

Syllabus for Trade Test for the recruitment of Technical Assistant (Group III) against CSIR-CMERI Advt. No. 04/2021

(A) Mechanical / Production

- Identifying common measuring instruments and cutting tools used in a manufacturing workshop and their applications
- Machining a mild steel or low carbon steel part from a given raw stock as per a given production drawing, using a conventional general purpose lathe and milling machine, measurement of this machined parts using a given set of measuring tools and reporting the dimensions achieved
- Preparing programme (ISO format) for machining a given part / part drawing in a CNC (Computer Numerical Control) turning / machining centre
- Constructing two dimensional (2D) orthographic projections from a given isometric drawing of a part; Constructing isometric drawing of a part from a given set of 2D orthographic projections of it
- Designing a pattern (including pattern allowances), gating and riser system for sand casting of a given part / part drawing; Preparing green sand mould using a given pattern, set of components of gating system and riser

(B) Electrical / Electronics Engineering

Electric Circuits & Networks: Network Theorems (Thevenin's theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem, Power in three phase circuits, Half and Full Wave Rectifier circuits, Star-Delta conversion, basic idea of Filter circuits.

Electronic Devices and Circuits: diodes, BJT & Transistor Amplifiers, JFET, MOSFET & UJT, Operational Amplifier (Op-Amp), Power Amplifier, Feedback Amplifier & Oscillator, Waveform Generator, Op-Amp using IC.

Measurements and Instrumentation: PMMC & MI meters, Wattmeter, Power Factor meter, Energy meter (single & three phase), Transducers (RTD, LVDT, Piezoelectric etc.) and Potentiometers (DC & AC), Temperature measurement (Thermistor, Thermocouple), Level measurement, Pressure & Flow measurement, Function Generator, Microprocessor based instrumentation system.

Digital Electronics & Microcontroller: Logic Gates, Combinational circuits, Sequential circuits, Basics of 8051 microcontrollers, Programming using ASM/C, Arithmetic logic instructions, Delay generation, Interfacing with LCD, Keyboard, Stepper Motor & ADC/DAC.

Power Electronics & Industrial Automation: Power Diodes, Power Transistors, MOSFET & IGBT, Thyristors, SMPS, PWM control circuit, Power supply, Rectifier circuit, Introductory Process Control, Sensors & Actuators.



(C) Civil Engineering

a) Surveying :

Methods of measuring horizontal distance: Pacing, odometer reading, tachometry, chaining and taping.

Chain and tape survey in a field: Measurement by chain – on level ground and sloping ground, reduction to measurement in slope, ranging – direct and indirect ranging, survey lines, check lines, tie lines, base line. Taking offsets – perpendicular and oblique offset, long and short offset, degree of offset, error in offset, limiting length of offset, points to be considered in selecting station.

Prismatic compass, and trough compass: Component and use.

Use of Engineers' level: Dumpy level – components, use, tilting level and automatic level or self-levelling level. Use of dumpy level, temporary adjustments and taking reading on levelling staff. Differential levelling practice, reduction of level by rise & fall method.

Different methods of plane tabling work: Radiation, intersection, traversing and resection – three point problem.

Theodolite Survey.

b) Construction materials:

Building stones: Classification of rocks (physical), requirement of good building stone.

Bricks: Conventional bricks, standard bricks, strength of bricks, select class of bricks from sample, perform field test of bricks, dropping test, striking test, etc. crushing strength testing of bricks.

Mortars: Tests for mortar.

Rebar: Tensile test of reinforcement bars, identifying various diameters of rebars.

Aggregates: Identify various sizes of available coarse aggregates from sample, Aggregate crushing value test.

Bitumen: Softening point and penetration test of bitumen.

Steel: Identification of standard steel sections with measurement of dimensions as per codes.

c) Concrete Technology:

Determination of: Fineness of cement by sieving, standard consistency of cement, initial and final setting time of cement, compressive strength test of cement, bulking of sand, water absorption of fine and coarse aggregate, grading of fine and coarse aggregate by sieve analysis, determination of fineness modulus & grading zone of sand by sieve analysis, workability of concrete by slump cone test, compressive strength of concrete cube, cylinder.



d) Preparation of drawing:

Preparation of 2D drawing: (Plan, cross section and Elevation) of buildings, etc. using Auto CAD.

e) Geotechnical Engineering:

Water/Moisture content of soil: Determination of water content by oven drying method, bulk unit weight, dry unit weight, Liquid limit & Plastic limit of given soil sample as per IS Code.

f) Estimation and costing: Estimation of items based on drawing-earthwork, PCC, RCC, Shuttering, Reinforcement, Brick work, plastering, etc.

(D) Electical Engineering

Fundamentals of Electrical Engineering and Electric Circuits

Testing of passive (Resistors, Capacitors, Inductors) and active (Diodes, Transistors, FET, MOS, CMOS and op-amp and others) electronic components like identification, measurement of values/parameters with their units in series/ parallel or other combinations. Circuit testing using application of network and circuit analysis theorems (Thevenin's, Norton, Superposition and Maximum power transfer Theorem, mesh analysis, node analysis, source transformation). Determining different parameters of R-L-C circuits (in DC and AC system) using standard equipment. Active, reactive, apparent power, frequency, power factor and other line and phase quantities (voltage, current, power etc) in balanced/unbalanced, star/delta, single-phase/three-phase system.

