Group-8 (Level of Exam- Diploma in Instrumentation & control)

1) General awareness, Reasoning, Quantitative Aptitude, Science, History including Haryana related history, current affairs, literature, Geography, Civics, Environment, Culture etc. -
Weightage 20%

2) Computer terminology, Fundamentals, word software, excel software, Power point, internet, web browsing, Communication, emails, downloading and uploading data on websites etc**. -**
Weightage 10%

3) Subject related syllabus- **Weightage 70%**

BASICS OF CONTROL SYSTEM

Introduction: Basic elements of control system, open loop control system, closed loop control system, control system terminology, manually controlled closed loop systems, automatic controlled closed loop systems, basic elements of a servo mechanism, Examples of automatic control systems, use of equivalent systems for system analysis, linear systems, non-linear systems, control system examples from chemical systems, mechanical systems, electrical systems, introduction to laplace's transform.

Transfer function: Transfer function analysis of ac and dc servomotors synchro's, stepper motor, amplidyne. ac position control system, magnetic amplifier.

Control system representation: Transfer function, block diagram, reduction of block diagram, problems on block diagram, Mason's formula signal flow graph.

Time Response Analysis: Standard test signals, time response of first and second-order system, time constant, time response of second order system, time response specifications, steady-state errors and error constants, problems in first and second order system.

Stability: Routh Hurwitz Criterion, Root Locus, Bode Plotting using semi log graph paper.

ELECTRICAL AND ELECTRONICS MATERIALS AND COMPONENTS

Materials: Classification of materials, Conducting, semi-conducting and insulating materials through a brief reference to their atomic structure and energy bands, Conducting Materials, - Resistors and factors affecting resistivity such as temperature, alloying and mechanical stressing, Classification of conducting materials as low resistivity and high resistivity materials, Applications of Copper, Aluminium, Steel, low resistivity copper alloys such as brass, bronze, copper, graphite etc in the field of electrical engineering. - Superconductivity and piezoelectric ceramic materials, Insulating Materials, Important relevant characteristics (electrical, mechanical and thermal) and applications of the following material: Mica, Glass, Copper, Sliver, PVC, Silicon, Rubber, Bakelite, Cotton, Ceramic, Polyester, Polythene and Varnish, Magnetic Materials, Different Magnetic materials; (Dia, Para, Ferro) and their properties. Ferro magnetism, Domains, permeability, Hysteresis loop. Soft and hard magnetic materials, their examples and typical applications Special Materials, Thermocouple, bimetals, lead soldering and fuse material, mention their applications, Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc.

Components: Capacitors a) Concept of capacitance and capacitors, units of capacitance, types of capacitors, constructional details and testing specifications b) Capacity of parallel plate capacitors, spherical capacitors, cylindrical capacitor. c) Energy stored in a capacitor. d) Concept of di-electric and its effects on capacitance, di-electric constant, break down voltage. e) Series and parallel combination of capacitor. Simple numerical problems of capacitor. f) Charging and discharging of capacitor with different resistances in circuit, concept of current growth and decay, time constant in R-C circuits, simple problems, Resistors: Carbon film, metal film, carbon composition, wound and variable types (pre-sets and Potentio-meters), Transformer, inductors and RF coils: Methods of manufacture, testing, need of shielding, application and troubleshooting, Surface Mounted Devices (SMDs): Constructional detail and specifications, Connectors, Relays, switches and cables: Different types of connectors, relays, switches and cables, their symbols, construction and characteristics,Semi-Conductors and Integrated Circuits (ICs) - Characteristics and testing, Basic characteristics of semiconductor materials, testing of diodes, transistors, FETs and SCRs. - Various processes in IC manufacturing. Hybrid IC technology.

