# M.Sc. ELECTRONICS & INSTRUMENTATION TECHNOLOGY

RULES & REGULATIONS AND SYLLABUS

(To come into effect from the academic year 2015-16)

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# RULES AND REGULATIONS

## 1. ELIGIBILITY CRITERIA:

The eligibility criteria for admission into M.Sc Electronics & Instrumentation Technology as follows,

1. Candidates should have passed B.Sc., Examination with at least second class with Mathematics, Physics and any one of the following subjects.
   1. Electronics
   2. Instrumentation
   3. Computer Science
2. Post-Graduate Diploma Holders in Instrumentation of Nagarjuna.University or any University recognized as equivalent thereto by the Nagarjuna University.

## 2. DURATION

Two years (Four semesters Course).

Note: This is Industrial oriented TWENTY-FOUR months professional course. There will not be any vacation over this period.

## 3. TOTAL NO. OF SEATS.

| | | |
|---|---|---|
| Regular Seats | : | 12 |
| Sponsored Seats | : | 4 |
| Total Seats | : | 16 |

**Sponsored Seats:**

FOUR of the allocated for the candidates sponsored from the USIC's/RIC's/Central & State Government R&D Organizations / Central &State Government industries/Universities, who satisfy the minimum eligibility criteria specified and who should have put in a minimum service of 3 years after the qualifying examination. This may be notified in the Advertisement for admission and also in the Prospectus.

## 4. SELECTION CRITERIA

Selection of the candidates shall be done as per the admission rules laid by the University.

Additional Weightage marks will be given to the Post- Graduate Diploma holders in Instrumentation on their securing a class in this examination.

| | |
|---|---|
| I class | : 8 marks |
| II class | : 6 marks |

## 5. FEE STRUCTURE

The candidate has to pay the following fee in addition to the regular Fees prescribed by the University

| | |
|---|---|
| Fee for Regular Candidates | Rs.**20, 000** per academic year. |
| For Sponsored Candidates | Rs.**30, 000** per academic year. |

**If sponsored seats are not filled, they may be filled with regular candidates.**

The expenses for Project Work and Industrial Tour have to be met by the student.
Other admission fee and scholarships are as per the existing rules in vogue.

# COURSE STRUCTURE

| PAPER | SCHEME OF EXAMINATION Sem. Exams | I.A. | Credits | Total Marks |
|---|---|---|---|---|
| **I SEMESTER** | | | | |
| E&IT-101: Instrumentation Technology | 70 | 30 | 4 | 100 |
| E&IT-102: Advanced Analog and Digital Electronics | 70 | 30 | 4 | 100 |
| E&IT-103: Sensors and Transducers | 70 | 30 | 4 | 100 |
| E&IT-104: Computer Programming in C | 70 | 30 | 4 | 100 |
| Lab 1: Analog and Digital Electronics | 70 | 30 | 4 | 100 |
| Lab 2: Computer Programming in C | 70 | 30 | 4 | 100 |
| Total | | | 24 | 600 |
| **II SEMESTER** | | | | |
| E&IT-201: Electrical and Electronic instrumentation | 70 | 30 | 4 | 100 |
| E&IT-202: Control Systems and Automation | 70 | 30 | 4 | 100 |
| E&IT-203: Microcontrollers and Applications | 70 | 30 | 4 | 100 |
| E&IT-204: Digital Signal Processing | 70 | 30 | 4 | 100 |
| E&IT-205: Principles of Instrumentation( Non-Core-I) | 70 | 30 | 3 | 100 |
| Lab 3: Transducer & Instrumentation Laboratory | 70 | 30 | 4 | 100 |
| Lab 4: Microcontroller Laboratory | 70 | 30 | 4 | 100 |
| Total | | | 27 | 700 |
| **III SEMESTER** | | | | |
| E&IT-301: Analytical Instrumentation | 70 | 30 | 4 | 100 |
| E&IT-302: Embedded System | 70 | 30 | 4 | 100 |
| E&IT-303: Bio-Medical Instrumentation | 70 | 30 | 4 | 100 |
| E&IT-304: Industrial and Process Control Instrumentation | 70 | 30 | 4 | 100 |
| E&IT-305: Principles of Biomedical Systems (Non-Core-II) | 70 | 30 | 3 | 100 |
| Lab 5: Embedded Systems Laboratory | 70 | 30 | 4 | 100 |
| Lab 6: Advanced Instrumentation Laboratory | 70 | 30 | 4 | 100 |
| Total | | | 27 | 700 |
| **IV SEMESTER** | | | | |
| E&IT-401: PC Based Instrumentation with Labview | 70 | 30 | 4 | 100 |
| E&IT-402: VLSI Design | 70 | 30 | 4 | 100 |
| Lab 7: Virtual Instrumentation Laboratory | 70 | 30 | 4 | 100 |
| Project Work***** | 210 | 90 | 10 | 300 |
| Total | | | 22 | 600 |
| **Grand Total** | | | 100 | **2600** |

**Project Work**

*Maximum Marks-300: Evaluation of project work, seminar and Viva.*

**Project Work for a minimum of <u>Three Months</u> In - Industry / R&D Organization like Advanced Institute of Electronics & Process Control, ET&DC, ECIL, DRDL, DLRL, LRDE (Bangalore) etc., or any University Including Nagarjuna University.**

# 7. EXAMINATIONS

The Theory examination will be of **two** parts Viz**., i)** ***internal evaluation*** **for 30 marks and ii)** ***external evaluation*** **for 70 marks** in each theory paper where as in practicals the evaluation of each laboratory is 20 marks for record, 30 marks for Viva-Voce examination and 50 marks for doing of practical.

The semester end, practical evaluation will be done by an external examiner and one internal examiner.

**Internal evaluation**: Internal evaluation consists of **30** marks in each theory paper.
Two tests will be conducted for internal evaluation and best of the two is taken as internal assessment marks.
If the candidate fails to attend both the internal assessment examinations, candidate will not be allowed to attend the semester end examination in that particular paper.

