

नेपाल विद्युत प्राधिकरण

प्राविधिक सेवा, इलेक्ट्रिकल समुह/उपसमुह, तह-१० 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	

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(२x१५=३०, १x२०=२०) - अङ्क ५०

1. Generation and Grid Interconnection:

- 1.1. Hydroelectric Power Plants: selection of water turbines; essential features of hydroelectric alternators; choice of size and number of generating units; auxiliaries in hydroelectric plant, governing mechanism
- 1.2. 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
- 1.3. Synchronous Generators: Construction, Operating Characteristics, Steady state and transient equivalent circuits, Excitation system and requirements, PQ capability curve Parallel operation and synchronization to grid
- 1.4. Induction generator Operating principles, controllers and harmonics, Field of applications
- 1.5. Transformers: Operating characteristics, Losses and efficiency, Voltage regulation, Grounding, Current harmonics, Parallel operation, Overloading capacity, Temperature rise, Auto-transformers, Instrument transformers

2. Power System Analysis:

- 2.1. Performance analysis of transmission lines and Fault calculations in integrated power systems, algorithms for identifying fault locations in transmission and distribution lines
- 2.2. Corona phenomenon: Factors affecting corona and its disadvantages; corona loss, audible noise and radio interference;
- 2.3. Inductive interference between power and communication lines
- 2.4. Transient stability: Equal area criterion, Swing equation for a multi-machine system, stability enhancement techniques
- 2.5. Protection of generators, transformers and transmission/distribution lines
- 2.6. Insulation coordination, Over voltages and Lightning protection

3. Distribution System and Smart Grid:

- 3.1. Distribution system Layouts, UG/ overhead, Rural/ Urban Distribution.
- 3.2. Load Forecasting, Small area load forecasting methods, Techniques, Distribution Transformer selections,
- 3.3. Distribution Automation; Distribution network reconfiguration and other intelligent distribution, Control methods, optimal capacitor placements in primary distribution systems
- 3.4. Distribution system protection coordination, Fault analysis
- 3.5. Distributed renewable, Integration of renewable energy to grid, changing the power system network topology with decentralized power generation and virtual power plants. Emerging technologies with renewables.
- 3.6. Distribution system reliability indices: Reliability Models, System Reliability, Reliability and Quality Planning, Functional Zones, Generation Reliability Planning Criteria, Transmission Reliability Criteria, Distribution Reliability, Reliability Evaluation, Grid Reliability, Reliability Target, Security Requirement, Disaster Management, Quality of Supply, Reliability and Quality Roadmap.

4. Power Electronics in Power System:

- 4.1. Switched mode DC-AC and AC-DC converters Sinusoidal PWM, dynamic model and control of PWM inverters
- 4.2. AC-AC Converters: Single-phase AC regulator; Three-phase AC regulators, Single-phase and three-phase Cyclo-converters
- 4.3. Buck, boost & buck- boost convertors construction, operation & applications
- 4.4. Basics of Flexible AC transmission systems (FACTS).
- 4.5. Principles of series and shunt compensation. Thyristor controlled compensators Static var compensators (SVC), series compensators (TCSC), series compensator (SSSC)
- 4.6. Phase shifters (SPS), and Unified power flow controller (UPFC), STATCOM
- 4.7. Active Front End Rectifiers: Power factor correction, single phase and three-phase, control schemes
- 4.8. Active filters

5. Electric Energy System Management:

- 5.1. Load dispatching: Principle of economic load dispatch, requirements, tools and role of dispatcher, Rationale and tools of demand side management.
- 5.2. Economic analysis and control of power utility, Electrical load forecasting, Generation scheduling, Technical and Economic issues of generation and energy dispatch, Grid Code.
- 5.3. Optimal load flow, fixed variable state variables, control variables, equality and inequality constraints, solution techniques, PQ decoupling
- 5.4. Voltage stability, PQ capacity of transmission line, voltage collapse, Concept of frequency stability
- 5.5. Power evacuation standards considering line congestion, stability and security criterion, guide line for preparing a Grid code.
- 5.6. **Consumer Side Management in Smart Grids:** Demand Side Management in Smart Grids, Price-based Demand side integration implementations (Time of use, Real-time pricing, Critical peak pricing), Incentive-based DSI implementations

6. Power Supply Quality:

- 6.1. Power quality indicators: definition of power quality, voltage and frequency fluctuations, short duration and long duration voltage variations, waveform distortion
- 6.2. Power Quality symptoms: Sensitive Electronic Equipment, Nuisance tripping of circuit breakers, Malfunction of UPS systems and generator systems, Metering problems, Overvoltage problem
- 6.3. Power quality issues: power acceptability curves, options to address power quality problem, Power quality standards.
- 6.4. Voltage sag/swell; definition, standards, effects of sags on equipment, testing equipment, tolerance to voltage sags, Areas of occurrence,
- 6.5. Causes for Voltage sag/swell: motor starting, ground faults, transformers energizing, Sudden load changes
- 6.6. Remedy Voltage sag/swell: general solutions, improving equipment immunity
- 6.7. Power Quality Testing: Lab testing, on site testing
- 6.8. Power Quality Certification

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(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

8. Smart Grids:

- 8.1. 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
- 8.2. Communication Technologies for Smart Grid: IEEE 802 series (Ethernet, Wireless LAN, ZigBee and 6LoWPAN, WiMAX), Mobile Communications, Multi-protocol label switching, Power line communication (IEEE P1901, Home Plug), Standards for information exchange (Standards for smart metering, Modbus, DNP3, IEC 61850)
- 8.3. Transmission System Operation: Data Sources-IEDs and SCADA, Phasor Estimation, Phasor Measurement Units (PMU), Energy Management Systems, Wide Area Applications: Wide Area Monitoring System (WAMS), Visualization techniques
- 8.4. Advanced Metering Infrastructure (AMI), Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS)

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. Koshi Agreement, 1954/1966,
- 11.2. Gandak Agreement, 1959,
- 11.3. Electricity Exchange 1961,
- 11.4. Treaty between the then His Majesty's Government of Nepal and Government of India concerning the integrated development of Mahakali River including Sarada Barrage, Tanakpur Barrage and Pancheswar Project

12. Service-Related Manuals:

- 12.1. Manual for public Involvement in Environmental Impact Assessment (EIA) process of Hydropower Projects
- 12.2. Manual for preparing Terms of Reference (TOR) for environmental Impact Assessment (EIA) of Hydropower Projects
- 12.3. Manual for preparing Scoping Document for Environmental Impact Assessment (EIA) of Hydro power Projects
- 12.4. Manual for preparing Environmental Management Plan (EPM) for Hydropower Projects
- 12.5. National Environmental Impact Assessment Guidelines, 1993
- 12.6. Safety Guidelines and standards for Generation, Transmission and Distribution of Electricity
- 12.7. Compliance with standards, Importance of Inspection & testing of electrical equipment.
- 12.8. International standards: IEC, ISO, IEE, AS, BS, CS, IS, NS etc.

