Electromagnetic Waves & Radiating Systems, 2ed Edition –E. C. Jordan and K.G. Balmain, Pearson Education.
2. Elements of Electromagnetics, 4th Edition – Matthew N O Sadiku Oxford University Press
3. Engineering Electromagnetics, 2ed Edition - Nathan Ida Springer India

**Reference Book:**

1. Electromagnetics, 2ed Edition – J A Edminister Tata-McGraw-Hill
2. Electromagnetic Waves – R K Shevgaonkar Tata-McGraw-Hill
3. Engineering Electromagnetics, 7thEdition-W.H.Hayt & J.A.Buck Tata-Mc Graw-Hill

# Nano Electronics

Concept of quantum wells, inversion layers, quantum wires, superlattices of nonparabolic materials with graded interfaces under magnetic quantization, quantum wire superlattices with different band structures and other field assisted systems; Einstein relation in compound semiconductors and their nanostructures, low dimensional III-V,II-VI,IV-VI semiconductors. magnetic quantization, Bismuth, stressed compounds, nipi structures, cross field configuration, 3D quantized system, transport properties of confined semiconductors, quantum capacitance, carbon nanotubes, nano scale transistor and related tropics.

**Reference Book:**

1 Davis, low dimensional semiconductor-oxford;
1. Fundamentals of Carrier Transport Mark lundstrom,
2. Einstein Relation in Compound Semiconductors and Their Nanostructures Ghatak Kamakhya Prasad, Bhattacharya**,** Sitangshu, De, Debashis, Springer.

# 3rd Year 5th Sem

## Instrumentation Devices-II

Radiation sensors: LDR, photovoltaic cells, photodiodes, photo emissive cells- types, materials, construction, response. Geiger counters, Scintillation detectors

Introduction to Smart sensors.

Piezo-electric transducers and their applications for measurement of force and vibration; charge amplifiers, seismic transducers and accelerometers;

Use of feedback principles in Instrumentation and their applications.

Elements of Electronic, Pneumatic and Hydraulic control systems: Flapper nozzle amplifiers, Servomotors of different types, tachogenerators and stepper motors;

Measurement of process parameters like pH, conductivity, viscosity etc.

Digital Transducers: Shaft encoders; Sources of noise and their reduction, Grounding and shielding techniques.

Signal transmission: 4-20mA current loop;

Serial data communication using RS232 and RS485 based system, distributed measurement system, IEEE488 protocol.

**Books:**

1. Golding E.W. & Wides F.C. : Electrical Measuring Instruments & Measurements ; Wheeler
2. Harris, F. K. – Electrical Measurements, Wiley.
3. E. A. Doebelin, Measurement Systems: Application and Design Mc Graw Hill, New York
4. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta
5. Nagrath I. J. and Gopal M.,"Control Systems Engineering", New Age International (P) Ltd.
6. Gopal: Modern Control System, New Age International

# Linear Control System Engineering

**Introduction to Control systems:** Classification of control system ,Examples of control system ,Physical elements of a control system, effects of feedback.

**Mathematical Model of Physical Systems:** Block diagram algebra, Signal flow graphs, Mason's Gain formula

**State Variable Analysis:** Concepts of state, state variables and state model, State models of linear continuous-time systems, Relating transfer function with state model, Concept on Controllability and Observability, Illustrative examples.

**Control System Components:** Potentiometer, DC & AC servomotors, tacho-generators, Synchro error detectors, Stepper motors, Areas of Application.

**Time Response Analysis:** Introduction, Standard test signals, Performance indices, Time response of first order system, Time response of second order systems, steady state error and their minimization, error coefficients,

**Control Actions:** Proportional (P), Integral (I), Derivative (D) and their combination (PID)

**Stability Analysis in Time Domain:** The concept of stability, Assessment of stability from pole positions, Necessary conditions for stability, Routh Stability Criterion, Relative stability analysis, Illustrative examples.

**Root Locus Technique:** Introduction, The root locus concept, Root locus construction rules, Root contours, Case studies.

**Frequency Response Analysis:** Introduction, Performance indices, Frequency response of second order systems, Polar plots, Bode plots, All pass systems, Minimum-phase and Non-minimum-phase systems, Illustrative examples

**Stability Analysis in Frequency Domain:** Introduction, A brief review of Principle of Argument, Nyquist stability criterion, Assessment of relative stability – Gain Margin and Phase Margin, Closed loop frequency response, Illustrative examples.

**Design & Compensation in frequency domain:** Lag Compensation, Lead Compensation and Lag-Lead Compensation and Actuator design

**Books ;**

1. Kuo B.C. Automatic Control System, PHI
2. Nagrath I J & Gopal M : Control Systems Engineering, New Age International Pub.
3. Ogata K : Modern Control Engg. PHI
4. Dorf R C & Bishop R.H.: Modern Control System ; Addison – Wisley
5. Gopal: Modern Control System Theory, New Age International
6. Gopal: Digital Control Engineering, New Age International

# Electronic Instrumentation and Measurement

Basis Measurement Techniques for Analog and Digital Measurements Units and standards of physical quantities. Documentation standards. Block diagram of Instrumentation schemes – Static and Dynamic.

Accuracy, Precision, Fidelity, speed of response, Linearization of techniques.

Errors in measurement: Classifications of errors, Statistical Analysis, Introduction to Reliability.

Electronic voltmeters – analog and digital. Audio oscillators, signal generators and frequency counter

Digital Multi-meters, Theory of Operational and Constructional Details SHE, A-D-C D-A-C, Multiplexing, Data Acquisition Systems, Actuator, Elements of Transducer, Analog Multiplier, R M S and Average value detectors, Wave and Spectrum Analyzers, Q-meters.

Voltage controlled oscillators, Phase Locked Loop, Measurement of high frequencies RF and VHF

C.R.O. construction & principle measurement of voltage, current, frequency and phase by oscilloscope.

Sampling oscilloscope, DSO.

**Text Books:**

1.Jain—Digital Electronics, 2/e,TMH
2.Malvino & Leach – Digital Principles & Application , 5/e,TMH
3.Helric A.D & Cooper W.D—Modern Electronic Instrumentation & Measuring Instruments, Wheeler Pub.
4.Dhir S.M—Applied Electronics & Instrumentation, TMH
5. Digital design principals and applications (6/e) by D.P.Leach, A.P.Malvino, G.Saha (TMH)
6. Electrical and electronics Measurement: R.K.Rajput ;S.Chand
7. Elements & Electronic Instrumentation and Measurement (3/e) – by J. Carr (Pearson)
8. Digital Instrumentation – by Bowens (TMH)

**Reference Books:**

1. Taub & Schilling – Digital Integrated Electronics,TMH
2. Givone—Digital Principles & Design,TMH
3. Shawney A.K—A course in Electrical & Electronic Measurements, Dhanpat Rai & Sons.