TEST AND MEASURING INSTRUMENTS

Classification, Absolute and secondary instruments, indicating recording and integrating, instruments, Review of units, dimensions and standards, Symbolic representation of circuits, Measurement of Resistance, Inductance and Capacitance, Measurement of resistance: Ohmmeters, Meggers, Wheatstone Bridge, Kelvin Bridge,Potentiometer method, Impedance Measurement: Measurement of inductance and capacitance: AC bridge method, Wagner earth devices,Detectors – classification and types, Vibration galvanometers, Ammeter, Voltmeter and Multi-meter, Zero error Moving Iron, Permanent Magnet Moving Coil Meters, Range Extension, Thermal type,electrostatic inductor, rectifier instruments, Electronic voltmeter, Digital Voltmeter (DVM)- ramp, type and integrating type digital voltmeters, D' Arson oval Galvanometer, dynamo galvanometer, equation of motion, damped, under damped and critical damped, Multi-meter: Principle of measurement, Measurement of d.c voltage and a.c voltage, a.c and d.c, sensitivity, Shunt and multiplier for range extension, Power and Energy Measurements, Watt meters – types, definition, classification, Wattmeter and Wattmeter methods, Energy, Measurement, Energy meters – types, definition, principle, Maximum demand indicators, 5. Frequency and Phase difference Measurement, Stroboscopes, synchro-scopes, Power factor meters, Digital frequency meters, phase sequenceindicators, Illumination Instrument, Definition, Flicker, illumination photo meter, Cathode ray Oscilloscope, Block diagram, Construction of Circuit, Deflection sensitivity, Various controls, X–Y Section, delay, line, Horizontal sweep section, synchronization of sweep and triggered sweep, Measurement ofvoltage, current, phase angle, frequency, CRO probes, dual trace beam, high frequency beam,Digital Storage Oscilloscope (DSO), Construction, principle and operation of the following Meters and Instruments, Q-meter, transistor tester, LCR Bridge, function generator, Tong tester, flux meter, spectrumanalyser.

PRINCIPLES OF INSTRUMENTATION

Basics of Instrumentation Systems, - Scope and necessity of instruments - Measurement, its significance and types - Building blocks of instrumentation systems - Various testing signals - Important process variables and their units, Performance Characteristics of Instruments, Static characteristics of instruments-accuracy, precision, linearity, resolution, sensitivity, hysteresis, drift, dead time, loading effects. - Dynamic inputs and dynamic characteristics-time constant, response time, natural frequency, damping coefficient. - Reliability, serviceability, cost effectiveness, and availability - Static and dynamic response (step response) - Order of Instruments - Environmental

Effects - Calibration tools, Display and recording devices - Operating mechanism in indicating and recording devices - Various indicating, integrating and recording methods and their combination - Merits and demerits of circular chart and strip chart recorder - Basics of printing devices - Scanning, data logging and field buses - Bar graph LCD, Seven segment display, X-Y recorder, scanners - Design experiments for display system, Errors - Calibration of instruments - Sources of errors - Classification of errors - Grounding/earthing – Precautions.

FUNDAMENTALS OF DIGITAL ELECTRONICS

1. Introduction: a) Distinction between analog and digital signalb) Applications and advantages of digital signals.

2. Number System: a) Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal tobinary and vice-versa.b) Binary addition, subtraction, multiplication and division including binary points. 1's and 2'scomplement method of addition/subtraction, sign magnitude method of representation,floating point representation

3. Codes and Parity: a) Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and grey code.b) Concept of parity, single and double parity and error detectionc) Alpha numeric codes: ASCII and EBCDIC.

4. Logic Gates and Families: a) Concept of negative and positive logicb) Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND andNOR as universal gates.(c) Logic family classification:- Definition of SSI, MSI, LSI, VLSI- TTL and C MOS families and their sub classification-Characteristics of TTL and C MOS digital gates. Delay, speed, noise margin, logic levels,power dissipation, fan-in, power supply requirement and comparison between TTL and CMOS families

5. Logic Simplification: a) Postulates of Boolean algebra, De Morgan's Theorems. Various identities. Formulation oftruth table and Boolean equation for simple problem. Implementation of Boolean (logic)equation with gatesb) Karnaugh map (upto 4 variables) and simple application in developing combinational logiccircuits.

