

नेपाली सेना

प्रा.उ.से. ईलेक्ट्रिकल ईन्जिनियर (खुला) पदको लिखित परीक्षाको पाठ्यक्रम

समय : २ घण्टा ३० मिनेट

पुर्णाङ्क : १००
उत्तीर्णाङ्क : ४०

यो पाठ्यक्रम नेपाली सेनाको विभिन्न ईकाईहरूमा रिक्त रहेको प्रा.उ.से.ईलेक्ट्रिकल ईन्जिनियर (खुला) पदका उम्मेदवार छनौट परीक्षाको लागि निर्धारण गरिएको हो । लिखित परीक्षामा सरिक हुने उम्मेदवारहरूको पेशा सम्बन्धि विषयलाई आधारमानी प्रश्नहरू सोधिने छ ।

- (क) लिखित परीक्षाको माध्यम नेपाली/अंग्रेजी वा दुवै भाषा हुनेछ ।
- (ख) लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र अर्को चरणको परीक्षामा सम्मिलित गराईने छ ।
- (ग) प्रश्न पत्र निर्माण गर्दा पाठ्यक्रममा समावेश भएका सबै विषयहरूलाई समेटिनेछ ।
- (घ) नेपाली सेनाको आवश्यकता तथा विविध परिस्थितिमा नेपाली सेना अनुकूल हुने गरी उल्लेखित विवरणहरूमा हेरफेर हुन सक्नेछ ।
- (ङ) पाठ्यक्रमको रूपरेखा देहायमा उल्लेख गरे अनुसार हुनेछ ।
- (च) पाठ्यक्रम लागु मिति २०७३/०३/२२ गते ।

लिखित परीक्षा योजना र पाठ्यक्रम

विषय	पुर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली		प्रश्न संख्या X अङ्क	समय
पेशा सम्बन्धी	१००	४०	वस्तुगत (Objective)	बहुवैकल्पिक प्रश्न (MCQs)	४० प्रश्न X १ अङ्क = ४०	२ घण्टा ३० मिनेट
			विषयगत (Subjective)	छोटो उत्तर	६ प्रश्न X ५ अङ्क = ३०	
				लामो उत्तर	३ प्रश्न X १० अङ्क = ३०	

(SYLLABUS FOR ELECTRICAL ENGINEER)

1. BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

- 1.1 Magnetic circuits: Flux linkage, inductance and energy; magnetic materials and their properties; magnetically induced emf and force; AC operation of magnetic circuits; hysteresis and eddy current losses.
- 1.2 DC and AC fundamentals: Phasor representation; series and parallel AC circuits; waveforms and harmonics; power in single phase AC circuits; complex power; voltage, current and power in balanced three phase circuits; per unit quantities; load characteristics.
- 1.3 Semiconductor Devices and its applications: Diodes, Transistors, MOSFET, JFET, their types, Biasing and working principle.

2. COMPUTER PROGRAMMING

- 2.1 Introduction to Computers, Problem Solving Using Computer, Introduction to C, Input and Output Statement, Control Statement and Structure of programs, Arrays, Modular Programming and Subprograms, Data file, Data Structures, Structured Programming, Programming Projects and Software Management

3. LOGIC CIRCUIT

- 3.1 The basic gates (NOT, OR, AND), universal logic gates (NOR, NAND), AND - OR- INVERT gates
- 3.2 Boolean Laws and Theorems, Truth Table, SOP and POS method, Karnaugh Simplifications
- 3.3 Multiplexer, DE multiplexers, Decoder, Encoder, Flip Flops, Synchronous machine, Asynchronous machines, Digital Design example

4. COMMUNICATION SYSTEM

- 4.1 Representation of basic communication system (Analog & Digital), components of communication system, communication channel,
- 4.2 Need for modulation, Amplitude Modulation and Demodulation, Frequency Modulation and demodulation, Phase modulation, Frequency division Multiplexing system.
- 4.3 Super heterodyne receiver in communication system, Representation of random signals and noise in communication system, Noise performance of analog communication systems.

