**Q. Code: 132763**

**Reg. No.** | | | | | | | | | | | | | |

# B. E / B. TECH.DEGREE EXAMINATIONS, MAY 2024

Third Semester

## CH18302 – FLUID MECHANICS

*(Chemical Engineering)*

**(Regulation 2018 / 2018A)**

**TIME:3 HOURS** **MAX. MARKS: 100**

**CO1** Obtain the basic fluid properties, like density viscosity and surface tension.
**CO2** Examine the fluid flow problems using different laws like Euler's law, Bernoulli law etc.
**CO3** Discuss the pressure drops during the flow of fluids through different physical systems like pipes, valves, fixed and fluidized beds etc.
**CO4** Identify several machineries used to transport the fluid and their performance including the flow measurements.
**CO5** Compare the fluid flow characteristics during the turbulent conditions using the analogies.

### PART- A(10x2=20Marks)

(Answer all Questions)

| | | CO | RBT LEVEL |
|---|---|---|---|
| **1.** | Elucidate the continuum concept of a fluid. | **1** | **2** |
| **2.** | Give an example for thixotrophic and Pseudoplastic fluid. | **1** | **2** |
| **3.** | Distinguish between gauge pressure and absolute pressure. | **2** | **2** |
| **4.** | Enumerate the characteristics of the manometric fluid. | **2** | **2** |
| **5.** | Find the velocity of water flowing in a pipe when a cylindrical tube has 0.4 cm in diameter and length 12 cm and the discharge is 2.5 kg/s. | **3** | **3** |
| **6.** | Distinguish between minimum fluidization velocity and interstitial velocity. | **3** | **2** |
| **7.** | Indicate the factors influencing the selection of pump. | **4** | **2** |
| **8.** | Explicate on the NPSH and the effect of a negative NPSH. | **4** | **3** |
| **9.** | Illustrate the principle of dimensional homogeneity with a suitable example. | **5** | **2** |
| **10.** | Differentiate between the kinematic and dynamic similarity. | **5** | **2** |

### PART- B (5x 14=70Marks)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **11. (a)** | With a neat sketch of rheological behavior explain the behavior of Newtonian fluid and non Newtonian fluids. | **(14)** | **1** | **3** |
| | **(OR)** | | | |
| **(b)** | Find the specific gravity, dynamic viscosity and kinematic viscosity of oil having density 981kg/m3. The shear stress at a point in oil is | **(14)** | **1** | **3** |

0.25 $N/m^2$ and velocity gradient at that point is 0.2 per second. Also determine the compressibility of the liquid, if the pressure is increased from 0.7 MPa to 1.3 MPa while the volume decreases by 0.15 percent.

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|---|---|---|---|---|
| **12. (a)** | A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U tube is 12 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line reduced to 9850 $N/m^2$, calculate the new difference in the level of mercury. Sketch the arrangement in both the cases. | **(14)** | **2** | **3** |
| | **(OR)** | | | |
| **(b)** | Derive the Bernoulli equation with fluid friction and pump work for a flow of an incompressible fluid. | **(14)** | **2** | **3** |
| **13. (a)** | Develop the Ergun equation for pressure drop in a fluidized bed and the expression for minimum fluidization velocity in the Stoke's law regime. | **(14)** | **3** | **3** |
| | **(OR)** | | | |
| **(b)** | A bed containing 38000 kg of sand particles of diameter 0.18 mm is to be fluidized with air at 400°C and 20 $Kgf/cm^2$ pressure in a cylindrical vessel of 3 m diameter. The density of sand particles is 2.8 $g/cm^3$. The viscosity of air at the operating condition is 0.034 cP. Calculate,<br>(i)The min height of fluidized bed ($\varepsilon = 0.56$)<br>(ii) The pressure drop in the fluidized bed | **(14)** | **3** | **3** |
| **14. (a)** | A 20 cm x 10 cm venturimeter is provided in a vertical pipe line carrying oil with a specific gravity 0.85, the flow being upwards. The difference in levels of the throat section and entrance section of the venturimeter is 60 cm. The differential U-tube manometer shows a gauge deflection of 45 cm. Evaluate the discharge of oil and pressure difference between the entrance section and throat section. Use Cd = 0.98. | **(14)** | **4** | **3** |
| | **(OR)** | | | |

| | | | | |
|---|---|---|---|---|
| **(b)** | Explain the working principle and characteristics curve of a Centrifugal pump with a neat diagram in detail. | **(14)** | **4** | **3** |
| **15. (a)** | The thrust 'F' of a screw propeller is dependent upon the diameter 'd', speed of advance 'v', fluid density 'ρ ', revolutions per second 'n' and coefficient of dynamic viscosity 'μ '. Using Buckingham-Pi theorem show that it can be expressed by the equation $F = \rho d^2 v^2 \Phi \{\mu/(\rho v d), (nd)/v\}$ | **(14)** | **5** | **3** |

**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | Explain the principle of dimensional homogeneity with an example and also list the steps involved in the Pi-theorem of dimensional analysis. | **(14)** | **5** | **3** |

## PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **16.** | Evaluate the application of various types of flow measuring devices in chemical process Industries. | **(10)** | **4** | **5** |

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