**External evaluation:**

**Theory:** The examination in each theory paper is of three hours duration for **70** marks. Each paper consists of **5 questions** of each 14 marks. The candidate has to answer only five questions. The fifth question consists of four short answer questions covering the total syllabus and the candidate has to answer any two.
**5 Questions X 14 marks = 70 marks.**

**Practical:** The duration of each practical examination is of 4 hours duration of maximum marks 100. The evaluation of each laboratory examination is splitted into three categories.
Laboratory record is evaluated for 20 marks,
Viva-Voce examination for 30 marks,
Doing practical is for 50 marks,
Total 100 marks.

# 8. SCHEME OF EXAMINATION

***I Semester***

**Theory**

| | |
|---|---|
| Theory Papers | 4 X 100(70+30) Marks = 400 Marks |

**Laboratory**

| | |
|---|---|
| Practicals including Record | 2 X 100 Marks = 200 Marks |
| | Total 600 Marks |

***II Semester***

**Theory**

| | |
|---|---|
| Theory Papers | 4 X 100(70+30) Marks = 400 Marks |

**Laboratory**

| | |
|---|---|
| Practicals including Record | 2 X 100 Marks = 200Marks |
| | Total 600 Marks |

***III Semester***

**Theory**

| | |
|---|---|
| Theory Papers | 4 X 100(70+30) Marks = 400 Marks |

**Laboratory**

| | |
|---|---|
| Practicals including Record | 2 X 100 Marks = 200Marks |
| | Total 600 Marks |

***IV Semester***

**Theory**

| | | |
|---|---|---|
| Theory Papers | 2 X 100(70+30) Marks | = 200 Marks |

**Laboratory**

| | | |
|---|---|---|
| Practicals including Record | 1 X 100 Marks | = 300Marks |

**Project Work**

| | | |
|---|---|---|
| Dissertation Evaluation, Seminar presentation and Viva - Voce Examination | | 300 Marks |
| | Total | 600 Marks |

TOTAL MARKS IN FOUR SEMESTERS **2400** Marks.

## 9. DECLARATION OF RESULTS

A candidate is declared to have passed the Examination if he secures the minimum aggregate marks of

(a) 50% in Theory
(b) 50% in Practical
(c) 50% in Project

If any candidate fails to secure the minimum marks of 40% in any of the subjects, he/she is declared failed in that subject and such candidate is required to take the examination once again in that part only and should secure a minimum of 50% for a pass in individual subject. No class will be awarded to a student if he passes subjects compartmentally, even if his over all aggregate marks are higher.

If any candidate fails to secure the Minimum Aggregate Marks of 50% in any Semester he/she is declared failed in that Semester and such a candidate is required to take the examination once again in the concerned Semester only.

The standing committee is requested to recommend for the constitution of a separate Board of Studies for M.Sc. ELECTRINICS & INSTRUMENTATION TECHNOLOGY out of the list of Experts List in the field of ELECTRINICS & INSTRUMENTATION TECHNOLOGY Submitted herewith.

## 10. REGULATION FOR PASSING AND RANKING

A Candidate is declared to have passed the examination if he secures not less than 40% in each paper and 50% on the aggregate.

A Candidate is placed in First Class if he secures 60% or more and less than 70%.
A Candidate is placed in second Class if he secures 50% or more and less than 60%.
A Candidate passes a paper if he secures not less than 50%
A candidate FAILS if he gets the aggregate less than 50%

All the other rules applicable for other P.G.course are applicable to this course.

# 11. SYLLABUS

## E&IT- 101: INSTRUMENTATION TECHNOLOGY

Total Hours: 48

UNIT I: INSTRUMENTS AND THEIR CLASSIFICATION 12 Hrs

Typical Applications of Instrument systems. Functional elements of Instrumentation and measuring systems. Standards and Calibrations. Introduction to errors and uncertainties in the measurement of performance parameters of instruments. Propagation of uncertainties in compound quantities. Order of instruments: Zero, First, Second and Nth order instruments.
Null & Deflection, Manual & Automatic, Self generating& Power operated, Proximity& Non-proximity types, Analogue & Digital types.

UNIT II: INSTRUMENTS PERFORMANCE CHARACTERISTICS 12 Hrs

Static : Static performance parameters (characteristics) Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Dead band, Backlash, Drift, Span. Impedance loading and Matching. Specifications of an instrument. Selection of an instrument.
Dynamic: Introduction, Formulation of system equations, Dynamic Response of first order and second order instrument to periodic-Harmonic, Non-Harmonic, Transient and Random input signals, compensations.

UNIT III: DATA PRESENTATION ELEMENTS 12 Hrs

Digital display modules: LED, 7-seg displays, LCD, Dot matrix and graphical display modules. Recorders -Basic recoding systems. Strip chart recorder. Galvanometer and Potentiometer type recorder. X-Y recorder (direct and null type). Servo recorder. Thermal type recorder. Data logger.

UNIT IV: DATA ANALYSIS AND BASIC STATISTICAL CONCEPTS 12 Hrs

Interpolation and approximation: Lagrange and Newton interpolations. Numerical differentiation and integration: Extrapolation methods, Trapezoidal Rule, Simpson's 1/3 and 3/8 rule. Numerical Solution of ordinary differential equations. Euler's method, Range-Kutta method. Functional approximation: Least Square Approximation, least square curve fitting procedure, fitting a straight line, non-linear curve fitting. Solution of linear systems: Direct method, Gauss-elimination method, matrix inversion method, Jacob's method, Gauss-Seidal method.

BOOKS FOR STUDY:

1. Instrumentation measurement & analysis-Nakra/Choudhary(Unit I, II, III)
2. A Course in Mechanical Measurements & Instrumentation – A. K. Sawhney (Unit I, II, III).
3. Introductory Methods of Numerical Analysis – S. S. Sastry (Unit IV)

BOOKS FOR REFERENCE:

1. Instrumentation devices & systems-Rangan, Mani, Sharma(Unit I,II,III)
2. Measurement of systems—Application and design—Earnest O. Doeblin
3. Electronic Instrumentation and Measurement Technique—William David Cooper & Albert D Helfrick.
4. Transducers – Neubert.
5. Mechanical Measurements – Beckwith, Marangoni, Lienhard.
6. Numerical Methods for Scientists and Engineers, S. R. Iyangar & M. K. Jain, PHI, 1999.
7. A Textbook of Computer Oriented Numerical Methods & Linear Programming, G. K. Ranganath, B. Suryanarayana, Chand Publications.

