

नेपाल विद्युत प्राधिकरण

प्राविधिक सेवा, इलेक्ट्रिकल समुह/उपसमुह, तह-९ उप-प्रबन्धक पदको
खुला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

द्वितीय पत्र: सेवा सम्बन्धी विस्तृत ज्ञान (१०० पुर्णाङ्क)

पत्र	विषय	पुर्णाङ्क	उत्तीर्णाङ्क	खण्ड	परीक्षा प्रणाली	प्रश्न संख्या	प्रति प्रश्न अङ्कभार	समय
द्वितीय	सेवा सम्बन्धी (विस्तृत ज्ञान)	१००	४०	क	लामो उत्तर/ विश्लेषणात्मक समिक्षा	२	१५	३ घण्टा
					विश्लेषणात्मक समिक्षा/समस्या समाधान	१	२०	
				ख	लामो उत्तर/ विश्लेषणात्मक समिक्षा	२	१५	
					विश्लेषणात्मक समिक्षा/समस्या समाधान	१	२०	

खण्ड (क)

(२x१५=३०, १x२०=२०) - अङ्क ५०

1. Electrical Machines:

- 1.1. Transformers: Construction, Losses and efficiency, innovations in reducing transformers no load losses, Voltage regulation, multi-phase Connections, Grounding, Current harmonics at no load and loading conditions, Parallel operation, short time Overloading capacity, Temperature rise, Auto-transformers, Instrument transformers, trends for dry-transformer at higher voltage level, challenges and applications, 3-core transformers applications & advantages, special considerations for transformers at solar and wind power plants.
- 1.2. Synchronous Synchronous Machines: Construction, Operating Characteristics, Losses and efficiency, Steady state and transient equivalent circuits, Excitation system and requirements, Stability, Parallel operation and hunting, Field of applications, PMSG construction, equivalent circuit and applications
- 1.3. Induction Machines: Construction, Operating Characteristics, Losses and efficiency, Equivalent circuits, Starter and speed control of induction motor, Induction generator controllers and harmonics, Field of applications and selection of induction machines
- 1.4. DC Machines: Construction, Characteristics, Losses and efficiency, Armature reaction, Starter and speed regulation of motors, Applications

2. Power Plant:

- 2.1. Hydroelectric Power Plants: Merits and demerits; site selection; classification; elements of hydroelectric power plant and schematic layouts; different types of water turbines; efficiency curves; selection of water turbines; essential features of hydroelectric alternators; choice of size and number of generating units; auxiliaries in hydroelectric plant; Nepalese power plants, their types, salient features and locations. Governing mechanism
- 2.2. Diesel Electric Power Plants: Merits and demerits; application; site selection; elements of a diesel plant and its schematic arrangement; performance and thermal efficiency.
- 2.3. Renewable energy technology: Micro hydro, solar photovoltaic, wind and geothermal method of power generation and their importance, grid interconnection of renewable energy, maximum power point tracking technologies for solar and wind generation;

changing the power system network topology with decentralized power generation and virtual power plants. Emerging technologies with renewables.

- 2.4. Plant factor; utilization factor and plant use factor; significance of load factor and diversity factor in generation planning, plant capacity factor

3. Transmission System:

- 3.1. Transmission Systems: Choice of voltage, Surveying, Route selection, Right of way
- 3.2. Choice of conductor: ASCR, steel and ACCC conductors their advantages and disadvantages & applications
- 3.3. Performance analysis of transmission lines, Surge impedance and surge impedance loading, Proximity effect, Skin effect
- 3.4. Corona phenomenon: Factors affecting corona and its disadvantages; corona loss, audible noise and radio interference
- 3.5. Inductive interference between power and communication lines
- 3.6. Principles of power system protection, Protection system components, Disconnecting switches and contactors, Types and characteristics of circuit breakers and protective relays, Automatic reclosure
- 3.7. Protection of generators, transformers and transmission/distribution lines
- 3.8. External and internal over voltages; temporary, switching and lightning over voltage computations, sub synchronous resonance and Ferro resonance
- 3.9. Factors affecting the different types of over voltages and controlling the over voltages
- 3.10. Insulation coordination and insulator design for transmission line, transformers and cables
- 3.11. Characteristics and suitability of different types of surge arrestors, MOV

4. Power System Analysis:

- 4.1. Load flow study: N-R, decoupled and DC Load flow methods
- 4.2. Symmetrical and unsymmetrical faults in power system, Fault calculations in integrated power system, algorithms for identifying fault locations in transmission and distribution lines
- 4.3. Power system stability: Steady state, dynamic and transient stability, Equal area criterion, Swing equation for a multi-machine system, stability enhancement techniques
- 4.4. Load dispatching: Principle of economic load dispatch, requirements, tools and role of dispatcher, Rationale and tools of demand side management, concept of economical emission dispatch, optimal power flow, optimum generation scheduling with renewables
- 4.5. Real power/frequency balance, Reactive power/ Voltage balance, voltage stability and voltage collapse, frequency stability
- 4.6. Power evacuation standards considering line congestion, stability and security criterion, Scope and objective of Grid code