Electrical and Electronic Measurements

Different components of measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale. Measurements of DC/AC voltage, current using PMMC and moving iron instrument, voltmeter, ammeter, CT, PT etc, measurement of power (Active, reactive, apparent power) using 1/2/3 wattmeter method, electrical energy using single and three phase electronic energy meter etc. Measurement of AC and DC quantities in a working circuit. Other meters: Earth tester, Megger and Ohm meter, Digital Multi-Meter; clamp-meter, L-C-R meter, Frequency meter (ferromagnetic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchro scope, Tri-vector meter, Single beam/single trace CRO, Digital storage Oscilloscope etc. Measurements of parameters using different bridges.



Electrical Machines

Single and three phase transformers, parallel operations of transformers, functioning, characterization, voltage regulations, voltage-ratio, efficiency, power factor, testing and maintenance of transformer like open circuit short circuit testing, transformer oil testing, polarity test, phasing out test. Special purpose transformers: pulse and isolation transformer, auto-transformer in step-up and down mode. Electric generators and motors: alternating current/ direct current/ synchronous/ induction/ stepper/ servo (AC/DC) etc., its various characteristics curves of motors and generators like efficiency, power factor, voltage and speed regulations using open circuit/short circuit, torque-speed/slip characteristics, different starters like DOL, star-delta, auto-transformer starters, testing like no load and block rotor test, brake test, heat run test and controls like speed control, direction reversal etc.

Utilization of Electrical Energy

Illumination, different type of light fittings, illumination level assessment with and without reflectors, polar curve of different lamps (Incandescent, Fluorescent, CFL, LED, HPSV, HPMV). Industrial drives: Speed control of motor (DC/AC/IM, single or three phase) using voltage/current/frequency control. Speed control of motor (DC/AC/IM, single or three phase) using power electronic drives like chopper, single phase/three-phase converters etc, Utilization of electrical energy for electric heating, electroplating, electric welding etc.

Installation, Commissioning, testing & maintenance of electrical equipment

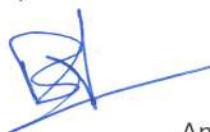
Electrical Safety and Insulation; Installation, Erection and Commissioning of static and rotating electrical machineries, transformers. Testing of electrical equipment during maintenance/ trouble shooting.

Estimation & Costing

Design electrical installation with costing for tendering, quotation for different electrical materials. Design electrical installation scheme (based on National Electrical Code 2011), estimation and costing of installation of industrial/non-industrial, public lighting (street light), distribution line, LT substation based on the drawings.

Fundamentals of Power Electronics

Characteristics of Power Electronic Devices and determining various parameters like break down voltage, latching current and holding current, firing angle for switches like SCR, MOSFET and IGBT, DIAC, TRIAC etc. Operation and waveforms of single phase half & fully-controlled converter with R & RL load, trouble shooting of power electronic systems like step down and step up MOSFET based choppers, IGBT based single, three phase PWM inverter, switched mode power supply (SMPS), uninterrupted power supply (UPS), power factor correction (PFC) etc.



(E) Automobile Engineering

a) Automotive Engines:

- Assembling engine parts such as piston, connecting rod, cylinder head, rocker arm assembly & mini force engine, F.I. pump, injector, fuel filter & other accessories.
- Determine B.H.P, I.H.P, BSFC of a multi cylinder engine
- Servicing of inlet, exhaust manifolds silencers & tenpin.
- Overhauling of fuel feed pump (both diesel & petrol).
- Testing of fuel injection system and adjustment of pressure of a fuel injector.

b) Auto Electrical:

- Automotive wiring & Lighting Circuits (Light Vehicle).
- Install inverter of given lead acid battery.
- Trouble Shooting on Alternator, Battery, AC Connection.
- Use of Automotive Gauges-Temperature, Engine Oil Pressure, Fuel gauge, Speedo Meter.
- Current Draw Test, Ground Circuit Test, Insulated Circuit Resistance Test.
- Adjustment of Head Light Beam, Wiper and Indicators.
- Locate Various Components of Electronic fuel injection system.

c) Two / Three Wheeler Tech:

- Preparation Two / Three Wheeler Transmission System Layout.
- Carburetors Cleaning.
- Dismantle of two wheeler engine, checking engine bore, piston rings, connecting rod, bearings, crankshaft, engine assembly & tune up.
- Measurement of piston ring gap, the piston ring to groove clearance, piston OD, cylinder to piston clearance, piston pin OD.
- Alignment of connecting rod for twist and bend.

d) Auto Hydraulics:

- Dismantle & assemble Lubricating oil Pump of Car.
- Trace & Draw Hydraulic Circuit & Components of Automobiles Hydraulic brake of 4-wheel vehicle.
- Hydraulic brake assembly of LMV/HMV Vehicles.
- Brake control System: Antilock braking system (ABS), Electronic Brake-force Distribution (EBD) & Traction Control System (TCS).
- Layout and Assembly of Hydraulic connection of Tractor.
- Listing out the Hydraulic & pneumatic system valves and their assembly to Heavy Vehicle.
- Hydraulic steering systems of Automobile, Power steering, power windows.



e) Vehicle Maintenance:

- Compression Test on Petrol / Diesel Engine.
- Assembly of Drive & Differential assembly with relevant adjustments.
- Layout and assembly of Steering Gear Box & Steering Linkage
- Wheel Balancing & Alignment of Car on Balancing Machine.
- Tyres & designation, dimensions.
- Differential of a Tractor.
- Power train & transmission layout of a tractor.
- Dismantle (i) rear axle (ii) differential and find out the gear ratio of crown wheel & driven sun gear and planet pinion.
- Valve Clearance Adjustment and Valve Timing.
- Dismantle and assemble a Multi-plate clutch assembly used in Two Wheelers.