## E&IT-102: ADVANCED ANALOG AND DIGITAL ELECTRONICS

Total Hours: 48

### UNIT I: POWER SUPPLIES AND REGULATION 12 Hrs

Rectifiers - Half wave, Full wave, Bridge. Voltage multipliers. Filters - RC, LC, ΠΠ-sections. DC voltage regulation - Zener and Electronic regulation. LM723 regulator and 3-terminal regulators. Switch Mode Regulated Power Supplies (SMPS). AC voltage regulation: Step voltage regulation and servo voltage regulation. Principles of Invertors-Low tension DC to High tension AC or DC using electronic choppers.

### UNIT II: ANALYSIS OF OPERATIONAL AMPLIFIERS 12 Hrs

Concept of an amplifier, classification, Amplifier parameters, CE and RC coupled amplifier - frequency response. Feedback in amplifiers – Effect of negative feedback on amplifier performance.

Introduction to Operational Amplifiers. Characteristics of an Ideal and Practical operational amplifier. Circuit details of typical operational amplifier equivalent circuits. Operational amplifier configurations - Inverting and Non-Inverting, Current and Voltage followers, Differential amplifier and Comparator.

Introduction to special purpose amplifiers.

### UNIT III: OP-AMP APPLICATIONS 12 Hrs

Summing, scaling and averaging amplifiers. Integrator, Differentiator, Schmitt trigger, sample and hold, Logarithmic and Anti-logarithmic amplifier, Differential amplifier, Instrumentation amplifier, Voltage to current and Current to voltage converters, Precision rectifiers, Peak detectors - analog multiplexers, Active Filters –LPF, HPF, BPF, Higher order and their comparision. Waveform generators - Barkhausen criterion for oscillators - RC Oscillators, LC Oscillators - Multivibrators.

Timer ICs and applications: Internal block diagram of 555 IC timer, Astable and Monostable multivibrators using Timer IC – 555 IC.

### UNIT IV: DIGITAL PRINCIPLES 12 Hrs

Number system: Binary, Decimal and Hexa-decimal number' system. Conversions to each other. Binary coded decimal (BCD - 8421) and gray code, conversion between Binary and gray code. The ASCII code (American Standard Code for information. interchange) . Logic Gates TTL and CMOS logic & characteristics - Arithmetic and Logic circuits, Sequential Logic, Flip-Flops, Registers, Counters. 74193 counter - Interfacing devices- buffers, decoders, BCD-to-7 segment decoder/driver, encoders, latches, Multiplexers, Demultiplexers, Magnitude comparator and tri-state buffers. Data converters ADC and DAC.

BOOKS FOR STUDY:

1. Electronic Devices and Circuit Theory Nishalisky and Robert Boylestad.
2. Operational Amplifiers-Ramakant Gayakwad..
3. Digital Principles –Malvino & Leach (Unit IV)

BOOKS FOR REFERENCE:

1. Operational Amplifiers and Characteristic- Robert G Irvine
2. An introduction to operational Amplifiers and their Applications – S.V.Subrahmanyam, Y.Narasimha Murthy - Macmillan.

## E&IT-103: SENSORS AND TRANSDUCERS

Total Hours: 48

UNIT I: FUNDEMENTAL OF SENSORS AND TRANSDUCERS 12 Hrs

Introduction and Classifications of Sensors and Transducers - - Physical Principles of Sensing - Electric Charges, Fields, and Potentials - Capacitance - Magnetism - Induction - Resistance - Piezoelectric Effect - Pyroelectric Effect - Hall Effect -Seebeck and Peltier Effects -Sound Waves - Temperature and Thermal Properties of Materials -Heat Transfer -Light

UNIT II : DISPLACEMENT, PRESSURE AND FLOW SENSORS

Position, Displacement, and Level, Force, Strain, and Tactile Sensors, Pressure Sensors, Flow Sensors

UNIT III: TEMPERATURE, CHEMICAL AND FILM SENSORS

Temperature Sensors, Chemical Sensors, Thin and Thick Film sensors And Their Processing Methods, Light Detectors

UNIT IV: ADVANCED SENSORS

MEMS: Introduction – Sensor Materials and Surface processing techniques - R&D on MEMS - Current and Future Technology - The NANO/MEMS Program. Applications: Energy Management, Medical Industry. Automotive Applications of Microelectromechanical Systems (MEMS)

BOOKS FOR STUDY:

1. Handbook of Modern Sensors - Physics, Designs and Applications (3rd Edition) Search Within, Jacob © 2004 Springer – Verlag. (Units – I,II,III)

2. Sensors Handbook - Sabrie Soloman, McGraw-Hill (Second ed.,)(Unit-IV)

BOOKS FOR REFERENCE:

1. Instrumentation measurement analysis - Nakra and Choudary (Unit I)
2. Industrial Control Electronics – Michel Jacob
3. Measurement of systems—Application and design — Earnest O Doeblin
4. Hand Book of Biomedical Instrumentation –R S Khandpur (TMH)

## E&IT-104 : COMPUTER PROGRAMMING IN C

Total Hours: 48

UNIT I: INTRODUCTION TO COMPUTERS AND BASICS OF C LANGUAGE 12 Hrs

Basic principle and working of computers. Need for programming languages. Machine and user oriented languages. Assemblers and compilers. Elements of computer programming. Algorithm, Flow chart, Syntax and Semantic errors. Introduction to operating systems - Windows and Linux. **Overview of C** : Basic Structure of C Programs , Executing a 'C' Program, **Constants, Variables, and Data Types :** Constants, Variables, Data Types, Declaration of Variables, Declaration of Storage Class, Assigning Values to Variables.

UNIT II: DATA I/O, EXPRESSIONS, BRANCHING 12 Hrs

Input and Output Operations : Reading a Character, Writing a Character, Formatted Input, Formatted Output. Operators and Expressions : Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators, Special Operators, Arithmetic Expressions, Evaluation of Expressions, Precedence of Arithmetic Operators, Some Computational Problems, Type Conversions in Expressions, Operator Precedence and Associativity, Mathematical Functions. Decision Making and Branching : Decision Making with if Statement, Simple if Statement, The if.....else Statement, Nesting of if....else Statements, The Else if Ladder, The Switch Statement, The ? : Operator, The Goto Statement. Decision Making and Looping; The While Statement, The do Statement, The for Statement, Jumps in Loops.

