PLAN OF EXAMINATION

1. The Examination shall be conducted according to the following plan:-

Part I—The written Examination will comprise two sections—Section I consisting only of objective types of questions and Section II of conventional papers. Both Sections will cover the entire syllabus of the relevant engineering disciplines viz. Civil Engineering and Electrical Engineering. The standard and syllabi prescribed for these papers are given in Section-II. The details of the written Examination i.e. subject, duration and maximum marks allotted to each subject are given in para 2 below.

Part-II—Personality test carrying a maximum of 200 marks of such of the candidates who qualify on the basis of the written examination.

2. The following will be the subjects for the written examination:-

CATEGORY I
CIVIL ENGINEERING

	Subject	Duration	Maximum Marks
	Section-I Objective Papers		
1	General Ability Test	2 Hrs	200
	(Part A : General English)		
	(Part B : General Studies)		
2	Civil Engineering (Paper-I)	2 Hrs	200
3	Civil Engineering (Paper-II)	2 Hrs	200
	Section II Conventional Papers		
4	Civil Engineering (Paper-I)	3 Hrs	200
5	Civil Engineering (Paper-II)	3 Hrs	200
	Total		**1000**

CATEGORY II
ELECTRICAL ENGINEERING

	Subject	Duration	Maximum Marks
	Section-I Objective Papers		
1	General Ability Test	2 Hrs	200
	(Part A : General English)		
	(Part B : General Studies)		
2	Electrical Engineering (Paper-I)	2 Hrs	200
3	Electrical Engineering (Paper-II)	2 Hrs	200
	Section II Conventional Papers		
4	Electrical Engineering (Paper-I)	3 Hrs	200
5	Electrical Engineering (Paper-II)	3 Hrs	200
	Total		**1000**

3. In the Personality Test special attention will be paid to assessing the candidate's capacity for leadership, initiative and intellectual curiosity, tact and other social qualities, mental and physical energy, powers of practical application and integrity of character.

4. Conventional papers must be answered in English. Question papers will be set in English only.

5. Candidates must write the papers in their own hand. In no circumstances will they be allowed the help of a scribe to write the answers for them.

6. The Manipur Public Service Commission shall have discretion to fix qualifying marks in any or all the subjects of the examination.

7. Marks will not be allotted for mere superficial knowledge.

8. In the question papers, wherever required, SI units will be used.

9. Candidates will be permitted to bring and use battery operated pocket calculators for conventional (essay) type papers only. Loaning or inter-changing of calculators in the EXAMINATION HALL will not be permitted. Candidates will be not permitted to use calculators for answering Objective Type Paper (Test Booklets). They should not, therefore, bring the same inside the Examination Hall.

10. Candidates should use only International form of Indian numerals (e.g. 1,2,3,4,5,6 etc.) while answering question papers.

SECTION-II
Standard and Syllabi

The standard of paper in General Ability Test will be such as may be expected of an Engineering/Science Graduate. The standard of papers in other subjects will approximately be that of an Engineering Degree Examination of an Indian University. There will be no practical examination in any of the subjects.

GENERAL ABILITY TEST

Part A: General English. The question paper in General English will be designed to test the candidate's understanding of English and workmanlike use of words.

Part B: General Studies: The paper in General Studies will include knowledge of current events and of such matters as of everyday observation and experience in their scientific aspects as may be expected of an educated person. The paper will also include questions on History of India and Geography of a nature which candidates should be able to answer without special study.

CIVIL ENGINEERING

(For both objective and conventional type papers)

PAPER-I

1. BUILDING MATERIALS

Timber : Different types and species of structural timber, density-moisture relationship, strength in different directions, defects, influence of defects on permissible stress, preservation, dry and wet rots, codal provisions for design, plywood.

Bricks : Types, Indian Standard classification, absorption, saturation factor, strength in masonry, influence of morter strength on masonry strength.

Cement : Compounds of different types, setting times, strength.

Cement Mortar : Ingredients, proportions, water demand, mortars for plastering and masonry.

Concrete : Importance of W/C Ratio, Strength, ingredients including admixtures, worksability, testing for strength, elasticity, non-destructive testing, mix design methods.

2. SOLID MECHANICS

Elastic constants, stress, plane stress, Mohr's circle of stress, strains, plane strain, Mohr's circle of strain, combined stress; Elastic theories of failure; Simple bending, shear; Torsion of circular and rectangular sections and simple members.

3. STRUCTURAL ANALYSIS

Analysis of determinate structures – different methods including graphical methods. Analysis of indeterminate skeletal frames - moment distribution, slope-deflection, stiffness and force methods, energy methods, Muller-Breslau principle and application. Plastic analysis of indeterminate beams and simple frames - shape factors.

4. DESIGN OF STEEL STRUCTURES

Principles of working stress method. Design of connections, simple members, Built-up sections and frames, Design of Industrial roofs. Principles of ultimate load design. Design of simple members and frames.