5. NETWORK ANALYSIS

- 5.1 Ohms law, Kirchoff's law, nodal and mesh analysis, Series and parallel circuit, delta-star and star-delta transformation, Concept of complex Impedance and Admittance RLC series and parallel circuit

- 5.2 Network Theorem: Thevenins theorem, Nortons theorem, Superposition theorem, Reciprocity theorem and Maximum power transfer theorem.
- 5.3 Resonance in series and parallel RLC circuit, Active, Reactive and Apparent power, Transient response of RLC circuit excited by DC and AC sources
- 5.4 Fourier analysis, Two-port network: Z, Y, T and h parameters, T to Π and Π transformation, two-port network connection, three-phase circuit analysis, phase and line quantities

6. CONTROL SYSTEM

- 6.1 Mathematical modeling: differential equation representation, transfer function notations and state space representations of physical systems, Block diagram algebra, signal flow graphs
- 6.2 Transient and steady state response: impulse response, step and ramp response analysis of a 1st and 2nd order systems, overshoot and damping, steady state error and error constants ,Effect of feedback on stability and steady state error
- 6.3 Stability: Relative and absolute stability, Routh -Herwitz criterion
- 6.4 Root locus: Manual plotting and judging the relative stability using root locus technique
- 6.5 Frequency response: Polar, and Bode plots, stability in frequency domain, gain margin and phase margins, Nyquist criterion for stability
- 6.6 Root locus: Manual plotting and judging the relative stability using root locus technique
- 6.7 Control system design: lead-lag and PID controllers and setting the controller parameters using Root locus and Bode plots

7. STATIC AND DYNAMIC ELECTRICAL MACHINES

- 7.1 Transformer: Working principle, Equivalent Circuit, Losses and efficiency, Voltage regulation, Transformer tests, Auto transformer, Three phase transformer connections, Parallel operation
- 7.2 D.C. Machine: Constructional detail, Operation in motoring and generating mode, Back emf in DC motor, Types of DC motor, their characteristics and applications, DC motor starter, Speed control of DC motor
- 7.3 Induction machine: Equivalent circuit, Torque-speed characteristic, Losses and efficiency, Starting methods, Speed control of three phase induction motor, Induction motor tests, Single phase induction motors- types, characteristics and applications
- 7.4 Synchronous machine: Salient pole and cylindrical rotor construction, generating and motoring principle, phasor diagram and power angle characteristics, Parallel operation of synchronous generators, Starting methods for synchronous motor, Effect of excitation, V and Inverted V curves, Synchronous condenser

8. ELECTRICAL SUPPLY SYSTEMS

- 8.1 Power Plants: components of hydro power plant, Steam power Plants and Diesel Power Plants; Turbine classifications, governing systems, Plant use factor; load sharing between base load and peak load plants
- 8.2 Transmission system: Overhead and underground transmissions, EHV AC and HVDC Transmission
- 8.3 Electrical and Mechanical design of Over head AC transmission: Selections of conductor size and configuration, supports and cross arms, insulators, sag and tension calculation
- 8.4 Power Distribution System: primary and secondary distribution, Distribution network layouts, protection coordination in distribution system.

9. POWER SYSTEM ANALYSIS

- 9.1 Computation of transmission line parameters, GMD and GMR, proximity effect and skin effect
- 9.2 Transmission line performance: Per unit system representation, Single line diagram, Lumped and distributed parameter modeling, ABCD parameters, efficiency & regulations calculations, Ferranti effect, surge impedance loading
- 9.3 Load flow: Basic Load flow equation, Gauss-Seidal and Newton-Raphson methods
- 9.4 Over voltages in transmission lines: Power frequency, switching and lightning over voltages, surge arrestors
- 9.5 VAR compensation: Real and reactive power flow through transmission line, series and shunt compensations
- 9.6 Fault calculations: Symmetrical and unsymmetrical faults
- 9.7 Power system stability studies: Steady state & transient stability limits, swing equations, equal area criterion, stability enhancement techniques.
- 9.8 Corona: corona inception voltage, power loss, waveform deformation, RI and AN due to corona

