Register No: _____

# THE KAVERY ENGINEERING COLLEGE

*(An Autonomous Institution)*

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

*Third Semester*

*Chemical Engineering*

CH3352 - Fluid Mechanics for Chemical Engineers

*Regulations - 2021*

*Duration : 3 Hrs* *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

| *Q.No* | *Questions* | *BLT* | *CO* | *Marks* |
|---|---|---|---|---|
| 1. | State Newton's law of viscosity. | RE | 1 | 2 |
| 2. | Distinguish between a real fluid and an ideal fluid. | UN | 1 | 2 |
| 3. | State Bernoulli's theorem. | RE | 2 | 2 |
| 4. | What do you understand by continuity equation? | RE | 2 | 2 |
| 5. | Define dimensional homogeneity. | RE | 3 | 2 |
| 6. | Define scale ratio. Evaluate scale ratio for area. | RE | 3 | 2 |
| 7. | Compare laminar flow and turbulent flow. | UN | 4 | 2 |
| 8. | Differentiate major and minor head loss. | UN | 4 | 2 |
| 9. | Write the applications of flow measurement. | RE | 5 | 2 |
| 10. | List out the various types of compressors. | RE | 5 | 2 |

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

| *Q.No* | | | *Questions* | *BLT* | *CO* | *Marks* |
|---|---|---|---|---|---|---|
| 11. | a | i | Explain briefly about the Newtonian fluids and Non- Newtonian fluids with neat sketch. | AP | 1 | 7 |
| | | ii | The velocity distribution in m/s near the solid wall at a section is a laminar flow is given by u = 5 sin ($\pi$y). If μ = 5 poise. Find the shear stress at y = 0.05m in N/m$^2$. | AP | 1 | 6 |
| | | | Or | | | |
| | b | i | Two horizontal plates are placed 1.25 cm apart. The space between them is being filled with oil of viscosity 14 poises. Examine the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s. | AP | 1 | 8 |
| | | ii | Briefly describe about classification of fluid motion. | AP | 1 | 5 |
| 12. | a | i | Derive Euler equation of motion. | AP | 2 | 5 |
| | | ii | Derive the continuity equation for a three dimensional incompressible flow. | AP | 2 | 8 |
| | | | Or | | | |
| | b | | State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumption made for such a derivation. | AP | 2 | 13 |

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|---|---|---|---|---|---|---|
| 13. | a | i | Discuss the types of non-dimensional numbers and derive any two of them. Also explain the significances of these dimensionless numbers for fluid flow problem. | AP | 3 | 8 |
| | | ii | Define Similitude and discuss its type of similarities in detail. | AP | 3 | 5 |
| | | | Or | | | |
| | b | | A 7.2 m height and 15 m long spillway discharge 94 $m^3/s$, under a head of 2 m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experience a force of 7500 N, Calculate the force on the prototype. | AP | 3 | 13 |
| 14. | a | | The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m, 210 m and of diameters 300 mm, 200 mm, 400 mm respectively, is 12 m. Determine the rate of flow of water if co-efficient of friction are 0.005,0.0052 and0.0048 respectively, considering:(1) minor losses also (2) neglecting minor losses. | AN | 4 | 13 |
| | | | Or | | | |
| | b | i | Discuss the concept of boundary layer formation, derive the expression for displacement thickness and list the methods of boundary layer separation. | AN | 4 | 5 |
| | | ii | Calculate the thickness of the boundary layer at the trailing edge of smooth plate of length 4 m and of the width 1.5 m, when the plate is moving with a velocity of 4 m/s in stationary air. Take kinematic viscosity of air as 1.5 x 10-5$m^2/s$. | AN | 4 | 8 |
| 15. | a | i | Explain about working principle of reciprocating compressors. | UN | 5 | 7 |
| | | ii | What is mean by flow measurement? Explain any one type of flow measurement device. | UN | 5 | 6 |
| | | | Or | | | |
| | b | | The centrifugal pump has the following characteristics. Outer diameter of impeller = 800 mm; width of the impeller vane at outlet = 100 mm. angle of the impeller vanes at outlet = 40°.The impeller runs at 550 rpm and delivers 0.98 $m^3/s$ under an effective head of 35 m. A 500 kW motor is used to drive the pump. Find the manometric, mechanical and overall efficiencies of the pump. Assume water enters the impeller vanes radially at inlet. | EV | 5 | 13 |

*PART – C (Marks 1*15 = 15)*

| *Q.No* | | | *Questions* | *BLT* | *CO* | *Marks* |
|---|---|---|---|---|---|---|
| 16. | a | i | State and explain about the Buckingham's pi-theorem. | AP | 3 | 7 |
| | | ii | Check the dimensional homogeneity of the following common equations in the field of hydraulics. a) Q = $C_d$. a.$\sqrt{2gH}$ b) V = C$\sqrt{m}$ | AP | 3 | 8 |
| | | | Or | | | |
| | b | | A plate of length 750 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 5 m/s. If the crude oil has a specific gravity of 0.8 and kinematic viscosity of 1 stoke, Estimate:<br>i) Boundary layer thickness at the middle of the plate<br>ii) Shear stress at the middle of the plate<br>iii) Friction drags on one side of the plate. | AP | 4 | 15 |