

Veer Narmad South Gujarat University,USIC
 Revised Syllabus (Effective from June-2011)
M.Sc. (Tech.) in Instrumentation
 (Structure of the 3rd and 4th Semester)
PART -II

THIRD SEMESTER

Course No.	Title	Theory/Lab Hours per week			Marks		
		Theory	Tutorial	Total Hours	External Exam	Internal	Total
INS -531	Electrical Machines & Power Electronics	04	01	05	70	30	100
INS -532	Integrated circuits and its Applications in Instrumentation	04	01	05	70	30	100
INS -533	Fundamentals of C Programming	04	01	05	70	30	100
INS -534	Process Instrumentation - I	04	01	05	70	30	100
INS -535	Laboratory INS 103	06		06	140	60	200

FOURTH SEMESTER

Course No.	Title	Theory/Lab Hours per week			Marks		
		Theory	Tutorial	Total Hours	External Exam	Internal	Total
INS -541	Advanced Electrical Machines & Control of Drives	04	01	05	70	30	100
INS -542	Electronic Instrument and instrumental System design	04	01	05	70	30	100
INS -543	Instrumentation system Design using Microcontroller	04	01	05	70	30	100
INS -544	Process Instrumentation - II	04	01	05	70	30	100
INS -545	Laboratory INS 203	06		06	140	60	200

DISTRIBUTION OF INTERNAL MARKS :

For Each Theory Papers	Marks
1.One Test per paper Semester	20
2.One Paper Per Semester	05
3.One Assignment per Semester	05
Total	30
For Laboratory Course per semester	Marks
1. One Test	40
2. Journal / Report writing / Seminar	20
Total	60

Semester-III
PAPER – INS - 531
Electronic Machines & Power Electronic

Unit – 1 D.C. Machines / A.C. Machines

Construction, Working Principle - Generator & Motor, Types & characteristics - Generator & Motor, emf equation, Numericals, Back emf, Numericals, Torque, Speed control Starters – Motor, Braking of DC Motor Applications - Generator & Motor.
Construction, Working Principle – Alternator, types, emf equation, Synchronous Motor - working principle, Starting Methods, ‘V’ – curves, Applications.

Unit – 2 Induction Motor

Three phase Induction motors - Construction, Types, Slip, Torque equations, characteristics, Application, Starting methods, Speed control Methods, Braking of IM, Single phase IM, Types, Universal Motor.

Unit – 3 Contactors & Relay

Basics of Contactor, Types, N.O. and N.C. Configurations, applications, Pressure switch, Pneumatic valves, Relays – basics, Use of Relay in Motor starters, MCC - their applications.

Unit – 4 Modern Power Semiconductor Devices

Thyristor, Series and Parallel operations of Thyristors, Diac, Triac, Phase Controlled, Inverter grade and Asymmetrical. Thyristors, RCT, GATT, SUS, SBS, LASCR, Power Transistors, Power MOSFETs, IGBT, SIT, GTO,- Latching Transistor-FCT, SITH, MCT, PIC.

Unit – 5 Phase controlled Rectifiers of Converters

Principle of Phase Control, Full Wave controlled Converters, Single phase Full wave Converters, Single phase Two-Pulse Converter Systems using Diodes, Three-phase Thyristor Converter Circuits, Effect of Source Impedance on performance of Converters, Dual Converters, Practical Dual Converter.

Unit – 6 Inverters / Choppers

Single-phase Voltage Source Inverters Operating Principle, Fourier Analysis of Single-phase Inverter output Voltage, Force - Commutated Thyristor Inverters, Three-phase Modulated Inverters, Reduction of Harmonics in inverter output voltage, current source inverters, Series and Parallel Inverters.

Principle of chopper Operation, control Strategies, Step-up choppers, Types of choppers circuits, Steady State Time-domain Analysis of Type -A chopper, Thyristor chopper circuits, Multiphase choppers.

