ललितपुर महानगरपालिका
नगर कार्यपालिकाको कार्यालय
पुल्चोक,ललितपुर, ३ नं प्रदेश, नेपाल

इञ्जिनियरिङ्ग सेवा, इलेक्ट्रिकल इञ्जिनियरिङ्ग समूह, जनरल इलेक्ट्रिकल इञ्जिनियरिङ्ग उपसमूह, छैठौं तह, ईलेक्ट्रिकल इञ्जिनियर पदको प्रतियोगितात्मक परीक्षाको लागि पाठ्यक्रम

पाठ्यक्रमको रूपरेखालाई निम्न अनुसार विभाजन गरिएको छ :

भाग १

लिखित परीक्षा (Written Examination) :– वस्तुगत (वहुबैकल्पिक) पूर्णाङ्क :– १००

भाग २

अन्तिम चरण (Final Examination):– अन्तर्वार्ता पूर्णाङ्क :– ५०

परीक्षा योजना (Examination Scheme)

पत्र	विषय	पूर्णाङ्क	उतीर्णाङ्क	परीक्षा प्रणाली	प्रश्नसंख्या X अङ्क	समय
प्रथम	ईलेक्ट्रिकल ईन्जिनियरिङ्ग / जनरल इलेक्ट्रिकल ईन्जिनियरिङ्ग सम्बन्ध	१००	४०	वस्तुगत : बहुवैकल्पिक प्रश्न (MCQs)	१०० प्रश्न X १अङ्क	१ घण्टा १५मिनेट

विषय	पूर्णाङ्क	परीक्षा प्रणाली
अन्तर्वार्ता (Interview)	५०	मौखिक (Oral)

द्रष्टव्य :

१. यो पाठ्यक्रम योजनालाई लिखित परीक्षा (प्रथम चरण) तथा अन्तिम चरण (अन्तर्वार्ता) गरी दुई भागमा विभाजन गरिएको छ ।

२. प्रश्नपत्र अंग्रेजी भाषामा हुनेछ ।

३. लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुनेछ ।

इञ्जिनियरिङ्ग सेवा, इलेक्ट्रिकल इञ्जिनियरिङ्ग समूह, जनरल इलेक्ट्रिकल इञ्जिनियरिङ्ग उपसमूह, छैठौं तह, ईलेक्ट्रिकल इञ्जिनियर पदको प्रतियोगितात्मक परीक्षाको लागि पाठ्यक्रम

४. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरुको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।

५. परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।

६. कार्यालय बाट संचालन हुने परीक्षामा परीक्षार्थीले मोबाइल वा यस्तै प्रकारका विद्युतीय उपकरण परीक्षा हलमा लैजान पाइने छैन ।

७. लिखित परीक्षामा छनौट भएका उम्मेदवारहरुलाई मात्र अन्तिम चरणको अन्तर्वार्तामा सम्मिलित गराइनेछ ।

८.यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भए तापनि पाठ्यक्रममा परेका कानून, ऐन, नियम तथा नीतिहरु परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाईएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्क्रममा परेको सम्झनु पर्दछ ।

९. पाठ्यक्रम लागू मिति : २०७६/०८/१३

इञ्जिनियरिङ्ग सेवा, इलेक्ट्रिकल इञ्जिनियरिङ्ग समूह, जनरल इलेक्ट्रिकल इञ्जिनियरिङ्ग उपसमूह, छैठौं तह, ईलेक्ट्रिकल इञ्जिनियर पदको प्रतियोगितात्मक परीक्षाको लागि पाठ्यक्रम

Section I

1. General Awareness and Contemporary Issues

1.1 Physical, socio-cultural and economic geography and demography of Nepal

1.2 Major natural resources of Nepal

1.3 Geographical diversity, climatic conditions, and livelihood & lifestyle of people

1.4 Notable events and personalities, social, cultural and economic conditions in modern history of Nepal

1.5 Current periodical plan of Nepal

1.6 Information on sustainable development, environment, pollution, climate change, biodiversity, science and technology

1.7 Nepal's international affairs and general information on the UNO, SAARC & BIMSTEC

1.8 The Constitution of Nepal (From Part 1 to 5 and Schedules)

1.9 Governance system and Government (Federal, Provincial and Local)

1.10 Provisions of civil service act and regulation relating to constitution of civil service, organisational structure, posts of service, fulfillment of vacancy and code of conduct

