

**Comp No. 24341 // No.A.12031/16/2025-PHE
GOVERNMENT OF MIZORAM
PUBLIC HEALTH ENGINEERING DEPARTMENT**

...
Dated Aizawl, the 23rd April, 2026

To

The Engineer-in-Chief, PHED
Mizoram, Aizawl.

Subj : Syllabus for Direct Recruitment to the post of Junior Engineer under PHE Department.

Ref : No.A-12018/1/2008-E-in-C/PHE/165 dt. 01.09.2025

Madam,

With reference to the above, I am directed to send herewith copy of Govt. Gazette of this Department notification No.A-12/6/2026-TECH-PHED dt. 07.04.2026 regarding Syllabus for direct recruitment to the post of Junior Engineer (Civil) (Electrical) and (Mechanical) for favour of information and reference.

Enclo: As above.

Yours faithfully,

Digitally signed by
NGURSANGZUALI SAILO
Date: 23-04-2026
16:13:15

(NGURSANGZUALI SAILO)

Under Secretary (A) to the Govt. of Mizoram
Public Health Engineering Department

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The Mizoram Gazette

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NOTIFICATION

No. A-12/6/2026-TECH-PHED, Aizawl, the 7th April, 2026: In the interest of public service, the Governor of Mizoram is pleased to notify Syllabus for direct recruitment to the posts of Junior Engineer (Civil) (Electrical) and (Mechanical), Level-7 in the Pay Matrix under Public Health Engineering Department, with immediate effect, as shown in the **Annexure** enclosed herewith.

This issues with the approval of DP&AR(GSW) vide I.D No.A.12045/21/2025-GSW-DPAR dated 27.03.2026.

Sudhir Kumar, IAS
Principal Secretary to the Govt. of Mizoram,
Public Health Engineering Department.

**Annexure to Govt. Notification No.A-12/6/2026-TECH-PHED, dt. 27.03.2026
- EComp. No.:24341**

**APPROVED SYLLABUS FOR DIRECT RECRUITMENT TO THE POST OF
JUNIOR ENGINEER (CIVIL) UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT**

The examination shall comprise of the following papers:

1. Paper - I : General English (Conventional type & MCQ with negative marking)	: 100 Marks (3 hours)
2. Paper- II : General Knowledge (MCQ with negative marking)	: 100 Marks (2 hours)
3. Paper - III: Technical Subject (MCQ with negative marking)	: 200 Marks (2 hours)
4. Paper - IV: Technical Subject (MCQ with negative marking)	: 200 Marks (2 hours)
Total of written examination	: 600 Marks
5. Personal Interview	: 75 Marks
Total	: 675 Marks

DETAILED SYLLABUS:

1) PAPER-I: General English (Conventional type & MCQ with negative marking)	: 100 Marks (3 hours)
(a) Précis Writing	: 10 Marks
(b) Letter Writing	: 10 Marks
(c) Comprehension of given passages	: 10 Marks
(d) Essay	: 10 Marks
(e) Grammar: Parts of Speech (MCQ with negative marking)	: 20 Marks
(f) Correct Usage and Vocabularies (MCQ with negative marking)	: 20 Marks
(g) Formation of Sentence (MCQ with negative marking)	: 20 Marks
2) PAPER - II: General Knowledge (MCQ with negative marking)	: 100 Marks (2 hours)
(a) Current events of state, national and International Importance	: 12 Marks
(b) History of India and Indian National Movement	: 12 Marks
(c) Indian and World Geography - Physical, Social Economic Geography of India and the World	: 12 Marks
(d) Indian Polity and Governance - Constitution, Political System, Public Policy, Duties & Rights Issues	: 12 Marks
(e) Economic and Social Development, Sustainable Development, Poverty, Inclusion, Demographics, Social Sector initiatives, and other related issue	: 12 Marks
(f) General issues on Environmental Ecology, Bio-diversity and Climate	: 12 Marks
(g) General Science	: 12 Marks
<i>The topics listed above shall cover the State of Mizoram wherever applicable.</i>	
(h) General awareness on Mizo culture, its heritage and society	: 16 Marks

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|--|-----------------------|
| 3) PAPER -III: Technical Subject (MCQ with negative marking) | : 200 Marks (2 hours) |
| (a) Building Materials And Building Construction | : 50 Marks |
| (b) Surveying | : 20 Marks |
| (c) Estimation and costing | : 50 Marks |
| (d) Theory of structures and concrete | : 20 Marks |
| (e) Design of RCC structure and RCC water tanks | : 20 Marks |
| (f) Soil Mechanics and foundation Engineering | : 20 Marks |
| (g) Construction Management | : 20 Marks |
| 4) PAPER- IV: Technical Subject (MCQ with negative marking) | : 200 Marks (2 hours) |
| (a) Water Supply Engineering | : 60 Marks |
| (b) Hydraulic | : 30 Marks |
| (c) Hydrology (including Groundwater) | : 30 Marks |
| (d) Environmental Engineering | : 30 Marks |
| (d) Sanitation | : 40 Marks |
| (e) Remote Sensing & GIS | : 10 Marks |

Paper-III (Technical Subject)

1. BUILDING MATERIALS AND BUILDING CONSTRUCTION (50 Marks):

Building materials: Physical and Chemical properties. Classification, Standard Test, Uses and Types of Materials:- Building stones, Bricks, Silicate based materials, Cement and Mortars, Sand, Aggregates, Asbestos products, Timber and Wood based Products, Paints, Varnishes, Ferrous metals, Lubricants, Sealants for Joints, Polymers and Plastics, Protective and decorative

Building Construction: Definition, purpose, types and properties of structural and nonstructural components of a building : Foundations, masonry, walls, arches and lintels, doors, windows, ventilators, floors, roofs, stairs, beams, columns, damp proofing, water proofing and surface finishes.