# Computer Organization & operating system

Computer arithmetic, point representations, introduction to CISC processor architecture, instruction set and addressing modes, hardware design principles polling of processors, memory types & interfacing & timing I/O handling, interrupts & DMA & device interfaces. CRT, floppy disk, HDD, optical disk, serial interfaces & data acquisition, operating system concepts & architectural support. Privileged mode, software interrupts memory hierarchy and virtual memory, multiprocessors concept, cache memory, pipelining and introduction, RISC processors, super scalar processors.

**Text Books:**

1.Computer Architecture & Organization , Hayes, 4/e, MH
2.Computer Architecture , B. Parhami, OUP
3. Computer System Architecture, 3/e, Mano, Pearson/PHI

**Reference Books:**

1. Computer Organization & Architecture (TMH WBUT Series), Ghosh & Pal,TMH
2.Computer Organization, Hamacher, 5/e, MH
3.Computer Architecture , N.Carter, Schaum Outline Series, MH
4.Computer Organization, ISRD, MH
5.Digital Logic & Computer Organization, V. Rajaraman & T. Radhakrishnan, PHI
6.Computer Architecture, A.S Tannenbaum, Pearson
7. Computer Architecture & Organization, P.Chakraborty, Jaico
8. Computer Architecture & Organization, Govindrajan, MH
9. Computer Architecture & Organization, Stallings, PHI/Pearson.
10. Computer System Organization & Architecture-Carpinelli-Pearson.
11.Milenkovie M., “Operating System : Concept & Design”, McGraw Hill.

## INDUSTRIAL INSTRUMENTATION

**UNIT – I: Metrology**
Measurement of length – Plainness – Area – Diameter – Roughness – Angle –Comparators – Gauge blocks – Optical Methods of length and distance measurements.

**UNIT – II: Velocity And Acceleration Measurement**
Relative velocity – Translational and Rotational velocity measurement – Revolution counters and Timers - Magnetic and Photoelectric pulse counting stroboscopic methods - Accelerometers of different types - Gyroscopes.

**UNIT – III: Force and Torque Measurement**
Force measurement – Different methods –Torque measurement – Dynamometers-Gyroscopic Force and Torque Measurement – Vibrating wire Force transducer

**UNIT – IV: Pressure Measurement**
Basics of Pressure measurement – Deadweight Gages and Manometers types –Force-Balance and Vibrating Cylinder Transducers – High and Low Pressure measurement – McLeod Gage, Knudsen Gage, Momentum Transfer Gages, Thermal Conductivity Gages, Ionization Gazes, Dual Gage Techniques.

**UNIT – V: Level & Flow Measurement**
Liquid Level measurement by various methods. Head type, Area type (Rota meter), electromagnetic type, Positive displacement type, mass flow meter, ultrasonic type, vertex shedding type, Hotwire anemometer type.. Laser Doppler -meter.

**UNIT – VI: Density Measurement**
Volume Flow meter Plus Density measurement – Strain Gauge load cell method –Buoyancy method - Air pressure balance method – Gamma ray method – Vibrating probe method. Direct Mass Flow meters.

**UNIT – VII: Temperature Measurement**
T/C, Thermister, RTD, Radiation Fundamentals. Radiation Detectors. Radiation Thermometers. Optical Pyrometers.

**UNIT – VIII: Other Measurements**
Sound-Level Meter. Microphones. Time, Frequency, and Phase-Angle measurement. Humidity. Chemical Composition. Particle Instruments and Clean-Room Technology.

**Text Books:**
1.Measurement Systems–Applications and Design–by Doeblin E.O.,4/e,McGraw Hill International, 1990.
2. Principles of Industrial Instrumentation – Patranabis D. TMH. End edition 1997
3. B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co., Philadelphia

**Reference Books:**

1. Process Instruments and Control Handbook–by Considine D.M., 4/e, McGraw Hill International, 1993.
2. Mechanical and Industrial Measurements – by Jain R.K., Khanna Publishers, 1986.
3. Instrument Technology, vol. I – by Jones E.B., Butterworths, 1981.

# Communication Theory

Basic blocks in a communication system: transmitter, channel and receiver; baseband and pass band signals and their representations; concept of modulation and demodulation. Continuous wave (CW) modulation: amplitude modulation (AM) - double sideband (DSB), double sideband suppressed carrier (DSBSC), single sideband suppressed carrier (SSBSC) and vestigial sideband (VSB) modulation; angle modulation - phase modulation (PM) & frequency modulation (FM); narrow and wideband FM. Pulse Modulation: sampling process; pulse amplitude modulation (PAM); pulse width modulation (PWM); pulse position modulation (PPM) ; pulse code modulation (PCM); line coding; differential pulse code modulation; delta modulation; adaptive delta modulation. Noise in CW and pulse modulation systems: Receiver model; signal to noise ratio (SNR); noise figure; noise temperature; noise in DSB-SC, SSB, AM & FM receivers; pre-emphasis and de-emphasis, noise consideration in PAM and PCM systems. Basic digital modulation schemes: Phase shift keying (PSK), amplitude shift keying (ASK), frequency shift keying (FSK) and Quadrature amplitude modulation (QAM); coherent demodulation and detection; probability of error in PSK, ASK, FSK & QAM schemes. Multiplexing schemes: frequency division multiplexing; time division multiplexing

**Text books:**

1. J. G. Proakis and M. Salehi, Communication system engineering, 2/e, Pearson Education Asia, 2002.
2. R. E. Ziemer, W. H. Tranter, Principles of Communications: Systems, Modulation, and Noise, 5/e, John Wiley & Sons, 2001.
3. B. P. Lathi, Modern Analog and Digital Communication systems, 3/e, Oxford University Press, 1998.

**Reference Books:**

1. Simon Haykin, Communication Systems, 4/e, John Wiley & Sons, 2001.
2. K. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley and Sons, 1979.
3. A. B. Carlson, Communication Systems,3/e, McGraw Hill, 1986.
4. H. Taub and D. L. Schilling, Principles of Communication Systems, 2/e, McGraw Hill, 1986.

# 3rd Year 6th Sem

## Process Control – I

The basic process control loop- different blocks in the loop. Process Equations - their limitations, scale modeling, typical processes and their transfer function deviations, Process modeling techniques.

Effect of disturbances and set-point variations in the loop transfer functions, Review of system response with standard inputs, offset, Process Reaction Curves, Controllability using deviation reduction factor, Gain band product and state variable formulation, Stability - review, Self-regulation.

Schemes and analysis of on-off control, Time-proportional control, P,I,D controls, Control action comparison, Pneumatic adjustment, Pneumatic, Electrical/Electronic and Hydraulic controllers, Introduction to programmable logic controllers.

Schemes and analysis of Split-Range control, Ratio control, Cascade control, Feed forward control, Selector control, Anti reset control, Introduction to Multivariable control systems. Control of flow, level, temperature and pressure.

Final control elements, The pneumatic actuator and control valves, Sizing and selection of control valves, Linearization, Positioners, Electrical actuators and their driver circuits, P-I and I-P converters. Safety valves and other associated components.

Introduction to Computer Control of Processes. Elements in a digital control loop, A simple case study. Introduction to digital control algorithm.

Discussions on control of specific plants like boilers, distillation column, paper plant, steel plant, power plant etc. Control of batch processes.