1.11 Functional scope of public services

1.12 Public Service Charter

1.13 Concept, objective and importance of public policy

1.14 Fundamentals of management : planning, organizing, directing, controlling, coordinating, decision making, motivation and leadership

1.15 Government planning, budgeting and accounting system

1.16 Major events and current affairs of national and international importance

2. General Ability Test

2.1 **Verbal Ability Test** Jumble words, Series, Analogy, Classification, Coding-Decoding, Matrix, Ranking Order Test, Direction and Distance Sense Test, Common Sense Test, Logical Reasoning, Assertion and Reason, Statement and Conclusions

2.2 Numerical Ability Test

Series, Analogy, Classification, Coding, Arithmetical reasoning/operation, Percentage, Ratio, Average, Loss & Profit, Time & Work, Data interpretation & Data verification

2.3 Non-verbal/Abstract Ability Test

Figure Series, Figure Analogy, Figure Classification, Figure Matrix, Pattern

Completion/Finding, Analytical Reasoning Test, Figure Formation and Analysis,

Rule Detection, Water images, Mirror images, Cubes and Dice &Venn-diagram

Section II

1. D.C. CIRCUIT ANALYSIS

1.1 Circuit elements: Resistor, Inductor and Capacitor

1.2 Dependent and independent current source and voltage source

1.3 Ohms law, Kirchoff's law, nodal and mesh analysis

1.4 Series and parallel circuit, delta-star and star-delta transformation

1.5 Network Theorem: Thevenins theorem, Nortons theorem, Superposition theorem, Reciprocity theorem and Maximum power transfer theorem.

1.6 Transient response of RLC circuit excited by DC source

2. A.C. CIRCUIT ANALYSIS

2.1 Alternating voltage and current, average and RMS value.

2.2 RLC series and parallel circuits, Phaser algebra

2.3 Concept of complex Impedance and Admittance

2.4 Resonance in series and parallel RLC circuit, bandwidth and effect of Q-factor

2.5 Active, Reactive and Apparent power

2.6 Transient response of RLC circuit excited by AC source

2.7 Fourier series and Fourier Transform

2.8 Two-port network: Z, Y, T and h parameters, T to Π and Π to T transformation, two-port network connection

2.9 Generation of three-phase voltages, star and delta connections, current and voltage relation in star and delta connections, three phase power measurement

3. ELECTRICAL MACHINES

3.1 Transformer : Constructional detail, Operating principle, Equivalent Circuit, Losses and efficiency, Voltage regulation, Exciting current harmonics, Transformer inrush current, Transformer tests, Auto transformer, Three phase transformer connections, Parallel operation.

3.2 D.C. Machine: Constructional detail, Operating principle of dc generator, Voltage build-up process, Types of dc generator,their characteristics and applications, Losses and efficiency, Armature reaction and commutation, Operating principle of dc motor, Back emf, Types of dc motor, their characteristics and applications, DC motors starter, Speed control of dc motor

3.3 Induction machine: Constructional detail, Operating principle of three phase induction motor, Equivalent circuit, Torque-speed characteristic, Losses and efficiency, Staring methods, Speed control of three phase induction motor, Induction motor tests, Induction generator, Single phase induction motors- types, characteristics and applications .

3.4 Synchronous machine: Constructional detail, Operating principle of synchronous generator, Armature reaction, Equivalent circuit, phasor diagram and power angle characteristics of cylindrical rotor machine and salient pole machine, Parallel operation of synchronous generators, Operating principle of synchronous motor, Starting methods, Effect of excitation on performance of synchronous motor, V and Inverted V curves.