UNIT III: ARRYAS, FUNCTIONS AND STRUCTURES 12 Hrs

**Arrays :** One-dimensional Arrays, Declaration of One-dimensional Arrays, Initialization of One-dimensional Arrays, Two-dimensional Arrays, Initializing Two-dimensional Arrays, Multi-dimensional Arrays: **Functions :** Elements of User-defined Functions, Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions, Passing Arrays to Functions, The Scope, Visibility and Lifetime of Variables. **Structures and Unions :** Defining a Structure, Declaring Structure Variables, Accessing Structure Members, Structure Initialization, Copying and Comparing Structure Variables.

UNIT IV: POINTERS, FILE MANAGEMENT AND APPLICATIONS OF C 12 Hrs

Pointers : Understanding , Accessing the Address of a Variable , Declaring Pointer Variables, Initialization of Pointer Variables, Accessing a Variable through its Pointer, Chain of Pointers, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, Pointers and Character Strings, Array of Pointers, Pointers as Function Arguments, Functions Returning Pointers, Pointers to Functions, Pointers and Structures. File Management in C: Defining and Opening a File, Closing a File, Input/Output Operations on Files, Error Handling During I/O Operations, Random Access to Files. Accessing hardware of computer, I/O applications through printer port. C programming for the solutions of problems using numerical methods.

BOOKS FOR STUDY:

1. Programming in ANSI 'C' – E. Balagurusamy (Unit I, II, III & IV)
2. Let us 'C' – Yeshwanth Kanetkar (Unit I, II, III & IV)
3. Numerical Methods in C – J.G.Kori (Laxmi Publication Pvt.Ltd., New Delhi) (for Laboratory purpose)

BOOKS FOR REFERENCE:

1. Numerical Methods for Scientists and Engineers, S. R. Iyangar & M. K. Jain, PHI, 1999.
2. A Textbook of Computer Oriented Numerical Methods & Linear Programing, G. K. Ranganath, B. Suryanarayana, Chand Publications.
3. Programming in C, V. Rajaraman

## E&IT- 201: ELECTRICAL AND ELECTRONIC INSTRUMENTATION

Total Hours: 48

UNIT I: GENERAL ANALOG MEASURING INSTRUMENTS 12 Hrs

Principle, Operation and constructional details of PMMC moving coil galvanometer, Moving Iron galvanometer, DC Ammeters, DC voltmeters. Ohmmeters: Series type, shunt type meters, Meggers. Extension of ranges of meters. AC meters – Electrodynamometers, Rectifier type and Thermal type Errors and their compensation. Design and constructional details of multimeters.

UNIT II: POWER & ENERGY METERS AND INSTRUMENT TRANSFORMERS 12 Hrs

Electrodynamometer type (power) watt meters-methods of connection, errors and their compensation. Principle, Operation, Constructional details of Hall effect and thermal type watt meters. Principle and construction of electro-dynamometers, watthour meters, power factor meter, Instrument transformers – Phaser diagram, expression for ratio and phase angle, applications of CTs and PTs.

UNIT III: PRECISION ANALOG MEASURING INSTRUMENTS 12 Hrs

Electronic voltmeter (Transistor and FET versions). DC and AC Milli/Micro voltmeters, Nano-ammeter. Analog frequency meter. Analog phase meter. Q-meter. Cathode Ray Oscilloscope- Signal beam, Dual trace, Dual beam.

UNIT IV: DIGITAL MEASURING INSTRUMENTS & WAVEFORM GENERATORS 12 Hrs

Digital voltmeter, Digital multimeter, Introduction to ICL 7106/7107 DVM I.C, Digital frequency meter, Digital phase meter, Storage Oscilloscope, Digital Storage Oscilloscope and Sampling Oscilloscopes. Sine/Square Wave Generator. R.F. Signal Generator. Standard Signal Generator. Function Generator.

BOOKS FOR STUDY:


1. Electronic Instrumentation and Measuring Techniques- Cooper (Unit I, II)
2. A course in Electrical and Electronic Measurements and Instrumentation-A K Sawhney (Unit I, II, & III)
3. Electronic Instrumentation - H S Kalsi (Unit III,IV)


BOOKS FOR REFERENCE:


1. Electronic Measurements and Instrumentation – Oliver & Cage
2. Instrumentation Devices and Systems- Rangan, Mani and Sharma
3. Experiments in Electronics- Subramanyam
4. Electrical Measurements and Measuring Instruments- Goldings & Widdis

## E&IT-202 : CONTROL SYSTEMS AND AUTOMATION

Total Hours: 48

UNIT I: INTRODUCTION TO CONTROL SYSTEMS AND MATHEMATICAL MODELING 12 Hrs

Open-loop and closed-loop control systems. Types of control system linear and non-linear, Time-invariant and Time-varying, continuous and sampled Data and Digital Control, Effects of Feedback on-Overall Gain, Stability, Sensitivity. Bandwidth and Noise. Differential Equation Approach to the Electrical Circuits and Components. Mechanical (Translational, Rotational and Gear train Systems).
Transfer function Approach to physical System. Block Diagram Algebra. Signal flow-graphs. Mathematical modeling of D.C servo motor Armature Controlled and field controlled. Thermal, Hydraulic (Valve, Amplifier, Motor) and Pneumatic (Bellow, Flapper-value and Relay) System.

UNIT II: TIME RESPONSE ANALYSIS AND STABILITY CRITERION 12 Hrs

Standard Test Signals, Time Response of First and second order system. Design Specifications of Second Order System. Performance Indices. Static error coefficients. Concept of Stability, Necessary condition for Stability. Hurwitz stability Criterion. Routh stability criterion. Relative stability Analysis.
Roots-Locus concepts. Construction of root-loci. Rules for constructing Root-loci. Root-locus Analysis of control System. Determination of roots from root locus, root contours.

