

## नेपाल विद्युत प्राधिकरण

प्राविधिक सेवा, इलेक्ट्रिकल समुह/उपसमुह, तह-८ सहायक 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. Electrical Engineering Fundamentals:

- 1.1. Active, reactive and apparent power computations, power factor, power factor improvement
- 1.2. Three phase systems; balanced and unbalanced systems, voltage current relations and computation of power in three phase systems
- 1.3. Transients in RL and RC and RL electrical Circuits
- 1.4. Operational Amplifiers; Operational Amplifier Concepts, Inverting and Non-inverting Amplifier Circuit, The Difference Amplifier, zero crossing detectors
- 1.5. Automatic feedback control system; Sensors and transducers time and frequency response, stability criterion, root locus, PID Controller
- 1.6. Power electronics devices; Diode, power transistors, MOSFET, thyristors, GTO, IGBT
- 1.7. Switched mode DC-AC and AC-DC converters Sinusoidal PWM, dynamic model and control of PWM inverters
- 1.8. AC-AC Converters: Single-phase AC regulator; Three-phase AC regulators, Single-phase and three-phase Cyclo-converters
- 1.9. Basics of Flexible AC transmission systems (FACTS)

### 2. Electrical Machines:

- 2.1. Transformers: Construction, Losses and efficiency, 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.
- 2.2. 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
- 2.3. 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,

- 2.4. DC Machines: Construction, Characteristics, Losses and efficiency, Armature reaction, Starter and speed regulation of motors, Applications

### **3. Power Plant:**

- 3.1. 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
- 3.2. Diesel Electric Power Plants: Merits and demerits; application; site selection; elements of a diesel plant and its schematic arrangement; performance and thermal efficiency
- 3.3. 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
- 3.4. Plant factor; utilization factor and plant use factor; significance of load factor and diversity factor in generation planning

### **4. Power Transmission and Distribution System:**

- 4.1. Transmission Systems: Choice of voltage, Surveying, Route selection, Right of way, advantages and limitations of HVDC lines, HTLS conductors technology and applications
- 4.2. Performance analysis of transmission lines, Surge impedance and surge impedance loading, Proximity effect, Skin effect
- 4.3. Principles of power system protection, Protection system components, Disconnecting switches and contactors, Types and characteristics of circuit breakers and protective relays, Automatic reclosure,
- 4.4. Protection of generators, transformers and transmission/distribution lines
- 4.5. Distribution system layouts, Radial, loop and ring distribution system, primary and secondary voltage selection criterion, overhead and underground distributions, ABC cables
- 4.6. Substation layout and location, Bus bar schemes, substation automations
- 4.7. Urban and rural distribution; scope of renewable energy for rural electrification
- 4.8. Consumer Load Characteristics, Concept of load curve; load duration curve; demand factor; Small area load forecasting methods
- 4.9. Protection coordination, Transmission & Distribution system reliability indices,

### **5. Power System Analysis:**

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

## 6. High Voltage Engineering:

- 6.1. Corona phenomenon: Factors affecting corona and its disadvantages; corona loss, audible noise and radio interference;
- 6.2. Inductive interference between power and communication lines
- 6.3. External and internal over voltages; temporary, switching and lightning over voltage computations, sub synchronous resonance and Ferro resonance
- 6.4. Factors affecting the different types of over voltages and controlling the over voltages
- 6.5. Insulation coordination and insulator design for transmission line, transformers and cables
- 6.6. Characteristics and suitability of different types of surge arrestors, MOV
- 6.7. Insulation withstands tests, Generation of high AC, DC and impulse voltage for testing
- 6.8. Dielectric strength and breakdown of gas, liquid and solid dielectrics, partial discharge
- 6.9. Leakage resistance and Dielectric loss computations in cables
- 6.10. High voltage testing of electrical apparatus, non-destructive testing of materials and apparatus, High voltage testing procedures and statistical treatment of results; test Standards (IEC, IEEE, CIGRE, etc.)

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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: 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

## 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
- 10.2. Regulated and deregulated power market, Power pool, energy wheeling charges
- 10.3. Energy exchange market concept

## **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 Mahakali 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.

