

SCHEDULE-II

(See sub-regulation (2) of regulation 4)

SYLLABI FOR DEPARTMENTAL EXAMINATION IN RESPECT OF OFFICERS HOLDING THE POST OF JUNIOR ENGINEER/DRAFTSMAN-I

PUBLIC WORKS CADRE

ENGINEERING PAPER

Duration – 3 hours

(Civil Engineering)

PART – A (50 Marks)

1. **Surveying for building works**
 - Unit of Measurements
 - Care and uses of Survey Instruments
 - Preparation of Building Plan, Elevation and Sectional drawings
 - Reading and writing of Architectural Drawings.
2. **Building Materials**
 - Natural Building Materials
 - Brick, cement, Timber, Lime, Lime mortar, Lime Concrete, Plastic, Paints & Varnishes, Damp Proof Material.
 - Characteristics
 - Common tests for quality control
3. **Building Construction**
 - Types of Foundations in buildings, depth of foundation
 - Soil bearing capacity of various types of soil, common test for quality control.
 - Buildings Byelaws
 - Form work for Concrete structures
4. **Analysis of Rates, Estimating quantities of materials, Transportation cost, Preparation of Estimate/DPR, methods of measurement for building works.**
5. **RCC Structures**
 - Basic theory and property of RCC
 - Bond length, Anchorage length, Development length & splicing
 - Permissible stress in Concrete & Steel Reinforcement
 - Stresses: Compressive, Tensile, Shear, Stress & Strain relation
 - Water cement Ratio, Slump test, Gradation of Aggregate curing, compaction of concrete and form work.
6. **Standard Specification for various items of Building Works.**

PART - B (50 MARKS)

1. **Surveying**
 - Description, use and care of various types of survey instrument for Road work
 - Contour survey
 - Levelling
 - Hill road survey
 - Different stages of road survey.
 - Preparation of DRP Estimate
 - Measurement of Road works.
2. **Geometric Design of Highways**
 - Formation width of Different class of road
 - Right of way
 - Hight of structures
 - Extra Widening of pavement
 - Width of pavement
 - Camber
 - Circular curve
 - Gradient
 - Transition curve
 - Vertical curve
 - Passing place.
3. **Construction of Road Formation**
 - Jungle clearance
 - Tree cutting
 - Design of cut slope
 - Earth work
 - Disposal of excavation materials.
4. **Road Construction Materials**
 - Pavement materials & Physical Properties
 - Common test for quality control.
5. **Bridge, Culvert and Drainage**
 - Survey for bridge site
 - Bridge site selection & requirement
 - Importance Road side drain
 - Cath water drains
 - Causeway
 - Culvert.
6. **Protection work**
 - Types of retaining walls
 - Construction Procedure
 - Size of stone
7. **Pavement**
 - Types of pavement
 - Composition of Rigid Pavements
 - Joints in Rigid pavement, Dowel Bars
 - Traffic count, and wheel load survey
 - Components of Flexible pavement
 - Preparation of subgrade layer
 - Stages of Pavement Construction
 - Temperature requirement for bituminous construction
 - Rolling of Pavement layers

ENGINEERING PAPER

(Electrical Engineering)

Duration - 3 hours

PART - A (50 Marks)

1. **Detail Study of Internal Electrification System used in Public Works Department**
 - Illumination; Laws of illumination, simple calculation of illumination, requirement and selection
 - Electrical Plan and Drawing; simple electrical plan drawing for internal electrification
 - Circuit Diagram; Simple circuit diagram, drawing for internal electrification
 - Earthing; different type, importance and construction
 - Wiring; Different types of internal electrification wiring, LT Panel Board, Distribution Board, Switch Board, Panel Board DB, Point wiring
2. **Estimating and costing**
 - Simple Estimation and costing for internal wiring
3. **Maintenance**
 - Fault diagnosis
 - Repairing of Internal Electrification

PART - B (50 MARKS)

1. **Generator Set & Transformer**
 - General Principle
 - Periodic Maintenance
 - Installation of Transformer and maintenance
2. **Electrical Measuring Instruments**
 - General Principle
 - Uses
3. **Air Conditioning and Refrigeration**
 - General principle
 - Periodic Maintenance
4. **Lift/Elevator**
 - General principle
 - Periodic Maintenance

ENGINEERING PAPER

(Mechanical Engineering)

Duration - 3 hours

PART - A (50 Marks)

1. **Detail Study of Various type of Machine and Equipment used in Public Works Department**
 - Uses
 - Functions
 - Maintenance
2. **Fundamental of Diesel and Petrol Engines**
 - Operation
 - Advantages and disadvantages
 - Periodic and daily maintenance
 - Cooling and lubrication system
 - Trouble shooting and fault diagnosis.