UNIT III: FREQUENCY RESPONSE ANALYSIS & STABILITY CRITERIA 12 Hrs

Introduction, correlation between time and frequency responses. Polar plots, Bode plots. All pass and minimum phase systems, Experimental determination of transfer functions. Bode plots.
Introduction to mathematical preliminaries. Nyquist stability Criterion. Assessment of relative stability. Stability Analysis Gain Margin (GM) and Phase Margin (PM) Closed-loop Frequency response. Constant M and N circles. Nicholas Chart.

UNIT IV: STATE VARIABLE ANALYSIS AND DESIGN 12 Hrs

Concept of state, State variables and state model. State models for Linear continuous and Time-varying system. Diagonalization. State transition matrix. Solutions of state equations. Concepts of Controllability and observability. State variables and linear discrete time system.

BOOKS FOR STUDY:

1. Control Systems Engineering – Nagrath. I. J. & Gopal. M (Unit I, II, & III)
2. Automatic Control Systems- Benjamin C. Kuo (Unit II & III)
3. Modern Control System Engineering – K. Ogata (Unit IV)

BOOKS FOR REFERENCE:

1. Feedback Control System Analysis & Design – D Azz, J.J and Houpis C.H
2. Control System Design – Savant C. J.
3. Basic Automatic Control Theory – Murphy G.J.

## E&IT- 203: MICROCONTROLLERS AND APPLICATIONS

Total Hours: 48

UNIT I: MCS-51 MICROCONTROLLER SYSTEMS 12 Hrs

Introduction to Microcontroller Systems - Block diagram of 8051 Mc - functional units - memory organization - ports, interrupts, timers - Addressing modes, instruction set - I/O Ports, Interrupts, Timer/Counter, Serial Communication.

**UNIT II: PIC MICROCONTROLLER ARCHITECTURE AND PROGRAMMING**

12 Hrs

**PIC Microcontrollers- Overview and features, PIC 18FXX, PIC reset actions, Oscillator connection, Memory organization, PIC 18FXX instructions, Addressing modes, I/O ports, Interrupts, PIC 18FXX timer and A/D converter. PIC 16FXX Flash Microcontrollers- Pin diagram of 18FXX, STATUS Register, OPTION_REG Register, Power Control Register, PIC 18F8XX program memory, data memory, Data EEPROM and Flash Program EEPROM, Interrupts in 18F877, I/O ports and Timers.**

UNIT III: INTERFACING WITH 8051 AND PIC MICROCONTROLLERS 12 Hrs

Interfacing of LED, 7-segment Display, Multiplexed7-segment Display, LCD, Keyboard, Stepper motor, ADC and DAC and their applications. Measurement of Frequency and Pulse width - Generation of PWM waveforms.

UNIT IV: ADVANCED APPLICATIONS USING PIC MICROCONTROLLER 12 Hrs

Application on Graphical LCD - SD Card - $1^2C$, USB Bus - CAN Bus —Interface - Interface- RFID & Bluetooth, GSM&GPRS.

BOOKS FOR STUDY:


1. The 8051 microcontroller and embedded systems - Muhammad Ali Mazidi & J G Mazidi (Unit I&III).
2. Advanced PIC Microcontroller Projects in C: From USB to RTOS with the PIC18F Series - Dogan Ibrahim (Newnes publications)
3. Advanced PIC microcontroller projects in C: from USB to ZIGBEE with the PIC18F series/Dogan Ibrahim - (Newnes publications)
4. Design with PIC Microcontrollers – John B. Peatman (Unit III and IV)


BOOKS FOR REFERENCE:


1. MCS51 user manual -Intel Corporation.
2. Embedded microcontrollers data book- Intel Corporation.
3. Embedded microcontrollers application- Intel Corporation.
4. PICs in practice - F P Volpe & S Volpe, Elector Electronics
5. Embedded Control Handbook - MICROCHIP (Vol. 1 & 2)
6. The 8051 Microcontroller: Architecture, Programming and Applications - Kenneth J Ayala.
7. Design with Microcontroller- John B. Peatman.

## E&IT-204 : DIGITAL SIGNAL PROCESSING

Total Hours: 48

UNIT I : SAMPLING OF CONTINUOUS-TIME SIGNALS 12Hrs

Periodic sampling, Frequency-domain representation of sampling, Reconstruction of a band limited signal from its samples, Discrete-Time processing of continuous-time signals, Continuous-Time processing of discrete-time signals, Changing the sampling rate discrete-time processing, Multi- rate signal processing, Digital processing of analog signals.

UNIT II : STRUCTURES FOR DISCRETE-TIME SYSTEMS 12Hrs

Block diagram representation of linear constant-coefficient difference equations, Signal flow graph representation of linear constant- coefficient difference equations, Basic structures for IIR systems, Basic network structures for FIR systems, Overview of finite-precision numerical effects, The effects of coefficient quantization. Filter design techniques- Design of discrete-time IIR filters from Continuous-time filters, Design of FIR filters by windowing, examples of FIR filter design by the Kaiser Window method, Optimum approximations of FIR filters.

UNIT III : THE DISCRETE FOURIER TRANSFORM 12Hrs

Representation of periodic sequences: the discrete Fourier series, The Fourier transform of periodic signals, sampling the Fourier transform, Fourier representation of Finite-domain sequences: The discrete Fourier transform, Linear convolution using the discrete Fourier transform. Computation of the Discrete Fourier Transform- Efficient computation of the discrete Fourier transform, The Goertzed Algorithm, Decimation-in-time FFT algorithms, Decimation-in-frequency FFT algorithms, Practical considerations, The Chirp Transform algorithm.

UNIT IV : ARCHITECTURE OF TMS320C5X 12Hrs

Bus structure, Central Arithmetic Logic Unit(CALU), Auxiliary Register ALU, Index Register, Auxiliary Register Compare Register, Block Move Address Register, Block Repeat Registers, Parallel Logic Unit, Memory-Mapped Registers, Program Controllers. TMS320C5X Assembly Language Instructions- Assembly Language Syntax, Addressing modes, Load/Store instructions, Addition/Subtraction instructions, Move instructions, Multiplication instructions, The NORM instruction, Program control instructions, Peripheral control.

