

DETAILED SYLLABUS FOR THE POST OF INSTRUMENT
MECHANIC (Medical Education) - Direct Recruitment and NCA for
:SCHEDULED CASTE
(CAT.NOS: 050/2022, 075/2022)

Sl. No.	TOPICS	Marks
Module 1	Precision Measuring Instruments, Gauge blocks, Sine bar, Dial indicators, Vernier Calipers, Micrometers, Bevel protractor, Thickness gauges. Element & types of screw threads used in instruments, Calculation of drill size for tapping.	10 Marks
	Types of tubes used for instrumentation. Tube cutter, Flaring tools, Swedging tools, equipment & fixture required for pipe bending, straightening, thread cutting etc.	
	Electrical components conductor, semiconductor & insulators. Standard wire gauge (SWG). Introduction of electricity- static electricity. Current, voltage, P.D, E.M.F, resistance. Electrical circuit - D.C & A.C circuit differences. Importance of grounding.	
	Uses of multimeter. Resistor, Resistivity and colour code, Types of resistors used in instrumentation.	
	Types of soldering irons. Solder & flux. Ohm's law & Kirchhoff's laws. Series & parallel circuits. Primary & secondary cells and batteries. (Liquid & dry).	
	Switches and types. Magnet and magnetism, magnetic properties. Explanation of Electro-magnetism, application-types E.M. relays.	
Module 2	Principles of alternating current, A.C & DC electricity, types of wave forms, time period and frequency, peak to peak values, RMS values, Average values.	10 Marks
	Inductor and Inductance, types of inductors, Factors affecting the value of inductance, self inductance (L), Capacitance, types of capacitor, unit of capacitance, energy stored in capacitors. Capacitors in series and parallel. Capacitors in DC circuit.	
	A.C. impedance, Inductive reactance, capacitive reactance. AC current through - R, L, C circuits. Resonance in RLC circuit. Importance - of series and parallel resonance.	
	Introduction of AC and DC generators working principles, EMF equation. Faraday's Law, Lenz's Law, Fleming's left Hand and right-hand rules. DC motors working principles, Different speed controlling techniques of DC motors. AC motors, induction motors, three phase motors, stepper motors.	
Module 3	Transformer, types, transformation ratio. Open circuit test and short circuit test, regulation Autotransformer. Current measurement. Instrument transformer. Potential transformer and current transformer.	10 Marks
	Basics of electrical measuring instruments- Types - absolute and secondary instruments. Types of secondary instruments, DC instruments - D'Arsonval meter, PMMC meter- working principle, moving coil operation. (FSD) full scale deflection reading, measurement value, meter sensitivity, accuracy. Meter range extension- Converting galvanometer into ammeter, voltmeter. Range	

	extension of voltmeter, ammeter. Shunt resistance and series resistance value calculation. Meter resistance, meter FSD identification techniques.	
	Ohmmeters- measuring electrical resistance. Types of Ohm meter - series and shunt type of ohm meters. Megger/insulation tester, earth tester ± AC instruments - types of AC measuring instruments -MI, electro dynamometer type. Induction type meters working principle - single phase and three phase energy meter, watt meter. Watt hour meter, Ampere Hour meter, power factor meter etc. Special instruments: voltage tester, continuity tester, rotation test, phase sequence indicator, synchronizing, the synchroscope, _ frequency meter. Thermocouple type ammeters.	
Module 4	<p>Intrinsic and extrinsic semiconductor. PN junction diode, Forward and Reverse characteristics. Specification of diodes. Special semiconductor diode-Zener diode, tunnel diode, Photo diode. Transistors. NPN& PNP transistor, Symbol, operation, Biasing of Transistor. Transistor CB, CC, CE Amplification, current gain, voltage gain, and power gain. Introduction to FET, MOSFET. Rectifiers: half wave rectifier, full wave (bridge & center tapped) rectifier. Voltage multipliers. Filters: Introduction, purpose and use of ripple filter. Types of filters. Capacitance filter, inductance filters, RC filters, LC filters, voltage dividers and bypass filters. Voltage regulators. Introduction & purpose Zener regulators, shunt regulators, series regulators, IC regulators, variable regulators.</p> <p>Power Supply units. Introduction, purpose & use. UPS and SMPS, inverters and converters and their applications. General characteristics of an amplifier, Concept of amplification. PCB basic construction, applications. Lay outing circuit on PCB.</p> <p>Oscillator's oscillations, oscillation frequency, basic working principle and working of Talk circuit, Crystal controlled oscillators, Phase shift oscillators, RC phase shift oscillators, Colpitt, Hartley.</p> <p>Operational Amplifier. Differential amplifier, ideal Op-amp. Inverting and Non-inverting and inverting amplifier, Op-amp as summer, differential amplifier. V to I converter and I to V converter, Instrumentation amplifier Basics of op- amp applications - integrator, differentiator, Introduction of timers (555) and its applications.</p>	10 Marks
Module 5	<p>Number systems; binary, octal, decimal and hexadecimal number system. Conversion of number systems. Boolean algebra, binary addition, subtraction, multiplication and division. 1's and 2's compliment, BCD code, ASCII code, gray code. Logic Circuits. Basic gates-AND, OR and NOT gates. De-Morgan's Theorem.</p> <p>Universal gates - NAND and NOR gates. Special gates - Ex-OR, Ex-NOR gates and Buffer and its applications. Basic digital ICs, function, digital application, logic symbols. Adders - Half adder, full adder Subtractor - Half subtractor, full subtractor. Flip flops - RS flip flop, clocked RS flip flop, JK flip flop, Basics of Counters and registers. Multiplexer and de-multiplexer. Digital meters: displays: LED, 7 segment display, LCD, CRT, electro- luminescent displays, electro-phoretic image display, liquid vapor display, dot matrix display. A/D and D/A converters, Introduction, weighted register</p>	10 Marks

