VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Tech.) Part – II

Instrumentation

4.1 Course & Structure

Control System Components and Power Electronics
PGI 201

1. **generators : (DC and AC) :**
   Types, characteristics,Applications

2. **Motors :**

   (DC, Single phase and Three phase Induction motors, Synchronous motors… FHP motors)…. Types, Mechanical characteristics, Transfer function. Application, Motor Generator sets (DC Motor/ Alternator and Induction motor / D.C.Generator combinations.)

3. **Servomotors :**

   (AC and DC) Principle,Transfer Function, Applications in A.C. and D.C. servo Control systems (Position control and speed control systems). Synchros.

4. **Stepper Motor :**

   Type,principle,Transfer Function, Microprocessor interfacing circuits and Applications.

5. **Sequencing and Interlocking, Staring, stopping, emergency shut down of motor systems.Starting of Induction motor in full load both directions, reduced stator voltage, (star delta connections) braking (Counter current and direct current braking) starting with variable speeds, protection circuits.**

6. **Switches, Contactors :**

   (N.O. and N.C. Configurations),Replays (Open contact, and hermetically sealed and reed relays) starters, MCC their applications. types of Cables and Specifications,Troubles shooting procedure,analysis and modifications.

7. **Pneumatic components**

   Fpaller/Nozzle system, Reverse acting relay single, double acting cylinder, Air supply, Air regulator, pressure switch, pneumatic, valves, Motors and actuators. Special cylinders like cushion, double rod, tandem cylinders, multiple position cylinders rotary cylinders. Electro pneumatic gagging , application of air gagging sequence diagrams and systolic representation of sequences, Application of pneumatic circuits like sequencing anti-cycle repetition etc. Introduction to fluidic gates and pneumatic sensors.

8. **Hydraulic Components :**

   Pumps, actuators, hydraulic valves, power cylinders, Servo Motors, Power supply,Hydraulic Circuits and Hydraulic Transmission (Transfer function calculation) Hydraulic Circuit applications like motor speed control, reciprocating, loading, upgrading, sequencing of cylinders and direction control.

9. **safety in electrical circuits, fundamental safety rules and electric system earthing Encoders and Automation sensors.**

10. **Modern Power Semiconductors Devices :**

    Thyristor, Serise and Prallel operations of Thyristors, Diac, Triac, Phase Controlled, Inverter grade and Asymmetrical. Thyristors, Rct, GATT,SUS,SBS,LASCR Power Tracsistors, Power MOSFETs , IGBT, SIT, GTO,- Latching Transistor-FCT,SITH,MCT,PIC.

11. **Phase controlled Rectifiers of Converters :**

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

12. **Inverters :**

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

13. **Choppers :**

    Principal 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.

14. **Cycloconverters**

    Principal of cycloconverter operation, Single-phase to Single-phase circuit-step-up cycloconverter , Single-phase to Single-phase-Step-down Cycloconverter, Three-phase Halt-wave Cyclovonverters.

15. **Control of D.C. Drives :**

    Basic Machine Equations, Breking 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, P L L Controls of D.C.Drives, Microcomputer Control of D.C. Drives.

16. **Control of A.C.Drives :**

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

REFERENCE BOOKS :

1. **Electrical Technology by B.L.Theraja.**
2. **Control System components by Deltoro.**
3. **Process Control and Instrument Technology by C.D.Johnson.**
4. **Automatic Control Engineering by Ravan.**
5. **Industrial Hydrautics byPipinger.**
6. **Process Measurement by B.G. Liptak.**
7. **SCR and TRIAC by Rammurthy.**
8. **Control system components by Gibson Tutor (MGH)**
9. **Variable speed drives (ISA)**
10. **Power Electronics- P.C.Sen**
11. **Power Electronics- P.S.Bimbhra**
12. **Power Electronics- singh and Khanchandani**
13. **Power Electronics, Circuits Devices and Application – M.H. Rashid**
14. **Thyristor Engineering – M.S.Berde**
15. **Power Electronics – C.W.Lender**

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Tech.) Part – II

Instrumentation

PGI 202

ELECTRONIC INSTRUMENTATION AND INSTRUMENTAL SYSTEM DESIGN

1. Measuring Instruments :

True RMS meter Vector volt meter O meter RLC bridge, Tan delta meter, high voltage Insulation testers, Output power meter, gauss meter, Milli and micro ohm meter, Automatic bridges, Virtual instruments and instrumentation, Standard AC and DC sources, B.I.S for Calibration.

