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

Question Paper Code: 31015

B.E. / B.Tech. DEGREE EXAMINATION, OCTOBER 2014.

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. Distinguish between ideal fluids and real fluids.
2. What is Newton's law of viscosity?
3. State Pascal's law.
4. What is buoyancy?
5. Differentiate between uniform flow and non-uniform flow.
6. What is a flow net? What are its uses?
7. Mention any four discharge measuring devices.
8. State impulse momentum principle.
9. What is dimensional homogeneity?
10. Define Froude number. State its application in fluid mechanics.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Calculate the specific weight, specific mass, specific volume and specific gravity of a liquid having a volume of 6 m^3 and weight of 44 kN. (10)

(ii) Define surface tension. Find the surface tension in a soap bubble of 62.5 mm diameter when inside pressure in excess of the outside pressure is 20 N/m^2. (6)

Or

(b) (i) A 18 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 18.12 cm. Both the cylinders are 30 cm height. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 20 Nm is required to rotate the inner cylinder at 120 rpm, determine the viscosity of the fluid. (10)

(ii) A cylinder contains a liquid of volume 0.0135 m^3 at a pressure of 750 N/m^2. When compressed to reach a volume of 0.0134 m^3 the pressure is increased to 1400 N/m^2. Determine the bulk modulus of elasticity of the fluid. (6)

12. (a) (i) A solid cylinder 2 m in diameter and 2 m high is floating in water with its axis vertical. If the specific gravity of the material of cylinder is 0.65 find its metacentric height. Also state whether the equilibrium is stable or unstable. (10)

(ii) The right limb of a U tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 25 cm below the level of mercury in the right limb. Find the pressure in the pipe, if the difference of mercury level in the two limbs is 45 cm. (6)

Or

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

(i) The resultant force acing on the gate and position of centre of pressure;
(ii) The force acting horizontally at the top of the gate which is capable of opening it. Assume that the gate is hinged at the bottom. (16)

13. (a) (i) Derive the continuity equation for three dimensional flows in Cartesian coordinates. (10)

(ii) Distinguish between

(a) Rotational flow and irrotational flow and (3)

(b) Path line and streak line. (3)

Or

(b) (i) The velocity components in a two dimensional incompressible flow are, $u = y^3 + 6x - 3x^2y$; $v = 3xy^2 - 6y - x^3$. Find the velocity potential function. (10)

(ii) A stream function is given by $\Psi = 2x^2 - 3y^2$. Calculate the velocity component at a point (1, 2) and the resultant velocity. (6)

14. (a) (i) Derive Euler's equation of motion along a stream line for an ideal fluid. (10)

(ii) An orificemeter with orifice diameter 12 cm is inserted in a pipe of 24 cm diameter in which oil of specific gravity 0.88 is flowing. The reading of differential manometer shows 40 cm of mercury. Find the rate of flow of oil through the pipe. Take C_d=0.65. (6)

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:

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

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)