

# Introduction

## MICRO HYDROPOWER

# Course introduction

2

Year: III

Part: II

| Teaching Schedule |             |   | Mode      |          |           |          |            | DISTRIBUTION OF MARKS |             |            |             |            |           | Total Marks | Remark |
|-------------------|-------------|---|-----------|----------|-----------|----------|------------|-----------------------|-------------|------------|-------------|------------|-----------|-------------|--------|
| SN                | Course Code | Course Title                                      | L         | T        | P         | Lab      | Total Hour | Theory                |             |            | Practical   |            |           |             |        |
|                   |             |   |           |          |           |          |            | Asst. Marks           | Final Marks | Time Hours | Asst. Marks | Mark Final | Time Hrs. |             |        |
| 1                 | EG 3211 EE  | Electrical Energy Audit and Conservation          | 3         |          | 1         |          | 4          | 20                    | 80          | 3          |             |            |           | 100         |        |
| 2                 | EG 3213 EE  | Project II  |           |          | 6         |          | 6          |                       |             |            | 90          | 60         | 6         | 150         |        |
| 3                 | EG 3214 EE  | Power System Operation and Maintenance            | 3         |          |           | 3        | 6          | 20                    | 80          | 3          | 30          | 20         | 3         | 150         |        |
| 4                 | EG 3215 EE  | Electrical Repair and Maintenance II              |           |          | 4         |          | 4          |                       |             |            | 60          | 40         | 3         | 100         |        |
| 5                 | EG 3216 EE  | Industrial Attachment                             |           |          | 6         |          | 6          |                       |             |            | 100         |            |           | 100         |        |
| 6                 | EG 3201MG   | Entrepreneurship Development                      | 3         |          | 2         |          | 5          | 20                    | 80          | 3          |             |            |           | 100         |        |
| 7                 | EG 3219 EE  | Transmission and Distribution of Electrical Power | 3         | 1        |           |          | 4          | 20                    | 60          | 3          | 10          | 10         | 1.5       | 100         |        |
| 8                 | EG 3218 EE  | Elective (One of the followings)                  | 3         |          | 2         |          | 5          | 20                    | 60          | 3          | 10          | 10         | 1.5       | 100         |        |
|                   |             | a) Micro Hydro                                    |           |          |           |          |            |                       |             |            |             |            |           |             |        |
|                   |             | b) Instrumentation & transducers                  |           |          |           |          |            |                       |             |            |             |            |           |             |        |
|                   |             | c) Electric Drives                                |           |          |           |          |            |                       |             |            |             |            |           |             |        |
|                   |             | d) Renewable Energy Technology                    |           |          |           |          |            |                       |             |            |             |            |           |             |        |
|                   |             | <b>Total =</b>                                    | <b>15</b> | <b>1</b> | <b>20</b> | <b>4</b> | <b>40</b>  | <b>100</b>            | <b>360</b>  |            | <b>300</b>  | <b>140</b> |           | <b>900</b>  |        |

# Course introduction

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## **Micro Hydro Power**

**EG3218 EE**  
(Elective)

Year: III  
Semester: II

**Total: 5 hour /week**  
**Lecture: 3 hours/week**  
**Tutorial: hours/week**  
**Practical: 2 hours/week**  
**Lab: hours/week**

### *Course Description:*

This course deals with the Micro Hydro Power (MHP) plant. The main focus of this course is the constructional details and functions of various components of a MHP plant and management, operation and maintenance aspect of MHP plant.

### *Course Objective:*

After completion of this course, student will be able to explain the basic constructional details, function and operation of various components of a MHP plan such as – Civil construction components, electro-mechanical components, protection system, and distribution system. The students also will be familiar with the basic concept of survey, design, management, operation and maintenance of MHP plant.

