

# नेपाल विद्युत प्राधिकरण

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

द्वितीय पत्र: सेवा सम्बन्धी बिस्तृत ज्ञान

खण्ड क:

(२x१५=३०, १x२०=२०) - ५० अंक

## 1. Electrical Machines

- Transformers: Construction, Equivalent circuits, Operating characteristics, Losses and efficiency, Voltage regulation, Connections, Grounding, Current harmonics, Parallel operation, Overloading capacity, Temperature rise, Auto-transformers, Instrument transformers
- 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
- 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
- DC Machines: Construction, Characteristics, Losses and efficiency, Armature reaction, Starter and speed regulation of motors, Applications

## 2. Power Plant

- 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
- Diesel Electric Power Plants: Merits and demerits; application; site selection; elements of a diesel plant and its schematic arrangement; performance and thermal efficiency.
- Renewable energy technology: Micro hydro, solar photovoltaic, wind and geothermal method of power generation and their importance, grid interconnection of renewable energy
- Plant factor; utilization factor and plant use factor; significance of load factor and diversity factor in generation planning

## 3. Transmission System

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

**4. Power System Analysis**

- Load flow study: N-R, decoupled and DC Load flow methods
- Symmetrical and unsymmetrical faults in power system, Fault calculations in integrated power system
- Power system stability: Steady state, dynamic and transient stability, Equal area criterion, Swing equation for a multi-machine system, stability enhancement techniques
- Load dispatching: Principle of economic load dispatch, requirements, tools and role of dispatcher, Rationale and tools of demand side management.
- Real power/frequency balance, Reactive power/ Voltage balance

**5. Distribution System Planning and Automation**

- 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
- Underground Cable; classification, cable resistances and capacitances, insulation resistance, selection of cable, handling of cable and protection, cable joints
- Substation layout and location, Bus bar schemes
- Electricity and rural development, Technology and approaches for rural electrification, Role of micro and mini hydropower and other renewable energy technologies in rural electrification
- Consumer Load Characteristics, Concept of load curve; load duration curve; demand factor
- Load Forecasting, Small area load forecasting methods, Techniques, Distribution Transformer selections
- Distributions System Load Flow techniques, load flow with Distributed generation, unbalancing load cases
- Distribution system loss reduction techniques and Voltage drop control methods, distribution reconfigurations, optimal capacitor placements in primary distribution systems
- Distribution system protection coordination, Fault analysis
- Distribution system reliability indices
- Concept of Distribution automation; fault identification, optimal service restoring

**6. Power Electronics in Power System**

- Switched mode DC-AC and AC-DC converters Sinusoidal PWM, dynamic model and control of PWM inverters
- AC-AC Converters: Single-phase AC regulator; Three-phase AC regulators, Single-phase and three-phase Cyclo-converters
- Working and application of HVDC transmission system, Basics of Flexible AC transmission systems (FACTS)
- Principles of series and shunt compensation..Thyristor controlled compensators Static var compensators (SVC), series compensators (TCSC), series compensator (SSSC)
- Phase shifters (SPS), and Unified power flow controller (UPFC), STATCOM
- Active Front End Rectifiers: Power factor correction, single phase and three-phase, control schemes
- Active filters

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**7. Engineering Economics**

- Disbursement scheduling, Cash flow analysis, Time value of money
- Project evaluation indicators, IRR, Payback period and others Criterion, Choosing the best alternative
- Incremental Analysis, Sensitivity & breakeven analysis
- Risk analysis, Inflation & price change
- Rationing limited financial resources between projects
- Taxation system in Nepal
- Energy tariff schemes and regulatory issues

**8. Safety Engineering**

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

**9. Contract Management**

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

**10. Trends and Status of Power Sector Development**

- 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

**11. International Treaty and Conventions**

- Electricity Exchange, 1961
- 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/Test**

- Manual for preparing Environmental Management Plan (EPM) for Hydropower Projects
- National Environmental Impact assessment Guidelines, 1993
- Safety Guidelines and standards for Generation, Transmission and Distribution of Hydro Electricity
- IEC Standards for transformer test, circuit breaker test, cable test, generator and motor test, insulation withstand test