6. Arithmetic circuits: a) Half adder and Full adder circuit, design and implementation.b) Half and Full subtracter circuit, design and implementation.c) 4-bit adder/subtracter.d) Adder and Subtractor IC (7484).

7. Decoders, Multi-plexeres and De Multi-plexeresa) Four-bit decoder circuits for 7 segment display and decoder/driver ICs.b) Multiplexers and De-Multiplexersc) Basic functions and block diagram of MUX and DEMUX. Different types and ICs.

8. Latches and flip flops: a) Concept and types of latches with their working and applicationsb) Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops.c) Difference between a latch and a flip flopd) Flip flop ICs.

9. Counters: a) Introduction to Asynchronous and Synchronous countersb) Binary countersc) Divide by N ripple counters, Decade counter.d) Pre settable and programmable counterse) Up/down counterf) Ring counter with timing diagramg) Counter ICs.

10. Shift Register: Introduction and basic concepts including shift left and shift right.a) Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.b) Universal shift registers c) Buffer register, Tristate Buffer registerd) IC 7495

11. A/D and D/A Converters: a) Working principle of A/D and D/A convertersb) Brief idea about different techniques A/D conversion and study of: Stair step Ramp A/D converter, Dual Slope A/D converter, Successive Approximation A/D Converterc) Detail study of Binary Weighted D/A converter R/2R ladder D/A converterd) Performance characteristics of A/D and D/A converter.e) Applications of A/D and D/A converter.

MICROPROCESSORS, MICROCONTROLLERS AND THEIR APPLICATIONS

Microprocessors 1. Introduction – evolution, importance, and application. 2. Architecture of a Microprocessor- 8085 a) Concept of a bus and bus organization. b) Functional block diagram and function of each block. c) Pin details of 8085 and related signals. d) Demultiplexing of address/data bus and memory read/write cycles. 3. Programming (with respect to 8085 microprocessor) a) Brief idea of machine and assembly languages, Machines and Mnemonic codes. b) Instruction format and Addressing modes. Identification of instructions as to which addressing mode they belong. c) Concept of Instruction set. Explanation of the instructions of the following groups of instruction set d) Data transfer groups, Arithmetic Group, Logic Group, Stack, I/O and Machine Control Group. e) Programming exercises in assembly language. (Examples can be taken from the list of experiments). 4 Interfacing and Data Transfer Schemes a) Memory mapped I/O and I/O mapped schemes. b) Interrupts of 8085, maskable and non-maskable interrupts, software interrupts, marking of interrupts 5. I/O Chips a) 8255: pin configuration & block diagram b) 8259: pin configuration & block diagram c) 8257: pin configuration & block diagram, Micro controllers 6. Introduction Comparison of microcontroller and microprocessor, Architecture of 8051, hardware I/O pins, ports, connecting external memory, counters, timers serial port, I/O interrupts. 7. Instruction set and Addressing Modes - Addressing Modes and its types - Basic Instruction like: - Data Transfer, Conditional and Arithmetic) 8. Assembly Language Programming - Assemblers and Compilers - Programming based on basic instructions.

TRANSDUCERS AND SIGNAL CONDITIONING

1. Basic concepts- Definition and classification of transducers, selection criteria, characteristics2. Variable Resistance TransducersConstruction, working principle, selection criteria and application ofPotentiometer, strain gauge, load cell, Hot wire anemometer, photo resistors, Resistive temperature transducers, Thermistors, Carbon Microphones, Accelerometer advantages, disadvantage, and limitation. 3. Variable Inductance transducerConstruction, working principles and application of Electromagnetic pick up, Induction potentiometer, Linear variable differential transformer, Synchronous transmitter and receivers, advantages, disadvantages, and limitations, 4. Variable capacitance Transducers (08 hrs)