PART - B (50 MARKS)

1. **Survey Report**
 - Preparation of survey report
 - Repair Estimate
 - Maintenance of Log Book
 - History sheet.
2. **Welding, Soldering and Brazing**
 - Different Methods
 - Technique
 - Application
3. **Measuring Tools & Instruments Used in Machine Shops**
 - General studies
 - Uses
 - Applications.

ENGINEERING PAPER

(Draftsman Grade-I)

Duration - 3 hours

PART - A (50 Marks)

1. **ARCHITECTURAL DESIGN**
 - Basic Design - Elements and principles, comparison of designed and non-designed objects ;
 - Standard dimensions and space requirements, visual textures and tonal variations, dimensional relationships ;
 - Importance of scale in architecture- human scale and monumental scale; interrelation of form, function and circulation in architectural design ;
 - Elementary principles of Architectural Design on the basis of structure, function and aesthetics ;
 - Design of small structures and objects of interest with respect to form and construction ;
 - Building details - functional use of materials ;
 - Barrier free design - Standard dimension, space standards, accessibility, choice of materials and arrangement of spaces ;
 - National Building Code norms.
2. **CLIMATOLOGY**
 - Necessity of studying climatology in architecture ;
 - Concept of thermal comfort-different factors determining thermal comfort of human being in a built environment ;
 - Thermal conductivity of building materials and their impact in thermal comfort ;
 - Effect of sun in architecture- orientation of sun, azimuth and altitude ;
 - Light - visual efficiency, day lighting, source and factor concept, design variables;
 - Energy efficient building design .
3. **BUILDING MATERIALS AND CONSTRUCTION**
 - Building materials ;
 - Sources, general and special characteristics ;
 - Composition, physical and chemical properties ;
 - Advantages and disadvantages of use of various materials, sustainability of use ;
 - Stones, bricks, clay, lime, cement, timber, cement concrete, steel, glass ;
 - Insulation materials, sealants and adhesives, protective and decorative coatings, water proofing and damp proofing materials ;

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- Building construction ;
- Components of buildings – technical terms, definitions and pictorial representation;
- Foundations – definition, purpose, types ;
- Brick masonry, masonry bonds – English bond, Flemish bond, Raking bond ;
- Stair – technical terms, classifications ;
- Doors and windows – types of doors, classifications of windows ;
- Roofs and roof coverings – technical terms, classification, types, GI sheet roof covering

4. BUILDING SERVICES

- Electrical services-types, wiring systems, types of ear thing, main and distribution boards ;
- Fire safety – Fire fighting equipments in buildings, fire detection system, fire alarm system, regulations and requirements, dry and wet risers, automatic sprinklers;
- Lighting – renewable energy sources, importance of light in architecture, perception of light and color ;
- Mechanical equipment for vertical transportation, physically handicapped mechanical safety systems ;
- Ventilation – Natural or mechanical, principles of natural ventilation, Air-conditioning-control of quality, quantity, temperature and humidity ;
- Acoustics ;
- Intelligent buildings.

5. ENVIRONMENTAL POLLUTION AND CONTROL

- Quantity of water – purpose of demand, factors affecting rate of demand ;
- Sources of water and their characteristics, rainfall and runoff ;
- Quality of water – meaning of pure water, maintenance of purity of water, water quality analysis;
- Conveyance of water ;
- Distribution System – general considerations, methods of distribution, methods of layout of pipe distribution ;
- Pipe appurtenances – Necessity ;
- Purpose and principles of sanitation ;
- Collection and conveyance of sewage – methods of carrying and collecting sewage ;
- Design and construction of sewers ;
- Sewer appurtenances ;
- House drainage – principles, types of traps ;
- Treatment and disposal of sewage.

6. SURVEY THEORY

- General principles, classifications, purpose of survey, common terms and definitions used ;
- Surveying instruments and their adjustments ;
- Chain surveying ;
- Compass surveying ;
- Plane table surveying and leveling ;
- Survey using digital theodolite and total station ;
- Surveying of a site for computing earthwork.

7. ESTIMATION & COSTING AND BUILDING SPECIFICATIONS

- Glossary of technical terms ;
- Stages of detailed estimate ;
- Analysis of rates ;
- Detailed specification for various items of works – earthwork, stone, cement, brick, steel, plastering, pointing, flooring, painting, doors and windows, glazing, false ceiling, GCI sheet roofing, AC sheet roofing.