5. DESIGN OF CONCRETE AND MASONRY STRUCTURES

Limit state design for bending, shear, axial compression and combined forces. Codal provisions for slabs, beams, walls and footings. Working stress method of design of R.C. members. Principles of prestressed concrete design, materials, methods of prestressing, looses, Design of simple members and determine structures. Introductions to prestressing of indeterminate structure.
Design of brick masonry as per I.S. Codes.

6. CONSTRUCTION PRACTICE, PLANNING AND MANAGEMENT

Concreting Equipment :
Weight Batcher, Mixer, vibrator, batching plant, concrete pump.
Cranes, hoists, lifting equipment.
Earthwork Equipment :
Power shovel, hoe, dozer, dumper, trailwes and tractor, roller, sheep foot rollers, pumps.
Construction, Planning and Management :
Bar chart, linked bar chart, work-break down structures, Activity –on-arrow diagrams. Critical path, probabilistic activity durations; Event-based networks.
PERT network : Time-cost study, crashing; Resources allocation.

PAPER-II

1. (A) FLUID MECHANICS, OPEN CHANNEL FLOW, PIPE FLOW :\

Fluid Properties, Pressure, Thrust, Buoyancy; Flow Kinematics; Integration of flow equations; Flow measurement; Relative motion; Moment of momentum; Viscosity, Boundary layer and Control, Drag, Lift, dimensional Analysis, Momentum and Energy

principles in open channel flow, Flow controls, Hydraulic jump, Flow sections and properties; Normal flow, Gradually varied flow; Surges; Flow development and losses in pipe flows, Measurements; Siphons; Surges and water hammer; Delivery of Power Pipe Networks.

(B) HYDRAULIC MACHINES AND HYDROPOWER

Centrifugal pumps, types, performance parameters, scaling, pumps in parallel; Reciprocating pumps, air vessels, performance parameters; Hydraulic ram; Hydraulic turbines, types, performance parameter, controls, choice; Power house, classification and layout, storage, pondage, control of supply.

2. (a) HYDROLOGY

Hydrological cycle, precipitation and related data analyses, PMP, unit and synthetic hydrograph; Evaporation and transpiration; Floods and their management, PMF; Streams and their gauging; River morphology; Routing of floods; Capacity of Reservoirs.

(b) WATER RESOURCES ENGINEERING

Water resources of the globe; Multipurpose uses of Water; Soil-Plant-Water relationships, irrigation systems, water demand assessment; Storages and their yields, ground water yield and well hydraulics; Water logging, Drainage design, Irrigation revenue; Design of rigid boundary canals, Lacey's and Tractive force concepts in canal design, lining of canals; Sediment transport in canals; Non-Overflow and overflow sections of gravity dams and their design, Energy dissipaters and tail water rating; Design of headworks, distribution works, falls, cross-drainage works, outlet, River training.

3. ENVIRONMENTAL ENGINEERING

(A) WATER SUPPLY ENGINEERING :

Sources of supply, yields, design of intakes and conductors; Estimation of demand; Water quality standards; Control of Water-borne diseases; Primary and secondary treatment, detailing and maintenance of treatment units; Conveyance and distribution systems of treated water. Leakages and control; Rural water supply; Institutional and industrial water supply.

(B) WASTE WATER ENGINEERING

Urban rain water disposal; Systems of sewage collection and disposal; Design of sewers and sewerage systems; pumping Characteristics of sewage and its treatment, Disposal of products of sewage treatment, stream flow rejuvenation, Institutional and industrial sewage management; Plumbing systems; Rural and semi-urban sanitation.

(C) SOLID WASTE MANAGMENT

Source, classification collection and disposal; Design and Management of landfills.

(D) AIR AND NOISE POLLUCTION AND ECOLOGY

Sources and effects of air pollution, monitoring of air pollution; Noise pollution and standards; Ecological chain and balance, Environmental assessment.

4. (a) SOIL MECHANICS

Properties of soil, classification and interrelationship; Compaction behaviour, methods of compaction and their choice; Permeability and seepage, flow nets, Inverted filters; Compressibility and consolidation; Shearing resistance, stresses and failure; soil testing in laboratory and in-situ; Stress path and applications; Earth pressure theories, stress distribution in soil; soil exploration, samplers, load tests, penetration tests.

(b) FOUNDATION ENGINEERING

Types of foundations, Selection criteria, bearing capacity, settlement, laboratory and field tests; Types of piles and their design and layout, Foundations on expansive soils, swelling and its prevention, foundation on swelling soils.

5. (a) SURVEYING

Classification of surveys, scales, accuracy; Measurement of distances - direct and indirect methods; optical and electronic devices; Measurement of directions, prismatic compass, local attraction; Theodolites - types; Measurement of elevations - Spirit and trigonometric levelling; Relief representation; Contours; Digital elevation modelling concept; Establishment of control by triangulations and traversing - measurements and adjustment of observations, computation of coordinates; Field astronomy, Concept of global positioning system; Map preparation by plane tabling and by photogrammetry; Remote sensing concepts, map substitutes.

