MICRO - HYDRO POWER

**Course Objective:**  
To introduce operation, maintenance and design aspect of Micro Hydro power plant including basic hydrology and geology.

1. **Micro hydro basics and status in Nepal (2 hours)**
   1. Necessity of micro hydro power, Power from water, typical layout, isolated /mini grid or grid connected scheme, Micro hydro design approach, Status of micro hydro power development in Nepal and agencies involved.

1. **Hydrological and demand survey (7 hours)**
   1. Plant factor and load factor, Hydrograph and flow duration curve, Hydrological cycle, Matching power supply with demand, Capability and demand survey, Methods of finding ADF (annual average daily flow), Methods of head measurements, Methods of flow measurements, load demand curves of various loads, Peak demand forecasting, Optimum generating installed capacity, Geological consideration.

1. **Turbines, drive system and governors (9 hours)**
   1. Turbine types for micro hydro, their constructional features and operational characteristics, Effect on efficiency during part flow conditions, Nomogram and turbine selection, Comparison of costs of the turbines
   2. Introduction to drive system, Various drive arrangements and their features, Drive problem, Design parameters for a drive system
   3. purpose of speed governing, Various governing mechanisms, Electrical load controller as a governor in micro hydro, Ballast load, water cooled and air cooled ballasts, Effect of ballast on generator sizing, Ballast sizing.

1. **Generators and voltage regulators (9 hours)**
   1. Choice between AC and DC, Synchronous generator specifications, Brushless synchronous generator and its operational features, voltage regulation, Automatic voltage regulator(AVR), Practical consideration for AVR, Induction generator specifications and its operation, Induction generator controller, Induction generator sizing, Sizing of excitation capacitance, comparison of induction generator with other systems, Mechanical consideration to be given to the induction generators.

1. **Switchgear, protection and measurement (4 hours)**
   1. Isolators, fuses, main switches, Moulded case circuit breakers(MCCB), Oil and air CB, earth leakage CB, contactors, Under voltage trips, Over voltage trips, Over current trips, temperature trips, lightening protection, Earthing system, metering equipment, voltmeter, ammeter‐AC and DC, Energy meter, speed meter, pressure gauge, frequency meter, appropriate choice of switchgear, protection and measurement.

1. **Testing , Commissioning, Operation and Maintenance (5 hours)**
   1. Head works, Electro‐mechanical equipment, Alternator, Loading machine on main load, Taking readings, Setting up trips.
   2. Types of manuals‐operation manual, component manual, installer manual, preventive maintenance schedule, log sheet, repair manual, training manual, responsibility of designers, installer and users as regards to O and M.

1. **Financial Evaluation, Tariff design and Issues in Micro hydro (9 hours)**
   1. Cost elements, The time value of money, compounding and discounting, Future and present values, Cash flows , Benefit cost ratio, Net present value, Internal rate of return, Comparison with alternatives
   2. Tariff category, Principals of tariff design, Unit energy cost, Flat power tariff VS energy tariff.
   3. Issues: Reliability, funding requirement, Subsidy policy and mechanism, Cost per KW, Sustainability, Operation and maintenance, Local people’s participation, End use of electricity for project viability.

**Practical:**

1. Flow and head measurement in actual site, load demand survey in actual site.
2. Calculating and forecasting the peak demand and its matching by water supply.
3. Turbine and generator sizing and selection‐various alternatives.
4. Approximate design of unit or wattage subscription category(primary tariff)
5. Designing the basic hydraulic structures such as diversion weir, intakes, desiliting basins, canal tunnel, penstock pipe, reservoir etc.
6. To find out the total capital cost investment and calculate the cost per KW.
7. To find out total annual costs (annual fixed costs and annual operating costs).
8. To design tariff category and fix the charges for each categories.

**References:**

1. Adam Harvey with Andy Brown, Priyantha Hettiarachi and Allen Inversin: Micro Hydro Design Manual, A Guide to Small Scale Water Power Schemes (ITDG Publication).
2. D.P. Kothari, K.C. Singal and Rakesh Ranjan: Renewable Energy Sources and Emerging Technologies, Printice Hall of India Ltd.