RURAL ELECTRIFICATION

**Course Objectives:**  
To present a summary of rural livelihood and to present the basic concepts of rural electrification and its impact upon the development of rural communities

1. **Rural livelihood and Social, cultural and human factors in development (4 hours)**
   1. Components of rural livelihood and livelihood indicators
   2. Social, cultural and human factors in development
   3. Industrialization and urbanization
2. **Electricity and rural development (4 hours)**
   1. Rural electrification– National objectives, targets and key players (National Water Plan)
   2. Impact of electrification on rural and village life
   3. End use of electricity
3. **Rural electrification technologies– Nepalese context (8 hours)**
   1. Grid based rural electrification
      1. Utility operated: Voltage levels, Investment modality, Construction and operation modality, Consumer services, tariffs
      2. Community operated (CBRE, CBOM etc): Voltage levels, Investment modality, Construction and operation modality, Consumer services, tariffs
   2. Electrification through Isolated hydropower stations
      1. Micro Hydro components (Civil, Mechanical and Electrical components including T&D network)
   3. Electrification through alternative energy sources
      1. Solar (Components of Solar Home system)
      2. Wind (Components of Wind Power)

1. **Environmental concerns, safety considerations and reliability indices in RE (8 hours)**
   1. Environmental concerns in rural electrification
   2. Equipment and human safety in construction and operation of Rural electrification network as per Electricity regulation Nepal
   3. Plant factor of Micro Hydro Schemes, load factor, load curve and reliability indices in Rural Electrification, SAIFI, SAIDI, CAIDI, ASAI
2. **Design of Rural Electrification network (10 hours)**
   1. Load points fixation in contour map and load calculation
   2. Transformer installation point and Line route fixation
   3. Selection criteria of distribution system– single or three phase
   4. Hardware in RE Networks: Poles and supporting accessories, Conductors and Fixtures (Cross arm, clamps etc), Insulators, Transformers, HT Metering units, Energy Meters, Current limiters, Service wire, Power cables, Isolators, Load break switches
   5. Protection system of RE Networks :
      1. 11/33 kV Feeder protection: Lightning arrestors, Circuit breakers with tripping provision on Over current, Short circuit, Earth Fault
      2. LV feeder protection: ACBs, MCCBs, HRC/Kitkat fuses
      3. Transformer (33/0.4 and 11/0.4 kV) protection: Lightning arrestors, Drop out fuses, MCCBs/ HRC fuses
   6. Load flow diagram preparation and Voltage drop calculation: kVA‐km conductor loading / Voltage drop calculation
   7. Economic analysis of RE
3. **RE Network operation (10 hours)**
   1. Load management: Load switching, Load shedding, Peak load tariff
   2. Energy loss measurement and monitoring
      1. Load curve, Load factor, loss factor and Energy Loss calculation
      2. Metering and measurement
      3. Condition monitoring of RE network components: Poles, Jumpers, Insulators, Transformers, Distribution boxes, Clearances, Feeder loading
   3. Types of faults frequently occur in RE Network
   4. Correction, Corrective action and preventive actions
   5. Metering, Billing and revenue collection
   6. Inventory management

**Practical:**

1. Case studies in rural electrification
   1. Technical Aspects
      1. Energy loss of the network
      2. Quality of the service provided– Voltage, frequency and interruption frequency and duration
      3. Condition monitoring and Repair and maintenance of RE network
   2. Economic Aspects
      1. Revenue generation
      2. Operating expenses
      3. Capital Investment
      4. Profitability of the scheme
   3. Social Aspects
      1. Energy based Enterprise development
      2. Energy based Income Generation activities introduced
      3. Impact on social life – Health, education, security, communication

A report to be produced by each student on case study.

**References:**

1. AS Pabla Electric Power Distribution TATA McGRAW HILL
2. Bhjendra Aryal Cultural and human factors in Rural development Dikshant Prakashan
3. AEPC/ESAP Guideline for detailed feasibility study for projects from 100 kW to 1000 kW
4. Electricity regulation 2050, Nepal
5. National water Plan, Nepal
6. Samudayik Bidyut bitran niyamawali 2060, NEA
7. ISO 9001 standard
8. AEPC status/progress reports on renewable energy