ENERGY ELECTRICAL SYSTEM MANAGEMENT

**Course Objective:**  
To study planning and management aspects of electrical energy supply and to gain some familiarity with demand characteristics and load forecasting.

1. **Power utilities and power sector development (9 hours)**
   1. Functional block model
   2. Classifications: Centralized government owned, Locally owned, private/public, foreign investor owned
   3. Power sector development in Nepal: History, growth of government and private utilities, achievements, various utilities in existence and their organization
   4. Nepalese Power industry Regulatory framework: Company act, Industrial enterprises act, Hydropower development policy, Water resource act and regulation, Electricity act and regulation, Foreign investment and technology transfer act, Factory act
   5. Power sector restructuring : Goals, constraints, pre‐requisites and different models.

1. **Financial Analysis and project funding (9 hours)**
   1. Basic accounting principles: Cash basis and Accrual basis of accounting,
   2. Depreciation: straight line method, declining balance method and sum of years digit method, inflation and depression
   3. Investment decisions: Interest and discount rates, inflation and depression, Present worth, Future worth, NPV, B/C ratio, IRR, Payback period , decision criteria
   4. Electric utility funding requirements: capital requirement, operating requirement, Cash flow
   5. Sources of project funding: Public finance, corporate finance and project finance

1. **Electrical load forecasting (9 hours)**
   1. Load curves and load factor, demand factor, diversity factor, coincidence factor
      1. Load and their characteristics : Domestic, industrial, commercial, non commercial, transport, irrigation etc.
   2. Objectives and classification of load forecasting
   3. Tools and approaches
   4. Errors and uncertainties
   5. A accuracy and error analysis based on time series approach
   6. Forecasting methods: mean and single moving average method, mathematical models: Linear , Parabolic and Exponential method of extrapolation and the method of survey, SIMCRED equation

1. **Power system security and reliability (9 hours)**
   1. Security definitions
   2. Security measures
   3. Maintaining reserves: spinning reserve, scheduled or offline reserve, static reserve, Sources of reserves
   4. Physical constrains to system security
   5. Effects of system diversity, system interconnection, import/export.
   6. Approaches to reliability, Reliability and quality, Repairable and non repairable components, The bathtub curve, Reliability function, Properties of reliability, Reliability indices: Mean Time to Failure, Mean Time Between Failures, Availability/Unavailability, Forced outage rate, Loss of Load Probability, Loss of Load Expectation
   7. System reliability models: Series system, parallel system, Series parallel system, Parallel series system, Non series parallel system
   8. Cost of reliability and unreliability.

1. **Unit Commitment and Economic load dispatch of generating units  
   (9 hours)**
   1. Understanding Unit commitment problem, solution approaches, Priority list scheme, Unit commitment schedule for a particular load curve.
   2. Elements of a constrained optimization problem, LaGrange theorem as a tool to solve optimization problem
   3. Characteristics of generating units (thermal and hydro): Incremental fuel cost, incremental cost of production
   4. Economic dispatch problem of thermal units excluding and including transmission losses, Graphical solution, Penalty factor and its physical insight, Use of penalty factor in power transaction
   5. Economic dispatch of energy and VARs as an operational problems: Problems in new loading conditions, effect of power factor, VAR compensation techniques

**Practical:**

1. Presentation on Nepalese power utilities and regulatory environments
2. Solving economic dispatch problem of hydro units for loss minimization
3. Exploring demand supply situation of certain sector of the Nepalese power system and forecast the power and energy demand
4. Reliability evaluation ( calculating LOLP) of a certain load center fed by different hydro units in Nepalese system
5. Exploring the security situation of a typical power system through N‐1 contingency criteria
6. Preparing unit commitment schedule for a particular load centre fed by different hydro unit in Nepalese system

**References:**

1. Robert N Anthony and James S Reece: Management Accounting Principles
2. Allen J Wood and Bruce W Woolenberg: Power Generation Operation and Control
3. C. L. Wadhwa: Electrical Power Systems, Willey Eastern Limited
4. V. N. A. Naikan: Reliability Engineering and Life Testing, Printice Hall of India Ltd.
5. S. Makridakis, S.C. Wheelwright, V.E. Mc Gee: Forecasting Methods and Applications
6. I.G. Nagarath and D.P. Kothari: Power System Engineering, Tata Mc Grawhill Publishing Company