4. INSTRUMENTATION

4.1 Transducers: Measurement of electrical, mechanical, thermal and hydraulic variables

4.2 Moving Coil and Moving Iron Instruments: Galvanometer, Ammeter, Voltmeter, Wattmeter, Watt-hour meter, Maximum Demand Meter, Frequency Meter and Power Factor Meter

4.3 Accuracy and Precision: Parallax, Absolute and Relative Errors

4.4 Measurement of low, medium, high resistances and Megger

4.5 DC and AC bridge circuits

4.6 Operational Amplifier and filters: Ideal Op-Am, Feedback Op-Am, Adder, Signal Amplification, attenuation, differentiation and integration

4.7 Oscilloscope: Operating principles, Analog and Digital Oscilloscope

4.8 Analog to Digital and Digital to Analog converters: Weighted resistor type and Ladder type D/A converters, Dual-ramp type and Successive approximation type A/D converters

4.9 Digital instrumentation: Fundamental principles, interfacing to the computers, Microprocessor based instrumentation

4.10 Instrument Transformers: Construction and Operating Principles of Measuring and Protection type CTs, Potential transformers

5. GENERATION, TRANSMISSION AND DISTRIBUTION

5.1 Hydroelectric Power Plants: Hydraulic to electrical energy conversion, output power equation, classification, elements of hydroelectric power plant and schematic layouts, site selection, classification of water turbines, working principle of different types of water turbines, physical characteristics and efficiencies, governing of water turbines, selection of water turbines, essential features of hydroelectric alternators, auxiliaries in hydroelectric plant, advantages and disadvantages of hydroelectric plants.

5.2 Steam power Plants: Elements of a steam power plant and their schematic arrangement; working principle, vibration monitoring, governing, cooling efficiency, alternators used for steam turbine driven units

5.3 Diesel Power Plants: Elements of a diesel power plant, schematic arrangement; working principle, efficiency, cooling, governing, speed control, application, performance and thermal efficiency, alternators used for diesel units, advantages and disadvantages of diesel plants.

5.4 Non-Conventional method of power generation: Concept ofsolar photovotalic, wind and geothermal method of power generation and their importance

5.5 Power transmission system: Overhead and underground transmissions, advantages and limitations of high voltage transmission; choice of working voltage, conductor size and configuration, supports and cross arms, insulators used in overhead lines, vibration dampers sag tension calculation.

5.6 Power Distribution System: Voltage levels, primary and secondary distribution, radial and ring mains distribution, single phase and three phase ac distribution, pole/tower types, conductors and insulators used in distribution lines, distribution transformer and its accessories, protection coordination in distribution system.

6. POWER SYSTEM ANALYSIS

6.1 Transmission line parameters: Computation of series and shunt parameters of transmission line equivalent circuits, concept of GMD and GMR, proximity effect and skin effect.

6.2 Per unit system representation: Single line impedance and reactance diagrams

6.3 Transmission line performance: Lumped and distributed parameter modeling, ABCD parameters, efficiency & regulations calculations, Feranti effect, surge impedance loading

6.4 Load flow: Y-bus of a power system network, Gauss-Seidal and Newtan-Rapshon methods

6.5 Over voltages in transmission lines: Power frequency, switching and lightning over voltages, surge arrestors

6.6 VAR compensation: Real and reactive power flow through transmission line, series and shunt compensations

6.7 Fault calculations: Symmetrical components, grounded & ungrounded systems, L-G, L-L, L-L-G and 3-phase faults.

6.8 Stability studies: Steady state & transient stability limits, swing equations, equal area criterion, stability enhancement techniques.

6.9 Corona: corona inception voltage, power loss, waveform deformation, RI and AN due to corona

7. SWITCHGEAR AND PROTECTION

7.1 Fuse: Types, characteristics and operating principles

7.2 Magnetic Contactors: Types, construction, operating principles

7.3 Isolators (Disconnecting switches): types, construction and operating principles

7.4 MCB and MCCB: Construction, operating principles, characteristics

7.5 Relays: Electromagnetic and Static Relays, Over current Relay, Impedance Relay, Directional Relay

7.6 Circuit Breakers: ACB, OCB, ABCB, VCB and SF6 CB; construction, operating principles and applications

7.7 Protection schemes: Over current, under voltage, differential, distance protection

7.8 Grounding: System and equipment grounding, electric shock, safe value of current and voltages, touch and step potentials, Ground Fault Current Interrupters

8. AUTOMATIC CONTROL SYSTEM

8.1 Mathematical modeling: differential equation representation, transfer function notations and state space representations of a physical systems.