Application Programs in C5X- C50-based DSP starter kit, Programs for familiarization of the Addressing Modes, Program for familiarization of Arithmetic instructions, Programs in C5X for Processing Real Time Signals.

**Books for study:**


1. Discrete-Time Signal Processing, - Alan V. Oppenheim, Ronald W. Shafer and John R. Buck, 2/e, Pearson Education, Inc., 2000. (UNIT- I,II,III)
2. Digital Signal Processors: Architecture, Programming and Applications - B. Venkataramani and M. Bhaskar TMH, 2002. (UNIT IV)


**Reference Books:**


1. Sanjit K. Mitra, “Digital Signal Processing: A Computer Based Approach”, TMH, 1998.
2. Johnny R. Johnson, “Introduction to Digital Signal Processing”, PHI, 2000.
3. Boaz Porat, “A Course in Digital Signal Processing”, John Wiley & Sons (Asia) Pte. Ltd., 1997.
4. Texas Instruments TMS 320C5X User’s Guide, 1997.

# E&IT-205: Principles of Instrumentation

**(Paper offered under choice-based credit system for semester #2)**

**Chapter – 1: Qualities of measurement**

The elements of measurement – Static characteristics – Accuracy – Sensitivity – Reproducibility – Dynamic characteristics – Speed of response – Fidelity.

**Chapter – 2: Pressure measurement**

Manometers – Bourdon tubes – Diaphragm elements – Bellows elements – Electrical types.

**Chapter – 3: Temperature measurement**

Thermometers – RTDs – Thermistors – Thermocouples – Pyrometers.

**Chapter – 4: Analytical instrumentation**

Introduction – Classification of the methods of analysis – Classical and instrumental methods.

**Chapter – 5: Spectroscopic methods**

UV-VIS spectrophotometer – IR spectrometer – NMR spectrometer.

**Chapter – 6: Electro-analytical methods**

pH – Conductivity.

**Chapter – 7: Chromatographic methods**

Gas chromatography – HPLC.

**Books**

| | | |
|---|---|---|
| Principles of industrial instrumentation | - | D. Patranabis |
| Principles of industrial instrumentation | - | D.P. Eckman |
| Instrumental methods of analysis | - | Willard |
| Instrumental methods of chemical analysis | - | Sharma |

## E&IT-301: ANALYTICAL INSTRUMENTATION

Total Hours: 48

### UNIT I: COLORIMETERS AND SPECTROPHOTOMETERS 12 Hrs

Colorimeters- Principle and working with a Block diagram. Salient features of individual blocks. Specifications of a colorimeter. Applications of colorimeters.
Spectrophotometers-Principle and working with block diagram. Salient features of individual blocks. Specification and operation of Spectrophotometer. Types of spectrophotometers –Ultraviolet, Visible and Infrared.- AAS - Applications of Spectrophotometers to chemical analysis.

### UNIT II: CONDUTIVITY, pH METERS AND POLAROGRAPHS 12 Hrs

Conductivity Bridge- Principle and working of a conductivity bridge with a block diagram. Salient features of individual blocks. Applications of conductivity bridges.

pH meters- Principle and working with a block diagram. Salient features of individual blocks. Types of pH meters. Applications of pH meters in chemical and industrial fields.

Polorograph-principle and working with a block diagram. Salient features of individual blocks. Characteristics of dropping mercury electrode. Polorogram. Applications of polorograph in chemical and industrial fields.

### UNIT III: RESONANCE AND MASS SPECTROMETERS 12 Hrs

Nuclear Magnetic Resonance Spectrometers- Principle and working with suitable schematic/block diagrams. Experimental arrangement. Salient features of individual blocks. Applications of NMR spectrometer.

Electron Spin Resonance- Principle and working with suitable schematic/block diagrams. Experimental arrangement. Salient features of individual blocks. Applications of ESR spectrometer.

Mass Spectrometer- Principle and working. Description of individual blocks of experimental arrangement. Application of Mass Spectrometers.

### UNIT IV: ELECTRON MICROSCOPES, THERMAL ANALYSIS AND CHROMATOGRAPHS 12 Hrs

Transmission Electron Microscope- Principle and working with a block diagram. Salient features of individual blocks.
Scanning Electron Microscope- Principle and working with a block diagram. Description of individual blocks. Applications of Electron Microscopes.

Thermo gravimetric and Differential Thermal Analysis-Principle and working with a Schematic diagram. Description of individual blocks. Applications.

Chromatographs- Gas and Liquid Chromatographs- Principle and working with a block diagrams. Applications.

BOOKS FOR STUDY:

1. Hand Book of Analytical Instruments- R. S. Khandpur (Unit IV
2. Principles of Instrumental Analysis- Skoog (Unit IV)
3. Instrumental methods of Analysis- Chatwal and Anand (Unit I, II, III)
4. Instrumental methods of Chemical Analysis- B. K. Sharma. (Unit IV)

BOOKS FOR REFERENCE:

1. Instrumental methods of Analysis- Willard, Merrit and Dean.
2. Industrial Instrumentation – Soisson.
3. Molecular Spectroscopy- Singh and Dikshit\

## E&IT-302 : EMBEDDED SYSTEMS

Total Hours: 48

UNIT I: EMBEDDED SYSTEMS AND PROGRAMMING

Embedded System Architecture - Introduction - hardware and software components - Classification –Embedded Systems on a Chip (SoC). I/O Devices - Device I/O Types and Examples –. Review of C Programming - Program Elements, Macros and functions -Use of Pointers - NULL Pointers - Use of Function Calls – Multiple function calls in a Cyclic Order in the Main Function Pointers – Structures and Unions – Data Structures - Linked Lists.

UNIT II: OS FOR EMBEDDED SYSTEMS

Basic Features of an Operating System - Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System - Processes and Threads - Inter-process Communication – Signals, Shared Memory Communication, Message-Based Communication.