### Books:

1. D. Patranabis, Principles of Process Control, TMH, New Delhi, 2nd Ed.
2. D. P. Eckman, Automatic Process control, John Wiley, New York
3. B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co., Philadelphia
4. P. Harriott, Process control, Mc Graw Hill, New York

# Power Electronics

**Module I**

Power semiconductor devices: Power diodes-types, power transistors, thyristors family, SCRs, Triac, GTOs, power MOSFETs, IGBTs, MCTs-static and dynamic characteristics, protection circuits, series and parallel connections, turn-on characteristics, turn off characteristics

**Module II**

Controlled rectifiers- single phase and three phase converters-power factor improvements-design of converter circuits-AC voltage controllers-single phase and three phase-cyclo converters-single phase and three phase, design of AC voltage controller circuits.

**Module III**

DC choppers – principle of step down and step up operations – step down chopper with RL load, Classes of chopper, MOSFET/IGBT choppers. DC to AC converters: Thyristors inverters, McMurray-McMurray Bedford inverter, current source inverter, voltage control waveform control, inverters using devices other than thyristors, vector control of induction motors.

**Module IV**

DC and AC power supplies: Switched mode, resonant, bi-directional and multistage conversions, buck, boost, buck boost regulators. UPS-block diagram, types. Drive requirements and design of simple drive circuits for power BJT, MOSFET and IGBT. Advanced control of power electronic circuits using microprocessors, microcontrollers, isolation amplifier circuits, synchronisation circuits.

**Text Books**

1. M. H. Rashid, *Power Electronics: Circuits, Devices and Applications*, 3rd ed., Pearson Education, Delhi,2002
2. 2. N. Mohan, T. M. Underland, and W. P. Robbins, *Power Electronics: Converter, Applications and Design*,John Wiley & Sons, New York, 1995.

**Reference Books:**

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

# Biomedical instrumentation

Introduction to the physiology of cardiac, nervous & muscular and respiratory systems. Transducers and Electrodes: Different types of transducers & their selection for biomedical applications. Electrode theory, selection criteria of electrodes & different types of electrodes such as Hydrogen Calomel, Ag- Agcl, pH, etc.

Cardiovascular measurement: The heart & the other cardiovascular systems. Measurement of Blood pressure, Blood flow, Cardiac output and cardiac rate. Electrocardiography, phonocardiography, Ballistocardiography, Plethysmography, Magnet- cardiography. Cardiac pacemaker & computer applications.

Respiratory System Measurement: Respiratory Mechanism, Measurement of gas volumes & flow rate. Carbon dioxide and Oxygen concentration in inhaled air. Respiratory controllers.

Measurement of Electrical Activities in Muscles and Brain: Electroencephalograph, Electromyograph & their interpretation.

Instrumentation for clinical laboratory: Measurement of pH value of Blood, ESR measurements, Haemoglobin measurements, Oxygen & carbon dioxide concentration in Blood. GSR measurements, polarographic measurements. Computer applications.

Medical Imaging: Ultra sound imaging, Radiography & applications.

Biotelemetry: Transmission & reception aspects of Biological signals. Aspects of patient care monitoring.

C T scan, MRI.

**Reference Books:**

1. L. Cromwell, ‘Biomedical Instrumentation and Measurements’, Pearson Education
2. R. S. Khandpur, ‘Handbook of Biomedical Instrumentation’, TMH, New Delhi
3. J. S. Webster, ‘Medical Instrumentation- Application and Design’
4. Rana, ‘Essentials of Ecology and Environmental Science’, PHI
5. P. Saha and A. K. Chakraborty, ‘Environmental Studies’, Allied Publishers
6. Venugopal Rao, ‘Text Book of Environmental Engineering’, PHI

# Microprocessor and Microcontrollers

Introduction: Block diagram of a Computer system, central processing Unit (CPU), memory, input/output (I/O) Ports, address, data and control Buses, Evolution of microprocessors – the Intel and Motorola variants, Microprocessors as the CPU of computer systems.

The 8085 family of microprocessors: Hardware Overview: Internal architecture, Address bus, Data bus and Control bus, Clocking, Reset operation, Status pins, Addressing modes and their features.

Memory Management: The von Neumann architecture, Partitioning of the available memory space into program memory, data memory and memory-mapped devices, Planning for building up a microprocessor board.

Programming the 8085: Introduction to microprocessor programming paradigm, Assemblers, Linkers, Loaders and Cross-compilers. Assembly language Programming - Instruction format, Instruction set. Use of flowcharts to build-up simple programs, Stack and Stack handling, Programming exercises.

Timing Diagrams: Instruction cycle, machine cycle, T-states. Analysis of Memory and I/O read/write cycles. Generic state transition diagram.

Interrupts: Introduction, Interrupt vector table, Interrupt service routine, interrupt timing. Design of programs using interrupts.

Data Transfer Schemes & Interfacing: Serial and parallel data transfer schemes, Polling and interrupt driven data transfer, Direct memory access, Interfacing input-output ports, Programmable peripheral Devices (PPI)- , Programmable interval timer; Interfacing A/D and D/A converters.

**16 bit processors:** 8086 and architecture, segmented memory has cycles, read/write cycle in min/max mode. Reset operation, wait state, Halt state, Hold state, Lock operation, and interrupt processing. Addressing modes and their features. Software instruction set (including specific instructions like string instructions, repeat, segment override, lock prefizers and their use) and Assembly Language programming with the same

Brief overview of some other microprocessors (e.g. 6800 Microprocessor) and microcontroller.

**Reference Books:**

1. Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd, 1989 by Ramesh S. Gaonkar
2. Intel Corp: The 8085 / 8085A. Microprocessor Book – Intel marketing communication, Wiley inter science publications, 1980.
3. An introduction to microcomputers Vol. 2 – some real Microprocessor – Galgotia Book Source, New Delhi by Adam Osborne and J. Kane
4. Advanced Microprocessors by Ray and Bhurchandi - TMH
5. Intel Corp. Micro Controller Handbook – Intel Publications, 1994.
6. Microprocessors and Interfacing by Douglas V. Hall, McGraw Hill International Ed. 1992
7. Assembly Language Programming the IBM PC by Alan R. Miller, Subex Inc, 1987
8. The Intel Microprocessors: 8086/8088, 80186, 80286, 80386 & 80486, Bary B. Brey, Prentice Hall, India 1996.

# Data Communication Networks

Introduction. Data and signals. Transmission media and impairments. Data encoding techniques - Analog and digital encoding of digital data .Frequency and time-division Multiplexing techniques. Flow control. Error detection and error control techniques. Standards for interfacing to media.

Network architecture for data and computer communications. Circuit switching. Packet switching. Frame relay and ATM. Routing in packet-switched networks -fixed, random and adaptive approaches. Congestion and its control.

Local area networks - Common topologies. Medium access control-round-robin, reservation and contention-based strategies. ALOHA protocol and its variants. CSMA and CSMA/CD protocols. Token-ring protocol. IEEE 802 standards for local area networks. High speed LANs - Fast and Gigabit Ethernet, FDDI. Wireless LANs. Internetworking - Repeaters, bridges, routers and gateways. TCP/IP protocol suite. TCP/IP Sockets. Client-Server computing. Name Service. Application protocols over TCP/IP. Network Security.