(b) TRANSPORTATION ENGINEERING

Planning of highway systems, alignment and geometric design, horizontal and vertical curves, grade separation; Materials and construction methods for different surfaces and maintenance: Principles of pavement design; Drainage.
Traffic surveys, Intersections, signalling: Mass transit systems, accessibility, networking.
Tunnelling, alignment, methods of construction, disposal of muck, drainage, lighting and ventilation, traffic control, emergency management.
Planning of railway systems, terminology and designs, relating to gauge, tractive power and track modernisation; Maintenance; Appurtenant works; Containerisation.

Harbours - layouts, shipping lanes, anchoring, location identification; Littoral transport with erosion and deposition; sounding methods; Dry and Wet docks, components and operational Tidal data and analyses.
Airports - layout and orientation; Runway and taxiway design and drainage management; Zoning laws; Visual aids and air traffic control; Helipads, hangers, service equipment.

ELECTRICAL ENGINEERING

(For both objective and conventional type papers)

PAPER I

1. EM Theory

Electric and magnetic fields, Gauss's Law and Amperes Law. Fields in dielectrics, conductors and magnetic materials. Maxwell's equations. Time varying fields. Plane-Wave propagating in dielectric and conducting media. Transmission lines.

2. Electrical Materials

Band Theory, Conductors, Semi-conductors and Insulators. Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics, Properties and applications. Hall effect and its applications. Special semi conductors.

3. Electrical Circuits

Circuits elements. Kirchoff's Laws. Mesh and nodal analysis. Network Theorems and applications. Natural response and forced response. Transient response and steady state response for arbitrary inputs. Properties of networks in terms of poles and zeros. Transfer function. Resonant circuits. Threephase circuits. Two-port networks. Elements of two-element network synthesis.

4. Measurements and Instrumentation

Units and Standards. Error analysis, measurement of current, Voltage, power, Power-factor and energy. Indicating instruments. Measurement of resistance, inductance, Capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter. Transducers and their applications to the measurement of nonelectrical quantities like temperature, pressure, flow-rate displacement, acceleration, noise level etc. Data acquisition systems. A/D and D/A converters.

5. Control Systems

Mathematical modelling of physical systems. Block diagrams and signal flow graphs and their reduction. Time domain and frequency domain analysis of linear dynamical system. Errors for different type of inputs and stability criteria for feedback systems. Stability analysis using Routh-Hurwitz array, Nyquist plot and Bode plot. Root locus and Nicols chart and the estimation of gain and phase margin. Basic concepts of compensator design. State variable matrix design. Sampled data system and performance of such a system with the samples in the error channel. Stability of sampled data system. Elements of non-linear control analysis. Control system components, electromechanical, hydraulic, pneumatic components.

PAPER II

1. Electrical Machines and Power Transformers

Magnetic Circuits - Analysis and Design of Power transformers. Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer, 3-phase transformer. Parallel operation.
Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage losses and efficiency.
D.C. Machines. Construction, Excitation methods. Circuit models. Armature reaction and commutation. Characteristics and performance analysis. Generators and motors. Starting and speed control. Testing, Losses and efficiency.
Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient-pole machine, Parallel operation. Hunting. Short circuit transients.
Induction Machines. Construction. Principle of operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control.
Fractional KW motors. Single-phase synchronous and induction motors.

2. Power systems

Types of Power Stations, Hydro, Thermal and Nuclear Stations. Pumped storage plants. Economics and operating factors.
Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. Z-Bus formulation. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady-state stability of power systems. Equal area criterion.
Power system Transients. Power system Protection Circuit breakers. Relays. HVDC transmission.

3. ANALOG AND DIGITAL ELECTRONICS AND CIRCUITS

Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers, switching behavior of diodes and transistors.
Small signal amplifiers, biasing circuits, frequency response and improvement, multistage amplifiers and feed-back amplifiers, D.C. amplifiers, coupling methods, push pull amplifiers, operational amplifiers, wave shaping circuits. Multivibrators and flipflops and their applications. Digital logic gage families, universal gates combinational circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and ROMs.

4. MICROPROCESSORS

Microprocessor architecture-Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Micro-processors in power system.

5. COMMUNICATION SYSTEMS

Types of modulation; AM, FM and PM. Demodulators. Noise and bandwidth considerations. Digital communication systems. Pulse code modulation and demodulation. Elements of sound and vision broadcasting. Carrier communication. Frequency division and time division multiplexing, Telemetry system in power engineering.

6. POWER ELECTRONICS

Power Semiconductor devices. Thyristor. Power transistor, GTOs and MOSFETs. Characteristics and operation. AC to DC Converters; 1-phase and 3-phase DC to DC Converters. AC regulators. Thyristor controlled reactors; switched capacitor networks. Inverters; single-phase and 3-phase. Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.