Construction, basis principles of selection criteria and application ofCapacitance pick up, Condenser microphone, Differential capacitor pick up advantages, disadvantages, and limitations5. Piezoelectric Transducers, Construction, basic principle, selection criteria and application ofPiezoelectric Transducer, Seismic pick up, Ultrasonic Transducer, Advantage, disadvantages, and limitations6. Other types of transducers, Transducers based upon hall effect - Optical transducers-photo diode, photo transistor LDR and LED, Digital transducer-single shaft encoder, Techno generator, Advantage and disadvantage and limitations, - Magneto strictive transducers, 7. Principle of Analog Signal Conditioning, Linearization, Various types of conversions (from V to F, from F to V, V to I converters and I to V, converters), Filtering and impedance matching.

ADVANCED CONTROL SYSTEM

1. Single and Multiloop Control System, Introduction to single and multiloop control system and its types like feedback, feedforward, cascade, ratio, split range, control system. Study of each of above control system with a suitable example, three element drum level control. 2 Non-Linear Control System, Introduction, behaviour of non-linear control system. Different types of non-linearities, saturation, backlash, hysteresis, dead zone, relay, fiction, characteristics of non-linear control system, limit cycles, jump resonance, jump phenomenon. Difference between linear and non-linear control system. 3. Introduction to Artificial Intelligence and Robotics, Fuzzy Logic and neuro fuzzy logic in control system, Artificial Neural Networks, Robotics, degree of freedom, the robot arm configuration.

PRINCIPLES OF TELEMETRY

Land line telemetry - Pneumatic system - Flopper nozzle - Pilot relay - Non bleed type - Bleed types feedback - Limitations Electric system - Current system - Impulse system - Position system or Ratio system - Frequency system - Voltage system RF Communication - Amplitude modulation - Frequency modulation - Phare modulation - Pulse modulation - Pulse code modulation.Transmitters - Pneumatic Transmitter - PDPT bellow type - PDPT diaphragm type - Electric transmitters - Electronic force balance DPT - Hydraulic transmitter, Transmission Channels - Wireline channels - Radio Channels - Multiplexing channels - Time division multiplexing - Frequency division multiplexing, Data Communication, Modulation & demodulation of signals using - Amplitude shift keying - Frequency shift keying - Phase shift keying Errors and correction in above systems, Instrumentation Buses - General view of instrumentation buses - Field programmable buses, Inter-bus.

ANALYTICAL AND ENVIORONMENTAL INSTRUMENTS

1. Introduction: Fundamental blocks of analytical instruments (brief details)2. Spectroscopic analysis - Absorption spectroscopy- NMR spectroscopy- Mass spectroscopy(Brief concepts of all these methods)3. Gas analysis- Infra-red gas analyser - Paramagnetic oxygen analysers - Thermal conductivity analysis(Principles of working of these analysers and block-diagram explanation only)4. Gas Chromatography – Introduction- Related instruments like injectors, oven, column and detectors. - Infra-red analysers.5. Liquid Analysis- Principle of pH measurement - Electrodes for pH measurement - Electrochemical analyser 6. Environmental pollution monitoring instruments, Air quality standards, Types, and measurement of concentration of various gas pollutants in atmosphere, Dust measurement7. Electrochemical instruments, Electrochemical cell - Types of electrodes, Conductivity meters- Aqua meters8. Instrumentation used for water and noise pollution and their monitoring.

PROCESS INSTRUMENTATION

1. Introduction, Measurement of length, angle, area, working principle of vernier callipers, micrometre, comparator. Least count of each instrument 2. Measurement of Pressure, Torque, Power, Speed and Force, Various methods 3. Measurement of Stress and Strain, Strain gauges, their types, gauge factor, load cells, temperature compensation. 4. Measurement of Motion, Displacement, velocity, acceleration; seismic pickups. 5. Thickness Measurement, Thickness measurement by using: - Resistive method - Inductive method - Capacitive method - Ultrasonic method 6. Measurement of Density, pH, Humidity and Viscosity.

