विद्युत नियमन आयोग

इन्जिनिरिङ सेवा, इलेक्ट्रिकल समूह, तह ७, इन्जिनियर पदको

खुला/आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

यस पाठ्यक्रमलाई दुई चरणमा विभाजन गरिएको छः

प्रथम चरण :- लिखित परीक्षा (Written Examination) पूर्णाङ्क :- २००

द्वितीय चरण :- अन्तर्वार्ता (Interview) पूर्णाङ्क :- ३०

परीक्षा योजना (Examination Scheme)

१. प्रथम चरणः लिखित परीक्षा (Written Examination) **पूर्णाङ्क :- २००**

पत्र	विषय	पूर्णाङ्क	उत्तीर्णाङ्क	खण्ड	परीक्षा प्रणाली	प्रश्न संख्या	अङ्क भार	समय
प्रथम	सामान्य ज्ञान, बौद्धिक परीक्षण तथा विद्युत नियमन सम्बन्धी	१००	४०	(क)	वस्तुगत बहुवैकल्पिक प्रश्न (MCQs)	५०	१	१ घण्टा ३० मिनेट
	General Technical Subject			(ख)	वस्तुगत बहुवैकल्पिक प्रश्न (MCQs)	५०	१	
द्वितीय	Technical Subject	१००	४०	(क)	छोटो उत्तर आउने प्रश्न	२	५	३ घण्टा
					लामो उत्तर आउने प्रश्न	४	१०	
				(ख)	छोटो उत्तर आउने प्रश्न	२	५	
					लामो उत्तर आउने प्रश्न	४	१०	

२. द्वितीय चरणः अन्तर्वार्ता (Interview) **पूर्णाङ्क :- ३०**

विषय	पूर्णाङ्क	परीक्षा प्रणाली
अन्तर्वार्ता	३०	मौखिक

द्रष्टव्यः

१. लिखित परीक्षाको माध्यम भाषा नेपाली अथवा अंग्रेजी वा नेपाली र अंग्रेजी दुवै हुन सक्नेछ।

२. प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ।

३. लिखित परीक्षामा सोधिने प्रश्न संख्या र अङ्कभार यथासम्भव सम्बन्धित पत्र / विषयमा दिइए अनुसार हुनेछ।

४. वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको 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. वस्तुगत बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा परीक्षार्थीले उत्तर लेख्दा अंग्रेजी ठूलो अक्षर (Capital Letter) A, B, C, D मा लेख्नुपर्नेछ। सानो अक्षर (Small Letter) a, b, c, d लेखेको वा अन्य कुनै सङ्केत गरेको भए सबै उत्तरपुस्तिका रद्ध हुनेछ।

६. बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको क्यालकुलेटर (Calculator) प्रयोग गर्न पाइने छैन।

७. विषयगत प्रश्नहरूको हकमा एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरू (Short notes) सोध्न सकिनेछ।

८. विषयगत प्रश्न हुने पत्र/ विषयको प्रत्येक खण्डका प्रश्नका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन्। परीक्षार्थीले प्रत्येक खण्डका प्रश्नको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नुपर्नेछ।

९. यस पाठ्यक्रम योजना अन्तर्गतका प्रश्न/ विषय विषयवस्तुमा जुनसुकै कुरा लेखिएको भए तापनि पाठ्यक्रममा परेको कानुन, ऐन, नियम, विनियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाइएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ।

१०.प्रथम चरणको परीक्षाबाट छनौट भएका उमेदवारहरूलाई मात्र द्वितीय चरणको परीक्षामा सम्मिलित गराइनेछ।

११.पाठ्यक्रम स्वीकृत मिति : २०८२/०१/०८

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खुला/आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

प्रथम पत्र :

खण्ड (क) सामान्य ज्ञान, बौद्धिक परीक्षण तथा विद्युत नियमन सम्बन्धी : ५० अङ्क

1. सामान्य ज्ञान (१५ × १ = १५ अङ्क)

1.1 नेपालको भूगोल र आर्थिक तथा सामाजिक क्रियाकलापः धरातलीय स्वरुपको किसिम र विशेषता, नेपालमा पाइने हावापानीको किसिम र विशेषता, नदीनाला, तालतलैया, खनिज पदार्थ, प्राकृतिक श्रोत साधन, विद्युत, शिक्षा, स्वास्थ्य र सन्चार सम्बन्धी जानकारी

