



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS / B.Tech(AUE-OLD) / SEM-3 / AUE-302 / 2012-13**

**2012**

**FLUID MECHANICS AND MACHINERY**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives of the following :  $10 \times 1 = 10$ 
  - i) The unit of viscosity is
    - a)  $\text{metre}^2$  per sec
    - b) kg-sec per  $\text{metre}^2$
    - c) newton-sec per  $\text{metre}^2$
    - d) newton- $\text{sec}^2$  per metre
    - e) all of these.
  - ii) Falling drops of water become spheres due to the property of
    - a) adhesion
    - b) cohesion
    - c) viscosity
    - d) compressibility
    - e) surface tension.



- iii) A body floats in stable equilibrium
- a) when its metacentric height is zero
  - b) when the metacentre is above c.g.
  - c) when its c.g. is below its centre of buoyancy
  - d) metacentre has nothing to do with the position of c.g. for determining stability
  - e) none of these.
- iv) Ratio of inertia force to surface tension is known as
- a) Mach number
  - b) Froude number
  - c) Reynolds number
  - d) Weber's number
  - e) none of these.
- v) Bluff body is the body of such a shape that pressure drag as compared to friction drag is
- a) same
  - b) more
  - c) less
  - d) zero.
- vi) A draft tube is used with
- a) impulse turbine
  - b) pelton wheel turbine
  - c) reaction turbine
  - d) very high specific speed turbine
  - e) axial turbine pump.



- vii) Cavitation is caused by
- a) high velocity
  - b) high pressure
  - c) weak material
  - d) low pressure
  - e) low viscosity.
- viii) Which of the following represents unsteady non-uniform flow ?
- a) Flow through an expanding tube at an increasing rate
  - b) Flow through an expanding tube at constant rate
  - c) Flow through a long pipe at decreasing rate
  - d) Flow through a long pipe at constant rate
  - e) None of these.
- ix) Which of the following is not a rotary pump ?
- a) Gear
  - b) Vane
  - c) Screw
  - d) Axial
  - e) Cam and piston.



x) If pump NPSH requirements are not satisfied

- a) it will not develop head
- b) it will be cavitated
- c) efficiency will be low
- d) it will consume excessive power
- e) no flow will take place.

### GROUP – B

#### ( Short Answer Type Questions )

Answer any *three* of the following.  $3 \times 5 = 15$

2. Calculate the kinetic energy correction factor  $\alpha$  from the following velocity distribution in a circular pipe of radius

$$r_0 : \frac{u}{u_m} = \left[ 1 - \left( \frac{r}{r_0} \right)^2 \right]$$

3. Derive an expression for the velocity distribution for the viscous flow through a circular pipe.
4. Define stream function and velocity potential. Establish the relationship between stream function and velocity potential.
5. Derive an expression for the loss of head due to friction in pipes.
6. What is specific speed for a turbine ? Derive an expression for the specific speed. State its significance in study of hydraulic machines.

1 + 3 + 1



**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

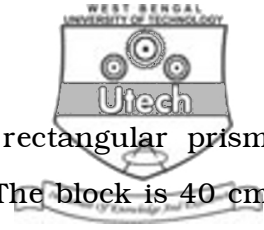
7. a) Derive an expression for the force exerted on a submerged inclined surface by the static liquid and locate the position of centre of pressure.
- b) A 30 cm  $\times$  15 cm venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.9, the flow being upward. The difference in elevations of the throat section and entrance section of the venturimeter is 30 cm. The differential U-tube manometer shows a gauge deflection of 25 cm. Calculate —
- (i) the discharge of oil
- (ii) the pressure difference between the entrance section and the throat section.

(Take co-efficient of the manometer as 0.9 and specific gravity of Hg as 13.6)

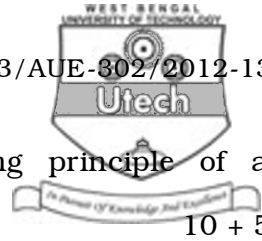
8 + 7

8. a) Derive from first principles Bernoulli's equation for fluid motion along a streamline.
- b) A 45° reducing pipe bend (in a horizontal plane) tapers from 600 mm diameter at inlet to 300 mm diameter at outlet. The pressure at inlet is 140 kN/m<sup>2</sup> and the rate of flow of water through the bend is 0.425 m<sup>3</sup>/s. Neglecting friction, calculate the resultant force exerted by water on the bend.

8 + 7



9. a) A Wooden block in the form of a rectangular prism floats with its shortest axis vertical. The block is 40 cm long, 20 cm wide and 15 cm deep with a depth of immersion of 12 cm. Calculate the position of metacentre and comment on the stability of the block.
- b) A lawn sprinkler has two identical nozzles of diameter 7.5 mm each provided at the ends of the sprinkler rotor. One nozzle discharges water vertically upward while the other nozzle discharges water in the downstream direction. The velocity of flow from each nozzle is 10 m/s and nozzles are at a radial distance of 20 cm and 15 cm from the centre of rotor.
- (i) Determine the torque to be exerted so as to hold the system in stationary position.
- (ii) Also determine the constant speed of rotation of the arm if it is free to rotate. 7 + 8
10. a) The impeller of a centrifugal pump is single inlet type, having inlet and outlet diameters 700 mm and 1200 mm respectively. At outlet, the width is 200 mm, relative flow angle  $25^\circ$  and absolute flow angle  $10.5^\circ$ . The pump runs at 480 rpm with an efficiency of 77%. Considering 5% blockage at outlet, calculate the pump discharge, head and specific speed.



- b) With diagram describe the working principle of a centrifugal pump. 10 + 5

11. Write short notes on any *three* of the following : 3 × 5

- a) Draft Tube
- b) Skin friction drag & pressure drag
- c) Positive displacement pump
- d) Buckingham's theorem
- e) Cavitation.

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