UNIT III: SCHEDULING AND MEMORY MANAGEMENT

Scheduling - Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling - Real-time Memory Management - Process Stack Management, Dynamic Allocation - I/O- Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Real-time Transactions and Files - Example Real-time OS – VxWorks, RT-Linux, Psos

UNIT IV : NETWORK BASED EMBEDDED APPLICATIONS

Network Fundamentals - Layers and Protocols - Network Architectures, Network Components: Bridges, Routers, Switches - Distributed Embedded Architectures -Elements of Protocol Design

Network Based Design - Internet-Enabled Systems - Protocols for industrial and control applications, Internetworking Protocols - Wireless Applications ,Blue-tooth

BOOKS FOR STUDY:

1. Embedded Systems Architecture, Programming and Design - Rajkamal, TATA McGraw-Hill, First reprint Oct. 2003.
2. Real-Time Concepts for Embedded Systems - Qing Li and Carolyn Yao, CMP Books 2003.

BOOKS FOR REFERENCE:

1. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes,
2. David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
3. Wayne Wolf, Computers as Components; Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001.
4. Frank Vahid and Tony Givargis, Embedded Systems Design – A unified Hardware /Software Introduction, John Wiley, 2002.
For more details, visit www.annauniv.edu

## E&IT-303: BIOMEDICAL INSTRUMENTATION

Total Hours: 48

UNIT I: BIOMEDICAL ELECTRODES AND TRANSDUCERS 12Hrs

Bio-electrical signal, recording electrode for ECG, EEG, EMG. Monopolar, Bipolar and nonpolar electrode. Biochemical sensors, pulse and respiration sensors. Bioelectric amplifiers. Biopotential amplifiers.

UNIT II: CARDIO-VASCULAR SYSTEM, RESPIRATORY SYSTEM AND RELATED INSTRUMENTATION 12Hrs

Physiology of heart and cardiovascular systems, electrocardiography, pace makers, defibrillators, measurement of blood pressure, temperature and pulse recorders.
Physiology of respiratory system – mechanism of breath , pulmonary function analysers, respiratory gas analysers, artificial heart, lung mechanisms .

UNIT III: NERVOUS AND SENSOR SYSTEMS AND RELATED INSTRUMENTATION 12 Hrs

Physiology of nervous system, neuronal communication, organization of brain, electro-encephalograph and reflex of the brain, experimental study of the behavior and physiological measurement. instruments for testing of motor responses and sensory measurements .

UNIT IV: MODERN IMAGING SYSTEMS 12 Hrs

X-ray, computer aided tomography and applications, NMR imaging techniques and Applications. Medical Ultra sound, Pulse echo transmitter and receiver, A- scan, Echo-Opthamoscope, Echo-Cardiogram and B-scan, Biological effects of Ultra sound. Heomodialysis machine. Applications of Ar, Ruby AND Diode lasers in Biomedical field.

BOOKS FOR STUDY:


1. Hand book of Biomedical Instrumentation -R S Khandpur (Unit I, II).
2. Biomedical Instrumentation and Measurements- Leslie, Cromwel, Fred Wailbell, Erich, Pfeiffer (Unit I, II, III & IV)
3. Biomedical Instrumentation – Arumugam (Unit I, II)
4. Biomedical Equipment and Technology – Joseph Brown (Unit I, III, IV)


BOOKS FOR REFERENCE:


5. Biomedical Instrumentation and Measurements, allied- Harry E Thomas.
6. Hand book of Biomedical Engineering –Jacob Kline
7. Transducers for Biomedical Measurments –Richard S C Cobold
8. Biomedical Electronics- Joseph Dubovy
9. Biomedical Instruments, Theory and Design-Welkowitz and Dentsch
10. Biological Engineering –Mech Schwan
11. Biomedical Engineering system- Climes and Muliem

## E&IT-304: INDUSTRIAL AND PROCESS CONTROL INSTRUMENTATION

Total Hours: 48

UNIT I: INDUSTRIAL COMPONENTS AND CONTROL SYSTEMS 12 Hrs

Elements of process Instrumentation: Switches, Relays, Actuators & Valves, Transmitters. Basic control actions - Proportional (P), Proportional + Integral (PI), Proportional + Derivative (PD), Proportional + Integral + Derivative (PID) Hydraulic, Pneumatic and Electronic Controllers.
Digital PID Controllers, Cascade and Feed Forward Control Systems, Direct Digital Control Systems, Supervisory Control Systems, Distributed Control Systems (DCS).

UNIT II: PLC, SCADA AND FUZZY LOGIC CONTROLLERS 12 Hrs

PLC block diagram, PLC Hardware, PLC Operations, Instructions of PLC, Programming the PLC, Ladder diagram programming, Applications of PLC.
Fuzzy set theory, concepts and properties, fuzzy logic, block diagram of fuzzy logic controller, membership functions, fuzzification, defuzzification techniques, typical applications.
SCADA fundamentals, Overview of SCADA software

UNIT III: INSTRUMENTATION IN IRON AND STEEL INDUSTRIES 12 Hrs

Description of the process, Measurement hardware, valves, Controllers and displays, Computer Applications and Typical control systems as applied to the iron and steel industries.

UNIT IV: INSTRUMENTATION IN PETROCHEMICAL AND PAPER INDUSTRIES 12 Hrs

Control of Distillation Towers, Refrigeration units, System boilers, Furnaces, Crystallizers, Heat exchanges, Pumps, Compressors and Evaporators as applied to the petrochemical industry.

BOOKS FOR STUDY:


1. Chemical Process Industries – R.Norris Shreve, Joseph A.Brink
2. Modern Control Technology – Christopher T. Killian (Unit I)
3. Process/Industrial Instrumentation – D. M. Considine (Unit I, II)
4. Industrial Instrumentation and Control – S. K. Singh (Unit II)
5. Fuzzy sets, fuzzy logic theory & Applications-G J Klir /B Yuan (Unit II).
6. Fuzzy logic with Engineering Application- Timothy J Ross (Unit II).
7. Instrumentation in Process Industries -B. G. Liptak (Unit III, IV )
8. Computer based Industrial Control – Krishna Kant (Unit III)


BOOKS FOR REFERENCE:


1. Computer based Industrial Control – Krishna Kant
2. Control System Engineering - Nagrath & Gopal
3. Modern Control Engineering - K Ogata
4. Automatic Control Systems - B C Kuo
5. Programmable Logic Controllers – John Webb
6. Programmable Logic Controllers: Programming Methods and Applications – John R. Hackworth
7. Industrial Control Electronics - J. Michael Jacob.
8. Industrial Control Electronics – Michael Jacob (Unit I)