**Reference Books:**

1. A S Tanenbaum – Computer networks, Prentice Hall of India, 3rd Ed/ Pearson Education
2. W Stallings – Data & Computer Communication, Peasrson Education
3. Forouzan, Data Communication & Networking, (3rd Edition ), TMH
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data Communication & Networking, PHI

# Group Discussion and Seminar

# 4th Year 7th Sem

## Process Control – II

Sampled-data control system: Digital Computer as a controller in process control loop, advantages and disadvantages of sampled-data control systems, discrete time signal, sampling of continuous signal, signal reconstruction, z-transform, difference equation and z-transform, pulse transfer function, analysis of SISO process control loop by z-transform technique, z-and s-domain relationship, stability analysis of discrete systems in z-plane, stability analysis by using Bilinear transformation, Jury's stability test, steady-state error analysis of sampled-data control systems, Digital implementation of PID controller, Digital control algorithms - controller design by transformation from s-domain to z-domain, deadbeat control, Dahlin's technique, Kalman's algorithm.

Distributed Control System: Architecture and loop elements, networks, gateways and connectivity, proprietary software protocol, redundancy, interfacing units, operating stations.

Case study: Enhanced boiler drum level control.

Programmable Logic Controller: Architecture, Programming, Application case study.

Multivariable control system: Loop interaction, Pairing controlled and manipulated variables, Design and tuning of Decouplers, Tuning multivariable control systems.

Adaptive and Self-tuning control: Need for adaptive control, adaptive control by preset compensation, adaptive control by pattern recognition, adaptive control by discrete parameter estimation.

Dead time compensation - Smith predictor and Dahlin controller.

Process Control Systems – case studies:

(1) Control of distillation column.
(2) Control of cement production.

**Text Books:**

1. D. Patranabis, Principles of Process Control, TMH, New Delhi, 2nd Ed.
2. D. P. Eckman, Automatic Process control, John Wiley, New York
3. B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co., Philadelphia
4. P. Harriott, Process control, Mc Graw Hill, New York

**Reference Books:**

1. J. R. Leigh, Applied Digital Control, Prentice Hall International, London
2. C. L. Smith, Digital Computer Process Control, Intex Publishers, Scranton
5. P.B. Deshpande and R. H. Ash, Elements of Computer Process Control, ISA, prentice Hall, Englewood

# Optoelectronic Instrumentation

**Module I**

Fundamentals of optics-light sources-principle of polarization-diffraction and interference. Display devices-lightemitting diode-plasma displays-liquid crystal displays-photo detectors-PIN diodes-avalanche photodiodesoptocouplers-various types-modulation of light-electro-optic, magneto-optic, acoustic-optic modulators,Interferometry-Michelson, Fabry-Perot, Jamin & Mach-Zehnder Interferometers-interference filters-interferometermethods in metrology and testing of optical components-Fiezeau & Tymann-Green interferometers-opticalspectrum analyser

**Module II**

Lasers-Principle of operation-Einstein relations-population inversion-optical feedback.
Laser modes-axial and transverse modes. Classes of lasers-solid state, gas and liquid dye lasers, semiconductor lasers. Properties of lasers-Q switching, mode locking, frequency doubling. Applications of lasers-fabrication processes, velocity measurements, distance measurements

**Module III**

Holography, Construction of holograms, holographic interferometry, applications of holography, distance measurements, information storage, optical methods. Fibre optics-light guidance through fibres, multimode and single mode fibres, step index and graded index fibres,properties of optical fibres, fibre fabrication, fabrication of perform, fibre drawing process

**Module IV**

Measurement of fibre characteristics-attenuation, dispersion and refractive index profile measurements, opticaltime domain reflectometer, fibre optic joining- couplers, splicers and connectors, losses in optical fibres,application of optical fibres, fibre optic sensors-measurement of temperature, liquid level, and fluid flow,microbend sensors, optical fibre communication–recent trends and developments-optical telemetry.

**Text Books:**

1. J. R. Meyer-Arendt, *Introduction to Classical and Modern Optics*, 4th ed., Prentice Hall, N.Y., 1995
2. L. Wilson and J. F. B. Hawkes, *Optoelectronics: An Introduction*, 3rd ed., Prentice Hall of India, New Delhi, 1998

**Reference Books:**

1. K Thyagarajan and A. K. Ghatak, *Lasers: Theory and Applications*, Plenum Publishing Corporation, NewYork, 1981
2. G. Keiser, *Optical Fibre Communications*, 3rd ed., Mc Graw-Hill, New York, 2000.
3. J. Singh, *Optoelectronics: An Introduction to Materials and Devices*, Tata McGraw Hill, New Delhi, 1996

# Digital Signal Processing

Discrete-time Fourier transform: Definition of Fourier transform ( FT), important properties of FT, properties of FT for real-valued sequences, use of FT in signal processing, FT of special sequences, the inverse FT, FT of the product two discrete-time sequences, program to evaluate the FT by computer.

Discrete Fourier Transform: The definition of the Discrete Fourier Transform (DFT), computation of the DFT from the discrete-time sequence, properties of the DFT, circular convolution, performing a linear convolution with the DFT, computations for evaluating the DFT, programming the DFT, increasing the computational speed of the DFT, intuitive explanation for the decimation-in-time FFT algorithm, analytic derivation of the decimation-in-time FFT algorithm, some general observations about the FFT.

Z-transform: Definition of the z-transform, properties of the z-transform, the system function of a digital filter, combining filter sections to form more complex filters, digital filter implementation from the system function, the complex z-plane, the region of convergence in the z-plane, determining the filter coefficients from the singularity locations, geometric evaluation of the z-transform in the z-plane, relationship between the Fourier transform and the z-transform, the z-transform of symmetric sequences, the inverse z-transform.

Digital filter: Definition and anatomy of a digital filter, frequency domain description of signals and systems, typical applications of digital filters, replacing analog filters with digital filters, filter categories: IIR and FIR, recursive and non-recursive.

Digital Filter Structures: The direct form I and II structures, Cascade combination of second-order sections, parallel combination of second-order sections, Linear-phase FIR filter structures, Frequency-sampling structure for the FIR filter.

Effect of word length: Round off error, truncation error, qunatization error, limit cycle.

**Text Books :**

1. Theory and Applications of Digital Signal Processing – Rabiner and Gold, Pearson
2. Digital Signal Processing – Oppenheim and Schafer, Pearson
3. Digital Signal Processing : A Computer Based Approach, Sanjit K. Mitra, TMH

## Engineering Economics and Costing

1.INTRODUCTION TO ECONOMICS

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

2. VALUE ENGINEERING

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

3. CASH FLOW

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

4. REPLACEMENT AND MAINTENANCE ANALYSIS

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

5. DEPRECIATION

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives-introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

**Text Book:**

Panneer Selvam, R, Engineering Economics, Prentice Hall of India Ltd, New Delhi, 2001.