2. Active and passive component testing Instruments for digital and analog circuit testing and automatic test equipment.

3. Signal sources:

Function generator, sinewave synthesis, pulse generator and its application, sine wave generator, square wave generator pulse and arbitrary waveform generator.

4. Oscilloscope :

Sweep modes, active and passive probes, delay line, details of digital storage oscilloscope and its features like Roll, Refresh and sampling rate, applications in Instrumentation and measurements and recent trends in oscilloscope technology and sampling oscilloscope, LCD screen Oscilloscopes.

5. A/D and D/A Converters and their types, specifications, Sample and hold devices, Analog multiplexes and switches, data loggers.

6. Supervisory control and data acquisition Systems:
Introduction, need, configuration, general set up,Remote terminal unit, Master terminal unit and Ma-machine interface, software features,selection criteria, reliability features and application.

7. Digital Instruments :

DMM, Digital frequency meter, digital capacitance meter, universal counters and their application like event, ratio totailsing and timers etc. Automation in digital instruments, significance of ½ and ¾ digits, features of microprocessor based instruments.

8. Serial/ Parallel Communication Interfaces (Rs.-232,IEEE – 422/ 488,485) centronics interface – hardware overview, universal synchronous / asynchronous receiver transmitter (USART 8251). ISA and PCI interface.

9. Digital Transmission Techniques :

Introduction to data transmission techniques advantages and disadvantages of digital transmission over analog.Time division and frequency division multiplexing, Pulse modulation, digital modulation techniques like ASK,PSK, QPSK and delta modulation techniques, modems, telemetry and their applications in Instrumentation.

10. Introduction to total harmonic distortion, Distortion analyzer, wave analyzer, spectrum analyzer and its types, FFT analyzer and Network analyzer and their applications.

11. Using Electronic Instruments :

Impedance considerations, distributed, lumped parameters and component conderations, digitalm Interface issues like interface drivers, data compression and interface standards Reliability in electronic instruments and its concepts.

12. Basic concepts on instruments design:

Functional requirement and specifications, operational environment commercial industrial military, NEMA,DINm BIS and ANSI standards with special reference to packaging.

13. Enclosure design guidelines :

Grounding and shielding techniques, protection against electromagnetic interference and electrostatic discharge. Packaging for various operational environments including IP-51 and IP-54.

14. Electronic design guidelines :
Noise in electronic circuits, the design of low noise circuits, component limits, sensitive devices, sensitive inputs, input fitters, clamping suppressors.

15. Printed circuit board design guidelines :

General comments, layout scheme, grid systems, PCB size, mechanical stress. sign rules of digital circuits PCB and analog circuit PCB single and multilayer borads.

16. Automation and computers in PCB design, artwork CAD packages and tools soldering techniques, component assembly sting, cable design guidelines.

17. Reliability, MTTR,MTBF, concepts on availability component screening, infant mortality and bath tub curve, component aging, Failure rate analysis statistical sampling criteria, impaling for units low failure rates.

REFERENCE BOOKS :

1. **Electronic Instruments and Measurement techniques – Cooper and Hellfire PHF.**
2. **Electronic Instruments and Measurement – Chin and Jones, Willey 1997.**
3. **Elements of Electronic Instrumentation and Measurement – J.J.Carr, 3/e Reston 1996.**
4. **Electronic Instrumentation and Measurement – Oliver and Cage, Mc Graw Hill.**
5. **Instrumentation devices and systems – Rangan, Sharma and Mani, TMH 1997.**
6. **Electronic Instrument hand book – coombs.**
7. **Student reference manual for electronic Instrumentation – Laboratories Wolf and Smith (PHI)**
8. **Electrostatic Discharge and Electronics Equipment by Warren oxleitner, IEEE press.**
9. **Printed circuit Boards by Walter c.Bosshar, CEDT Series MH ?**
10. **Reliability Engineering by E.Balguruswamy,**
11. **Applications of Analog Integrated Circuits by S.Soclof, Prentice- Hall.**

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Tech.) Part – II
Instrumentation

PGI-203

PROGRAMMING IN C AND INSTRUMENTATION SYSTEM DESIGN USING μPS & μCS.

