NIRMA UNIVERSITY

| Institute: | Institute of Technology |
|-----------------------|---------------------------------|
| Name of Programme: | B. Tech. (Chemical Engineering) |
| Course Code: | 2CH203 |
| Course Title: | Fluid Flow Operations |
| Course Type: | Core |
| Year of introduction: | 2023-2024 |

| L | Т | Practical component | | | С | |
|---|---|---------------------|----|---|---|---|
| | - | LPW | PW | W | S | |
| 2 | - | 2 | - | - | - | 3 |

(BL2)

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

- 1. study the concepts of fluid flow operations
- apply fundamental flow equations to practical systems
 estimate the performance of various fluid transport, metering and agitation devices
 (BL3)
- 4. assess the behaviour of fluids flowing in closed conduits (BL5)

Syllabus:

Total Teaching hours: 30

| Unit | Syllabus | Teaching hours |
|----------|---|-------------------|
| Unit I | Fluid Statics: Concept of fluid and flow, Ideal and real fluids, Properties of fluids, Hydrostatic equilibrium, Pressure concept, Rheology of fluids, Viscosity, Reynolds no., boundary layer theory. | 04 |
| Unit II | Basic Equations of Fluid Flow: Mass balance (Continuity Equation), Mechanical Energy Equation (Bernoulli's equation with modifications), Correction factors. | 07 |
| Unit III | Pipeline flow: Shear stress and velocity in pipes, Hagen- Poiseuille law, Effect of Roughness, Friction Factor Chart, Minor losses, Darcy's Equation. | 07 |
| Unit IV | Transportation, Metering and Agitation of Fluids: Pipe and Joints, Pumps– Positive Displacement Pumps, Centrifugal Pumps, Characteristic curves, Cavitation and NPSH, Compressors, Valves, Notches, Flowmeters, Pitot tube, Standard Agitated Vessel, Power Consumption. | 12 |

Self-Study:

Self-study contents will be declared at the commencement of the semester. Around 10 % of the questions will be asked from the self-study contents.

Laboratory Works:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings/ References:

- 1. McCabe, W. L., Smith, J. C., & Harriott, P., Unit operations of chemical engineering McGraw-Hill.
- 2. Gupta, V., Gupta, S. K., Fundamentals of Fluid Mechanics, New Age International.
- 3. White, M., Fluid Mechanics, Tata Mc-Graw Hill Publication.
- 4. Wilkes, J. O., Fluid Mechanics for Chemical Engineers, Prentice Hall.
- 5. Fox, R.W., Pritchard, P.J., McDonald, A.T., Introduction to Fluid Mechanics, Wiley-India.
- 6. Mathieu, M., Fluid Mechanics for Chemical Engineers, Wiley.

Suggested List of Practical (not restricted to the following) only for information

| Sr. | Practical | No. of |
|-----|--|--------|
| | | Hours |
| 1 | To determine the viscosity of oil by Redwood viscometer. | 02 |
| 2 | To prove that the intensity of pressure at any depth of static liquid is proportional to the depth of immersion. | 02 |
| 3 | To study the flow pattern of a fluid flowing in a pipe. | 02 |
| 4 | To verify the principle of conservation of energy by finding out | 02 |
| | the pressure head and velocity head and applying the Bernoulli's | |
| | equation to a venturi meter. | |
| 5 | To calibrate the given Orifice meter. | 02 |
| 6 | To calibrate the given Venturi meter. | 02 |
| 7 | To calibrate the given Rotameter. | 02 |
| 8 | To measure velocity of flow using Pitot tube. | 02 |
| 9 | To determine head losses due to sudden contraction, sudden | 02 |
| | enlargement and fittings. | |
| 10 | To determine friction factor of different closed conduits. | 02 |
| 11 | To calibrate rectangular notch and triangular notch. | 02 |
| 12 | Virtual lab experiment | 02 |