8.2 Block diagram: block diagram representation of the control system components, signal flow graphs.

8.3 Time response: impulse response, step and ramp response analysis of a 1st and 2nd order systems, overshoot and damping concepts.

8.4 Steady state error: evaluation of the steady state error and error constants

8.5 Stability: Relative and absolute stability, Routh-Herwitz criterion.

8.6 Controllers: lead-lag and PID controllers.

8.7 Root locus: judging the relative stability and setting controller parameters of a close loop control system using root locus technique.

8.8 Frequency response: Polar and Bode plots, stability in frequency domain, gain margin and phase margins, controller parameters selection using frequency response.

9. BASIC ELECTRONICS

9.1 Bi-polar junction transistor: construction, operating characteristics, use as amplifier and switch.

9.2 Logic circuit: Decimal, Binary and Hexadecimal system, logic gates, adder, Endoder, Decoder, Multiplexer, Demultiplexer.

9.3 Power Electronics Devices: Thyristor, Triac, MOSFET, UJT, GTO –

Construction and their characteristics

9.4 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.

9.5 DC chopper: Step down chopper, Step up chopper.

9.6 Inverter: Single phase voltage inverter, There phase voltage inverter, current source inverter.

9.7 Cyclo-converter – Single phase and three phase.

9.8 AC voltage controller – with resistive load and inductive load.

10. UTILIZATION OF ELECTRICAL ENERGY

10.1 Economic considerations: Cost classification; interest and depreciation

10.2 Load 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

10.3 Plant use factor; load sharing between base load and peak load plants

10.4 Tariff: objective, factors affecting tariff, types of tariff

10.5 Illumination: Illumination and luminance, radiant efficiency, plane and solid angles, laws of illumination; polar curves, illumination requirement, design of indoor and out-door lighting scheme.

10.6 Lamps: Incandescent lamps, arc lamps, sodium discharge lamps, mercury fluorescent lamps, high pressure mercury vapor lamps

10.7 Electrical energy conservation and analysis.

Section III

1.HYDRO POWER POLICY AND PLANNING

1.1 History of power development in Nepal; hydro power potential; energy supply demand trends; challenges and prospects of hydropower development; role of government institutions; NEA and private sectors in power development; concept of deregulation and unbundling; Concept of independent regulatory commission; efforts towards power sector reform.

1.2 Salient features of various Nepalese power plants; current scenario of transmission and distribution networks and substations in Nepal.

1.3 Legal provisions:

- 1.3.1 Electricity Act
- 1.3.2 Electricity Regulation
- 1.3.3 NEA Act
- 1.3.4 Civil Service Act
- 1.3.5 Civil Service Regulation
- 1.3.6 Hydropower Development Policy

2. NETWORK ANALYSIS

2.1 Ohms law, Kirchoff's law, nodal and mesh analysis

2.2 Series and parallel circuit, delta-star and star-delta transformation

2.3 Concept of complex Impedance and Admittance RLC series and parallel circuit

2.4 Network Theorem: Thevenins theorem, Nortons theorem, Superposition theorem, Reciprocity theorem and Maximum power transfer theorem.

2.5 Resonance in series and parallel RLC circuit

2.6 Active, Reactive and Apparent power

2.7 Transient response of RLC circuit excited by DC and AC sources

2.8 Fourier analysis

2.9 Two-port network: Z, Y, T and h parameters, T to Π and Π to T transformation, two-port network connection

2.10 Three-phase circuit analysis, phase and line quantities

3 STATIC AND DYNAMIC ELECTRICAL MACHINES

3.1 Transformer: Working principle, Equivalent Circuit, Losses and efficiency, Voltage regulation, Transformer tests, Auto transformer, Three phase transformer connections, Parallel operation

3.2 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

3.3 Induction machine: Equivalent circuit, Torque-speed characteristic, Losses and efficiency, Staring methods, Speed control of three phase induction motor, Induction motor tests, Single phase induction motors- types, characteristics and applications

3.4 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

4. MEASURMENTS AND INSTRUMENTATION

4.1 Accuracy, Precision, Absolute and Relative Errors, Parallax

4.2 Deflection type measuring instruments: Galvanometer, Ammeter, Voltmeter, Wattmeter, Watt-hour meter, Maximum Demand Meter, Frequency Meter

