**19CE2102 - FLUID MECHANICS**

**(Civil Engineering)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Category** | Professional Core | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial - Practical** | 2-1-0 |
| **Prerequisite** | Engineering Mathematics-II, Engineering Physics. | **Sessional Evaluation** | 40 |
| **Semester End Exam. Evaluation** | 60 |
| **Total Marks** | 100 |

|  |  |  |
| --- | --- | --- |
| **Course Objectives** | 1. To understand various fluid properties and types of pressure. 2. To understand the concepts of pressure acting on submerged and floating bodies. 3. To study the concepts of fluid kinematics. 4. To understand the basic concepts of fluid dynamics and its applications. 5. To understand the factors influencing the efficiency of a pipe network. 6. To understand fluid flows in pipes under various flow conditions. | |
| **Course Outcomes** | CO1 | Determine the fluid properties, and fluid pressure in various conditions using manometers. |
| CO2 | Evaluate the hydrostatic pressure and buoyant force on plane & curved surfaces in floating and submerged conditions. |
| CO3 | Determine the velocity and acceleration components of a fluid flow. |
| CO4 | Apply the concepts of fluid dynamics to fluid flow problems. |
| CO5 | Compute the losses and efficiency of pipe networks. |
| CO6 | Analyze and apply the laminar and turbulent flow conditions for flow through pipes. |
| **Course Content** | **UNIT – I**  **DEFINITIONS& BASIC CONCEPTS:** Definition of fluid & solid; fluid properties – density, specific weight, specific gravity, specific volume; viscosity – kinematic and dynamic viscosity, Newton’s law of viscosity, variation of viscosity with temperature; concepts of - compressibility, bulk modulus, surface tension, capillarity, vapour pressure and cavitation.  **PRESSURE MEASUREMENT:** Fluid pressure - fluid pressure at a point; Pascal’s law; pressure variation in a fluid at a rest; types of fluid pressure – absolute, gauge, atmospheric & vacuum pressure; measurement of pressure – manometers, mechanical gauges; simple manometers- piezometer, U-tube manometer, single column manometer, differential manometers – U-tube differential manometer, inverted U-tube differential manometer.  **UNIT – II**  **FLUID STATICS:**Total pressure and centre of pressure on – vertical plane surface, horizontal plane surface, inclined plane surface, curved plane surface; buoyancy, centre of buoyancy, meta-centre, meta-centric height equation, conditions of equilibrium of a floating & submerged bodies.  **UNIT – III**  **FLUID KINEMATICS:** Methods of describing fluid motion; types of fluid flow; description of the flow patterns – streamline, stream tube, path line, streak line; basic principles of fluid flow- conservation of energy & momentum; continuity equation in Cartesian coordinates; velocity and acceleration – local & convective acceleration; velocity potential function and stream function, equipotential line, relationship between velocity potential function and stream function.  **UNIT – IV**  **FLUID DYNAMICS:** Equations of motion- Euler’s equation of motion, Bernoulli’s equation – assumptions, applications; impulse momentum equation; forces excreted by a flowing fluid on a pipe bend.  **DISCHARGE MEASUREMENT USING ORIFICES, MOUTHPIECE, NOTCHES & WEIRS:** Types of orifice and mouthpiece; hydraulic coefficients; classification of notches & weirs; discharge over rectangular and triangular notches.  **UNIT – V**  **ANALYSIS OF PIPE FLOW:** Reynolds experiment on pipe flow, loss of energy due to friction – Darcy-Weisbach equation; minor losses; hydraulic gradient line and total energy line; flow through syphon; pipes in series& parallel; equivalent pipe; branched pipes; water hammer in pipes – gradual closure of valve, sudden closure of valve in rigid and elastic pipes, control measures.  **UNIT VI**  **LAMINAR & TURBULENT FLUID FLOW IN PIPES:** Flow of incompressible fluid through circular pipe and between two rigid parallel plates – velocity distribution, ratio of maximum to average velocity, drop of pressure,shear stress distributions for given length of pipe. Coefficient of friction in terms of shear stress, shear stress in turbulent flow, Prandtl’s mixing length theory. | |

|  |  |
| --- | --- |
| **Textbooks**  **and Reference books** | **TEXTBOOKS:**   1. Dr. P.N. Modi, Dr. S.M. Seth, “*Hydraulics and Fluid Mechanics Including Hydraulics Machine”*Standard Book House, 21stEdition, 2017. 2. R.K. Bansal, “*A Textbook of Fluid Mechanics and Hydraulic Machines*” Laxmi Publications, 10thEdition,2019. 3. A. K. Jain “*Fluid Mechanics including Hydraulic Machines”*Khanna Publications, 2016.   **REFERENCE BOOKS:**   1. Frank M White, “*Fluid Mechanics in SI Units*” White, McGraw Hill Education India Private Limited, 8thEdition, 2017. 2. Yunus A. Cengel, Dr. John M. Cimbala, “*Fluid Mechanics: Fundamentals and Applications*” McGraw-Hill Education India Private Limited, 4thEdition, 2018. 3. Okiishi, Hubesh, and Rothmayer “*Fluid Mechanics”* Munson Johnwiley Publications, 7thEdition, 2017. |

**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** |
| **CO1** | 3 | 2 | - | 1 | 1 | - | - | - | 1 | - | 2 | 2 |
| **CO2** | 3 | 1 | - | 2 | 1 | - | - | - | 1 | 1 | 2 | 2 |
| **CO3** | 3 | 2 | - | 3 | 1 | - | - | - | 2 | - | 2 | 2 |
| **CO4** | 3 | 2 | 1 | 2 | 1 | - | - | - | 2 | 1 | 2 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | 1 | 3 | 2 |
| **CO6** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | - | 2 | 2 |