

Total No. of Questions : 8]

SEAT No. :

PC4814

[6352]-8R

[Total No. of Pages : 3

S.E. (Civil Engineering)

FLUID MECHANICS

(2019 Pattern) (Semester-III) (201003)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer any four questions from Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Figures to the right indicate full marks.
- 3) Draw neat diagrams wherever necessary.
- 4) Use of logarithmic table, slide rule and electronic pocket calculator are allowed.
- 5) Assume suitable data if necessary, stating it clearly.

Q1) a) Derive the dimensionless numbers: [5]

- i) Reynold number
- ii) Froude number and what are the field application of each.

b) What is a repeating variable and what are the criteria for selecting repeating variable? Explain Buckingham  $\pi$  theorem method of dimensional analysis. [6]

c) The resisting force for a ship is found to depend on its length L, velocity V, acceleration due to gravity g, and fluid density  $\rho$ , dynamic viscosity  $\mu$ . Develop a dimensionless relation for the resisting force. Use Buckingham's  $\pi$  method. [6]

OR

Q2) a) Derive expression for: [6]

- i) Displacement thickness
- ii) Energy thickness

b) A flat plate 10cm wide and 30cm long is placed in oil of relative density 0.85 and kinematic viscosity 0.6 stoke which is flowing with a velocity of 4.5m/s. Find the friction drag on the flat plate, shear stress and thickness of boundary layer at the trailing edge of plate. [6]

c) How does the pressure gradient along flow direction effect boundary layer separation. Explain any one method of controlling boundary layer separation. [5]

P.T.O.

- Q3)** a) Explain the Reynold Experiment for classification of fluid flow and classify the flow based on Reynold number. Also explain significance of lower and upper Reynold number. [6]
- b) A fluid of specific gravity 1.05 flows through a pipe of diameter 120mm. The viscosity of oil is 12 poise and the velocity of flow along centre line of pipe is 3.2 m/s. Find: [6]
- Pressure gradient in flow direction.
  - Shear stress at the pipe wall.
  - Reynold's number.
- c) What are the characteristics of turbulent flow in pipes? Explain hydrodynamically smooth and rough boundaries. [5]

OR

- Q4)** a) A horizontal compound pipe in series has 4 pipes. Pipe 1 is 5cm in diameter and 5m long, pipe 2 is 7.5cm in diameter and 7m long, pipe 3 is 10cm in diameter and 10 m long, pipe 4 is 7.5 cm in diameter and 3m long. The changes in pipe diameter is sudden. Draw the hydraulic gradient line(HGL) and total energy line for this compound pipe. Explain why total energy line always fall in the direction of flow, whereas the hydraulic gradient line may fall or rise. [6]
- b) What is major loss and minor loss in flow through pipe and why these losses occur in flow through pipes. Enlist all major and minor loss with relevant equations? [5]
- c) A pipe in series connects two reservoir and is having length of 150m and 200m. The diameter of the two pipes is 15 cm and 20cms respectively. If the difference in head between water surfaces in reservoir is 6m and friction factors are 0.02 and 0.015 respectively, find the rate of flow through the pipe. [6]

- Q5)** a) In what ways is the flow in open channel is different from the flow through pipe? What are the different types of flow that occur in an open channel flow. [6]
- b) Derive the Chezy' s equation for velocity of flow in an open channel.[6]
- c) A discharge of  $15\text{m}^3/\text{s}$  is to be carried at an average velocity of 1.85m/s. Calculate the dimensions for most efficient, Rectangular channel. [6]

OR

- Q6)** a) How does the specific energy of flow in an open channel differ from total energy of flow in open channel? Derive the equation for critical depth for Rectangular channel. [6]
- b) Explain with neat sketch specific force diagram. [6]
- c) A rectangular channel is 3.5m in wide carries a discharge of 2.8 m<sup>3</sup>/s with a depth of flow of 0.90m, if Manning N = 0.015 determine. [6]
- Specific energy
  - Channel bed slope
  - Critical depth
  - Nature of flow
- Q7)** a) State the assumptions made in the derivation of the dynamic equation for gradually varied flow and derive dynamic equation for GVF. [6]
- b) Classify various types of channel bed slope. [4]
- c) A wide rectangular channel carries a discharge of 7.5 m<sup>3</sup>/s/m width of channel. The slope of channel is 1 in 2000 and Manning's N=0.020. At a section in the channel the depth of flow is 4.5m, find the length of flow profile so developed between this depth and depth within 10% of normal depth. Take 2 steps, sketch the flow profile so developed. [8]
- OR
- Q8)** a) Distinguish between: [6]
- Streamlined body and bluff body
  - Skin friction drag and form drag
- b) Explain flow around a cylinder and development of Karman vortex street. [6]
- c) Tests were conducted on a flat plate 1.25m long and 0.80m wide in a wind tunnel. The wind speed was maintained at 25km/hr. The coefficient of lift and drag are 0.50 and 0.15 respectively. Find: [6]
- Lift force
  - Drag force
  - Resultant force
  - Direction of resultant force and
  - Power required to overcome resistance due to flow of wind. Take density of air as 1.2 kg/m<sup>3</sup>.