➤ REFERENCE BOOKS :

1. Electrical Technology Vol. – II -- B.L.Theraja.
2. Electrical Machines – Nagrath & Kothari.
3. Control System components by Deltoro.
4. SCR and TRIAC by Rammurthy.
5. Power Electronics- P.C.Sen.
6. Power Electronics- P.S.Bimbhra.
7. Power Electronics- singh and Khanchandani.
8. Power Electronics - Circuits Devices and Application – M.H. Rashid
9. Thyristor Engineering – M.S.Berde.
- 10 Power Electronics – C.W.Lender.

Semester-III
PAPER – INS - 532
Integrated Circuits and its applications in Instrumentation

Unit 1. General Linear Applications

DC and AC amplifiers, AC amplifiers with single supply voltage , peaking amplifier, Summing , Scaling and Averaging amplifier, Instrumentation amplifier – its block diagram along with applications, Differential input and differential out put amplifier, Voltage – to- current converter with floating load (low – voltage DC Voltmeter , low – voltage AC voltmeter , Diode match finder , Zener diode tester , Light – emitting diode tester), Current – to- voltage converter , Very high – input impedance circuit , Integrator, Differentiator.

Unit 2. Active Filters

First order and second order low pass and high pass Butterworth filter, band ,pass and band rejected filters , Notch filter, All pass filter

Unit 3. Timer IC and its applications

Introduction , features , terminals , Time on delay application ,555 timer as Astable Multivibrator , Design procedure , Application as a Square wave Oscillator and Free – running Ramp generator , 555 Timer as Monostable Multivibrator Design procedure , applications as pulse stretcher and frequency divider.

Unit 4. Data acquisition and conversion

Analog single processing - sample and Hold circuit , sampling theorem, Analog Mux and analog channel expansion , Data Logger

Unit 5. Non Linear Signal Processing

Introduction , Amplifier Modulation and Demodulation , amplitude modulation , Nonlinear modulation , Bandwidth of Angle – Modulated waves , Generating FM waves , Demodulation of FM signals

Unit 6. Fiber Optical Sensors

Introduction , Requirement of fiber optical sensor , Merits and Demerits over conventional sensors . Current sensor, Gyroscopic sensor , Rotation sensoer

REFERENCE BOOKS :

1. Kalsi H.S. electronic Instrumentation
2. Electronic Communication by Roddy & John Coolen IV EDITION PHI
3. Ramakant Gayakwad ; Op Amps and Linear Integrated Circuits, Pearson Education PHI
4. Coughlin and Driscoll :Op Amps and Linear Integrated Circuits,6th edition
5. SCHINIER , “ Fiber Optical Communication

Semester-III
PAPER – INS - 533
Fundamentals of 'C' Programming

Unit-1

Introduction to C, features of high level language, Operators & Data types.

Unit-2

The Decision control structure : if statement, if... else statement, nested if statements, if... else if... statements. Case control structure: Switch statement, go to statement, and break statement.

Unit-3

Loop control structure: entry control and exit control loop, for loop, while loop, do-while loop.

Unit-4

Array, one dimensional array, two dimensional array, string processing

Unit-5

Functions: library function, user defined functions, reentrant function, recursive function.

Unit-6

Pointers and Structures , Introduction I/o handling

Suggested List of experiments :-

1. Introduction to software development tools, editor, compiler, linker, debugger etc.
2. Programs based on operators and input/output library function
3. Programs based on loops
4. Programs based on one, two dimensional array.
5. Programs based on string processing.
6. Programs based on user defined functions
7. Programs based on array
8. Programs based on pointer and structure

Reference Books:

1. Let us C by Kanetkar.
2. Programming in C by Balaguruswami.
3. Programming in C by Byron Gottfrid.
4. Fundamentals of computers of programming by Jeenwala & Patel

Semester-III
PAPER – INS – 534
Process Instrumentation – I

Unit -1

Process characteristic: Types of processes, constant step analysis method of finding time constant, dead time, dynamic elements in control loop, single and multicapacity processes

Unit -2

Control Actions:

Flow, pressure, level, temperature, composition, ph, etc, P, PI, PID control action, comparison, Controller Tuning methods

Unit -3

Multiloop and multivariable process control systems:

On-Off control system, feedback control, feed forward control, cascade control, ratio control, Selective control, Optimization control system, Computed variable system

Unit -4

Process instrumentation for heat exchangers, evaporators and drivers, steam boilers, reactors, pumps, compressors and furnaces, discrete and regulatory controls, safety interlocks for batch control system.