1.2 नेपालको सामाजिक एवं सांस्कृतिक अवस्थाः परम्परा, धर्म, जाति, भाषाभाषी, कला, संस्कृति र साहित्य

1.3 नेपालमा विद्युत विकास, उर्जाका श्रोत र सम्भावना

1.4 नेपालको संघीय, प्रादेशिक र स्थानीय संरचना तथा शासन प्रणाली सम्बन्धी जानकारी

1.5 विश्वको भूगोलः महादेश, महासागर, अक्षांश, देशान्तर, अन्तर्राष्ट्रिय तिथि रेखा, समय, पर्वतशृंखला, नदी, हिमनदी. ताल, हिमताल

1.6 संयुक्त राष्ट्र संघ र यसका एजेन्सीहरू सम्बन्धी जानकारी

1.7 दक्षिण एशियाली क्षेत्रीय सहयोग संगठन (SAARC), SAARC- Energy Center, बिमस्टेक (BIMSTEC) सम्बन्धी जानकारी

1.8 राष्ट्रिय र अन्तर्राष्ट्रिय महत्त्वका समसामयिक घटना तथा नवीनतम गतिविधिहरू

2. संविधान, विद्युत क्षेत्रको नियमन र सम्बन्धित कानुनी व्यवस्था (१५ × १ = १५ अङ्क)

2.1 नेपालको संविधानः मौलिक हक र कर्तव्य, राज्यका निर्देशक सिद्धान्त, नीति तथा दायित्व, अनुसूचीहरू

2.2 विद्युत ऐन, २०४९ र विद्युत नियमावली, २०५०

2.3 विद्युत नियमन आयोग ऐन, २०७४ तथा विद्युत नियमन आयोग नियमावली, २०७५

2.4 विद्युत नियमन आयोग कर्मचारी प्रशासन विनियमावली, २०८१

2.5 सार्वजनिक खरिद ऐन, २०६३

2.6 विद्युत क्षेत्रमा नियमनको अवधारणा

2.7 विद्युत नियमन आयोगको काम, कर्तव्य तथा अधिकार

2.8 उपभोक्ता महशुल निर्धारणको सिद्धान्त तथा प्रक्रिया

2.9 विद्युत खरिद बिक्री दर निर्धारणका सिद्धान्त तथा प्रक्रिया

2.10 विद्युत नियमन आयोगको पाँच वर्षे मार्गचित्र २०८१-८६

3. Aptitude Test (20 ×1 = 20 Marks)

3.1 Verbal reasoning :

Series, analogy, classification, coding-decoding, insert the missing character, direction and distance sense test, ranking order, assertion and reason, statement and conclusion

3.2 Non-verbal reasoning:

Series, analogy, classification, matrices, figure formation and analysis, dot situation, water images, mirror images, embedded figures.

3.3 Quantitative aptitude:

Arithmetical reasoning/operation, percentage, fraction, ratio, average, profit & loss, time and work

3.4 General mental ability, logical reasoning and analytical ability, data interpretation

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खुला/आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

खण्ड (ख)

General Technical Subject तथा विद्युत नियमन सम्बन्धी : ५० अङ्क

(A). General Technical Subject (40 ×1 = 40 Marks)

1. **Fundamentals of Electrical Engineering**
   - 1.1 Electric charge and current, potential difference, power and energy; Ohm's Law, Kirchhoff's Law; Network theorems; superposition theorem, maximum power transfer theorem; Thevenin's theorem and Norton's theorem
   - 1.2 Transients in electrical circuits; natural and step response of RL and RC and RLC Circuits, Operational Amplifiers; Inverting and Non-inverting Amplifier Circuits, Two port networks, reciprocity theorems
   - 1.3 AC fundamental: Equation of alternating voltages and current, frequency, amplitude, concept of phase difference, RMS value, active and reactive power, complex power, power triangle, power factor, resonance in AC circuits
   - 1.4 Three phase systems; balanced and unbalanced systems, voltage current relations and computation of power in three phase systems, Star/ Delta and Delta/Star transformation