2. SURVEYING (20 Marks):

Basics of Surveying: Definition and principles (working from whole to part, location of a point by measurements from two points); classification of surveys (plane vs geodetic, land surveys - topographic, engineering). Linear Measurements: Chain and tape surveying - equipment (chains, tapes, ranging rods, arrows); methods of ranging (direct and indirect); chaining on flat and sloping ground (horizontal equivalent, slope correction); sources of errors in chaining and basic corrections (tape correction for temperature, pull, sag). Angular Measurements: Compass surveying - true north vs magnetic meridian; bearing systems (whole circle & reduced bearing); calculation of included angles; local attraction and its correction. Introduction to theodolite - horizontal angle measurement by repetition and reiteration, vertical angle measurement; principles of traversing with compass and theodolite, traverse adjustments (closing error, Bowditch rule qualitatively). Leveling and Contouring: Auto level and dumpy level - pans and temporary adjustments; levelling staff; methods of leveling (collimation/Height of Instrument method and Rise & Fall method); reduction of levels, booking in level field book; arithmetic check; types of benchmarks. Contouring; characteristics of contours, interval selection; methods of contouring (direct and Indirect); interpretation of contour maps (slopes, ridges, valleys). Plane Table Surveying: Equipment (alidade, drawing board, plumbing fork); methods (radiation, Intersection, traversing, resection - two-point and three-point problems basics); advantages fit limitations of plane tabling. Curve Setting: Elements of a simple circular curve

(deflection angle, radius, tangent length, mid-ordinate, long chord); setting out simple curves by linear measurements (chord offsets or perpendicular offsets) and by angular method (deflection angles with theodolite); basics of transition curves (purpose only, no design), Modern Surveying Techniques: Basic principles of Electronic Distance Measurement (EDM); total stations - features and applications (measuring angles, distances, coordinate computation); Global Positioning System (GPS) - concept of latitude, longitude, GPS accuracy, applications to surveying. Mapping & Survey Data: Use of Survey of India tope sheets and conventional symbols (brief); introduction to GIS (Geographic Information System) for storing and analyzing spatial data - layering concept examples of GIS use in civil engineering (asset mapping, terrain modeling).

(Note: Remote Sensing and GIS are also detailed separately in this syllabus.)

3. ESTIMATION & COSTING (50 Marks):

Types of Estimates: Definition and purpose of estimate; types - preliminary (approximate) estimates (plinth area, cubic rate, parametric estimates), detailed estimates (item rate estimates), revised estimates, supplementary estimates. Units and Measurement of Work: Standard units of measurement for various construction works (IS 1200 recommendations) - earthwork (cum), brickwork (cum), concrete (cum), timber (cum or sqm), flooring (sqm), steel reinforcement (kg), etc. Methods of measurement as per IS code - centerline method, long-wall & short-wall method for building works. Rate Analysis: Definition of rate analysis; factors affecting cost - material, labor, equipment, overheads, contractors profit Rate analysis for common items (earthwork, concrete, masonry, plastering) - labor and material requirement norms. Use of Standard Schedule of Rates (SOR) of PWD/CPWD; contingencies, work-charge establishment concept Detailed Estimate Preparation: Preparing detailed Bill of Materials (BOM) - listing of items, description as per Standard specifications, quantity calculations from drawings (taking out quantities for foundations, walls, roofs, floors, paint, etc.); abstract of cost Valuation Basics: Concepts of depreciation, salvage value, scrap value; methods of valuation of buildings (replacement cost method, rental method - simple numerical problems); fixation of rent by capitalization; present value concept. Contracts and Tenders: Basics of contracts - types (item rate, lump sum, EPC); tendering procedure in government works (notice inviting tender, earnest money, security deposit, tender opening, comparative statement, letter of award); overview of contract conditions in government projects (based on standard forms - payment terms, LD, defect liability), Professional Practice: Roles of a junior engineer in estimation - checking contractor bills, measurement book (MB) entries; Importance of accuracy and adherence to IS 1200 measurement standards In public works.

4. THEORY OF STRUCTURES AND CONCRETE TECHNOLOGY (20 marks):

Theory of structures: Elasticity constants, types of beams - determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams. Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns. Torsion of circular section.

Concrete Technology: Properties, Advantages and uses of concrete, cement aggregates, importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting. Repair and maintenance of concrete structures.

