Reg. No. : | | | | | | | | | | |

Question Paper Code: 33105

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Third Semester

Civil Engineering

01UCE305 – FLUID MECHANICS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. Define surface tension.
2. Define compressibility
3. Define metacentric height.
4. Write the continuity equation
5. Define stream tube.
6. Define path line
7. Define Bernoulli's equation.
8. Describe free liquid jet.
9. What is dimensional homogeneous?
10. Write the dimensions for force and viscosity.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) The dynamic viscosity of an oil is used for lubrication between a shaft and a sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190*rpm*. Calculate the horse power lost in the bearing for a sleeve length of 90*mm*. The thickness of the oil film is 1.5*mm*. (12)

(ii) Explain specific gravity and surface tension. (4)

Or

(b) Calculate the capillary rise in a glass tube of 2.5*mm* in diameter when immersed vertically in a water and mercury. The surface tension of water and mercury are 0.0725*N/m* and 0.52*N/m* respectively. The specific gravity of mercury is 13.6 and contact angle is 130^0 and give reason why there is a fall in mercury capillary. (16)

12. (a) An opening in a dam is covered by the use of the vertical sluice gate. The opening is 2*m* wide and 1.2*m* high on the upstream side of the gate. The liquid of specific gravity 1.45 lies up to a height of 1.5 *m* above the top of the gate whereas on the downstream side water is available up to a height touching the top of the gate. Find

(i) The resultant force acting on the gate and position of the centre of pressure

(ii) The force acting horizontally at the top of gate which is capable of opening the gate. Assume that gate is hinged at the bottom (16)

Or

(b) A uniform body of size 3*m* long 2*m* wide 1*m* deep floats in water. What is the weight of the body if the depth of the immersion is 0.8*m*? Determine the meta-centric height also. (16)

13. (a) In a two dimensional incompressible flow the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$; Where *u* and v are *x* and *y* components of velocity of flow. Show that the flow satisfies the continuity equation and obtain the expression for stream function. If the flow is potential, obtain also the expression for the velocity potential. (16)

Or

(b) If for a Two dimensional potential flow, the velocity potential is given by $\phi = x(2y-1)$, determine the velocity at P(4, 5) and the stream function at the point P. (16)

14. (a) Derive Euler's equation of motion along a stream line for an ideal fluid. (16)

Or

(b) (i) A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200 mm at a position A to 500 mm diameter to a position B which is 4 m at a higher level. If the pressures at A and B are 100 kN/m^2 and 60 kN/m^2 respectively. If the discharge is 0.20 m^3/s, determine the loss of head and direction of flow. (10)

(ii) A jet of water, 75 mm in diameter, issues with a velocity of 30 m/s and impinges on a stationary flat plate. Find the force exerted by the jet on the plate. (6)

15. (a) The resisting force F of a plane during flight can be considered as dependent upon the length of aircraft *l*, velocity *v*, air viscosity μ, air density ρ and bulk modulus of air *K* is given by:

$$F = p1^2V^2\varphi\left(\frac{\mu}{1vp}, \frac{K}{v^2 p}\right)$$

Perform the dimensional analysis using Buckingham's Pi Theorem. (16)

Or

(b) (i) An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2.5 m^3/s through a 1.20 m diameter pipe. Tests were conducted on a 12 cm diameter pipe using water at 20°C. If the viscosity of water at 20°C is 0.01 poise, find the velocity flow in the model and rate of flow in the model. (10)

(ii) Classify the hydraulic models. Discuss the merits and demerits of each model. (6)