**References:**

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, “Principles of Engineering Economy”, Ronald Press, New York,1976.
5. Smith, G.W., “Engineering Economy”, Lowa State Press, Iowa, 1973.

## Elective(1)

## Project phase-1

# 4th Year 8th Sem

## Industrial Management

Introduction to industrial management, Types of manufacturing Systems, Forecasting, Allocation of resources, Operations economy, Resource Scheduling, Work environment, Maintenance Management, Inventory Management, MRP, quality Control, Theory of Motivation, Management Information system (MIS), Organization and methods, Work Study, Operational research, Productivity, Case Studies.

**Text Books:**

1. Production and operations management: S.N.Chari
2. Industrial Management : Basu & Majmundar ( Birla Pub., Newdelhi)
3. Quantitative techniques in management : N.D.Vohra (Tata Mcgraw Hill)
4. Production systems analysis and control : Riggs
5. Works organization and management : Basu, Sahoo & Dutta.
6. Fuzzy logic with Engineering applications : Timothy J. Ross (Mcgraw Hill)

# Telemetry & Remote Control

**MODULE-I:**
Basic Concept: Telemetry- its purpose and application potential, basic schemes- pneumatic, current, voltage, frequency over short distances. Line length limitations; Wired and wireless types. Codes and Coding: Concepts of information transfer, bits and symbols; coding source, line and channel; biasing. BCD, ASCII, EBCDIC, BAUDOT; AMI, CMI, Manchester (phase), HDBN, Block; Differential, LRC, Hamming, Convolution, M-array

**MODULE-2:**
modulation Codes: PAM, PFM, PTM (PPM,PWM), PCM. Bit error rate, Parity checking, Effect of time delays and noise in bit information; Raised Cosine Spectrum and response; Noise induced bit errors etc.
Review of Modulation and Multiplexing: FM-FM, FM-AM, PAM-AM, PAM-FM, PCM-AM, PCM Sample and hold circuits, Quantization and Conversion methods, Errors in quantization; Bandwidth consideration.

**MODULE-3:**
FDM and TDM Systems: Frequency division multiplexing and demultiplexing Systems, IRIG Standards in FDM telemetry; SCO's and their circuits- Multiplexing and Demultiplexing circuits; Detectors and Demodulators, Pulse Averaging, Quadrature FM and PLL; Mixers. TDM Systems- their circuits, scanning techniques; TDM-PAM, PAM-PM Systems, Synchronization, TDM-PCM System; PCM Generation, Differential PCM Systems, PCM reception and demodulation

**MODULE-4:**
Modems: Digital modulation and shift keying techniques, ASK, OOK, FSK, PSK, DPSK, QPSK, etc, QAM; Modem Protocols, Synchronous protocols. Wave Propagation: Aspects of wave propagation; Space and Surface waves, Propagation in ionosphere, other related topics. Satellite Telemetry: Basics, TT&C Services and subsystems, the Subsystems, The earth station.

**MODULE-5:**
Fiber Optic Telemetry: Optic fiber as a transmission medium; Interconnections; Repeaters; Source and Detectors; Receivers, wavelength division multiplexing. Remote Control: Concept, Examples from practical industrial situations.

**Text Books:**
1. D. Patranabis, Telemetry principles, TMH, New Delhi
2. E. L. Gruenberg, Handbook of Telemetry and Remote control, Mc Graw Hill
3. A. S. Tanenbaum, Computer Networks, Pearson

## Analytical Instrumentation

Gas Analysis: Thermal Conductivity Type, Heat of Reaction Method, for oxygen analyzers – Paramagnetic, Dumbell, Servomax, Thermomagnetic, Zirconia Cell type. Spectroscopic Techniques, IR Radiation Absorption Type, Dual-Channel IR Spectrometry, Single-Channel IR Spectrometry, IR Sources, Comparison of their performances, IR Detectors, Dispersive Spectrometry using Grating/Prism monochromator, FT-IR Spectrometer based on Michelson Interferometer.

Liquid Analysis: Different Electrodes: Ion-selective and Molecular- selective types, their variations and application prospects, Dissolved Oxygen Analysis Cells, pH electrodes, circuits and applicatons, Conductivity Cells, Standards, Effect of frequency variation, circuits, Cells for different applications, Polarography: Determination of concentrations of constituents. Apparatus, Circuits; Pulse polarography, Spectroscopic Techniques: Absorption in Visible and UV-range, monochromators and detectors, Sources and their $\lambda$ - ranges, Colorimetry, Atomic Spetral Methods: Emission and Absorption: Visible, UV and X-rays; sources, principles, detectors, sample preparation etc.

Special Topics: Chromatography, GC, GLC, LC, HPLC, Columns, Detectors; X-ray methods of analysis; Humidity and Moisture; Turbidity meter and Nephelometer; Viscosity and Consistency; Density and Specific Gravity; Introduction to NMR and ESR

**Text Books:**

1. D. A. Skoog, Principles of Instrumental Analysis, Saunders College Publishing, Philadelphia
2. H. H. Willard, L.L. Merrit, J. A, Dean and F. A. Settle, Instrumental methods of Analysis, CBS Publishers, Delhi
3. D. Patranabis, Principles of Industrial Instrumentation, TMH, New Delhi
4. R.S. Khandpur, Handbook of Analytical Instruments, TMH, New Delhi

## Elective 2

## Grand viva

## Project phase-2

# ELECTIVES

## 1. Mobile Communication

Cellular concept. Mobile radio propagation. Co-channel interference. Diversity, Multiple accesses, Cellular Coverage planning, Wireless networking, Wireless systems and standards, fading channels, spreading codes, power control, WAP and other protocols for internet access, Data transmission in GSM and UMTS, TCP in wireless environment, multi-user detection and its performance analysis. Blue-tooth and other wireless networks, system comparison.
Spread spectrum concept, Basics of CDMA, Properties and generation of PN sequences, Applications of CDMA to cellular communication systems. Second and third generation CDMA systems/ standards, Multicarrier CDMA, Synchronization and demodulation Diversity techniques and rake receiver

## 2. Advanced Control System

Modeling of physical systems, Concepts of state, state-space, Controllability and Observability, Sensitivity and error analysis, Nonlinear systems, singular points, phase plane analysis, Lyapunov stability, describing functions, on-off and dual mode systems, Sampled Data Systems, Computer control systems.

## 3. Optimization Techniques

Introduction: Historical development, application to engineering problems, statement of optimization, Classification of optimization, examples of optimization problems

Linear Programming: Graphical method, simplex method, revised simplex method, Big-M method, 2-Phase method, alternate optimal solutions, unbounded LPs, degeneracy and convergence, duality in Linear programming, sensitivity analysis, dual simplex method, Transportation, assignment and other applications

Non-Linear Programming: Unconstrained optimization techniques, direct search methods (Fibonacci Method, golden section, quadrature and cubic interpolation) descent methods, constrained optimization, Direct and indirect methods, optimization with calculm, kuhn-tucker conditions

Dynamic Programming: Multistage decision process, principles of optimality, computational procedures in dynamic programming

# 4. Digital Image Processing

Introduction: Digital image, steps of digital image processing systems, elements of visual perception, connectivity and relations between pixels. Simple operations - arithmetic, logical, geometric operations. Mathematical preliminaries- 2D LTI systems, 2D convolution, correlation, 2D random sequence, 2D spectrum.