5. DESIGN OF RCC STRUCTURES AND RCC WATER TANKS (20 Marks):

Design of RCC structures: Principles of Limit state method (LSM) and Working stress method of design. Provisions of IS:456 and IS:13920 (Latest version) - Characteristic load & Strength, Partial factor of safety. Stress-strain characteristic of concrete and steel, Limit state of Durability, limit state of collapse in flexure and shear, limit state of serviceability. Theory and design of singly reinforced members. Bond, anchorage, development length and splicing. Design and IS code provisions for short columns, one way and two way slabs, Isolated footing

RCC Water tanks: Indian standard codes and provisions prescribed for designing water retaining structures, causes and control of cracking, Joints In water retaining structures. Removal of formworks/shutters. Lining, lighting protection and ventilation of water tanks. Regular capacity and design capacity of water tanks. Classification and layout of elevated tanks. Nomenclature and functions of ancillary items of water retaining structures. Components of water retaining structures.

6. SOIL MECHANICS AND FOUNDATION ENGINEERING (20 Marks):

Soil Mechanics: Origin of soil, phase diagram, Definitions Void ratio, porosity, degree of saturation, water content specific gravity of soil grains, unit weights, density index and Interrelationship of different parameters, Grain size distribution curves and their uses. Index properties of soils Atterberg's limits, ISI soil classification and plasticity chart Permeability of soil coefficient of permeability, determination of coefficient of permeability, Shear strength of soils, direct shear test, Vane shear test, Triaxial test. Soil compaction, Laboratory compaction test. Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test

Foundation engineering:- Foundation classification, Different type and selection criteria of foundation type, Requirements for a stable foundation, Minimum depth for shallow foundation. Definitions of bearing capacity of soil, Type of failure of soil below foundation footing, Determination of size of foundation footings.

7. CONSTRUCTION MANAGEMENT (20 Marks):

Project Planning & Scheduling: Importance of planning for timely project delivery; work breakdown structure (WBS); bar charts for construction schedule; network techniques -CPM (Critical Path Method) and PERT (basic concepts, network diagram drawing, critical path determination, float - simple problems). Advantages of CPM/PERT in project control. Construction Organization & Supervision: Roles of project team: project manager, site engineer, supervisors, foremen; labor management and productivity; material management (inventory control basics, storage of cement/ steel to prevent wastage); construction equipment planning (matching equipment to task, basics of output for excavators, mixers, etc.). Contracts Administration: Overview of FIDIC/CPWD contract clauses (general idea); managing contract variations, extra items and deviations; progress monitoring (daily progress reports, hindrance register); quality control on site (field tests for concrete, maintaining cube test records; checklist for works). Construction Safety: Common hazards on construction sites and safety measures - working at heights (scaffolding safety), excavation safety (trenches shoring and stepping), machinery safety (cranes, hoists), electrical safety, use of personal protective equipment (helmets, harness, etc.). National Building Code (NBC) Part 7 provisions on Constructional Practices and Safety - guidelines for safely executing building works, scaffolds and shoring standards, first-aid facilities on site. Project Management & Ethics: Importance of project cost control (budget vs actual tracking), quality assurance (site laboratories, QA/QC plans) and timely

completion; basics of construction ethics and public works code of conduct (integrity, transparency in procurement).

Paper -IV (Technical Subject)

1. WATER SUPPLY ENGINEERING (60 Marks):

Water Sources & Demand; Surface and groundwater sources; intake structures; population forecasting and design period; per capita water requirements as per standards (e.g. 135 LPCD for urban water supply); peak demand and fire demand estimation. Water Quality Standards: Physical chemical and bacteriological water quality parameters; potable water quality requirements as per IS 10500:2012 (Indian Drinking Water Standards) (eg. limits for turbidity, hardness, chlorides, coliforms). Water Treatment Processes: Conventional treatment flowchart - aeration, coagulation and flocculation, sedimentation, filtration (rapid sand & slow sand filters, disinfection (chlorination) - design principles and working of units as per CPHEEO Manual guidelines. Basic concepts of advanced treatments (water softening, removal of iron & manganese). Water Conveyance & Distribution: Gravity and pumping systems; types of pipes (CI, GI, PVC, HDPE etc.) and pipe jointing; pump types (centrifugal pumps, submersible pumps) and selection; head loss in pipes (Darcy-Weisbach and Hazen-Williams formulas); layout of distribution networks (dead-end, grid, ring systems); service reservoirs and overhead tanks (capacity planning); valves (sluice, reflux, air, scour) and meters in distribution network. Building Water Supply & Plumbing: Basic plumbing arrangements for buildings as per National Building Code (NBC) provisions - service connection, supply in multi-storey buildings, water supply fixtures and fittings (taps, closets, etc.), and prevention of back-flow (use of reflux valves).