10. MEASUREMENT AND INSTRUMENTATION

- 10.1 Accuracy, Precision, Absolute and Relative Errors, Parallax Deflection type measuring instruments: Galvanometer, Ammeter, Voltmeter, Wattmeter, Watt-hour meter, Maximum Demand Meter, Frequency Meter Instrument Transformers:
- 10.2 Operating Principles of Measuring and Protection type CTs, Potential transformers
- 10.3 Transducers: Tachometer, potentiometer, Measurement of electrical, mechanical, thermal and hydraulic variables
- 10.4 Measurement of low medium and high resistances by Ohmmeter method, Meggers and DC bridges, Measurement of inductance, capacitance and frequency by AC bridge circuits
- 10.5 Operational Amplifier: Signal Amplification, attenuation, differentiation, integration and adder, Operating principles of Analog and Digital Oscilloscope, Analog to Digital and Digital to Analog converters
- 10.6 Digital instrumentation: Fundamental principles, interfacing to the computers, Microprocessor based instrumentation

11. POWER SYSTEM PROTECTION

- 11.1 Fuse, Magnetic Contactors, Isolators, MCB and MCCB: characteristics and operating principles
- 11.2 Relays: Electromagnetic and Static Relays, Over current Relay, Impedance Relay, Directional Relay
- 11.3 Circuit Breakers: ACB, OCB, ABCB, VCB and SF6 CB; construction, operating principles and applications
- 11.4 Protection schemes: Over current, under voltage, differential, distance protection
- 11.5 Grounding: System and equipment grounding, electric shock, safe value of current and voltages, touch and step potentials, Ground Fault Current Interrupters

12. POWER ELECTRONICS

- 12.1 Devices: Power Transistor, Power Diodes, Thyristor, Triac, MOSFET, UJT, GTO – Construction and their characteristics
- 12.2 Rectifier: Rectifier using diodes - half wave, full wave, single phase, three phase, capacitor and inductor filters, Controlled rectifier using Thyristors - half wave, full wave, single phase, three phase
- 12.3 DC chopper: Step down chopper, Step up chopper.
- 12.4 Inverter: Single phase voltage inverter, three phase voltage inverter, current source inverter
- 12.5 Cyclo-converter: Single phase and three phase
- 12.6 AC voltage controller – with resistive load and inductive load

13. ECONOMICS OF POWER UTILIZATION

- 13.1 Economic considerations: Cost classification; interest and depreciation
- 13.2 Demand characteristics: load curves, load duration curve, demand factor; load factor, diversity factor, causes of low power factor and its disadvantages, power factor improvement and its economics
- 13.3 Tariff: objective, factors affecting tariff, types of tariff
- 13.4 Illumination: Illumination and luminance, radiant efficiency, plane and solid angles, laws of illumination; polar curves, illumination requirement, design of indoor and outdoor lighting scheme. Incandescent lamps, arc lamps, sodium discharge lamps, mercury fluorescent lamps, high pressure mercury vapor lamps

14. SAFETY ENGINEERING:

- 14.1 Physical effects of electric shock; safety and precaution; safety rules and regulation; safety tools and devices for electricity
- 14.2 Live line maintenance and precautions; earthing and shielding techniques; fire hazards; fire fighting techniques and equipment; First aid requirements after electrical accidents

15. AC MACHINES

- 15.1 Transformers: Equivalent circuits; losses and efficiency; efficiency curves; energy efficiency; regulation; grounding; transformer connections; parallel operation; overloading capacity; temperature rise; auto-transformer and instrument transformer
- 15.2 Synchronous Machines: Working principles; operating characteristics; losses and efficiency; steady state and transient equivalent circuits; excitation system and requirement, parallel operation, hunting.
- 15.3 Induction Machines: Working principles; operating characteristics of motoring and generating mode; losses and efficiency; equivalent circuit; starters; speed control and motor selection.