PART - B (50 MARKS)
(PRACTICALS IN COMPUTER APPLICATION)

- | | | | |
|----|---------------------|---|----------|
| 1. | Autocad 2D Drafting | - | 35 Marks |
| 2. | Excel Worksheet | - | 15 Marks |

POWER AND ELECTRICITY CADRE

ENGINEERING PAPER

(Electrical Engineering)

Duration - 3 hours

PART - A (50 Marks)

1. Preparation of estimates for construction of 11kV and LT Lines including Distribution Transformer Sub-Stations
2. Survey, Construction, Testing, Commissioning, Operation and Maintenance of Distribution Lines and Distribution Transformer Sub-Stations
3. Knowledge of The Electricity Acts 2003 and CEA (Measurement relating to Safety and Electric Supply) Regulation 2010 including subsequent amendments
4. Operation and Maintenance of Hydel Power Station
5. Testing, Commissioning, Operation and Maintenance of Battery Banks and Battery Charger
6. Earthing - Method of earthing and method of earth resistance measurement and testing, standard norms of earth resistance value

PART - B (50 Marks)

1. Electric measurement and measuring instruments : Voltmeter, Frequency Meter, Wattmeter, Energy Meter (Calibration & Testing)
2. Losses in Electrical Transmission, Transformation & Distribution System (including AT & C Losses)
3. Knowledge of prevailing P&E Department SOR
4. JERC for Manipur & Mizoram (Electricity Supply Code) Prevailing Tariff Schedule
5. JERC for Manipur & Mizoram (Electricity Supply Code) Prevailing Supply Code

ENGINEERING PAPER

(Civil Engineering)

Duration - 3 hours

PART - A (50 Marks)

1. Description, Care and use of Survey Instruments, Preparation of Plan, Elevation, Sectional drawings and reading & writing of design and architectural drawings
2. Construction materials commonly used, their characteristics quality and properties, bricks, stone masonry, coarse and fine aggregate, re-enforcement steel, cement, timber etc. and common test for quality test control
3. Analysis of Rates, Estimating quantities of materials & transport, preparation of estimates/method of measurement
4. Basic theory and properties of RCC curtailment of steel re-inforcement, bond length, stress-compressive, tensile, sheer, neutral axis, stress strain diagram
5. Water Cement Ratio, Slump test, Gradation of aggregate, curing and compaction of concrete, formwork

6. Hill road survey-different stages of survey, Estimating and measurement of road works, Road geometry, camber, super elevation, gradient, side slope, curves, classification of roads
7. Stone masonry works, construction, procedures for retaining wall, size of stone etc.

PART - B (50 Marks)

1. Identification of site for Small Hydel Project, selection of site for stream gauging, measurement of water discharge using (1) V-notch (2) Rectangular notch (3) Current meter and (4) Floating method
2. Power potential calculation and general knowledge gross head, net head, design head, rated head, head losses
3. Topographical survey of run-of-the-river schemes: scales contour intervals and particulars of survey require for river, general layout, diversion weir, water conductor/power alignment, forebay, penstock, power house & switchyard
4. General knowledge on live storage, dead storage, firm power, secondary power, load factor, installed capacity, peak load, average load, and dependability
5. Standard specifications of various items of work

PUBLIC HEALTH ENGINEERING CADRE

ENGINEERING PAPER

Duration - 3 hours

PART - A (50 Marks)

(Common for Junior Engineers in Civil, Electrical and Mechanical Engineering)

1. **Rain Water Harvesting**
2. **Pumps for Drinking Water Supply**
3. **The Mizoram Water Supply (Control) Acts & Rules**
4. **Conveyance of Water**
Pipes viz. GI, DI, CI, ERW, HDPE, PVC, Advantages & Disadvantages, Pipe Appurtenances.
5. **Water Supply**
Survey and investigation of water supply scheme. Selection of site for reservoir. Intake structures - different types of intakes, factors of selection and location of intakes.
6. **Hand Pump Tube Wells**
Types of HPTW. Importance of HPTW.
7. **Estimating of various works like -**
 - a) Earthwork
 - b) Masonry
 - Stone
 - Brick
 - c) Concrete
 - Cement Concrete
 - Reinforced Cement Concrete
 - d) Retaining Wall
 - e) Building
 - RCC Building
 - Assam Type Building
8. **Analysis of Rates**
9. **Septic Tank - Design & Construction**
10. **Economical Section of Open Channel viz. Rectangular and Trapezoidal Section**
11. **Rural Sanitation**
Conservancy, public latrine, night soil collection and disposal, trenching and composting methods. Two pit latrines, septic tank, soak pit.

