**Course Objective :**

1. TO familiarize the basic concepts of Fluid flow and hydraulics and their application in the context of hydropower development.
2. To make students acquainted with component of hydropower systems and their design principles
3. **Introduction to Basic Fluid Mechanics and Hydraulics   (14 hours)**
   1. Classification of Fluid Flows: Compressible versus incompressible flow, Laminar versus Turbulent flow, steady versus unsteady flow, One-, Two-, and Three-Dimensional flows
   2. Properties of fluid: Concept of Continuum, density and specific gravity, vapor pressure and cavitation, energy and specific heats, compressibility, viscosity, surface tension and capillary effect.
   3. Pressure and fluid statics: pressure at a point, variation of pressure with depth
   4. Pressure measurement devices; barometer, manometer and other devices.
   5. Hydrostatic forces on submerged plane surfaces and curved surfaces
   6. Mass, Bernoulli and Energy Equations: Conservation of Mass, Mechanical Energy and Efficiency
   7. The Bernoulli's Equation: Static, Dynamic and Stagnation Pressures; Limitation on the use of the Bernoulli's Equation; HGL and EGL, Applications of the Bernoulli's equation.
   8. Pipe Hydraulics: Laminar flow in pipes( pressure drop and head loss), turbulent flow in pipes (shear stress, velocity profile , The Moody's chart), Types of fluid flow problems in pipes, Minor losses, Series and parallel pipes, piping systems with pumps and Turbines.
   9. Unsteady flow in pipes: Water hammer  and its effects, Hydraulic hammer and hydrodynamic pressure calculations
   10. Open channel hydraulics: classification, Froude number, specific energy, uniform flow in channels, best hydraulic cross section.

1. **Introduction to Hydrology (5 hours)**
   1. Descriptive Hydrology: Hydrological Cycle, Types of precipitation, Measurement of rainfall, Intensity duration curves
   2. Stream gauging: selection of stream gauging site, river stage measurement, measurement of water depth, measurement of discharge , Area- velocity method, Current meter, Slope- area method, Salt concentration method, Stage discharge relationship
   3. Estimation of peak flow: Empirical methods, Rational methods, Probability plotting method, gumbel's distribution

1. **Planning of Hydropower projects (5 hours)**
   1. Introduction to Hydropower: Comparison of hydropower and thermal power, combined power system and grids, basic terms and definitions
   2. Investigation and planning: Planning parameters, power market, hydrology, topography, geology, soils and materials, Environmental issues, project appraisal and socio-economic considerations
   3. Hydropower Development cycle: Reconnaissance studies, Prefeasibility Studies and Feasibility Studies.
   4. Assessment of available Hydropower, necessity of storage and pondage, essential stream flow data, flow duration and power duration curve and their uses, Firm power and secondary power, Environmental flow.
   5. Types of Hydropower plants, General arrangement of a hydropower project (sketch also) ; intakes, conveyance systems, forebay, surge tanks, power house, tailrace,

1. **Dam Engineering (5 hours)**
   1. Classification of dams, gravity, arch, earth or rock fill and buttress dams( with sketches), Relative advantages and disadvantages of one type of dam over another. Investigation of dam site, Engineering surveys
   2. Gravity dam: Force acting on gravity dams(water pressure, uplift, wave pressure, silt pressure, wind pressure, earthquake forces), primary load combinations for the numerical problems( Water, uplift and self weight only)
   3. Stability requirements: Failure due to overturning and sliding, Elementary profile of gravity dam, Middle- third rule.
2. **Component of Hydropower System (6 hours)**
   1. Intake : Types, importance, location, Layout, Design Criteria only
   2. Hydraulic Tunnels : Lay out, Design Criteria
   3. Settling Basin : Lay out and Design Criteria
   4. Forebay and surge tanks: Layout and Design criteria
   5. Penstock Liners: Lay out and Design criteria
   6. Valves: Types and suitability

1. **Spillways (3 hours)**
   1. Design of spillways, definition, purpose, types
   2. Gates: types and their location
   3. Occurance of cavitation and cavitation erosion.

1. **Hydro-Electric Machines (7 hours)**
   1. Hydro-Mechanical installations: turbines- Pelton, Francis, Kaplan and their performance characteristics, selection of Turbines and their specific speed, draft tube and its importance
   2. Pumps: Centrifugal, Reciprocating and their performance characteristics, selection and starting speed
   3. Electro-mechanical installations: generators and their types, purpose and working principle of governers
   4. Power House: Classification and dimensions of Power House.

**Praticals**

1. Hydrostatics force on a submerged body
2. Verification of Bernoulli's equation
3. Head loss in a pipe
4. Performance characteristics of a pelton turbine
5. Performance characteristics of Francis turbine
6. Characteristics of a centrifugal pump.

**References:**

1. P.N.Modi and S. Seth " Fluid Mechanics and Hydraulics" Standard book house, 2009
2. Subramanya K. " Engineering Hydrology " Tata Mc graw hill publication
3. Dandekar M.M. and Sharma K.N. " Water power Engineering"
4. Hydraulic machines ,G. I Krivchenko, Mir publishers Moscow

**Evaluation Scheme**  
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

|  |  |  |
| --- | --- | --- |
| **Chapters** | **Hours** | **Mark Distribution\*** |
| 1 | 14 | 28 |
| 2 | 5 | 6 |
| 3 | 5 | 8 |
| 4 | 5 | 8 |
| 5 | 6 | 10 |
| 6 | 3 | 6 |
| 7 | 7 | 14 |
| **Total** | **45** | **80** |

**\*Note: There may be minor deviation in marks distribution**