PROCESS CONTROL

1. Basic Control Loops and Characteristics, Basics of process control, process variables, single and multi-capacity processes, single capacity level, pressure, temperature, and flow loop systems.

Process lag, measurement lag, transmission lag and dead time. 2. Controller Modes and Characteristics Concept of on-off, proportional, integral, derivative, P, PI and PID controls, their examples, merits and demerits. 3. Electrical Control Elements, Construction, and principle of operation of solenoids, stepper motor, limit switches, relays, auto transformer and magnetic amplifier. 4. Pneumatic and Hydraulic Control Elements, Pneumatic pressure supply, pneumatic actuator, pneumatic relay, pneumatic amplifiers, electro-pneumatic actuators, flapper-nozzle system and bellows, air filter and regulator. Hydraulic actuators and valves, electro hydraulic actuators 5. Control Valves, Principle of operation and constructional details of solenoid valve, diaphragm operated valve, globe valve, ball valve, butterfly valve, valve positioners. Control valve characteristics, their sizing and selection of valves. 6. Switches, Temperature switches, Flow switches, Pressure switches, interlocking and sequencing circuits, need of interlocks, annunciators.

PLC, DCS and SCADA

1. Introduction to PLC, what is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc. 2. Working of PLC - Basic operation and principles of PLC - Scan Cycle - Memory structures, I/O structure - Programming terminal, power supply 3. Instruction Set - Basic instructions like latch, master control self-holding relays. - Timer instruction like retentive timers, resetting of timers. - Counter instructions like up counter, down counter, resetting of counters. - Arithmetic Instructions (ADD, SUB, DIV,MUL etc.) - MOV instruction - RTC (Real Time Clock Function) - Watch Dug Timer - Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal - Programming based on basic instructions, timer, counter, and comparison instructions using ladder program. 4. DCS Concepts, Concept of DDC, DCS I/O hardware, Remote Terminal Unit 5. SCADA, Block Diagram of SCADA, Difference between Open Architecture and Dedicated System. Difference between DCS and SCADA.

ADVANCED MEASUREMENT TECHNIQUES

1. Review of Measurement System, Functional elements of a measuring system, Input – output configuration of instrumentation system 2. Measurement of Flow, Construction, working principle and application of flows with orifice, Magritte ultrasonic and rotameter 3. High Frequency Measurement, Resonance methods, Measurement of inductance and capacitance, Measurement of effective resistance by resistance variation method and reactance variation method, T networks – parallel T networks and bridge T networks, Radio frequency measurement – sensitivity and selectivity measurement of radio receiver 4. Opto-Electronic Measurement, Photo sensitive devices – light emitting diodes, photo diodes, photo conductors, Photo voltaic cell, photo thyristors, photo transistorsLight modulating techniques – light suppression, light attenuation, photo-metric and radiometric fittings 5. Temperature Measurement, Construction, working principle and application of temperature sensors, Thermocouple RTD’s, Thermistor, Radiation pyrometry, IR detectors 6. Measurement of Level, Construction, working principle and application of float, level gauges, optical level devices and thermal level sensors.

VIRTUAL INSTRUMENTATION

1. Introduction to Virtual Instrumentation, Historical perspective, advantages of virtual instruments over conventional/traditional instruments, block diagram and architecture of virtual instruments. 2. Learning Lab view, Introduction, Front panel, Block diagram, Menus, Palettes, VI &Sub VI, Editing and Debugging VI, Structures, Arrays, clusters, charts & Graphs, Data acquisition, Instrument control, signal processing examples 3. Data Acquisition Basics, ADC, DAC, DIO, connectors and timers, PC

hardware structure, Introduction to various Data Acquisition Cards. 4. Common Instrumentation Interfaces, Introduction to RS232 / RS485, GPIB, USB, instrumentation buses (introduction such as inter bus). 5. Applications of VI in process control like pressure, temperature control etc.

Important Note: The Weightage as mentioned against the syllabus is tentative & may vary.