2. HYDRAULICS (30 Marks):

Fluid Properties and Pressure Measurement: Properties of fluids (density, viscosity, surface tension); pressure and its measurement (piezometer, manometers - simple and differential). Hydrostatics: Hydrostatic pressure on plane surfaces (vertical and inclined); center of pressure; buoyancy and flotation principles (Archimedes' principle) - stability of floating bodies. Fluid Dynamics: Equation of continuity; Bernoulli's theorem and applications (venturimeter, orifice meter, pitot tube) for discharge and velocity measurement. Flow in Pipes: Laminar and turbulent flow (Reynolds number); head losses in pipes due to friction and minor losses; Darcy-Weisbach equation and Hazen-Williams formula for friction loss; pipe network analysis basics (Hardy Cross method principles, no detailed derivation). Open Channel Flow: Types of flow (steady, unsteady, uniform, non-uniform); Chezy's and Manning's formula for uniform flow in channels; most economical channel sections (rectangular, trapezoidal); specific energy and critical depth; concept of hydraulic jump (energy dissipation). Hydraulic Machines: Principles of operation of turbines (impulse and reaction turbines - Pelton wheel, Francis turbine basics) and pumps (centrifugal pump components and performance, priming, NPSH); pump characteristics and selection for water supply schemes.

3. HYDROLOGY (INCLUDING GROUNDWATER) (30 Marks):

Hydrologic Cycle & Precipitation: Hydrologic cycle components; forms of precipitation, measurement of rainfall (rain gauges types and density); presentation of rainfall data (mass curve, hyetograph); computation of average rainfall over an area (Arithmetic mean, Thiessen polygon, Isohyetal method). Runoff and Hydrographs: Factors affecting runoff (rainfall intensity, infiltration, catchment characteristics); estimation of peak runoff by Rational method; runoff hydrograph

concepts, unit hydrograph (basic idea, derivation not required at diploma level). Floods and Reservoir Capacity: Design flood, return period, frequency analysis (basic concepts); flood routing (elementary idea); methods of flood control (levees, reservoirs). Concepts of reservoir capacity and yield. Groundwater: Types of aquifers (unconfined, confined, perched); terms - porosity, specific yield, permeability; Darcy's law for groundwater flow; well hydraulics (drawdown, yield of an open well or tube well - introduction only); interference of wells and well spacing. Groundwater Management: Groundwater recharge techniques (recharge wells, percolation tanks); problems of groundwater (water table depletion, saline intrusion, arsenic & fluoride contamination - awareness of IS 10500 limits on these). Basic Introduction to groundwater quality standards and monitoring by Central Ground Water Board (CGWB).

4. ENVIRONMENTAL ENGINEERING (30 Marks):

Air Pollution: Sources of air pollution (industrial emissions, vehicular, domestic fuels); types of air pollutants (SPM, SO₂, NO_x, CO, etc.) and their effects on health and environment; Ambient Air Quality Standards (National Air Quality standards by CPCB); basic air pollution control methods (settling chambers, cyclones, bag filters, electrostatic precipitators - qualitative treatment only). Noise Pollution: Noise levels and units (decibel, dB(A)); sources of noise (traffic, industrial construction); permissible noise level standards (day/night levels); effects of noise on health; noise mitigation measures (sound insulation, green belts, zoning). Solid Waste Management: Types of solid waste (municipal biomedical, hazardous e-waste); collection of solid waste (systems of collection, segregation at source); transportation (haul routes, vehicles); methods of disposal - composting, biomethanation, incineration (fundamentals), sanitary landfill design principles (site selection, liner and leachate system basics). Municipal Solid Waste (Management & Handling) Rules overview and CPHEEO guidelines for solid waste management, Environmental Impact and Sustainability: Environmental Impact Assessment (EIA) - purpose and basic steps (identification of impacts, mitigation); environmental clearances for projects (awareness only). Sustainable development concepts in civil engineering (rainwater harvesting, green building basics, waste reuse).

(Note: Environmental Engineering section focuses on pollution control and solid waste management aspects beyond water and wastewater, which are covered under "Water Supply" and "Sanitation" sections.)

5. SANITATION (40 Marks) :

Domestic Sewage Characteristics: Composition of domestic wastewater - physical characteristics (turbidity, solids), chemical characteristics (pH, BOD, COD, chlorides, nitrogen, etc.), bacteriological quality; basics of standards for effluent discharge (as-per CPCB norms for treated sewage). Sewerage Systems: Types of sewerage systems (separate, combined, partially separate); sewer materials (CI, RCC, PVC pipes) and their joining; sewer appurtenances - manholes, drop manholes, catch basins, clean-outs, traps, flushing tanks. Hydraulic design of circular sewers (full flow capacity, self-cleansing velocity concept, no derivation of Colebrook-White). Sewage Treatment: Objectives of treatment; flow diagram of conventional sewage treatment plant - screening, grit removal, primary sedimentation, biological treatment (principles of activated sludge process, trickling filter), secondary clarifier, sludge digestion, drying beds. Low-cost treatment methods: septic tanks and soak pits (for small communities) as per IS 2470 code, stabilization ponds. Basics of emerging sewage treatment (constructed wetlands, aerated lagoons - concept only). On-site Sanitation & Rural Hygiene: Design and working of septic tanks (layout and sizing considerations as per IS 2470), twin-pit pour-flush latrines for rural areas, leach pits, composting toilets. Sludge management and disposal of septic

tank effluent (soakaway pits, dispersion trenches - principles only). Drainage and Sanitary Plumbing: Principles of house drainage; traps (P-trap, S-trap, floor trap, intercepting trap), house sewer, vent pipes, anti-siphonage; plumbing layout for drainage in buildings according to NBC Part 9 Section 2 (Drainage and Sanitation) - one-pipe and two-pipe systems, inspection chambers. Storm water drainage: estimation of storm runoff, design of storm sewers and street inlets; measures for preventing silting and choking of drains.