2. **Electrical Machines**
   - 2.1 Transformers: Equivalent circuits; losses and efficiency; voltage regulation; transformer connections; parallel operation; overloading capacity; temperature rise; Testing of transformers and their parameters; Auto-transformer and its uses in High voltage system; Instrument transformers (PT, CT)
   - 2.2 DC Machines: Working principles; types; operating characteristics; armature reaction; losses and efficiency; applications, starting and speed control of DC motors
   - 2.3 Synchronous Machines: Working principles; operating characteristics; losses and efficiency; steady state and transient equivalent circuits; excitation system and requirement, governor principle; parallel operation; hunting phenomenon
   - 2.4 Induction Machines: Working principles; operating characteristics during motoring and generating mode; losses and efficiency; equivalent circuits; starters; speed control and motor selection

3. **Power Generation**
   - 3.1 Hydroelectric Power Plants: Merits and demerits, site selection, classification; elements of hydroelectric power plant and schematic layouts; essential features of hydroelectric alternators; choice of size and number of generating units; auxiliaries in hydroelectric plant; Governor's principle and characteristic
   - 3.2 Non-conventional and renewable power generation: micro, hydro, solar photovoltaic, wind, generation schemes and their significance

4. **Transmission Lines**
   - 4.1 Transmission: Choice of voltage, conductor size, insulators used in overhead lines, vibration dampers, conductor configuration, clearances, span lengths, sag-tension calculation, pole/tower types; right of way, route selection
   - 4.2 Types of underground cable, cable resistances and capacitances, insulation resistance, selection criteria of cables, handling of cable and protection, cable joints
   - 4.3 Line parameters computations, Performance of short, medium and long transmission lines; ABCD constants; surge impedance loading, Ferranti effect
   - 4.4 Introduction to HVDC and EHV AC transmission lines; advantages, disadvantages and applications

5. **Power System Analysis**
   - 5.1 Per unit representation and its advantage
   - 5.2 Load Flow Study: load characteristics, effects on voltage and frequency, real power and frequency balance, reactive power and voltage balance, power flow equations for a network, voltage profile and VAR compensation
   - 5.3 Stability: Steady state, dynamic and transient stability, equal area criterion, Steady-state stability implications, maximum steady state power flow condition

6. **Power Electronics**
   - 6.1 Power electronics devices; Diode, Transistors, MOSFET, Thyristors, GTO, IGBT
   - 6.2 Rectifiers; uncontrolled and controlled rectifiers, operation with inductive loads, harmonic filtering, half wave and full wave rectifier circuits and the output waveforms
   - 6.3 Inverters: basic details and operation of inverters; voltage source and current source inverters, harmonic filtering
   - 6.4 DC choppers; cyclo-converters; AC voltage controllers

7. **Sub-stations, Switchyards, Switchgear and Protection**
   - 7.1 Classification of substation: indoor and outdoor substations; general layout of bus bar, arrangements sub-station
   - 7.2 Earthing and shielding of electrical system and methods of the earthing
   - 7.3 Control and protection: faults in power system and their calculation, symmetrical and unsymmetrical faults
   - 7.4 Protection for: generators, transformers, transmission line & distribution lines
   - 7.5 Circuit breakers: types and characteristics

8. **Power Distribution and Consumer Services**
   - 8.1 Types of distribution systems, distribution system reliability indices, loss reduction, consumer supply connection; metering system
   - 8.2 Quality of Electricity: Supply quality parameters, effect of quality on equipment and application, standards (voltage and frequency, harmonics)

9. **Instrumentation and Control**
   - 9.1 Electrical measurements: classification, working and applications of indicating, recording and integrating instruments for electrical measurements, analog-digital and digital-analog converters, concept of precision and errors
   - 9.2 Sensors and transducers: sensors and transducers for speed, position, fluid flow and temperature
   - 9.3 Automatic feedback control system; time and frequency response of first and second order systems, pole and zero concept, stability criterion, root locus and bode plots
   - 9.4 PID controller; controlling the transient response and steady state error

10. **Estimating, Costing, Specification and Valuation**
   - 10.1 Types of estimates and their specific uses
   - 10.2 Methods of calculating quantities
   - 10.3 Key components of estimating norms and rate analysis
   - 10.4 Preparation of bill of quantities
   - 10.5 Purpose, types and importance of specification
   - 10.6 Purpose, principles and methods of valuation

(B). सेवा तथा विद्युत नियमन सम्बन्धी (10 ×1 = 10 Marks)

11. **Hydropower Policy and Planning**
   - 11.1 History of power development in Nepal; efforts towards power sector reform, concept of deregulation and unbundling of NEA
   - 11.2 Current demand and supply scenario of electricity in the power system; status and prospects renewable energy
   - 11.3 Electricity Demand Forecast Report (2025-2040), WECS, GON
   - 11.4 Transmission System Development Plan of Nepal, RPGCL, GON