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12. **Solid Waste Management-**
 - (a) Characterization
 - (b) Segregation
13. **Storm Water Drainage**

PART - B (50 Marks)
(Junior Engineers in Civil Engineering)

1. **Building Materials**
 - Stones, Bricks, hollow blocks, Concrete blocks and their characteristics/properties
2. **Soil Mechanics & Foundation Engineering / Geotechnical Engineering**
 - Safe Bearing Capacity of soil (SBC)
 - RCC isolated footing
3. **Water Treatment**
 - Various Units of Water Treatment Plant viz. Sedimentation Filtration, Disinfection
4. **Quality of Water**
 - Drinking Water Standards
 - Permissible limit for Turbidity, PH, Iron
5. **Population Forecasting**
6. **Demand of Water**
 - Per capita consumption, Factors affecting per capita demand, population forecasting, different methods with merits and demerits
 - Types of water demand – domestic demand, institutional and commercial, public uses, fire demand
7. **Cement Concrete Works**
 - Ingredients of cement concrete and their properties.
 - Water cement ratio.
 - Different types of cement.
 - Taking out quantities of ingredients of cement concrete.
 - Proportioning of ingredients of cement concrete.
 - Mixing of ingredients of cement concrete.
 - Transportation of concrete mix.
 - Placing/Pouring of concrete mix.
 - Compaction and consolidation of concrete.
 - Curing of cement concrete works.
 - Setting of cement.
 - Shoring, scaffolding and formwork of cement concrete work.
 - Simple Designs – RCC footing, RCC Column, RCC Slab, RCC Beams viz. Cantilever, Simply Supported, Fixed and Continuous.
 - Requirement of Reinforcement for various RCC structures.
 - Spacing of Reinforcement.
 - Development length.
 - Cover to Reinforcement.
 - Plastering of cement concrete.
8. **Water Tanks**
 - Fundamentals
 - a) Minimum requirement of reinforcement.
 - b) Maximum free water cement ratio.
 - c) Minimum grade of cement concrete.

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- d) Limit on cement content of cement concrete.
 - e) Reduction of stresses in steel.
 - f) Minimum thickness of wall and base.
 - g) Development length.
 - h) Cover to reinforcement.
 - i) Cover slab or dome.
 - j) Lightning arrestor, ventilation, testing of water tank after completion.
9. **Drainage Systems**
- Storm water and sullage disposal.
 - Rain water harvesting and uses.
10. **Communicable Diseases**
- Terminology.
 - Classification.
 - Methods of communication.
 - General methods of control.
11. **Refuse Collection & Disposal**
- Garbage.
 - Ash.
 - Rubbish.
 - Collection methods.
 - Transportation.
 - Disposal of salvaging, dumping controlled tipping, incineration, composting and dung.
 - Disposal of digester, bio-gas plant.

PART - B (50 Marks)
(Junior Engineers in Electrical Engineering)

- 1. **Electrical Materials and Internal Electrification**
Conductors, Semi-conductors and Insulators, Circuit Diagram/Drawing, load calculation and simple estimation for Internal Wiring
- 2. **Earthing :**
Knowledge of Earthing, Types of earthing and its importance.
- 3. **Power factor:**
Knowledge of Power factor, measurement and its improvement.
- 4. **Tools and Plants:**
Tools and Plants required for maintenance of Electrical System of Water Supply Scheme (Pumping Scheme)
- 5. **Electrical Machines Theory**
Electric and Magnetic fields, conductors and magnetic materials.
- 6. **Electrical Machines and Power Transformers**
Testing of Electrical Machines like Induction Motor, Transformer & Switch-gear.
- 7. **Operation & Maintenance**
Operation and Maintenance of Induction Motor, Alternator, Transformer, Battery & Charger and Switch-gears.
- 8. **Different types of Starters ;**
DOL, Auto-Transformer, Star Delta & Soft Starter.
- 9. **Power System :**
Components, operation and maintenance of Transmission Line (Upto 33kV)
- 10. **Switch-gears:**
Knowledge of Protective and Measuring Instruments for Electrical System/Sub- Station.

PART - B (50 Marks)
(Junior Engineers in Mechanical Engineering)

1. **Theory of Machines** : i) Motion
ii) Mechanism
2. **Thermal Engineering** : i) IC and CI engines
ii) Fuels and combustion
3. **Water Supply** : i) Population forecast
ii) Design of pumping main
iii) Design of power for pump
4. **Survey and preparation of repair estimate of pumping equipments**
5. **Different types of pipes used for water supply, their life period and jointing procedures**
6. **Pumps** : i) Different types of pump
ii) Characteristics of pump
7. **Operation and Maintenance** : i) Engine/ Diesel Generating Set
ii) Pumps
8. **Operation Research** : i) Water supply plant maintenance
9. **Welding and related processes** : i) Different types and application
10. **Maintenance of Log books for water supply plants**