6. REMOTE SENSING & GIS (10 marks);

Fundamentals of Remote Sensing: Definition of remote sensing; electromagnetic spectrum concepts - bands used in remote sensing (visible, infrared, microwave); interaction of EM radiation with atmosphere and earth surface (reflection, absorption); satellite sensors and resolution (spatial, spectral, temporal) - concepts of panchromatic vs multispectral images. Remote Sensing Platforms and Data; Types of platforms -ground, aerial (aircraft; UAVs/drones), space-borne (satellites). Overview of Indian remote sensing satellites (IRS series) and their applications (IRS, Cartosat, Resourcesat brief). Aerial photography basics (scale, relief displacement). Image Interpretation: Elements of visual Image interpretation (tone, texture, shape, size, pattern, shadow); Introduction to digital image processing (concept of pixels, false color composites). Applications of remote sensing in civil engineering: land use/land cover mapping, flood mapping, geological surveys, urban planning (basic examples). Geographic Information System (GIS): Definition and components of GIS (hardware, software, data, people, methods); spatial data models - raster and vector; concept of layers and attribute data; coordinate system and map projections (basic awareness, e.g. latitude/longitude, UTM). GIS Applications: Creation of thematic maps (contour maps, utility maps) using GIS; GIS in survey data management, cadastral mapping, transportation planning (e.g. road network analysis), environmental management (mapping pollution sources). Use of public geospatial data - Survey of India maps, National Remote Sensing Centre (NRSC) data services. Basic understanding of global navigation satellite systems (GPS/GNSS) integration with GIS for real-time data capture.

* Note: All sections above are aligned with Diploma level knowledge in Civil Engineering. Relevant Indian Standards (IS codes) and government manuals are referenced for guiding norms - for example, IS 10500 for drinking water quality, CPHEEO manuals for water supply and sewerage, NBC 2016 for building services and safety provisions, IS 2470 for septic tank design, and IS 1200 for measurement of works. Candidates are expected to be conversant with these standards and their applications in the above topics.

Notes regarding Negative Marking:

- 1) There will be penalty (negative marking) for every wrong answer given by a candidate in the MCQ type questions.
- 2) For each question for which a wrong answer has been given by the candidate, one third of the marks assigned to that question will be deducted as penalty.
- 3) If a candidate gives more than one answer to one question, it will be treated as wrong answer even if any one of the given answers happens to be correct and there will be same penalty as above for that question.
- 4) If any question is left blank i.e. no answer is given by the candidate, there will be no penalty for that question.

**APPROVED SYLLABUS FOR DIRECT RECRUITMENT TO THE POST OF JUNIOR ENGINEER
(ELECTRICAL) UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT.**

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(b) History of India and Indian National Movement	: 12 Marks
(c) Indian and World Geography - Physical, Social Economic Geography of India and the World	: 12 Marks
(d) Indian Polity and Governance - Constitution, Political System, Public Policy, Duties & Rights Issues	: 12 Marks
(e) Economic and Social Development, Sustainable Development, Poverty, Inclusion, Demographics, Social Sector initiatives, and other related issue	: 12 Marks
(f) General Issues on Environmental Ecology, Bio-diversity and Climate	: 12 Marks
(g) General Science	: 12 Marks
<i>The topics listed above shall cover the State of Mizoram wherever applicable</i>	
(h) General awareness on Mizo culture, its heritage and society	: 16 Marks

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| 3) PAPER - III: Technical Subject (MCQ with negative marking) | : 200 Marks (2 hours) |
| (a) Electrical Circuits and Material | : 40 Marks |
| (b) Electrical Measurements | : 30 Marks |
| (c) Analog Electronics | : 30 Marks |
| (d) Digital Electronics | : 30 Marks |
| (e) Electrical Utilization | : 20 Marks |
| (f) Renewable Energy Sources | : 20 Marks |
| (g) Electrical Estimation and Design | : 30 Marks |
| 4) PAPER - IV : Technical Subject (MCQ with negative marking) | : 200 Marks (2 hours) |
| (a) DC Machines | : 30 Marks |
| (b) AC Machines | : 30 Marks |
| (c) Power System | : 40 Marks |
| (d) Power Electronics and Drives | : 30 Marks |
| (e) Control and Automation | : 30 Marks |
| (f) Standby Power Systems | : 20 Marks |
| (g) Testing and Maintenance | : 20 Marks |

Paper-III (Technical Subject)