1. **Introduction to C**
2. **Operators & Data types.**
3. **The Decision control structure**
   if statement, if… else statement, nested if statements, if… else if… statements.
4. **Case control structure**
   Switch statement, go to statement
5. **Loop control structure**
6. **Array**
7. **Pointers**
8. **Functions**
9. **Structures.**
10. **Review of 8085 microprocessor and architecture.**
    Instruction Set, Memory orgranisation and addressing, interrupts, Hardware and software, Programming of Microprocessor.
11. **Programmable I/O. Devices:**
    8255, 8553, 8251,8279, Different Programming Modes,Operation and interfacing with microprocessors.
12. **Data Acquisition :**
    ADC and DAC interfacing , Memory Mapped and I/O Mapped I/O. Data transfer, Scheme, Asynchronous, Synchronous, Serial and Parallel transfer.
13. **Introduction to 8 Bit microcontroller :**
    8051 microcontroller, I/o pins, ports, interfacing of external memory, contrers and timers, serial and serial out interrupts.

14. **Programming of micro controller:**

    Assembly language programming through micro controller, moving data, arithmetic data, logical operations, jump and call.

1. **System Designing:**

    System designing using microprocessor and micro controller, case study of temperature data acquisition and control, weight measurement and stepper motor control.

REFERENCE BOOKS :

1. **8051 micro controller by Ayala.**
2. **Programming & customizing the 8051 micro controller by Myke Prdko.**
3. **Microprocessor architecture, programming and applications by Gaonkar.**
4. **Introduction to Microprocessor by L.A.Laventhal.**
5. **Intel Handbook for peripheral chip and up & uc.**
6. **Assembly language programming for 8085 by L.A.Laventhal.**
7. **Microprocessor & Peripherals by Brey.**
8. **Let us C by Kanetkar.**
9. **Programming in C by Balaguruswami.**
10. **Programming in C by Byron Gottfrid.**
11. **Fundamentals of computers of programming by Jeenwala & Patel**

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Tech.) Part – II

Instrumentation

PGI 204

Process Instrumentation and Signal Processing

1. **Process charcteristic : Types of processes, constant step analysis method of finding time constant, dead time, dynamic elements in control loop, single and multicapacity processes, PID control of processes.**

2. **Analysis and properties of some common loops:**
   Flow, pressure, level, temperature, composition, ph D. Degree etc,. Linear and non-linear controller, performance criteria, model-based PID controller, digital controller, Single loop and multiloop controller.

3. **Multiloop and multivariable process control systems, feedback, control, feed for ward control, cascade control, ratio control : Two selective control, shcosing, pairing and manipulating controlled variables, coupling and decoupling control systems, scaling the instruments.**

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

5. **Application of distributed control system for distillation columns.**

6. **Linear signal processing :**
   Introduction, General considerations, inviting amplifiers, summing amplifires, current to voltage converter, integrator, non-inverting amplifier, buffers, differentiation amplifier and its adaptations, instrumentation amplifier, isolation amplifier.

7. **Active Filters :**
   Introduction, classification of ideal filter characteristics- LPF,HPF,BPF, BRF and all pass filters, Filters requirements in instrumentation schemes, specifications of practical filters, normalized LPF, low pass filter configurations LPF circuit realizations, high pass filters, band pass filters, band rejection filters, switched capacitor filters.

8. **Non-linear signal processing :**
   Introduction, Modulation and Demodulation, Amplitude modulation and demodulation, principles of amplitude modulation, A M demodulation, effects of harmonics in the carrier, circuit schemes for A M modulation and demodulation, multiplier based A M modulator, Simple modulator with analogue switch, balanced modulator and demodulator using analogue switch, envelope detector, frequency modulation, phase locked loops, non-linear amplifiers.

9. **Noise and system performance :**

   Introduction, external noise and elimination or minimisation of conducted, capacitively, inductively and magnetically coupled noise, characterization of random signals, internal noise and minimize of its effect, amplifier selection depending on signal source, performance of modulation systems in the presence of noise, noise performance of A M and F M Systems.

10. **Analogue digital interface :**

    Introduction signal conversion basis, sampling hardware, sample and hold operation, ample- hold topologies, voltage references, specifications of ADCs and DACs and errors introduced, AC and ADC types.

