

Roll No.

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BT-4 / M-14

FLUID MECHANICS-II

Paper-CE-206 E

Time allowed : 3 hours]

[Maximum marks : 100

Note : Attempt five questions in all. First question is compulsory and attempt one question from each unit.

1. (a) Indicate the most appropriate statement/statements from the following :
- (i) A flow is said to be laminar when
 - (a) the fluid particles move in a zigzag way
 - (b) the Reynolds number is high
 - (c) the fluid particles move in layers parallel to the boundary.
 - (d) the fluid particles do not move at all.
 - (ii) For pipes arranged in series
 - (a) the head loss must be same in all the pipes
 - (b) the velocity must be same in all the pipes
 - (c) the total flow must be same flowing through each pipe
 - (d) the total flow equals the sum of the flow rates through each pipe.
 - (iii) Drag is defined as the force exerted by the flowing fluid on a solid body
 - (a) in the direction of flow
 - (b) perpendicular to the direction of flow
 - (c) at an angle of 45 to the direction of flow
 - (d) in any direction.

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- (iv) The depth of flow at which specific energy is minimum is called
 - (a) normal depth
 - (b) critical depth
 - (c) alternate depth
 - (d) conjugate depth. 4
- (b) Fill in the blanks with appropriate word/words :
 - (i) The ratio of average velocity to maximum velocity for steady laminar flow in circular pipes is
 - (ii) Separation of boundary layer occurs when dp/dx becomes
 - (iii) When a falling body has attained terminal fall velocity, the weight of the body is equal to
 - (iv) The specific speed of a turbine has the dimensions of 6
- (c) Write 'T' for true or 'F' for false statement from the following statements :
 - (i) Turbulence in flow implies the random component of velocity superimposed on mean flow.
 - (ii) The direction of lift force on an immersed body is tangential to the direction of motion of the body.
 - (iii) The specific energy in an open channel is the sum of datum head and the depth of flow.
 - (iv) A normal shock occurs when an abrupt change takes place supersonic to subsonic flow. 4
- (d) Write short answers for the following :
 - (i) Stoke's law
 - (ii) Equivalent pipe
 - (iii) Elastic wave. 6

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Unit-I

2. (a) Derive a relationship for mean velocity of flow of a viscous fluid through a circular pipe. Also show that the loss of pressure head in any given length of the pipe varies linearly with the mean velocity. 10
- (b) The radial clear distance between a hydraulic plunger and the cylinder walls is 0.05 mm, the length and diameter of plunger being 20 cm and 10 cm, respectively. Calculate the velocity of leakage when the difference of pressure between the two ends of plunger is 10 m of water. Take viscosity as 0.0125 poise. <http://www.kuonline.in> 10
3. (a) Distinguish the total energy line and the hydraulic gradient line. 8
- (b) Calculate the difference in water surface elevations of the two tanks connected by a horizontal pipe of diameter 25 cm and length 500 m. The rate of flow of water through the pipe is 250 l/s. Assume friction factor f to be 0.033. Consider relevant losses. 12

Unit-II

4. (a) Distinguish a stream-lined body and a bluff body.
- (b) A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical in shape and has a diameter of 3 m against the resistance of air with a uniform velocity of 25 m/s. Calculate the weight of the man if the weight of parachute is 9.81 N. Take C_D as 0.5 and the density of air as 1.25 kg/m. 12
5. (a) Show that the critical depth is two-third the specific energy in a channel of rectangular section. 8

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- (b) Calculate the slope of water surface in a rectangular channel of width 20 m and depth of flow 6 m that carries a discharge of 50 m³/s. Take bed slope of the channel as 1 in 5000 and Chezy's coefficient as 60. 12

Unit-III

6. A gas is flowing through a horizontal pipe at a temperature of 4.0°C. The diameter of the pipe is 8 cm at a section and the pressure there is 30 N/cm² (gauge). The diameter of the pipe suddenly changes from 8 cm to 4 cm and the pressure at the section downstream is 20 N/cm² (gauge). Calculate the velocities of the gas at these sections assuming an isothermal process. The value of R may be assumed as 287.14 Nm/kg°K and the atmospheric pressure as 10 N/cm². 20
7. Derive an expression for the velocity of sound wave in a compressible fluid when the process is assumed to be adiabatic. 20

Unit-IV

8. (a) Prove that the area of indicator diagram is proportional to the work done by the reciprocating pump. 10
- (b) A centrifugal pump delivers water against a head of 15 m and design speed of 1000 rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and the outer width is 50 mm. Calculate the discharge of the pump if manometric efficiency is 90%. 10
9. A reaction turbine works at 500 r.p.m. under a head of 125 m. Its diameter at inlet is 120 cm and the flow area is 0.5 m². The angles made by absolute relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Calculate the volume flow rate, the power developed and the hydraulic efficiency assuming whirl at outlet to be zero. 20

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