Image Transforms: 2D orthogonal and unitary transforms- properties and examples. 2D DFT, FFT, DCT, Hadamard transform, Haar Transform, Slant transform, KL Transform- properties and examples. Image Enhancement: point processing, spatial filtering-in space and frequency, Nonlinear filtering, Color image processing fundamentals.

Image Restoration: Image observation and degradation model, circulant and block circulant matrices and its application in degradation model, Algebraic approach to restoration, Inverse by Wiener filtering,Generalized inverse- SVD and iterative methods, blind deconvolution, imagereconstruction from projections.

Image compression: redundancy and compression models loss less and lossy. Loss less- variable-length, Huffman, Arithmetic coding, bit-plane coding, Loss less predictive coding, lossy Transform (DCT) based coding, JPEG standard, sub band coding.

Image segmentation: Edge detection, line detection, curve detection, Edge linking and boundary extraction, boundary representation, region representation and segmentation, morphology-dilation, erosion, opening and closing.

Image understanding and recognition: Matching by templates, classifiers-models, statistical, neural network based, matching shapes by contour and texture.

Applications: Automatic visual system in part inspection, forensic and security system, entertainment- multimedia, scientific and medical investigation

# 5. Data Structure and Algorithm

Analysis of Programs: Complexity, Big O notation. Arrays. Queues and Stacks: Linear and Circular Queues, Evaluation of Expressions using Stacks. Linked lists: Singly Linked Lists, Polynomial Addition, Doubly Linked Lists and Dynamic Storage Management, Garbage Collection and Compaction, Strings. Trees & Graphs: Binary Tree - Representations and Traversal Techniques, Threaded Binary Trees, Graph Representation and Traversal Techniques, Shortest Paths.

Searching & Sorting Techniques - Linear and Binary search, Hashing, Internal Sorting Techniques - Bubble Sort, Quick Sort, Heap Sort; External Sorting Techniques - Merge Sort.

# 6. Fuzzy Logic and Neural Network

Unit – I: Introduction to Neural Networks
Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Unit- II: Essentials of Artificial Neural Networks
Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

Unit–III: Single Layer Feed Forward Neural Networks
Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model.

Unit- IV: Multilayer Feed forward Neural Networks
Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

Unit V: Associative Memories
Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis.

Unit – VI: Classical & Fuzzy Sets
Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT VII: Fuzzy Logic System Components
Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT VIII: Applications
Neural network applications: Process identification, control, fault diagnosis. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

## 7. Advanced Microprocessors and Microcontrollers

Typical CPU architectures for Embedded systems Microprocessors, Memory interfacing and management, Memory technologies, IO devices,IO techniques, DMA, Interrupt handling, Data transfer techniques and protocols, AD, DA, Watchdog circuit etc. Language issues, Addressing modes, Instruction set support for application programming and operating systems. Assembly level programming environments. Other programmable devices, PAL, PLA, FPGA etc.

Programmable & digital systems modeling, Specification, design, Verification & testing issues. Behavioral modeling, Modeling languages, Design of finite state systems, Concurrent processes, Logic level & timing modeling, Synthesis with device libraries, Techniques for design verification at various design levels. Introduction to software tools, Design issues for PC boards. Layout and routing. Testing of Embedded systems. Embedded systems design case studies.

## 8. VLSI Technology

Issues of digital IC design: general overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging styles, design automation principles; MOSFET fabrication: basic steps of fabrication, CMOS p-well and nwell processes, layout design rules, Bi-CMOS fabrication process; basic electrical properties of MOS and Bi-CMOS circuits: MOS transistor operation in linear and saturated regions, MOS transistor threshold voltage, MOS switch and inverter, Bi-CMOS inverter, latch-up in CMOS inverter, inverter properties (robustness, dynamic performance, regenerative property, inverter delay times, switching power dissipation), MOSFET scaling (constant-voltage and constant-field scaling); logic design with MOSFETs: switch logic (networks derived from canonical form and Shannon expansion theorem, Universal Logic Modules, networks derived from iterative structures), gate restoring) logic, Programmable Logic Array (PLAs), Finite State Machine (FSM) as a PLA, personality matrix of a PLA, PLA folding, pseudo-nmos logic; basic circuit concepts: Sheet resistance and area capacitances of layers, driving large capacitive loads, super-buffers, propagation delay models of cascaded pass transistors, wiring capacitances; dynamic CMOS design: steady-state behavior of dynamic gate circuits, noise considerations in dynamic design, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic, problems in single-phase clocking, two-phase non-overlapping clocking scheme; low-power CMOS logic circuits: low-power design through voltage scaling, estimation and optimization of switching activity, reduction of switched capacitance, adiabatic logic circuits; subsystem design: design of arithmetic building blocks like adders (static, dynamic, Manchester carry-chain, look-ahead, linear and square-root carry-select, carry bypass and pipelined adders) and multipliers (serialparallel, Braun, Baugh-Wooley and systolic array multipliers), barrel and logarithmic shifters, area-time tradeoff, power consumption issues; semiconductor memories: dynamic random access memories (DRAM), static RAM, non-volatile memories, flash memories; bipolar ECL inverter: Features of ECL gate, robustness and noise immunity, logic design in ECL, single-ended and differential ECL; physical design: rief ideas on partitioning, placement, routing and compaction, Kernighan-Lin and Fiduccia-Mattheyses partitioning algorithms, area routing and channel routing algorithms; testability of VLSI: Fault types and models, stuck-at fault models, scanbased techniques, Built-in Self-test (BIST) techniques, Boolean differences, PLA testability; laboratory: Specifying the design of digital circuits including moderately complex computer, traffic light controller, divider, multiplier, Fibonacci sequence generator etc. in Verilog or VHDL language and simulating the same under Model Sim simulator

## 9. Embedded systems

Introduction to issues in embedded system, Design using microcontrollers, Microcontroller architecture, memory interfacing, serial and parallel I/O interfacing, analog interfacing, interrupt synchronization. Embedded software.

## 10. Antenna and wave Propagation Engineering

Retarded potential, radiation from current element and dipole, radiation patterns, impedance, reciprocity. Various types of antennas, interferometers and multi-element arrays, Antenna Measurements. Ground wave propagation, terrain and earth curvature effects.Tropospheric propagation; fading, diffraction and scattering; Ionospheric Propagation-refractive index, critical frequencies, effects of magnetic field.

## 11. Industrial Automation & Control

Brief introduction about industrial processes and their automation; Elements of pneumatic, hydraulic and electrical control systems; Valves and Actuators; Stepper motors; PID controllers and their tuning; Implementation of digital controller; Control strategies for industrial processes; Programmable logic controller; Real-time issues on signal transmission and control; Communication systems for industrial automation; Data acquisition and Supervisory control; Control of discrete manufacturing processes; Intelligent systems for monitoring ,s supervision and control; Case studies of industrial control systems.