4.3 Instrument Transformers: Operating Principles of Measuring and Protection type CTs, Potential transformers

4.4 Transducers: Tachometer, potentiometer, Measurement of electrical, mechanical, thermal and hydraulic variables

4.5 Measurement of low medium and high resistances by Ohmmeter method, Meggers and DC bridges

4.6 Measurement of inductance, capacitance and frequency by AC bridge circuits 4.7 Operational Amplifier: Signal Amplification, attenuation, differentiation, integration and adder

4.8 Operating principles of Analog and Digital Oscilloscope

4.9 Analog to Digital and Digital to Analog converters

4.10 Digital instrumentation: Fundamental principles, interfacing to the computers, Microprocessor based instrumentation

5 ELECTRICAL SUPPLY SYSTEMS

5.1 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

5.2 Transmission system: Overhead and underground transmissions, EHV AC and HVDC Transmission.

5.3 Electrical and Mechanical design of Over head AC transmission: Selections of conductor size and configuration, supports and cross arms, insulators, sag and tension calculation.

5.4 Power Distribution System: primary and secondary distribution, Distribution network layouts, protection coordination in distribution system.

6. POWER SYSTEM ANALYSIS

6.1 Computation of transmission line parameters, GMD and GMR, proximity effect and skin effect.

6.2 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 6.3 Load flow: Basic Load flow equation, Gauss-Seidal and Newtan-Rapshon methods

6.4 Over voltages in transmission lines: Power frequency, switching and lightning over voltages, surge arrestors

6.5 VAR compensation: Real and reactive power flow through transmission line, series and shunt compensations

6.6 Fault calculations: Symmetrical and unsymmetrical faults

6.7 Power system stability studies: Steady state & transient stability limits, swing equations, equal area criterion, stability enhancement techniques.

6.8 Corona: corona inception voltage, power loss, waveform deformation, RI and AN due to corona

7 POWER SYSTEM PROTECTION

7.1 Fuse, Magnetic Contactors, Isolators, MCB and MCCB: characteristics and operating principles

7.2 Relays: Electromagnetic and Static Relays, Over current Relay, Impedance Relay, Directional Relay

7.3 Circuit Breakers: ACB, OCB, ABCB, VCB and SF_6 CB; construction, operating principles and applications

7.4 Protection schemes: Over current, under voltage, differential, distance protection

7.5 Grounding: System and equipment grounding, electric shock, safe value of current and voltages, touch and step potentials, Ground Fault Current Interrupters

8. CONTROL SYSTEM

8.1 Mathematical modeling: differential equation representation, transfer function notations and state space representations of physical systems, Block diagram algebra, signal flow graphs.

8.2 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

8.3 Effect of feedback on stability and steady state error

8.4 Stability: Relative and absolute stability, Routh -Herwitz criterion.

8.5 Root locus: Manual plotting and judging the relative stability using root locus technique.

8.6 Frequency response: Polar, and Bode plots, stability in frequency domain, gain margin and phase margins, Nyquist criterion for stability.

8.7 Root locus: Manual plotting and judging the relative stability using root locus technique.

8.8 Control system design: lead-lag and PID controllers and setting the controller parameters using Root locus and Bode plots.

9.POWER ELECTRONICS

9.1 Devices: Power Transistor, Power Diodes, Thyristor, Triac, MOSFET, UJT, GTO – Construction and their characteristics

9.2 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. 9.3 DC chopper: Step down chopper, Step up chopper.

9.4 Inverter: Single phase voltage inverter, There phase voltage inverter, current source inverter.

9.5 Cyclo-converter – Single phase and three phase.

9.6 AC voltage controller – with resistive load and inductive load.

10. ECONOMICS OF POWER UTILIZATION

10.1 Economic considerations: Cost classification; interest and depreciation

10.2 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

10.3 Tariff: objective, factors affecting tariff, types of tariff

10.4 Illumination: Illumination and luminance, radiant efficiency, plane and solid angles, laws of illumination; polar curves, illumination requirement, design of indoor and out-door lighting scheme. Incandescent lamps, arc lamps, sodium discharge lamps, mercury fluorescent lamps, high pressure mercury vapor lamps.