	D / A converter, binary(R-2R) ladder D / A converter, specification for D / A converter, Ramp or counter type A/D converter, GPIB (general purpose interface bus) IEEE - 488, RS 232. ladder D / A converter, specification for D / A converter, Ramp or counter type A/D converter, GPIB (general purpose interface bus) IEEE - 488, RS 232.	
	Digital meters: frequency meter, phase measuring meter, Digital capacitance meter. CRO: Functional block diagram of CRO, CRT power supply. Various types of probes. Applications of various types of CROs like dual beam CRO, Dual trace CRO, storage oscilloscope Computer-Software & Hardware familiarization of Multimedia System consisting of CD ROMS, DVD ROMS, Sound Cards. Computer hardware such as CPU, CPU operations, ROMs and RAMs, I/P and O/P and peripheral equipments, terminals, printers, MODEMS, Data interface, ADC and DAC. Introduction to microprocessor microcomputers, Memories Intel 8085. Architecture Instruction set of 8085, Microprocessor. 1. Data transfer group. 2. Arithmetic group. 3. Logic group Basic Programming of 8085 such as adding, subtraction of two 8-bit numbers, etc.	
Module 6	<p>Fundamentals of measurement systems functional block diagram of measurement system. Calibration and calibration standards± basic standards, secondary standards, working standards. Fundamental units - The metric system, Base & supplementary units, Derived Units, Multiplying factors and standards of length, mass, time & frequency. Temperature & electrical units. Instrument characteristics Static characteristics± accuracy, precision, sensitivity, resolution dead zone, repeatability, reproducibility, drift, Dead band, backlash, hysteresis. Dynamic characteristics± speed response, fidelity, lag. Error, deviation, true value, data. Types of errors- systematic, random error. Certainty/uncertainty, validity of result. Damping & its importance. Statistical analysis ± arithmetic mean, deviation from the mean average deviation, standard deviation. Stress & Strain Measurement. Introduction to Strain gauges, types of strain gauges and differences. Applications of strain gauges, load cells. LVDT, RVDT, Measurement of motion, velocity/vibrometers and acceleration. Difference between tachometer and speedometers. Types of tachometers-Eddy current type, AC and DC tachometer. Stroboscope and its applications. Seismic instrument.</p> <p>Principle of Pressure in Liquids & Gases. Properties of matter Principles of liquid pressure, units of pressure Liquids pressure and volume, density and specific gravity. Pressure relation with volume, temperature and flow. Units of pressure and unit conversions. Types of pressure: absolute, gauge, atmospheric and vacuum pressures and their relationships. Barometers, manometers types. Types of pressure sensing elements-bourdon tube, diaphragms, capsules, and bellows. Pressure switches types and applications.</p> <p>Electrical pressure transducers. Method of conversion, primary and secondary pressure transducers. Potentiometric pr. Transducers, Capacitive pr. transducers, reluctance-servo pressure transducers, strain gauge pressure transducers, piezo electric pressure</p>	10 Marks