- 1. Electrical Circuits and Materials (40 Marks):** Classification of electrical materials into conductors, semiconductors, insulators, superconductors and their properties; conducting materials such as copper and aluminium, resistance materials like nichrome and manganin, and insulating materials in solid, liquid and gaseous forms; dielectric properties including dielectric strength, loss and permittivity; magnetic materials - ferromagnetic, paramagnetic and diamagnetic types, their magnetic properties (permeability, retentivity, coercivity), hysteresis and applications; fundamentals of magnetic circuits including flux reluctance, and comparison with electric circuits; DC and AC circuit laws and theorems (Ohm's law, KCL, KVL, Thevenin's, Norton's, Superposition, Maximum Power Transfer), sinusoidal quantities, phasor representation, impedance and power factor in RLC circuits; series and parallel resonance, Q-factor and bandwidth; transient behaviour in RL and RC circuits, time constants, and AC/DC transient response,
- 2. Electrical Measurements (30 Marks):** Principles, construction and operation of measuring instruments including permanent magnet moving coil (PMMC), moving iron (MI), dynamometer type, and induction type; extension of range for voltmeters and ammeters; measurement of electrical quantities such as voltage, current, power, energy, resistance, inductance and capacitance; single-phase and three-phase power measurement using wattmeters; measurement of electrical energy with single-phase and three-phase energy meters, calibration and testing; measurement of frequency and power factor; use of instrument transformers (CTs and PTs) for measurement and protection; Introduction to transducers and their applications in electrical measurements; errors in measuring instruments and methods of minimisation.
- 3. Analog Electronics (30 Marks):** Basic concepts of semiconductor physics; construction, working, characteristics and applications of PN junction diode, Zener diode and light-emitting diode (LED); rectifiers - half-wave, full-wave and bridge types with filters, ripple factor and efficiency; bipolar junction transistor (BJT) - construction, types, input and output characteristics, biasing methods and stability; transistor as a switch and as an amplifier; Field Effect Transistor (FET) and

metal-oxide-semiconductor FET (MOSFET) - construction, operation, characteristics and applications; operational amplifiers (Op-Amps) - parameters, configurations (inverting, non-inverting, summing, differential) and applications in measurement and control; basic concepts of feedback in amplifiers.

4. **Digital Electronics (30 Marks):** Number systems - binary, octal, decimal and hexadecimal, and their interconversion; binary arithmetic including addition, subtraction and complements; logic gates - AND, OR, NOT, NAND, NOR, XOR and XNOR - symbols, truth tables and simple applications; Boolean algebra - basic laws, De Morgan's theorems and simplification of logic expressions; combinational logic circuits - half adder, full adder, half subtractor, full subtractor, encoders, decoders, multiplexers and demultiplexers; sequential logic circuits - flip-flops (SR, JK, D, T) - basic operation and truth tables; basic counters and shift registers; overview of digital memories (RAM, ROM, PROM, magnetic storage devices) and their applications; basics of DAC and ADC types and their role in instrumentation and control; and fundamentals of microprocessors - basic architecture, instruction set concept and simple applications.
5. **Electrical Utilization (20 Marks):** Principles and methods of electric heating - resistance, induction and dielectric heating - construction, working and applications; principles of electric welding - resistance welding and arc welding, equipment used and their operation; Illumination - laws of illumination, types of lighting schemes, lighting calculations, and different light sources including incandescent, fluorescent, mercury vapour, sodium vapour and LED lamps; electric traction - types of systems, supply arrangements, traction motors and their characteristics, starting and braking methods.
6. **Renewable Energy Sources (20 Marks):** Introduction to renewable energy and its importance; solar energy - solar radiation fundamentals, solar photovoltaic (PV) principles, basic components of a PV system, and applications; wind energy - basic principles, main components of wind energy systems and applications; biomass energy - sources, conversion technologies and uses; small hydro power - basic concepts and applications; introduction to other emerging sources such as tidal and geothermal energy; advantages and limitations of renewable energy systems; and basic awareness of integration of renewable energy with electrical systems.
7. **Electrical Estimation and Design (30 Marks):** Electrical symbols, standards and wiring diagrams; load calculation for domestic, commercial and industrial installations; selection of feeder size, main switches, subcircuits and protective devices; preparation of layout plans, single-line and multi-line diagrams; estimation of materials, quantities, and cost for service connections, industrial wiring and pole-mounted substations; design and estimation of distribution panels including busbars and metering; design principles for illumination schemes - laws of illumination, selection of luminaries and lighting levels for various applications; and preparation of detailed equipment lists with specifications for different types of installations.

Paper-IV-Technical Subject

1. **DC Machines (30 Marks):** Principles of electromagnetic induction as applied to DC machines; constructional features and types of DC generators and motors; armature windings - lap and wave; EMF equation of a DC generator; characteristics and applications of different types of DC generators (separately excited, shunt, series, compound); back EMF and torque equation of a DC motor; characteristics, starting methods and speed control of DC motors; losses, efficiency of DC machines.

