**19CE2203 - HYDRAULICS AND HYDRAULIC MACHINERY**

**(Civil Engineering)**

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

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| **Course Objectives** | 1. To understand the concepts of dimensional analysis and its importance in modeling.
2. To understand the concepts of boundary layer, drag and lift acting on a body.
3. To understand the basics of open channel flow for sectional design.
4. To examine the hydraulics of open channel flow.
5. To study the forces exerted by a jet on platesand there by understand the performance of the turbines.
6. To understand the working principle and characteristics of centrifugal pump
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| **Course Outcomes** | CO1 | Apply the concepts of modeling and similitude for a given flow condition. |
| CO2 | Illustrate the fundamental characteristics of the boundary layer and compute the lift and drag forces. |
| CO3 | Design the most economic geometric section of open channel. |
| CO4 | Analyze open channel flow and calculate key properties of hydraulic jump. |
| CO5 | Compute the forces exerted by a jet of fluid on stationary and moving plates and also determine the efficiency of turbine and draft-tube. |
| CO6 | Compute the losses in centrifugal pump and examine the importance of characteristic curves, cavitation and lift. |
| **Course Content** | **UNIT – I****DIMENSIONAL ANALYSIS, HYDRAULIC SIMILITUDE & MODEL TESTING**: Derived quantities; dimensional homogeneity; methods of dimensional analysis – Rayleigh’s method, Buckingham’s Pie-theorem; similitude – types and similarities; types of forces acting in moving fluid; dimensionless number; model laws.**UNIT – II****BOUNDARY LAYER THEORY:**Definitions – types of boundary layer; boundary layer theory, types of boundary layer thickness; drag force on a flat plate due to boundary layer; separation of boundary layer- effects and prevention.**UNIT – III****OPEN CHANNEL FLOW – I:** Types of flow in channel; geometric properties of channel section; velocity distribution in a channel section; uniform flow in channels – Chezy’s formula, Ganguillet-Kutter formula, Bazin’s formula, Manning’s formula; most economical channel section; specific energy & critical depth, critical flow and its computation – rectangular channel section; determination of mean velocity of flow in channel.**UNIT – IV****OPEN CHANNEL FLOW – II:** Gradually varied flow: dynamic equation of gradually varied flow; classification of channel bottom slopes and surface profiles; characteristics of surface profiles; hydraulic jump – assumptions, hydraulic jump in rectangular channel, types and application of hydraulic jump.**UNIT – V****IMPACT OF JETS:**Forces exerted by a jet on a vertical plate, inclined plate and curved plate - stationary and moving.**HYDRAULIC TURBINES:** Turbines – classification of turbines; definitions of heads and efficiencies of a turbine; Pelton wheel, Francis turbine, Kaplan turbine – velocity triangles, work done& efficiency; draft tube- classification, functions of draft tube; specific speed – derivation, significance, unit quantities and its uses; performance characteristics curves of hydraulic turbines; selection of turbines.**UNIT – VI****CENTRIFUGAL PUMPS – I:** Components of centrifugal pump; work done by impeller of the centrifugal pump; head of the pump – suction head, delivery head, static head; losses and efficiency of centrifugal pump – manometric, mechanical, overall; minimum speed for a centrifugal pump; multistage centrifugal pump – parallel, series; expression for specific speed of a centrifugal pump.**CENTRIFUGAL PUMPS – II:** Unit quantities; priming of a centrifugal pump; characteristic curves of centrifugal pump;cavitation; maximum suction lift, Net Positive Suction Head (NPSH). |
| **Textbooks****and Reference books** | **TEXTBOOKS:**1. Dr. P.N. Modi, Dr. S.M. Seth, Hydraulics *and Fluid Mechanics Including Hydraulics Machines,*Standard Book House, 21stedition, 2017.
2. R.K. Bansal, A *Textbook of Fluid Mechanics and Hydraulic Machines,* Laxmi Publications,10thedition, 2018.
3. K Subramanya,*Flow in Open Channels*,Tata McGraw-Hill Educational Private Ltd.,5thedition, 2019.

**REFERENCE BOOKS:**1. Madan Mohan Das, *Open Channel Flow*, PHI Publications, 3rdedition,2009.
2. VenTe Chow*, Open-Channel Hydraulics*, The Blackburn Press, 7thedition, 2009.
3. Terry W Sturm, *Open Channel Hydraulics*, Tata McGraw-Hill Educational Private Ltd., 2ndedition.
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**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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