IRRIGATION AND WATER RESOURCES CADRE

ENGINEERING PAPER

Duration - 3 hours

PART - A (50 Marks)

1. Basic principles of surveying, classification of surveying, survey scales, different types of survey instruments, their uses and application. Definition of term used in contour surveying, used and objective of contour survey, characteristics of contour lines.
2. Mensuration and calculation of volume, etc of works and materials, preparation of estimates.
3. Characteristics and properties of commonly used construction materials such as cement, sand, bricks, masonry, stone aggregate, timber and steel. Properties of hardened concrete, different method of measuring and proportioning of concrete mixes, water cement ratio, faults in concrete mix and remedial measures, slump test and grade of concrete, curing of concrete.
4. Properties of R.C.C, stress in steel and concrete, position of neutral axis, lever arm, under-reinforced, balanced and over-reinforced sections, strength requirements of cement concrete, permissible working (or design) stress for concrete, concrete coverings outside steel, general design principles for RC slabs, beams, column and RCC tanks.

PART - B (50 Marks)

1. Definition of various terms such as hydrology, rainfall, effective rainfall and runoff, catchment area. Types of rain gauges, importance of hydrology, concept of hydrological cycle.
2. Concept of crop water requirement, field irrigation requirement, crop seasons, duty, delta and base period- their relationship, gross command area, culturable command area, intensity of irrigation.
3. Definition and functions of different parts of weir & barrage, difference between weir and barrage, definition & function of regulatory work such as cross and head regulator, falls, energy dissipators, definition & functions and necessity of- aqueduct, siphon, classification of dam, type of dam, necessity & advantages of dam.

4. Definition of Irrigation, necessity of irrigation, types of irrigation, sources of irrigation water, concept of irrigation canals, different parts of irrigation canals and their functions, hydraulic design of irrigation canals- Manning's formula, various types of canal lining-advantages and disadvantages.

**COMMON ACCOUNTS PAPER FOR OFFICERS HOLDING THE POST OF
JUNIOR ENGINEER/DRAFTSMAN-I**

ACCOUNTS PAPER

Duration - 3 hours

PART - A (50 Marks)

1. Forms for bills and vouchers, used for payments.
2. Works of inescapable nature.
 - a) Emergent Works.
 - b) Urgent Works.
3. Documents of Accounts.
 - a) Bill register
 - b) Materials account
4. Construction Works
 - a) Detailed Project Report/ Detailed Estimate
 - b) Administrative approval & Expenditure Sanction
 - c) Technical sanction
 - d) Schedule of Rates (SOR)
5. Bidding System
 - a) Tender with 2(two)/3(three) bid system
 - b) Invitation of tender for works
 - c) Time limit for publicity of tenders
 - d) Tendering limits of contractors enlisted with central/state government departments
6. Contract Management
 - a) Earnest money, opening and accepting of tenders, rates of earnest money
 - b) Forfeit of earnest money
 - c) Performance guarantee
 - d) Signing of agreement
 - e) Security Deposit & Forms of Security deposit
 - f) Documentation of accounts
 - g) Mobilisation advance
 - h) Plan, Machinery & Shuttering material advance
 - i) Secured Advance
 - j) Measurement of work
 - k) Measurement of inadmissible items
 - l) Advance payments for work done measured/not measured
 - m) Documentation of hindrances
 - n) Extension of time (EOT) & rescheduling of milestone
 - o) Completion certificate
 - p) Deduction of income tax at source
 - q) Deduction of goods and services tax
7. General outlines of system of Accounts.
 - a) System of Account

8. **Relation with Account Officer**
 - i) General
 - ii) Inspection by the Audit/Account Officers
9. **Stores**
 - i) Stock
 - ii) Tools and Plant
 - iii) Road Metal
10. **Item rate contract**

References:

1. CPWD Works Manual.
2. Standard Operating Procedure for CPWD Works Manual
3. CPWD Accounts Code

PART - B (50 Marks)

1. **CCS (Conduct) Rules, 1964**
 - i) Rule 3 : General
 - Rule 3 'A' : Promptness and Courtesy
 - Rule 3 'B' : Observance of Government's policies
 - ii) Rule 7 : Demonstration and Strikes
 - iii) Rule 22 : Consumption of intoxicating drinks and drugs
2. **CCS (Leave Rules), 1972**
 - i) Kinds of leave due and admissible including special kinds of leave
 - ii) Grant of and return from leave
3. **CCS (CCA) Rules, 1965**
 - i) Penalties and disciplinary authorities
 - ii) Suspension