5. Distribution System Planning and Automation:

- 5.1. Distribution system layouts, Radial, loop and ring distribution system, 3-phase and single phase prospective, single-phase earth return systems, primary and secondary voltage selection criterion
- 5.2. ABC cables advantages and applications
- 5.3. Underground Cable; classification, cable resistances and capacitances, insulation resistance, selection of cable, handling of cable and protection, cable joints
- 5.4. Substation layout and location, Bus bar schemes, substation automations

- 5.5. Electricity and rural development, Technology and approaches for rural electrification, Role of micro and mini hydropower and other renewable energy technologies in rural electrification
 - 5.6. Consumer Load Characteristics, Concept of load curve; load duration curve; demand factor
 - 5.7. Load Forecasting, Small area load forecasting methods, Techniques, Distribution Transformer selections
 - 5.8. Distributions System Load Flow techniques, load flow with Distributed generation, unbalancing load cases
 - 5.9. Distribution system loss reduction techniques and Voltage drop control methods, distribution reconfigurations, optimal capacitor placements in primary distribution systems
 - 5.10. Distribution system protection coordination, Fault analysis
 - 5.11. Distribution system reliability indices
 - 5.12. Concept of Distribution automation; fault identification, optimal service restoring
 - 5.13. Introduction to smart grid: Evolution of Electric Grid, elements and measurement technologies, Concept of Smart Grid, Opportunities and barriers, Scenario of Nepal, Architecture of Smart Grid, Smart Grid standards and policies, Smart Grid control layer and components, Net metering and smart meters
- 6. Power Electronics in Power System:**
- 6.1. Switched mode DC-AC and AC-DC converters Sinusoidal PWM, dynamic model and control of PWM inverters
 - 6.2. AC-AC Converters: Single-phase AC regulator; Three-phase AC regulators, Single-phase and three-phase Cyclo-converters
 - 6.3. Buck, boost & buck- boost convertors construction, operation & applications
 - 6.4. Working and application of HVDC transmission system, Basics of Flexible AC transmission systems (FACTS)
 - 6.5. Principles of series and shunt compensation. Thyristor controlled compensators Static var compensators (SVC), series compensators (TCSC), series compensator (SSSC)
 - 6.6. Phase shifters (SPS), and Unified power flow controller (UPFC), STATCOM
 - 6.7. Active Front End Rectifiers: Power factor correction, single phase and three-phase, control schemes
 - 6.8. Active filters
- खण्ड (ख) (२x१५=३०, १x२०=२०)- अङ्क ५०**
- 7. Engineering Economics:**
- 7.1. General Characteristics of Capital Investments, Sources of Funds, Tax Considerations,
 - 7.2. Disbursement scheduling, Cash flow analysis, Time value of money
 - 7.3. Project evaluation indicators, IRR, Payback period and others Criterion, Choosing the best alternative
 - 7.4. Incremental Analysis, Sensitivity & breakeven analysis
 - 7.5. Risk analysis, Inflation & price change
 - 7.6. Rationing limited financial resources between projects
 - 7.7. Taxation system in Nepal

- 7.8. Energy tariff schemes and regulatory issues: Power billing (Utility costs, Customer classes and rate schedules, Commercial and Industrial rates, Real time prices) Need for demand charges, Time/price/demand correlation, Demand measures, Demand rates, Demand ratchets, Demand adjustments/low power factor

8. Safety Engineering:

- 8.1. Effects of non-ionizing magnetic fields on human body, Physical effect of electric shock, Safety considerations, Live line maintenance, Earthing and shielding technique, Firefighting techniques and equipment, Noise hazard, First aid requirements after Electrical accidents

9. Contract Management:

- 9.1. Preparation of contract documents, specifications, condition of contract and other contractual procedures
- 9.2. Familiarization with Procurement guidelines and standards of World Bank & Asian Development Bank (WB & ADB)
- 9.3. International Standard Bidding Document, National Standard Bidding Document
- 9.4. Arbitration

10. Trends and Status of Power Sector Development:

- 10.1. Role of Government institutions involved in power sector development, Role and importance of IPPs, Major projects under implementation and planning, Importance of power exchange agreement with India, Scope of power exchange with other countries, Cross border/regional power trade, Coordination between stakeholders in power sector, Scope for export-oriented development of power sector, Legal and economic aspects for cross border transactions
- 10.2. Electricity market: Market Principles, Power Pool, Independent System Operator, Distribution System Operator, Power Balancing, Market Participants, Power Markets, Market Rules, Bidding, Trading, Settlement System, Locational Marginal Pricing, Transmission Charges, Merchant Power, Differential Electricity, Congestion Management, Ancillary Services, Hedging, Smart Power Market.

11. International Treaty and Conventions:

- 11.1. Electricity Exchange, 1961
- 11.2. Treaty between the then His Majesty's Government of Nepal and Government of India concerning the integrated development of Mahankali River including Sarada Barrage, Tanakpur Barrage and Pancheswar Project

12. Service-Related Manuals/Test:

- 12.1. Manual for preparing Environmental Management Plan (EPM) for Hydropower Projects
- 12.2. Hydropower plant installation and maintenance manuals
- 12.3. National Environmental Impact Assessment Guidelines, 1993
- 12.4. Safety Guidelines and standards for Generation, Transmission and Distribution of Hydro Electricity
- 12.5. Compliance with standards: Importance of Inspection & testing of electrical equipment.
- 12.6. International standards: IEC, ISO, IEE, AS, BS, CS, IS, NS etc.