	<p>transducer. Differential pressure transducers.</p> <p>Low Pressure Measurement. Vacuum, gauges, thermal conductivity gauges, Pirani gauges, thermocouple gauges, slack diaphragm. Ionization gauge, McLeod gauge, Pressure instrument calibration. Dead weight tester and comparators/manifolds. Elements of pressure transmitters, pressure taps, Isolation valve, instrument piping, connections and fittings blow down valve, instrument valve, pulsation damper, diaphragm seal, pressure transmitter.</p>	
Module 7	<p>Basic properties of fluids, fluids in motion, units of flow rate and quantity flow, factors affecting flow rate, Reynolds number, relation between flow rate and pressure, area, quantity. Types of flow meters \pmhead type, variable area type, quantitative flow meters. Mass flow meters. Head type of flow meters: types venturi tube, orifice plates and its shapes. Pitot tube, flow nozzles. Open channel flow meters principle of open channel flow, weirs, notches and flumes. Various shapes and their applications, Variable area type flow meter- Rotameter, working principle, applications. Various shapes of float, type of materials used for body and float. piston meter, oscillating piston meter, rotating vane meter, rotating disk meter, lobed impeller and oval flow meter, calibrating positive displacement meters. Target flow meters, turbine flow meter, magnetic flow meters, vortex flow meter. Coriolis mass flow meter, thermal flow meters and summary basics of ultrasonic flow meters. The Doppler hit method. The beam deflection method, frequency difference method.</p> <p>Principles of level measurement. Types of level measurements-solid and liquid, volume and mass, mechanical and electrical type. Open and closed channel level measurements, level switches, mercury level switches in high pressure tank, level detectors, magnetic reed switches. Pressure head instruments. Hydrostatic pressure, specific gravity, pressurized fluids, pressure head instrumentation, air bellows, U- tube manometers, air purge systems, liquid purge systems, force balance diaphragm system.</p>	10 Marks
Module 8	<p>Temperature measurement. Temperature, heat, specific heat, changing physical state Fahrenheit and Celsius temperature scales Rankine and Kelvin scales, calibration of temperature scales. Industrial application of temperature measuring instruments with compensating link & precautions to be taken. Bimetallic and fluid filled temperature instruments. Bimetallic thermometers, liquid-in-glass thermometers, filled system thermometers, thermometer bulbs, capillary & bourdon tube, temperature transmitters for filled system. Electrical temperature instrument. Resistance thermometer, RTD bridge circuits, lead wire error, RTD elements, protecting wells for RTD, thermistors, thermocouples.</p> <p>Pyrometry-effects of temperature, wavelength and radiated energy, pyrometers and wavelengths, using of optical and radiation pyrometer, Measurement of humidity. Thermal imagers. Recorders, use of pneumatic and electronic recorders. Strip-chart, circular chart.</p> <p>Pneumatic and Hydraulic Actuators. Diaphragm actuator, spring and springless actuators, direct and reverse acting actuator, piston actuator, positioner, Electrical actuators</p>	10 Marks

	Control valves. types of control valves, based on valve flow characteristics liner, equal percentage, quick opening valves, globe valves, cage valves, butterfly valves, ball valves, sliding gate valves, diaphragm valves, split body valves, capacitive, inductive type valve, proximity switch, IR switch, micro switch, limit switch, other control valves, valve positioner.	
Module 9	Control loop measuring PV, amplifying signals final control elements, current proportioning, ON/OFF controllers, direct and reverse acting controllers proportional controllers, automatic/manual split control, pneumatic control. Adaptive, limiting and batch control, ratio control system, feed forward, feedback control systems and cascade control system.	10 Marks
	Controller models and tuning. Controller tuning, setting, controller modes, proportional mode, off-set, integral mode, reset mode, derivative mode(rate), single, mode controller, two mode controller, three mode controllers, tuning the control loop, step-change-response method.	
	Introduction to programmable controllers. general characteristics of programmable controllers, developing PLC programming.	
	Input/output devices. Definition of input /output devices, I/O interface, input modules, output modules, input devices encoders, output devices, the opto-isolators, safety. programming symbols, start, stop, station example, other programming symbol timers and counters.	
	Digital control systems: need of smart devices, HART transmitters futures, HART devices, HART protocol. HART communicators and PC based HART device configuration.	
Module 10	Networking: types of networks used in digital instrument systems. LAN, WAN, Ethernet. Point to point and multi networking. Ring, delta, star connections. Types of Cable categories (CAT), and their descriptions. Various types of Cable connectors. co-axial cable and fiber optic cables. Various tools used in networking- wire cutter, crimp tool, memory blade holder, memory blade cartridge, cable strip tool with blade cassettes. Modulation and demodulation, signal to noise ratio, digital communication basics-PWM, PCM, FSK. Fundamentals of SCADA and DCS. History of DCS development. Basic architecture, description advantages and disadvantages, applications. Terminology- RTU (remote transmitting unit, central monitoring station, types of communications, field instruments and types.	10 Marks
	Field bus working, Work station, Human Machine Interface (HMI). Controller (with basic types), field bus interfacing modules, gateway, network manager, I/O modules, field bus devices (I/O), remote transmission panel (RTP), Ethernet.	
	Analytical instruments. Types of electrodes used for PH measurements. Relation of PH and mV. PH indicator and controllers. Conductivity meters. Dissolved oxygen meter.	

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above

may be covered in the question paper.