Unit -5

Standard symbols & Instrumentation Diagrams:

Line symbols, Field mounted and Panel mounted symbols, Process equipment symbols

Unit -6

Important Engineering Drawing:

Loop Diagrams, Wiring diagram, P&I Diagram, Process Flow sheet, Etc.

REFERENCE BOOKS :

- 1 Industrial instrumentation:
Principles and Design by T.R.Padmanabhan
- 2 Industrial Instrumentation by Eckman
- 3 Process control system 3/e by F.G.Shinskey, Mc Graw Hill
- 4 Chemical process control, introduction to theory & practice by G.Stephanopoulos,
Prentice Hall.
- 5 Instrumentation for process measurement & control 3/e by N.A. Anderson, Chilton
Bk, Co.
- 6 Process control (instrument engineers Hand book) by Liptak, Cinton Book Co.

Semester-III
PAPER – INS - 535
Laboratory Session INS – 103

- 1. Study of Construction of DC Machine.**
- 2. Study of Construction of Synchronous Machine.**
- 3. Study of the Characteristics of Induction Motor.**
- 4. Study of the characteristics of SCR.**
- 5. Study of the characteristics of TRIAC.**
- 6. Study of the characteristics of a power MOSFET.**
- 7. Study of the characteristics of IGBT.**
- 8. Study of the characteristics of D.C. Motor.**
- 9. Study of speed control circuit of D.C. Motor.**
- 10. Study of Induction Motor Starters.**

➤ **Student should Prepare and Present a Seminar based on syllabus.**

Semester-IV
PAPER – INS - 541
Advanced Electrical Machines & Control Drives

Unit – 1 Protection of Motors

Sequencing and Interlocking, Starting, stopping, emergency shut down of motor systems, Starting of Induction motor in full load both directions, starting with variable speeds, protection circuits.

Unit – 2 Advance Electrical Machines / Synchros

Stepper Motor, Construction, Working Principle, Transfer Function, Microprocessor interfacing circuits and Applications. Servo Motor, Construction, Working Principle, types, Applications. PMDC, PMBLDC - Construction, Working Principle. Synchronous - types, Construction, Working Principle, Applications.

Unit – 3 Cable / Electrical Safety

Cable – types, Construction, Specifications, Applications, Trouble shooting procedure, analysis and modifications.

Types of Electrical hazards, Electrical safety in electrical circuits, Fundamental safety rules, Electric earthing, types of Earthing.

Unit – 4 Cyclo-converters

Principle of cyclo-converter operation, Single-phase to Single-phase circuit-step-up cyclo-converter, Single-phase to Single-phase-Step-down Cyclo-converter, Three-phase Half-wave Cyclo-converters.

Unit – 5 Control of D.C. Drives

Basic Machine Equations, Braking Modes, Schemes for D.C. Motor speed Control, Single –phase Separately Excited Drives, Braking Operation of Rectifier Controlled Separately Excited Motor, Power factor improvement, Three-phase separately, Excited Drives, D.C. Chopper Drives, Close-loop Control of D.C. Drives, PLL Controls of D.C. Drives, Microcomputer Control of D.C. Drives.

Unit – 6 Control of A.C. Drives

Basic Principle of Operation, Squirrel cage Rotor Design, Speed Control of Induction motors, Stator Voltage Control, Variable Frequency control, VVVF IM Drive, Rotor resistance control, Slip power recovery Scheme, Synchronous Motor Drives, Microprocessor Controlled A.C. Drives.