12. **Concept of Regulation, Regulatory Bodies and Relevant Legal Instruments**
   - 12.1 Concept of the independent regulator; global and regional trends in regulation of electricity business
   - 12.2 History of regulation of electricity sector in Nepal
   - 12.3 Stakeholder relations, protection of their right and public hearing
   - 12.4 Corporate Governance of Electricity Generation Company, Transmission Company, Electricity Trading Company, the Independent System Operator and Distribution Utilities
   - 12.5 Concept of sub-legislation (directives, by-laws and circulars) issued by regulatory bodies and their significance
   - 12.6 Principles of the consumer tariff fixation procedures in Nepal – past and present
   - 12.7 Power Purchase (Generation Tariff Fixation) Procedure in Nepal
   - 12.8 Types of Electricity Tariffs
   - 12.9 Concept of wheeling charges, methods of determination of wheeling charges

13. **Electricity Market**
    - 13.1 Concept of: power pool, electricity market (types of electricity market), open access, net metering, energy banking
    - 13.2 Elements of Power Purchase Agreement (PPA)
    - 13.3 Elements of Project Development Agreement (PDA)
    - 13.4 Cross border grid connectivity and Cross Border Energy Trade in Bangladesh, Bhutan, India and Nepal (BBIN) region and SAARC member states

14. **Reliability and Quality Concerns**
    - 14.1 Concept and metrics of reliability [System Average Interruption Duration Index (SAIDI), Customer Average Interruption Duration Index (CAIDI), System Average Interruption Frequency Index (SAIFI)] and impact of lower reliability
    - 14.2 Quality of electricity supply
    - 14.3 Customer Service Standards

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खुला/आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

द्वितीय पत्र :

Technical Subject

खण्ड (क) : ५० अङ्क

1. **Fundamentals of Electrical Engineering**
   - 1.1 Electric charge and current, potential difference, power and energy; Ohm's Law, Kirchhoff's Law; Network theorems; superposition theorem, maximum power transfer theorem; Thevenin's theorem and Norton's theorem
   - 1.2 Network analysis: Laplace Transform in Circuit Analysis; Transfer Function
   - 1.3 Transients in electrical circuits; natural and step response of RL and RC and RLC Circuits, Operational Amplifiers; Inverting and Non-inverting Amplifier Circuits, Two port networks, reciprocity theorems
   - 1.4 Magnetic Circuits: Flux and flux linkage, inductance and energy; magnetic materials and their properties; magnetically induced e.m.f. and force; AC operation of magnetic circuits; hysteresis and eddy current losses
   - 1.5 AC fundamental: Equation of alternating voltages and current, frequency, amplitude, concept of phase difference, RMS value, active and reactive power, complex power, power triangle, power factor, resonance in AC circuits
   - 1.6 Three phase systems; balanced and unbalanced systems, voltage current relations and computation of power in three phase systems, Star/ Delta and Delta/Star transformation

2. **Electrical Machines**
   - 2.1 Transformers: Equivalent circuits; losses and efficiency; voltage regulation; transformer connections; parallel operation; overloading capacity; temperature rise; Testing of transformers and their parameters; Auto-transformer and its uses in High voltage system; Instrument transformers (PT, CT)
   - 2.2 DC Machines: Working principles; types; operating characteristics; armature reaction; losses and efficiency; applications, starting and speed control of DC motors
   - 2.3 Synchronous Machines: Working principles; operating characteristics; losses and efficiency; steady state and transient equivalent circuits; excitation system and requirement, governor principle; parallel operation; hunting phenomenon
   - 2.4 Induction Machines: Working principles; operating characteristics during motoring and generating mode; losses and efficiency; equivalent circuits; starters; speed control and motor selection

3. **Power Generation**
   - 3.1 Hydroelectric Power Plants: Merits and demerits, site selection, classification (ROR, PROR, Storage, Pump Storage); elements of hydroelectric power plant and schematic layouts; essential features of hydroelectric alternators; choice of size and number of generating units; auxiliaries in hydroelectric plant; Governor's principle and characteristic