# Course introduction

- Unit 1. Introduction [4]**
- 1.1 Classification of hydro power plant by capacity
  - 1.2 Features of Micro Hydro Power (MHP) plant
  - 1.3 Role of MHP plant for rural development
  - 1.4 Historical background and current status of MHP in Nepal
- Unit 2. Basic Concept and Civil Construction Works of MHP Plant [6]**
- 2.1 Basic layout of a MHP plant
  - 2.2 Principle of power generation - Definition of head and discharge, Power equation.
  - 2.3 Components of MHP Plant, their constructional details and functions – Weir and intake, Canal, Desilting basin and spillway, Forebay, Penstock, Power house, Tailrace.
- Unit 3. Electro-mechanical component of MHP Plant [13]**
- 3.1 Turbines and valves – Types of turbine and their working principle, turbines for MHP plants, types of valve used in MHP plant.
  - 3.2 Synchronous generator–Basic construction and working principle, Excitation system.
  - 3.3 Induction generator - Basic construction and working principle, requirement of excitation capacitor.
  - 3.4 Coupling of turbine and generator - Direct coupling, Belt drive, Flywheel.
  - 3.5 Speed Governing – Hydraulic mechanical governor, Electronic Load Controller (ELC) – Basic principle, types of ELC – AC voltage controller based ELC, DC chopper based ELC, Discrete resistance type ELC.

# Course introduction

|                |   |            |
|----------------|---|------------|
| 3.6            | Voltage control – AVR for synchronous generator, VAR compensator (Thyristor Switched Capacitor and Fixed Capacitor Thyristor Control Reactor) for induction generator |            |
| <b>Unit 4.</b> | <b>Survey of MHP Plant and Basic Design Concept</b>   | <b>[6]</b> |
| 4.1            | Basic concept of site selection for MHP Plant   |            |
| 4.2            | Mesurement of discharge at site – Bucket method, Velocity area method, Weir method, Salt dilution method.   |            |
| 4.3            | Mesurement of head at site- Using clinometer, Using a water-filled tube, Using altimeter  |            |
| 4.4            | Power Calculation, selection and sizing of turbine and generator  |            |
| <b>Unit 5.</b> | <b>Protection System for MHP Plant</b>  | <b>[6]</b> |
| 5.1            | Over speed protection   |            |
| 5.2            | Over-load and short-circuit protection for generator  |            |
| 5.3            | Over voltage and under voltage tripping system  |            |
| 5.4            | Earthing for generator neutral and body   |            |
| 5.5            | Protection of generator and ELC from lightening strike  |            |
| 5.6            | Single-line diagram of control panel with protection devices  |            |
| <b>Unit 6.</b> | <b>Distribution System</b>  | <b>[4]</b> |
| 6.1            | Basic layout of distribution system   |            |
| 6.2            | Calculation of conductor size for distribution line   |            |
| 6.3            | Poles and insulators for distribution line  |            |
| 6.4            | Consumer's connection system  |            |
| <b>Unit 7.</b> | <b>Management, Operation and Maintenance of MHP Plant</b>   | <b>[6]</b> |
| 7.1            | Individual ownership management   |            |
| 7.2            | Community ownership based management  |            |
| 7.3            | Plant operator – starting up procedure, shutdown procedure, training of operator.   |            |
| 7.4            | Regular maintenance of procedure for intake system, canal, desilting basin and spillway, forebay, penstock, turbine, valve, generator.                                |            |

# Course introduction

## Practical Exercises:

[30]

- Exercise No.1:** Experimental study on synchronous generator at Lab,
- Study of excitation and voltage build-up at no-load
  - Operation with purely resistive load
  - Operation with inductive load and effect on terminal voltage

**Exercise No.2:** Experimental study on Electronic load controller at Lab.

**Exercise No.3:** Field study on an existing MHP plant.

**Exercise No.4:** Practice on field measurement – Measurement of flow, Head measurement, Calculation of power, section of turbine and generator.

## References:

- 1) Adam Harvey, "Micro-Hydro Design Manual – A guide to small-scale water power generation", published by Intermediate Technology Publication, 1993
- 4) Manual for survey and layout design of private micro-hydro power plants, published by ICIMOD, Kathmandu, Nepal, 1999
- 5) Maintenance and Repair Manual for private micro-hydro power plants, published by ICIMOD, Kathmandu, Nepal, 1999
- 6) Operation and Management Manual for private micro-hydro power plants, published by ICIMOD, Kathmandu, Nepal, 1999

# Marks Division

- ▶ Assessment
- ▶ Assignment
- ▶ Attendance
- ▶ Class Performance