REFERENCE BOOKS :

- 1) Electrical Technology Vol. – II -- B.L. Theraja.
- 2) Electrical Machines – Nagrath & Kothari.
- 3) Electrical Power System – V K Meththa.
- 4) Power Electronics- P.C.Sen.
- 5) Power Electronics- P.S.Bimbhra.
- 6) Power Electronics- Singh and Khanchandani.
- 7) Power Electronics - Circuits Devices and Application – M.H. Rashid.
- 8) Thyristor Engineering – M.S.Berde.
- 9) Power Electronics – C.W.Lender.
- 10) Variable speed drives (ISA)
- 11) Electrical Drives – G. K. Dubey.

Semester-IV
PAPER – INS - 542
Electronic Instrumentation and instrumental system design

Unit 1. Oscilloscope

Criterion for oscilloscope, Basic oscilloscope , special oscilloscope , Dual beam oscilloscope , Dual trace oscilloscope , Digital Storage oscilloscope , oscilloscope Probes

Unit 2. Signal Generators

Criterion for oscillation , sine wave generator , square wave generator , Triangular wave generator , Basic signal generator , Special signal generator , Function generator , Sweep generator

Unit 3. Digital Instruments

Introduction , Digital voltmeter, Ramp type digital voltmeter , Dual slope type digital voltmeter , Integrating type digital voltmeter , concept of half digit, Digital measurement of frequency and time, digital frequency meter, digital measurement of time

Unit 4. Wave from Analyzer

Basic wave analyzer , frequency selective wave analyzer, heterodyne , spectrum analyzer , harmonic distortion analyzer , harmonic distortion using resonance bridge and wein bridge

Unit 5. Digital Transmission Technique

Introduction to data transmission techniques, advantage and disadvantage over analog techniques , TDM and FDM , pulse Modulation techniques, PCM,DM, ASK, FSK, PSK and their application to instrumentation

Unit 6. Reliability Engineering

Reliability, MTBF , concept on available component screening , infant mortality and bath tub curve, component aging , Failure rate analysis

REFERENCE BOOKS :

- 1.Kalsi H.S. electronic Instrumentation
- 2.Electronic Communication by Roddy & John Coolen IV Edition PHI
- 3.Reliability Engineering by E. Balaguruswami
4. Ramakant Gayakwad : Op Amps and Linear Integrate Circuits , Pearson Education 4/e

Semester-IV
PAPER – INS – 543
Instrumentation System Design Using Microcontroller

Unit - 1 Introduction to 8051 Microcontroller

Introduction, Difference between Microprocessors and Microcontrollers. Overview of 8051 Microcontroller family, Introduction to different microcontroller families (PIC,AVR,ARM), Advancements in 8051 architecture like Infineon - XC88X, SiLabs-C8051F12X(CIP 51 core)

Unit - 2 Architecture of 8051 Microcontroller

Introduction, 8051 microcontroller hardware, Pin diagram of 8051, input/output pins, ports and circuits. Internal RAM and ROM , SFR's, interfacing with external memory, timers and counters, interrupts.. Serial data communication (UART).

Unit - 3 8051 Assembly language programming

Assembler directives, Addressing modes, data transfer instructions, Logical instructions, Arithmetic instructions, Branching (Jump & Call) instructions, Bit addressable instructions and special instructions, Interrupts and interrupt handler sub routines (Interrupt Service Routines).

Unit - 4 8051 programming in embedded C

Introduction, Date types in embedded C, arithmetic and logical operators,Control statements and loops in embedded C, Functions and Arrays in embedded C. Programming of input/ output ports, Programming of Timer & counters, writing interrupt service routines in Embedded C,Programming of UART and PCA Timer in embedded C.

Unit - 5 Hardware Interface

Introduction, Interfacing and C programming of 8051 with keyboard,Interfacing and C programming of 8051 with 7-segment display, Interfacing and C programming of 8051 with LCD display, Interfacing and C programming of 8051 with ADC-DAC and sensors, SPI and I2C serial communication protocols and their programming.

Unit-6 Applications and design of microcontroller based systems

Relay and optoisolators, Emergency Alarm System, stepper motor control, Temperature Control system, Traffic Light Control System, Weight Measurement, SCR firing circuit, DC motor interfacing and PWM.