11. **Digital signal processing for instrumentation :**

    Introduction, handling LUTs., digital filters, finite impulse response filter, filter design, IIR filters, other liner operations, DFT and FFT.
    Display

    Classification and comparison, characteristics of digital displays, digital display elements, display

REFERENCE BOOKS :

1. **Industrial Instrumentation :**

   Principles and Design by T.R.Padmanabhan

2. **Digital filters, Analysis design by Huelsman P.**
3. **Industrial Industrumentation by Eckman**
4. **Active and passive analogue filter design by Huelsman p.**

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Tech.) Part – II
Instrumentation

205
LABORATORY WORK

09 Hours / Week

Group A **03 Hours / Week**

Practicals shall be based on the syllabus of paper No. PGI-201.
Minimum of 12 Experiments to be performed

Group B **03 Hours / Week**

Practicals shall be based on the syllabus of paper No. PGI-202 & PGI-203
Minimum of 12 Experiments to be performed

Group C **03 Hours / Week**

Workshop practice and project
Industrial / In house Lab / R & D org. Training 8 Weeks.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Tech.) Part – II
Instrumentation

PGI-205
LABORATORY INDCUDING WORKSHOP PRACTICE & PROJECT

List of the Practical for Group -A

1. **Study of the Characteristics of Induction motor.**
2. **Study of the Characteristics of Servo motor.**
3. **Study of the stepper motor and up based controller.**
4. **AND / OR/ NOT rely logic application**
5. **Study of the characteristics of SCR and Triac.**
6. **Study of the Phase controlled circuit.**
7. **Study of the characteristics of a power MOSFET.**
8. **Study of the characteristics of a IGBT.**
9. **Study of the converter circuits.**
10. **Study of the inverter circuits.**
11. **Study of AC/DC drivers.**
12. **Study of the characteristics of dc moter.**
13. **Study of Synchro transmitter and receiver system.**
14. **Study of pressure switch.**
15. **Study of speed control circuit of induction motor.**
16. **Study of speed control circuit of D.C.motor.**
17. **Microprocessor based controlled A.C.motor**

List of the Practical for Group-B

1. **Study of RLC meter.**
2. **Study of Universal counter**
3. **Study of Digital multi-meter.**
4. **Measuring bandwidth, rise time and frequency response of X and Y amplifier of CRO.**
5. **Study of FT/Network/Wave analyzer.**
6. **Study of AC and DC standard sources.**
7. **Study of measuring intruments like Gavssmeter / Q meter / distortion meter.**
8. **Demonstration of various modulation techniques.**
9. **Study of some programme exercise in C.**
10. **Study of Software for SCADA systems.**
11. **Study of typical multi-channel DAS.**
12. **Two programs on assembly language programming (8085)**
13. **Two experimental on interfacing peripherals.**
14. **Two experimental on interfacing ADC/DAC**
15. **Four experiments on Micro-Controllers.**
16. **Designing PID controller using Micro-controller.**
17. **Designing logic functions using Micro-controller.**

List of the Practical for Group-C

1. **Workshop Practice :**
    1. **Introduction to various milling operations.**
    2. **Working mechanism of Universal dividing head**
    3. **Cutting dovetail & V block on shaping M/c.**
    4. **Various operation such as reaming, boring, internal threading & grooving on lath M/c.**
    5. **Conventional Vs CNC M/c tools.**
    6. **Introduction of G & M codes.**
2. **Project**

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Tech.) Part – II
Instrumentation

APPENDIX - B

A SCHEME FOR TEACHING AND EXAMINATION AT M.Sc.(Tech.) IN INSTRUMENTATION
M.Sc. PART - II

Course	Course No.	Teaching Scheme		Examination scheme				Total
		L	T	University Exam		Internal Exam		
				Theory Exam Hrs.	Marks	Theory Exam Hrs.	Marks	
Control System components and power Electronics	PGI-201	3	1	3	53	3	22	75
Electronic Instrumentation and Instrumental System Design	PGI-202	3	1	3	53	3	22	75
Programming in C and Instrumentation System Design using μps & μcs.	PGI-203	3	1	3	53	3	22	75
Process Instrumentation and signal processing	PGI-204	3	0	3	53	3	22	75
		Total of Theory Exam			212		88	300
Laboratory including workshop practice & project	PGI-205	9	0	-	140	9	60	200
		TOTAL MARKS			352	-	148	500