## 12. Nonlinear control

Describing function analysis -Fundamentals-common nonlinearities (saturation, dead-zone, on-off non-linearity, backlash, Hysteresis) and their describing functions-Describing function analysis of non-linear systems

Phase plane analysis -phase portraits-Singular points characterization-Analysis of non-linear systems using phase plane technique-Existence of limit cycles

Concept of stability -stability in the sense of Lyapunov-absolute stability-Zero-input and BIBO stability-Second (or direct) method of Lyapunov-stability theory for continuous and discrete time systems-Aizerman's and Kalman's conjecture-Construction of Lyapunov function-Methods of Aizerman-Zubov-variable gradient method-Lure problem-Popov's stability criterion-Kalman-Yakubovich Lemma-Popov's hyper stability theorem.

Non-linear control system design -concept of variable structure controller and sliding control-implementation of switching control laws-cascade designs-partial-state feedback design-feedback passivation of cascades-designs for TORA systems-recursive designs-back stepping-forwarding-interlaced systems

# 13. AI & Soft computing

Introduction: The foundations of AI. Importance of AI and related fields.

Logic: propositional and predicate logic, representation atoms, connectives, literals, CNF, DNF and casual form, interpretation and model, satisfiability, resolution principle and unification.

Reasoning under Uncertainty: basic probability notation, probabilistic reasoning, Bayesian networks, certainty factor methods, basics of fuzzy logic.

Rules: working memory, rule base, conflict set, conflict resolution strategies, backward and foreword chaining, meta rules.

Structure Representation: semantic networks, frames, conceptual dependency, scripts, inheritance, default values.

General issues in knowledge representation and interference: logical agents, reasoning and resolution, adequacy, richness, granularity, ease of representation and use, modeling uncertainty, the fame problem, declarative and procedural representation.

Problem solving by Searching: State space repetition, heuristics, heuristic evolution function, and problem reduction. Searching for solutions. Informed and uninformed search strategies.

Search Methods: generate and test, hill climbing, means-ends analysis, depth-first, breath-first, best first, exploiting domain constraints, dependency-directed back tracking, minimax, alpha- beta pruning, iterative deepening.

# 14. Fuzzy set and fuzzy logic

Unit-I

Fundamental Concepts Introduction and history, human brain, biological neuron, models of neuron, network architecture, knowledge representation. Error correction learning, Hebbian learning, competitive learning, Boltzmann learning, learning with and without teacher. Artificial neurons. Neural networks and architectures Introduction, neuron signal function, mathematical preliminaries, Feed forward & feedback architecture.

Unit-II

Geometry of Binary threshold neurons and their networks Pattern recognition, convex sets and convex hulls, space of Boolean functions, binary neurons for pattern classification, non linear separable problems, capacity of TLN, XOR solution. Perceptions and LMS Learning objective of TLN, pattern space & weight space, perception learning algorithm, perception convergence theorem, pocket algorithm, $\alpha$ - LMS learning, MSE error surface, steepest descent search, $\mu$ - LMS and application.

Unit-III

Back propagation algorithm Multilayered architecture, back propagation learning algorithm, practical considerations, structure growing algorithms, applications of FFNN. Statistical Pattern Recognition Bayes' theorem, classical decisions with bayes' theorem, probabilistic interpretation of neuron function, interpreting neuron signals as probabilities, multilayered networks & posterior probabilities, error functions for classification problems.

Unit-IV

Self-Organizing Feature MAP Introduction, Maximal eigenvector filtering, principal component analysis, generalized learning laws, competitive learning, vector quantization, maxican hat networks, SOFM, applications of SOFM. Other Networks Generalized RBF networks. Stochastic Machines: simulated annealing, Boltzmann machine, ART.

Unit-V

Fuzzy Logic Introduction, classical & Fuzzy sets, classical & fuzzy relations, membership function, geometry & operations of fuzzy sets, fuzzy rules, rule composition & defuzzification, fuzzy engineering applications, Neural network & fuzzy logic. Fuzzy Neural Control

## 15. Artificial intelligence and Robotics

Introduction: The foundations of AI. Importance of AI and related fields.

Logic: propositional and predicate logic, representation atoms, connectives, literals, CNF, DNF and casual form, interpretation and model, satisfiability, resolution principle and unification.

Reasoning under Uncertainty: basic probability notation, probabilistic reasoning, Bayesian networks, certainty factor methods, basics of fuzzy logic.

Rules: working memory, rule base, conflict set, conflict resolution strategies, backward and forward chaining, meta rules.

Structure Representation: semantic networks, frames, conceptual dependency, scripts, inheritance, default values.

General issues in knowledge representation and interference: logical agents, reasoning and resolution, adequacy, richness, granularity, ease of representation and use, modeling uncertainty, the fame problem, declarative and procedural representation.

Problem solving by Searching: State space repetition, heuristics, heuristic evolution function, and problem reduction. Searching for solutions. Informed and uninformed search strategies.

Search Methods: generate and test, hill climbing, means-ends analysis, depth-first, breath-first, best first, exploiting domain constraints, dependency-directed back tracking, minimax, alpha- beta pruning, iterative deepening.

## 16. Advance Mathematics

Fourier seriers: Periodic functions -Fourier series of functions with periods 2 and 21 half range - Fourier cosine and sine series - odd and even functions. Partial differential equations of first order: Formation Lagrange's methods for linear equations, standard types of non linear equations -Charpits methods- Fourier series solutions of one dimensional wave.

Special functions: Beta and Gamma functions - relation between beta and Gamma functions standard properties and problems.

Complex variables: Complex functions - limits, continuity and derivatives of functions - analytical item and equations of Cartesian and polar forms.

Calculus of variables: Variation of fundamental of a single variable with fixed boundary, Euler's equation, application to isoperimetric and minimal surface problems .Variations of functional dependent on higher derivatives. Simple problems. Finite differences: Differences table interpolation. Newton's forward and backward formale, sterling, Bassel, Evert and Langrange's Formulae. Newton- Rosphon methods of solution of equations. Iterative methods. Computation of Eigen value of a square matrix by power method and Jacobi's method.

Numerical solutions of differential equations: Numerical differentiation, Numerical integration, Simson's rule, Euler's and modified Euler's method. Taylor's, Runga Kutta's and Midne's method.

## 17. Computational Electrodynamics

Maxwell field as a classical 4-vector field ; Covariant formulation of the Hamiltonian principle ; Action integral ; Euler-Lagrange equations ; Electromagnetic field tensor ; Homogeneous Maxwell equations ; Lorentz invariants of the Maxwell field ; Wigner rotation and Thomas precession .

Lagrangian formulation of the free Maxwell field ; Stress-energy-momentum tensor ; Field angular momentum tensor ; Field theoretic conserved covariants ; Maxwell field interacting with its sources ; Inhomogeneous Maxwell equation ; Gauge invariance of he Maxwell field ; Proca field and its Lagrangian density ; 4-dimensional Green's function of the wave equation for the 4-potential in the Lorentz gauge.

