

# Hydropower Engineering (BEG453CI)

Year: IV

Semester: I

Teaching Schedule			Examination Scheme						Total Marks
			Final				Internal Assessments		
			Theory		Practical		Theory Marks	Practical Marks	
L	P	T	Duration	Marks	Duration	Marks			
3	2/2	3	3	80	-	-	20	25	125

### Course Objective:

The objective of this course is to make the students aware about the development of hydropower and to design the components of hydropower.

### Course Contents:

#### 1. Introduction

(4 hrs)

- 1.1 Introduction to Power, their types and comparison
- 1.2 Power Situation in Nepal and World
- 1.3 Historical Background and Development of hydropower in
- 1.4 Classification of Hydropower Plants as Low Head, Medium Head and High head
- 1.5 Run -off River, Storage and Pump Storage Plants

#### 2. Power Regulation

(6 hrs)

- 2.1 Firm Power, Secondary Power, Mean and Peak Load, Utilization and Diversity Factors, use of flow and power duration curve
- 2.2 Power Variation: Daily, Weekly and Seasonal
- 2.3 Introduction to Power System, Power Grids, Components of Power System

#### 3. Planning and Layout of Hydropower Projects

(4 hrs)

- 3.1 Site Selection for Hydropower Projects: Reconnaissance, Preliminary, Hydrological, Geological and Final Investigation
- 3.2 Requirements for Hydropower: Use of Flow Duration and Mass Curves, Energy Flow Diagram, Estimation of Power Potential, Demand and Prediction
- 3.3 Reservoir Regulation: Peak and Normal Flow Discharges, Distribution of Sediments and their Control, Life of Reservoir
- 3.4 Layout of Hydropower Projects: Intake, Reservoir, Pen stock, Supply Conduit, Casing, Draft Tube, Tail Race

#### 4. Water Retaining Structures

(9 hrs)

- 4.1 Dams: purposes, Different types of Dams based upon Function, Head, Hydraulic Consideration, Materials, Storage, rigidity, criteria for selection of a dam
- 4.2 Choice of Dam Depending upon Site Condition and Economy
- 4.3 General Consideration for Design of Dams

- 4.4 Design Principle of Straight Gravity Dam: Strength, Stability and Factor of Safety, middle third rule, elementary profile of a dam
- 4.5 Foundation Treatment: Grouting, Remedies against Piping and Exit Gradient
- 4.6 Design of Concrete Gravity Dams: General Considerations, Cross-Sectional Profiles, Strength, Stability and Safety Factors against Overturning, Sliding, Floating, Free-Board
- 4.7 Design of Earthen Dams: General Considerations, Strength, Stability and Safety Factors against Slope Stability; Phreatic Line, Seepage Flow Discharge

**5. Regulatory Structures (10 hrs)**

- 5.1 Intake: Importance, Location and Types
- 5.2 Design of Intake Structures
- 5.3 Hydraulic Tunnels: Definition; Rock Pressure; Hardness Coefficient of Rocks; Pressure and Non-Pressure Tunnels, their Types and Design; Head loss in Pressure Tunnels; Design of Tunnel Lining
- 5.4 Settling Basin: Types of Settling Basins and their Locations; Settling Velocity, Horizontal Velocity and Lifting Velocity; Characteristics of Suspended Sediments, Settling Basins with Periodic and Continuous Flushing; Components of Basins and their Designs
- 5.5 Forebay and Surge Tanks: Importance, Location, Condition of their Application;
- 5.6 Design of Forebay Structure, Design of surge tank, water hammer effect
- 5.7 Pen Stock Liners: Importance, Location, Condition of their Application; Hydraulic Hammer; Hydro dynamic Pressure Calculation; Turbine Head and Determination of Pen Stock Diameter, penstock design

**6. Spillway (4 hrs)**

- 6.1 Function of Spillway, Types and Capacity, Provision of Gates
- 6.2 Occurrence of Cavitation and Erosion
- 6.3 Energy Dissipation: Types of Energy Dissipators, their necessity; Role of Tail Water Depth
- 6.4 Design of Stilling Basin

**7. Hydro-Electrical Machines (8 hrs)**

- 7.1 Hydro-Mechanical Installation: Turbines - Pelton, Francis, Kaplan and their Performance Characteristics
- 7.2 Selection of Turbines and their Specific Speed
- 7.3 Introduction to Bulb Turbine; Draft Tube, Tail Race Canal and their Importance
- 7.4 Pumps: Centrifugal, Reciprocating and their Performance Characteristics; Selection and Starting Speed
- 7.5 Electro-Mechanical Installation: Generators and their Types
- 7.6 Purpose and Working Principles of Governors
- 7.7 Classification and Dimensions of Powerhouses

**Laboratories:**

- (i) Performance Characteristics of a Pelton Turbine.
- (ii) Performance Characteristics of a Francis Turbine.
- (iii) Characteristics of Centrifugal Pump.
- (iv) Characteristics of Reciprocating Pump.

**Field Visit:**

One day field visit of nearest hydropower site.

**References:**

- M. M. Dandekar, K. N. Sharma, Water Power Engineering.
- M. M. Grishin, Hydraulic Structures, Mir Publishers, Moscow, 1982.
- R. S. Varshney, Hydropower Structures, Nem Chand and Bros., Roorkee, 1986.4.