2. **AC Machines (30 Marks):** Construction, working principle and types of single-phase and three-phase transformers; EMF equation, transformation ratio, losses, efficiency and regulation; parallel operation of transformers; construction, principle and types of three-phase induction motors - squirrel cage and slip ring; torque-speed characteristics, starting and speed control methods; construction and principle of synchronous machines - alternators and synchronous motors - EMF equation, characteristics and applications.
3. **Power Systems (40 Marks):** Structure of electrical power systems - generation, transmission and distribution; types of power plants - thermal, hydro, nuclear and renewable-based - basic principles and layout; transmission systems - AC and DC, overhead lines and underground cables, line parameters and voltage regulation; distribution systems - radial, ring and inter-connected; substation types, equipment and layout; basics of power factor improvement, load curves and load factor; earthing methods and importance; basic protection principles and equipment - fuses, circuit breakers, relays, lightning arresters and isolators,
4. **Power Electronics and Drives (30 Marks):** Introduction to power electronics and its applications in motor control and power conversion; characteristics and operation of power semiconductor devices - diodes, thyristors (SCR), TRIAC, DIAC, MOSFET and IGBT; controlled and uncontrolled rectifiers - single-phase and three-phase; choppers, inverters and cycloconverters - basic principles and applications; motor starting methods - manual starters, DOL (Direct-On-Line) starter, star-delta starter, autotransformer starter, rotor resistance starter, and electronic soft starters; speed control of DC motors using converters and choppers; speed control of AC motors using inverters, cycloconverters and variable frequency drives (VFDs); introduction to braking methods in electric drives; and maintenance and troubleshooting of power electronic equipment in motor drive systems.
5. **Control and Automation (30 Marks):** Fundamentals of control systems - open-loop and closed-loop control, block diagram representation, and basic transfer function concepts; introduction to electrical and electronic control methods for motors and industrial processes; basics of contactor control circuits and interlocking; control elements - relays, timers, limit switches, pressure switches and proximity sensors; principles and applications of Programmable Logic Controllers (PLCs) - architecture, basic programming concepts and ladder diagrams; introduction to SCADA (Supervisory Control and Data Acquisition) - basic components and functions; overview of Internet of Things (IoT) applications in electrical systems, including remote monitoring, data acquisition and predictive maintenance; automation applications in pumping and water treatment systems.
6. **Standby Power Systems (20 Marks):** Principles and need for standby and emergency power systems; types of standby power sources - diesel generator sets, battery banks, UPS (Uninterruptible Power Supply) systems and renewable-based backup systems; components and operation of diesel generator sets - engine, alternator, control panel and protection systems; types of UPS - online, offline and line-interactive; battery types used in backup systems - lead-acid, Ni-Cd and lithium-ion - characteristics, charging methods and maintenance; changeover systems - manual changeover, automatic transfer switches (ATS) and auto mains failure (AMF) panels - operation, features and applications; sizing of standby power equipment based on load requirements.
7. **Testing and Maintenance (20 Marks):** Importance of testing and preventive maintenance in electrical installations; visual inspection and routine checks for electrical equipment; insulation

resistance testing using megger; continuity and polarity tests; earth resistance measurement; testing of transformers – insulation resistance, winding resistance, ratio and polarity tests; testing of motors – insulation resistance, winding resistance, no-load and load tests; testing of circuit breakers, relays and protective devices; preventive and breakdown maintenance procedures for motors, transformers, switchgear and control panels; common faults in electrical equipment, their causes and remedies; safety measures and use of personal protective equipment (PPE) during testing and maintenance work.

Notes regarding Negative Marking:

- 1) *There will be penalty (negative marking) for every wrong answer given by a candidate in the MCQ type questions.*
- 2) *For each question for which a wrong answer has been given by the candidate, one third of the marks assigned to that question will be deducted as penalty.*
- 3) *If a candidate gives more than one answer to one question, it will be treated as wrong answer even if any one of the given answers happens to be correct and there will be same penalty as above for that question.*
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**APPROVED SYLLABUS FOR DIRECT RECRUITMENT TO THE POST OF JUNIOR ENGINEER
(Mechanical) UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT**

The examination shall comprise of the following papers:

1. Paper – I : General English (Conventional type & MCQ with negative marking)	: 100 Marks (3 hours)
2. Paper – II : General Knowledge (MCQ with negative marking)	: 100 Marks (2 hours)
3. Paper – III : Technical Subject (MCQ with negative marking)	: 200 Marks (2 hours)
4. Paper – IV : Technical Subject (MCQ with negative marking)	: 200 Marks (2 hours)
Total of written examination	: 600 Marks
5. Personal Interview	: 75 Marks
Total	: 675 Marks

DETAILED SYLLABUS:

1) PAPER-I : General English (Conventional type & MCQ with negative marking)	: 100 Marks (3 hours)
(a) Précis Writing	: 10 Marks
(b) Letter Writing	: 10 Marks
(c) Comprehension of given passages	: 10 Marks
(d) Essay	: 10 Marks
(e) Grammar : Parts of Speech (MCQ with negative marking)	: 20 Marks
(f) Correct Usage and Vocabularies (MCQ with negative marking)	: 20 Marks
(g) Formation of Sentence (MCQ with negative marking)	: 20 Marks
2) PAPER-II : General Knowledge (MCQ with negative marking)	: 100 Marks (2 hours)
(a) Current events of state, national and international importance	: 12 Marks
(b) History of India and Indian National Movement	: 12 Marks
(c) Indian and World Geography-Physical, Social, Economic Geography of India and the World	: 12 Marks
(d) Indian Polity and Governance-Constitution, Political System, Public Policy, Duties & Rights Issues	: 12 Marks
(e) Economic and Social Development, Sustainable Development, Poverty, Inclusion, Demographics, Social Sector initiatives, and other related issue	: 12 Marks
(f) General issues on Environmental Ecology, Bio-diversity and Climate	: 12 Marks
(g) General Science	: 12 Marks

The topics listed above shall cover the State of Mizoram wherever applicable.