3.2 Types of water turbines; efficiency curves; selection of water turbines
3.3 Thermal Power Plant: Efficiency, merit and demerit, power plant control, concept of turbo alternators
3.4 Nuclear Power Plant: Efficiency, constituents of nuclear power plant and layout, pollution from the plants
3.5 Gas Power Plant: Efficiency, element of simple gas turbine power plant, operation and plant control, plant layout
3.6 Non-conventional and renewable power generation: micro, hydro, solar photovoltaic, wind, generation schemes and their significance
3.7 Fundamentals of: the Battery Energy Storage Systems (BESS), Hydrogen Energy, Captive Power Plants

4. **Transmission Lines**
4.1 Transmission: choice of voltage, conductor size, insulators used in overhead lines, vibration dampers, conductor configuration, clearances, span lengths, sag-tension calculation, pole/tower types; right of way, route selection
4.2 Types of underground cable, cable resistances and capacitances, insulation resistance, selection criteria of cables, handling of cable and protection, cable joints
4.3 Line parameters computations, Performance of short, medium and long transmission lines; ABCD constants; surge impedance loading, Ferranti effect
4.4 Corona phenomenon: Factors affecting corona and its disadvantages (corona power loss, audible noise and radio interference)
4.5 Inductive interference between power and communication lines
4.6 Introduction to HVDC and EHV AC transmission lines; advantages, disadvantages and applications
4.7 Introduction to HVDC Back to Back System

5. **Power System Analysis**
5.1 Per unit representation and its advantage
5.2 Load Flow Study: load characteristics, effects on voltage and frequency, real power and frequency balance, reactive power and voltage balance, power flow equations for a network, voltage profile and VAR compensation
5.3 Stability: Steady state, dynamic and transient stability, equal area criterion, Steady-state stability implications, maximum steady state power flow condition

खण्ड (ख): ५० अङ्क

6. **Power Electronics**
6.1 Power electronics devices; Diode, Transistors, MOSFET, Thyristors, GTO, IGBT
6.2 Rectifiers; uncontrolled and controlled rectifiers, operation with inductive loads, harmonic filtering, half wave and full wave rectifier circuits and the output waveforms

6.3 Inverters: basic details and operation of inverters; voltage source and current source inverters, harmonic filtering

6.4 DC choppers; cyclo-converters; AC voltage controllers

7. **Sub-stations, Switchyards, Switchgear and Protection**

7.1 Classification of substation: indoor and outdoor substations; general layout of bus bar, arrangements sub-station

7.2 Lightening phenomenon; types of lightening arrestor and operating principles

7.3 Earthing and shielding of electrical system and methods of the earthing

7.4 Control and protection: faults in power system and their calculation, symmetrical and unsymmetrical faults

7.5 Isolators/disconnecting switches

7.6 Protective relays: types, working principle and applications

7.7 Protection for: generators, transformers, transmission line & distribution lines

7.8 Circuit breakers: types and characteristics; construction and operating principles of ACB, OCB, VCB, ABCB and SF6 circuit breakers and their applications

7.9 Over voltage computations, protection against switching over voltage, surge arrestors and their applications, overhead earth wire

8. **Power Distribution and Consumer Services**

8.1 Types of distribution systems, distribution system reliability indices, loss reduction, consumer supply connection; metering system

8.2 Quality of Electricity: Supply quality parameters, effect of quality on equipment and application, standards (voltage and frequency, harmonics)

8.3 Category of consumers

9. **Economics of Power System**

9.1 Cost analysis of power plant; transmission lines, distribution system

9.2 Method of determination of depreciation: straight line method, declining balance method, sinking fund method

9.3 Demand side management, Load management, TOD meter, VAR compensation

9.4 Basic concept about energy audit

9.5 Power factor improvement: causes and effects of low power factor, advantages and methods of power factor improvement.

9.6 Economics of power generation: concept of load curve; load duration curve; mass curve; demand factors; plant factor; utilization factor and plant use factor; significance of load factor and diversity factor in generation planning

9.7 Load dispatching: principle, requirements, tools and benefits

10. **Instrumentation and Control**

10.1 Electrical measurements: classification, working and applications of indicating, recording and integrating instruments for electrical measurements, analog-digital and digital-analog converters, concept of precision and errors

10.2 Sensors and transducers: sensors and transducers for speed, position, fluid flow and temperature

10.3 Automatic feedback control system; time and frequency response of first and second order systems, pole and zero concept, stability criterion, root locus and bode plots

10.4 PID controller; controlling the transient response and steady state error

11. **Test Lab for Electrical Machine and Equipment**

11.1 Technical standards

11.2 Accreditation of lab

11.3 Calibration of testing devices