# E&IT-305: Principles of Biomedical Systems

**(Paper offered under choice-based credit system for semester #3)**

**Unit – 1: Bio-potential electrodes and transducers**

Introduction
Design of medical instrument
Components of biomedical instrument system
Electrodes
Transducers

**Unit – 2: Biomedical recorders**

Electrocardiography (ECG)
Electroencephalography (EEG)
Electromyography (EMG)

**Unit – 3: Respiratory system measurements**

Physiology of respiratory system
Pulmonary function analysis
Respiratory gas analyzer

**Unit – 4: Biomedical imaging systems**

X-ray and computed tomography system and applications
NMR imaging system and applications
Medical ultrasound imaging system
PET scanning system

Books

1. Biomedical instrumentation and measurements – L. Cromwet, Fred J. Weibell & Erich A. Pfeiffer
2. Biomedical instrumentation – M. Arumugam
3. Handbook of biomedical instrumentation – R.S. Khandpur

## E&IT-401: PC BASED INSTRUMENTATION

Total Hours: 48

UNIT I: INTRODUCTION TO PERSONAL COMPUTER (PC) AND PERIPHERALS 12 Hrs

Computer organization and architecture – Computer components and interconnections – Memory management – I/O devices - PC extension slots (ISA, EISA & PCI). Serial, parallel and USB ports and their applications. IEEE 488 and GPIB bus standard.

UNIT II: VI PROGRAMMING TECHNIQUES 12 Hrs

Virtual Instrumentation- Definition, flexibility- Block diagram and Architecture of Virtual Instruments- Data flow techniques- graphical programming in dataflow.
VI, sub VI, loops and charts, arrays, clusters and graphs, case and sequence structures, forma nodes , local and global variables, string and file Input/output, Instrument drivers.

UNIT III: DATA ACQUISITION IN VI

12 Hrs

Introduction to data Acquisition-signal conditioning –classes of signal conditioning-field wiring and signal measurement-ground loops-A/D,D/A converters. Design and interface of digital input/output and timer (DIOT) cards. Plug-in DAQ boards- Data acquisition modules with parallel and serial communication.

UNIT IV: PC FOR MEASUREMENT AND CONTROL 12 Hrs

Role of PC in instrumentation. Application of PC for measurement of Temperature, Pressure, Torque, Load, Displacement and $P^H$. Waveform generation- data visualization at multiple locations.

Real time control and applications: design of ON/OFF controller, PID controller, PC based digital storage oscilloscope. PC based UV - Visible spectrophotometers.

BOOKS FOR STUDY:


1. Microprocessor and Interfacing: Programming and Hardware – Douglas V. Hall
2. S.Gupta and J.P.Gupta, " PC interfacing for data acquisition and process control", Second Edition, Instrument Society of America,1994.
3. LabVIEW based Advanced Instrumentation Systems - S. Sumathi and P. Surekha ISBN-10 3-540-48500-7 Springer Berlin Heidelberg New York.
4. John Park and Steve Mackay, Practical Data Acquisition for Instrumentation and control Systems, Elsevier Publications.


BOOKS FOR REFERENCE:


1. The 80X86 IBM Pc and compatable computers Vol 1, 2. - Muhammad Ali Mazidi & J G Mazidi
2. The IBM PC Connection – James F. Caffron
3. Computer based Industrial Control – Krishna Kant
4. Computer Controlled Systems – K.J. Astram & B.Wittenmark.
3. IBM PC and Clones Hardware, Troubleshooting and Maintenance – B. Govindarajalu (Unit I, II)
4. IBM PC and Clones – Rajesh Hongal (Units I, II, III, IV).
5. Lab Equipment manuals.

## E&IT- 402 : VLSI DESIGN

Total Hours: 48

UNIT – I : AN OVERVIEW OF VLSI AND LOGIC DESIGN WITH MOSFETS 12 Hrs

Complexity and Design, Basic concepts, Ideal switches and Boolean operations, MOSFETs as switches, Basic logics gates in CMOS, Complex logic gates in CMOS, Transmission Gate circuits, Clocking and data flow control.

UNIT – II : PHYSICAL STRUCTURE AND FABRICATION OF CMOS ICs 12 Hrs

Integrated Circuit layers, MOSFETs, CMOS layers, Designing FET arrays, Overview of silicon processing, Material growth and deposition, Lithography, The CMOS process flow, Design rules.

UNIT - III : ELEMENTS OF PHYSICAL DESIGN AND ELECTRICAL CHARACTERISTICS OF MOSFETs 12 Hrs

Basic concepts, Layout of basic structures, Cell concepts, FET sizing and the unit transistor, Physical design of logic gates, Design hierarchies, MOS physics, nFET current-voltage equations, FET RC model, pFET characteristics, Modeling of small MOSFETs.

UNIT – IV : ELECTRONIC ANALYSIS AND DESIGNING OF CMOS LOGIC GATES 12 Hrs

DC characteristics of the CMOS inverter, Inverter switching characteristics, Power dissipation, DC characteristics: NAND and NOR gates, NAND and NOR transient response, Analysis of complex logic gates, Gate design for transient performance, Transmission gates and pass transistors.
Designing High-speed CMOS Logic Networks- Gate delays, Driving Large capacitive loads, Logical effort, BiCMOS drivers.

BOOK FOR STUDY:

1. John P. Uyemura, “Introduction to VLSI circuits and Systems”, John Wiley & Sons (Asia) Pte. Ltd., 2003.

REFERENCE BOOKS:

1. S.K. Ghandhi, “VLSI Fabrication principles”, 2/e, John Wiley & Sons (Asia) Pte. Ltd., 2003.
2. S.M. Sze, “VLSI Technology”, 2/e, McGraw-Hill, 1988.
3. N.H.E. Weste and K. Eshraghian, “Principles of CMOS VLSI design”, Pearson Education, Inc., 1999.
4. Yuan Taur and T.H. Ning, “Fundamentals of Modern VLSI devices”, Cambridge University Press, 1998.
5. R.L. Geiger, P.E. Allen and N.R. Strader, “VLSI design Techniques for Analog and Digital Circuits”, McGraw-Hill, 1990.