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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech III Semester End Examinations (Regular) - November, 2018

Regulation: IARE – R16

## FLUID MECHANICS AND HYDRAULICS

Time: 3 Hours

(AE)

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

### UNIT – I

- (a) Discuss Newton's law viscosity and explain how viscosity varies with temperature for liquids and gases. [7M]

(b) At a certain depth of a liquid where the pressure is  $850 \text{ N/cm}^2$  what will be the change in specific volume and specific weight with respect to the surface? Given that the specific weight of that liquid at the surface is  $1025 \text{ N/cm}^3$  and the bulk modulus of elasticity is  $24 \times 10^3 \text{ N/cm}^3$ . [7M]
- (a) A wooden cylinder of length  $L$  and diameter  $D$  is to be floated in stable equilibrium on a liquid keeping its axis vertical. What should be the relation between  $L$  and  $D$  if the specific gravity of liquid and that of the wood are 0.6 and 0.8 respectively? [7M]

(b) Convert a pressure head of 10 m of water column to kerosene of specific gravity 0.8 and carbon-tetra-chloride of specific gravity of 1.62. [7M]

### UNIT – II

- (a) An open circular cylinder of 15cm diameter and 100cm long contains water up to a height of 70cm. Calculate the speed at which the cylinder is to be rotated about its vertical axis so that the axial depth becomes zero. [7M]

(b) A uniform flow with a velocity of 3 m/s is flowing over a plane source of strength  $30 \text{ m}^2/\text{s}$ . The uniform flow and source flow are in the same plane. A point P is situated in the flow field. The distance of the point P from the source is 0.5 m and it is at an angle of  $30^\circ$  to the uniform flow. Determine: [7M]

  - Stream function at point P
  - Resultant velocity of flow at P
- (a) Derive an expression for the continuity equation of a three dimensional fluid flow. [7M]

(b) Given that  $u = x^2 - y^2$  and  $v = -2xy$ , determine the stream function and potential function for the flow. [7M]

### UNIT – III

5. (a) Distinguish between Venturimeter and Orificemeter with neat sketches. [7M]  
(b) Water flows at the rate of 200 lit/sec upwards through a tapered vertical pipe. The diameter at the bottom is 240 mm and at the top 200 mm and the length is 5m. The pressure at the bottom is 8 bar, and the pressure at the top is 7.3 bar. Determine the head loss through the pipe. Express it as a function of exit velocity head. [7M]
6. (a) State the Buckingham's Pi-theorem. Explain what are repeating variables and the guidelines for their selection. [7M]  
(b) Two velocity components are given in the following case, find the third component such that they satisfy the continuity equation. [7M]  
i)  $U = x^3 + y^2 + 2z^2$ ;  $V = -x^2y - yz - -xy$   
ii)  $V = 2y^2$ ;  $W = 2xyz$ .

### UNIT – IV

7. (a) Develop an expression for displacement thickness due to formation of boundary layer. [7M]  
(b) Water flows at a velocity of 1.2 m/s over a flat plate 1.2 m long. Determine the boundary layer thickness and displacement thickness. Compare the values with values calculated using laminar flow correlations [7M]
8. (a) What are the minor losses in pipes? Give the appropriate formulae to calculate the losses. [7M]  
(b) Briefly explain Hydraulic Gradient Line and total energy Line. [7M]

### UNIT – V

9. (a) Define cavitation and the reasons for its occurrence in hydraulic machines. Describe the effects of cavitation and the ways in which it could be avoided. [7M]  
(b) Differentiate pump and turbine. Draw velocity triangle for a pump in ideal flow condition. [7M]
10. (a) A typical household basement sump pump provides a discharge of 5gal/min against a head of 15 ft. Estimate  
(i) the maximum efficiency and  
(ii) the minimum horsepower required to drive such a pump at 1750 r/min. [7M]  
(b) Discuss briefly about the classification of Hydraulic Turbines according to the direction of flow through runner. [7M]

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