Radiation from accelerated charges in the comoving frame ; Larmor formula ; Polar plots and polarization charts ; Radiation from relativistic charges ; Linear accelerator and synchrotron radiation ; Maser formulae for the radiation from bounded charge-current distributions ; Time-harmonic and pulsed sources ; Multipole expansion of the electromagnetic fields ; Cherenkov radiation ; Transition radiation ; Ration reaction and selected topics from the electrodynamics of continuous media.

## 18. Operational research

Introduction to operation research : the origin, development, nature definition,History, scope and phase of operation, research, problem formulation, model Construction, deriving solution from model.

Linear programming : introduction general linear programming problem, mathematical formulation, graphical method for solution of L.P.P. , simplex method, slack surplus and artificial variable degeneracy ,duality in L.P.P., two method sensitivity analysis.

Assignment problems: introduction, mathematical statement, the Hungarian method, maximization problems, unbalanced problem, traveling sales problems. Project management: introduction, history, advantage and development, network construction, numbering the event, difference between C.P.M & P.E.R.T., P.E.R.T analysis updating analysis of resources.

Inventory management: introduction, cost event holding, const re-order cost inventory mode is deterministic, and probabilistic I to IV.

## 19. Advance Solid State Devices

Crystal Structures Translational symmetry Identifying lattice and basis, Primitive and non-primitive unit cells, Symmetry. Some common structures

Diffraction and the Reciprocal Lattice Theory of X-ray and neutron diffraction, Reciprocal lattice and its properties, Lattice planes and indices, Structure factor. Experimental arrangements

Lattice Dynamics One dimensional chain of atoms, dispersion relation, Dispersion relation in structures with more than one kind of atom or bond, Phonons and their interaction with other particles, Two and three dimensions, Neutron inelastic scattering, Revision of specific heat

Electrons in metals Revision of free electron gas. Specific heat. Transport properties. Wiedemann-Franz law. Hall effect. Wave-function in a periodic potential. Nearly Free Electron model. Two and three dimensional metals. Effective mass. Collisions. Classification of solids into insulators, semiconductors and metals. Overlapping bands. Fermi surfaces. The semi-classical model.

Semiconductors Revision of intrinsic semiconductors. Indirect gap semiconductors. Effect of impurities. Temperature dependence of carrier concentration in intrinsic and extrinsic regions. Mobility, conductivity and Hall effect.

## 20. Laser and Nonlinear Optics

Rigorous diffraction theory, Diffraction of a Gaussian beam Fresnel and Fraunhofer diffraction, Application to different apertures. Fourier optics Fourier transforming property of a thin lens, Spatial frequency filtering and its applications.

Coherence theory, Partial coherence, Holography, Construction and reconstruction of hologram, Lasers Two-level and three-level lasers.

Electromagnetic theory of optical fibres and wave guides, Scalar wave equation, Modes of a fibre and planar wave guides Periodic media, Bragg diffraction and Bragg devices

Nonlinear optics, Second harmonic generation, Optical phase conjugation, Optical bi-stability, Solutions Self and cross phase modulations; Optical Bloch equation

Electro-optic effects in different crystals, Acousto-optic effects, Raman-Nath diffraction and Acousto-optic devices.

# 21. Advanced Optoelectronics and Photonics

Introduction to Optoelectronics and Photonics.

Geometrical Optics: Ray Tracing - Snell's Law, Reflection, and Refraction ,Simple Optical Components - Lenses, Mirrors, and the eyes, Optical Confinement in Fibers, Graded-Index Optics - Fermat's Principle, Graded Index Fibers, Dispersion

Electromagnetic Optics - Wave Nature of Light, Light waves in a homogeneous medium, Refractive Index ,Group velocity and group index, Magnetic field, irradiance, and Pointing vector, Snell's Law and TIR, Fresnel Equations.

Resonator Optics –Multiple interference and optical resonators, Resonator Modes ,Finesse, spectral width, loss, and photon lifetime, The resonator as a spectrum analyzer More on EM Optics, Goos-Hanchen shift and optical tunneling, Temporal and spatial coherence, Diffraction principles

Dielectric Waveguides and Optical Fibers: Slab Waveguide, Modes, V-Number, Modal, Material, and Waveguide Dispersions, Numerical Aperture, Coupling Loss, Step-Index Fiber, Multimode and Single Mode Fibers.

Bit-Rate, dispersion and optical bandwidth: Graded-index fibers, Absorption and Scattering, Fiber Manufacture

Photons and Atoms: The photon, Atoms, Molecules, and solids, Interaction of Photons with atoms

Semiconductor Science and Light Emitting Diodes: Semiconductor concepts and energy bands, Direct and indirect band gap semiconductors p-n junction principles, The pn junction band diagram

Semiconductor Light Sources: Light-emission processes in semiconductors, Light-emitting diodes (LEDs) Stimulated Emission Devices Lasers Stimulated emission and light amplification, Einstein coefficients, Optical fiber amplifiers, Gas laser and He-Ne Laser, The output spectrum of a gas laser
Lasers, Laser oscillation conditions, Semiconductor lasers, (laser diodes), Rate equation, Light emitters for optical fiber communications, Semiconductor Detectors – Photo detectors, Principle of the pn junction photodiode, Absorption coefficient and photodiode materials, Properties of semiconductor detectors
The pin photodiodes, Avalanche photodiodes, Optical Fiber Communication, Multiplexing and coupling, System design and performance, optical Networks, WDM

**Text books:**

1. S. O. Kasap, "Optoelectronics and Photonics Principles and Practices", Prentice Hall, 2001.

**Reference Books:**

1. Optoelectronics, Pollock
2. Optical Electronics in Modern Communications, 6th Edition, Ammon Yariv & Pochi Yeh
3. B.E.A. Saleh and M. C. Teich, "Fundamentals of Photonics"
4. Joseph C. Palais, "Fiber Optic Communications"
5. John Silson and John Hawkes, "Optoelectronics"
6. E. Hecht, "Optics"

# 22. Elements of computer Graphics

Introduction to Computer Graphics: Overview, Presentation, Various types of display and plotters. Active and Passive Graphics Devices .Computer Graphics Software.

Two dimensional and Three dimensional Transformation: Transformation of lines and planes. Rotation, reflection and scaling, projection.

Plane curves: Parameter and non-parametric curves, parametric representation of circle, ellipse, parabola, hyperbola.

Space Curve: spline curves of different degrees Bezier Curve. B -spline and rational B-spline curves.

Surface description and generation: surface of revolution, sweep surfaces, quadratic surfaces. Piece wise surface representation, mapping parametric surfaces, bilinear surfaces, linear coons surfaces. B-Spline and Bezier Surfaces.

Solid Modeling: Representation, primitive instancing, sweep generation, boundary representation.

Visible Surface determination: Techniques and algorithm, Z-buffer, list Priority, scan-line, area subdivision algorithm. Algorithm for octrees and curves surfaces, visible surface ray tracing.

Animation: conventional and computer assisted animation, Animation Language, methods for controlling animation, Basic Rules for animation.

**References Books:**

1. Computer Graphics Principle and Practice – Foley,Dam,Feiner,Highun.