(h) General awareness on Mizo culture, its heritage and society	: 16 Marks
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| 3) PAPER-III: Technical Subject (MCQ with negative marking) | : 200 Marks (2 hours) |
| (a) Thermodynamics | : 40 Marks |
| (b) Heat Transfer, Refrigeration and Air Conditioning | : 40 Marks |
| (c) Fluid Mechanics | : 50 Marks |
| (d) Fluid Machinery | : 50 Marks |
| (e) Environmental Pollution and its Control | : 20 Marks |
| 4) PAPER-IV: Technical Subject (MCQ with negative marking) | : 200 Marks (2 hours) |
| (a) Manufacturing and Production Technology | : 50 Marks |
| (b) Theory of Machines | : 40 Marks |
| (c) Design of Machines | : 40 Marks |
| (d) Strength of Materials | : 40 Marks |
| (e) Engineering Materials | : 30 Marks |

Paper-III (Technical Subject)

1. **Thermodynamics: (40 Marks)**
 Basic concepts on cycles and IC engines, open and closed systems. Heat and work. Zeroth, First and Second Law, Application to non-flow and flow processes. Properties of ideal gases and vapours. Standard vapour, gas power and refrigeration cycles.
 Two stage compressors. C-I and S.I. Engines. Pre-ignition, detonation and diesel-knock. Fuel injection and carburation. Supercharging, engine cooling, emission & control, flue gas analysis, measurement of calorific values.
2. **Heat Transfer, Refrigeration and Air-Conditioning: (40 Marks)**
 Modes of heat transfer, one dimensional steady and unsteady conduction. Composite slab and equivalent resistance. Heat dissipation from extended surfaces, fins and its uses. Heat exchangers, Overall heat transfer coefficient, thermal boundary layer over a flat plate. Fundamentals of diffusive and connective mass transfer, black body and basic concepts in radiation.
 Heat pump and refrigeration cycles and systems, refrigerants. Condensers, evaporator and expansion devices, psychrometry, charts and application to air conditioning. Sensible heating and cooling, effective temperature, comfort indices, load calculations, solar refrigeration, controls and duct design.
3. **Fluid Mechanics: (50 Marks)**
 Properties and classification of fluids - Ideal & real fluids, Newton's law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids, forces on immersed surfaces. Pressure and its measurement, Buoyancy, Fluid Kinematics and Dynamics. Bernoulli's equation, fully developed flow through pipes, Pressure drops and its calculations. Basic principles of flow rate measurement: Venturi meter, Pilot tube, Orifice meter. Laminar and turbulent flows, Open channel flow, Water Hammer, Hydraulic jump and Normal shock wave.
4. **Fluid Machinery: (50 Marks)**
 Principles of pumps and its classifications, principles of Hydraulic Turbines and its classifications. Performance, operation and control of hydraulic Pump, impulse and reaction turbines, specific speed. Reciprocating. Centrifugal and axial flow Compressors. Design of pump and pipelines.
5. **Environmental Pollution and its Control: (20 Marks)**
 Basic concept on air, water, soil and noise pollution, different pollutants and its treatment.

Paper-IV (Technical Subject)**1. Manufacturing and Production Technology: (50 Marks)**

Basic concept on fabrication processes: Different types of welding process, principles of gas welding, arc welding, shielded arc welding, brazing and soldering. Welding Defects. Electrode and filler materials, weldability: metallurgy of welding. Metal cutting: Turning, Drilling, Boring, Grinding & Finishing Processes. Cutting tools materials, tool geometry, mechanism of tool wear, tool life & machinability. Unconventional machining processes. Jigs and fixtures. Fits and tolerances, measurement of surface texture. Lathe machine and its operations.

2. Theory of Machines: (40 Marks)

Kinematic and dynamic analysis of planer mechanisms. Cams, gears and gear trains. Flywheels and fluctuation of energy. Balancing of rigid rotors and field balancing. Balancing of single and multicylinder engines, Vibration and its control mechanism. Critical speeds and whirling of shafts.

3. Design of Machines: (40 Marks)

Type of gears, gear profile and gear ratio calculation, Governors – Principles and classification, Riveted joint, Welded Joints, Bearings, Friction in collars and pivots. Friction, brakes, clutches and lubrication system.

4. Strength of Materials: (40 Marks)

Friction, Concepts of stress and strain, elastic limit and elastic constants, uniaxial loading, thermal stresses.

Beams: Bending moment and shear force diagram, bending stresses and deflection of beams. Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, thick-and thin-walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure.

5. Engineering Materials: (30 Marks)

Heat treatment of steels and engineering materials. Basic concepts on structure of solids. Crystalline materials, defects in crystalline materials. Alloys and binary phase diagrams. Structure and properties of common engineering materials. Plastics, ceramics and composite materials. Common applications of various materials.

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