KUMARAGURU college of technology
character is life

Register Number: ……

**B.E DEGREE EXAMINATIONS: MAY 2015**

(Regulation 2013)

Third Semester

**AERONAUTICAL ENGINEERING**

U13AET301**:** Mechanics Of Fluids

**Time: Three Hours** **Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. Capillarity rise and depression
   a) Depend solely upon the size of the tube
   b) Depend solely upon the surface tension of the liquid
   c) Depend upon the surface tension of the liquid as well as the size of the tube
   d) Depend upon the pressure difference between the liquid and the environment
2. The hydrostatic law states that the rate of increase of pressure in a vertical direction is equal to ……..
3. The flow in a river during the period of heavy rainfall is
   a) Steady ,non uniform and three dimensional
   b) Steady ,uniform and two dimensional
   c) Unsteady ,uniform and three dimensional
   d) Unsteady ,non uniform and three dimensional
4. The metacentric height of a floating body is ……..
5. The equation of continuity in fluid mechanics
   a) Is a condition of equilibrium in the flow pattern
   b) Is an embodiment of the law of thermodynamics
   c) Is an embodiment of the law of conservation of mass
   d) Relates work and energy
6. Bernoulli's theorem deals with the law of conservation of ……..
7. Kinematic similarity between model and prototype means
   a) The similarity of shape
   b) The similarity of motion
   c) The similarity of forces
   d) The similarity of discharge

8. Euler's number is the ratio of ……..

9. The boundary layer separation takes place if

   a) Pressure gradient is zero
   b) Pressure gradient is positive
   c) Pressure gradient is negative
   d) Velocity gradient is zero

10. Drag is defined as the force exerted by a flowing fluid on a solid body in the ……..

**PART B (10 x 2 = 20 Marks)**

**(Not more than 40 words)**

11. Distinguish between Newtonian and Non Newtonian Fluids.
12. What is the pressure within a 1 mm diameter spherical droplet of water relative to the atmospheric pressure outside? Assume σ for pure water to be 0.073 N/m.
13. Define buoyancy.
14. If $\psi = 2xy$, determine the magnitude of the velocity vector at (2,-2).
15. Distinguish between a source and a sink flow.
16. List the various assumptions made in the derivation of Bernoulli's equation.
17. What is Mach number? State the purpose of it.
18. Define Buckingham's π theorem.
19. With a simple sketch show what is boundary layer thickness?
20. Write the Navier Stoke's equation.

**PART C (5 x 14 = 70 Marks)**

**(Not more than 400 words)**

**Q.No. 21 is Compulsory**

21. In a 2-dimensional incompressible flow, the fluid velocity components are given by u = (x - 4y) and v = (- y - 4x). Show that velocity potential exists and determine its form. Find also the stream function.

22. a) A vertical gap 2.2 cm wide of infinite extent contains a fluid of viscosity 2 Ns/m² and specific gravity 0.9. A metallic plate 1.2 m × 1.2 m × 0.2 cm is to be lifted up with a constant velocity of 0.15 m/s, through the gap. If the plate is in the middle of the gap, find the force required. The weight of the plate is 40 N.

**(OR)**

b) A U-tube manometer is used to measure the pressure of water in a pipeline, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and

mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipeline is reduced to 9810 N/m², calculate the new difference in the level of mercury. Sketch the arrangements in both cases.

23. a) With neat sketches, briefly explain the following important cases of potential flow.

i) Source flow (3)

ii) Sink flow (3)

iii) Free vortex flow (4)

iv) Doublet (4)

**(OR)**

b) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle.

24. a) The resisting force ***R*** of a supersonic plane during flight can be considered as dependent upon the length of the aircraft ***l***,velocity ***V***,air viscosity $\boldsymbol{\mu}$, air density $\boldsymbol{\rho}$ and bulk modulus of air ***K***. Express the functional relationship between these variables and the resisting force using Buckingham's $\pi$ theorem.

**(OR)**

b) i) The pressure drop in an airplane model of size 1/40 of its prototype is $80N/cm^2$.The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air = $1.24kg/m^3$.The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise. (10)

ii) What is the procedure for selecting repeating variables? (4)

25. a) Derive Navier Stoke's equation from fundamentals.

**(OR)**

b) Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $u/U = 2(y/\delta) - (y/\delta)^2$.

**********