Suggested List of experiments:-

1. **Introduction to Program development tool Chain using μ VISION3:**
Integrated development Environment (IDE), editor-assembler, compiler, linker, simulator, and debugger. Assembly and 'C' program development and debugging process.
2. Assembly language programming for addition, subtraction, multiplication and
3. division of two 8-bit numbers.
4. Assembly language programming for block data transfer between internal and
5. external memory including overlapping blocks. Occurrence of number from a set of data. Binary to BCD, Binary to ASCII code conversion, separation of odd/even, +ve/-Ve Numbers from a set of data
6. Assembly language programming for Timers in different modes.
7. I/O port programming in embedded C.
8. Timers and Counters programming in embedded C for time delay using ISRs.
9. Traffic Light Controller programming in embedded C
10. Digital clock programming using 7- segment display in embedded C.
11. Programming of LCD in embedded C.
12. Programming for Frequency Measurement and display on LCD display in Embedded C
13. Programming of keyboard in embedded C.
14. Serial communication and UART programming in Embedded C.
15. Programming of parallel ADC and DAC in embedded C.

Text Books:

1. The 8051 Microcontroller Architecture, Programming & Applications by Kenneth J. Ayala (Penram International)
2. The 8051 Microcontroller and embedded systems using Assemble and C. by Muhammad Ali Mazidi and Janice Gillipse Mazidi (Pearson Education)

References Books:

1. The 8051 Microcontroller & Embedded systems using Assembly and C. by K.J. Ayala, D.V. Gadre (Cengage Learning, India Edition)
2. Programming and Customizing the 8051 Microcontroller by Myke Predko (Tata Mcggraw Hill).
3. 8051 Microcontrollers: MCS51 family and its variants by Satish Shah, Oxford University Press.
4. www.infineon.com www.silabs.com

Semester-IV
PAPER – INS – 544
Process Instrumentation – II

Unit – 1 Control Valve:

Introduction, Common abbreviations in the valve industry, Definitions of terms associated with valves, Control Valve characteristics, Valve classifications & types, Selection criteria for control valves

Unit – 2 Control Valve Accessories:

I/P convertor, Positioners, Limit Switches, Hand-wheels, Lock up Relay, Solenoid Valves, Booster Relay, etc.

Unit -3 Programmable Logic Controllers: hardware

Introduction, Basic parts of a PLC , Operation of a PLC , Basic symbols used in PLC realization , Difference between PLC and Hardwired systems , Difference between PLC and computer, Classification of PLCs

Unit -4 Programmable Logic Controllers: Programming language

Relay logic to ladder logic, Ladder commands, Examples of PLC ladder diagram realization, PLC timers, PLC counters and examples,

Unit – 5 Distributed control System:

History of DCS, DCS concepts, DCS hardware & software, DCS structure, Advantages and disadvantages of DCS, Representative DCS,

Unit – 6 SCADA system:

Introduction of SCADA system,, SCADA hardware & software, Application examples.

Reference Books:

1. Applied Instrumentation: William G. Andrews., Vol.-1
2. Process Control Instrumentation Technology by C. D. Johnson; Prentice Hall India.
3. Industrial instrumentation: Principles and Design by T.R.Padmanabhan
4. Process control (instrument engineers Hand book) by Liptak, Cinton Book Co.

Semester-IV
PAPER – INS - 545
Laboratory Session INS – 203

- 1. Study of the Phase controlled circuit.**
- 2. Study of the converter circuits.**
- 3. Study of the inverter circuits.**
- 4. Study of AC Drives.**
- 5. Study of DC Drives.**
- 6. Study of Synchro transmitter and receiver system.**
- 7. Microprocessor based controlled A.C. Motor.**
- 8. Study of types of Earthing systems.**
- 9. Study of Cable construction.**
- 10. Study of speed control circuit of Induction Motor.**

➤ **Student should Prepare and Present a Seminar based on syllabus.**