16. TRANSMISSION AND DISTRIBUTION

- 16.1 A.C. transmission: Performance of short, medium and long transmission lines; ABCD constants; advantages and limitations of high voltage transmission; choice of working voltage; conductor size; spacing; supports and cross arms; insulators used in overhead lines; vibration dampers; conductor configuration; clearances; span lengths; sag tension calculation; right of way
- 16.2 Corona phenomenon: Factors affecting corona and its disadvantages; radio interference; inductive interference between power and communication lines
- 16.3 Distribution Systems: Distribution feeders; conductor size; route selection; pole types; distribution substations; bus bar schemes; power factor correction; distribution system protection devices; definition of distribution system reliability indices; transformer oil; consumer supply connection; metering system
- 16.4 Knowledge of Nepalese power transmission system: voltage levels and length; export-import links for power exchange with India

17. GENERATION OF ELECTRICAL POWER

- 17.1 Hydroelectric Power Plants: Merits and demerits; site selection; classification; elements of hydroelectric power plant and schematic layouts
- 17.2 Different types of water turbines; efficiency curves; selection of water turbines
- 17.3 Essential features of hydroelectric alternators; choice of size and number of generating units; auxiliaries in hydroelectric plant
- 17.4 Nepalese power plants, their types, salient features and locations
- 17.5 Diesel Electric Power Plants: Merits and demerits; application; site selection; elements of a diesel plant and its schematic arrangement; performance and thermal efficiency
- 17.6 Non conventional method of power generation: Micro hydro, solar photovoltaic, Solar Design wind and geothermal method of power generation and their importance
- 17.7 Concept of load curve; load duration curve; mass curve; demand factor; plant factor; utilization factor and plant use factor; significance of load factor and diversity factor in generation planning
- 17.8 Renewable energy, Sources of Renewable and Non Renewable energy, its advantages and disadvantages

यस पेशा सम्बन्धी विषयको पाठ्यक्रमका एकाईहरूबाट सोधिने प्रश्नहरूको संख्या निम्नानुसार हुनेछ ।

एकाई नं. (Unit No.)	अङ्कभार (Weightage)	बहुवैकल्पिक प्रश्न (MCQs) को संख्या	छोटो उत्तर प्रश्नको संख्या	लामो उत्तर प्रश्नको संख्या
१	२०	१०	६ प्रश्न X ५ अङ्क	३ प्रश्न X १० अङ्क
२				
३				
४				
५	२५	१०		
६				
७				
८				
९	२०	५		
१०				
११				
१२	३५	१५		
१३				
१४				
१५				
१६				
१७				
जम्मा	१००	४० प्रश्न X १ अङ्क = ४० अङ्क	६ प्रश्न X ५ अङ्क = ३० अङ्क	३ प्रश्न X १० अङ्क = ३० अङ्क

Marks Distribution for Practical Examination

S.N.	Topic	Marks	Time (Minutes)
1	Paper simulation	10	10
2	Fault finding in Electrical Circuit	10	10
3	Measurement of Electrical Parameters	10	10
4	Electrical Components Identification and its application	10	10
5	Workshop Administration	10	5
	Total	50	45

1. **Paper Simulation**

Candidates are presented with five questions for basic electrical and electronic circuits and provided with 5 marks per correct answer to a question.

2. **Fault finding in Electrical Circuit**

Candidates are presented with the five different faulty basics circuit to find the faults. 2 marks are allocated for each correct diagnosis of a fault.

3. **Measurement of Electrical Parameters**

Measurements of power in Dc circuit using wattmeter, Measurement of power in single phase ac circuit using wattmeter, Measurement of rms value, amplitude value, power factor by using oscilloscope, Measurement of power in three phase ac circuit is performed by candidate. Candidates are provided with basic measuring equipments to measure 5 different parameters. 2 marks are allocated per correct measurement.

4. **Electrical Components Identification and its application**

Various Electrical and Electronic components, Devices are made layout to identify and write its applications. For each righteous identification and application candidates are given with 2 marks.

5. **Workshop Administration.**

Candidates are questioned 5 different questions of workshops management techniques by an expert.