

June 2019

**FLUID MECHANICS & HYDRAULIC MACHINES**

Time Allowed: 3 Hours

Full Marks: 70

**Answer to Question No.1 is compulsory and to be answered first.**

**This answer is to be made in separate loose script(s) provided for the purpose.**

**Maximum time allowed is 45 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided.**

**On early submission of answer scripts of Question No.1, a student will get the remaining script earlier.**

**Answer any five questions from the rest.**

1. Choose the correct answer from the given alternatives: 1x20
- i) Compressibility can be measured as the reciprocal of density / bulk modulus.
  - ii) Capillary rise for water increases with increase / decrease of the diameter of the tube.
  - iii) The unit of Kinematic viscosity is poise / stoke.
  - iv) For the application of Bernoulli's Equation the flow must be uniform / steady.
  - v) Continuity equation is based on the conservation of mass / energy.
  - vi) Surface tension is generally expressed as Force per unit length / area.
  - vii) For a floating body in stable equilibrium, the centre of gravity must be above/ below the centre of buoyancy.
  - viii) Every fluid in reality is three / two / one dimensional.
  - ix) Pitot tube is a device used to measure velocity / discharge of a flowing fluid.
  - x) For turbulent flow the Reynolds number should be  $<2000$  /  $>4000$ .
  - xi) For maximum power transmission through a pipe the head loss due to friction is  $1/5$  /  $1/3$  /  $1/9$  of the the total head.
  - xii) The major loss in pipe flow is due to loss due to sudden enlargement/ due to friction.
  - xiii) The loss of head at entrance to a pipe is  $V^2/2g$  /  $V^2/2g$  /  $V^2/3g$ .
  - xiv) An impulse turbine is used for- low head of water / high head of water.
  - xv) The Francis turbine is an inward flow reaction turbine / impulse turbine.
  - xvi) Priming is necessary in centrifugal pump / reciprocating pump.
  - xvii) Air vessel are used in a reciprocating pump to reduce acceleration head / increase the flow.
  - xviii) Which of the following is suitable for small discharge and high heads-mixed flow pump / reciprocating pump.
  - xix) The energy stored in an accumulator is pressure energy / kinetic energy.
  - xx) Hydraulic intensifier is a device used to increase the intensity of pressure of water / discharge of water.
2. a) State and prove the Pascal's law.  
b) One litre of crude oil weighs 9.6 N. Calculate its specific weight, density and specific gravity. 5+5
3. a) Define the following: Uniform and Non-uniform flow, steady and unsteady flow, Laminar and turbulent flow.  
b) Explain the continuity equation.  
c) State Bernoulli's theorem. Derive Bernoulli's equation from Euler's equation. 4+2+4
4. a) What is Hydraulic gradient line and total energy line?  
b) A pipe of diameter 300 mm and length 3500 m is used for the transmission of power by water. The total head at the inlet of the pipe is 500 m. Find the maximum power available at the outlet of the pipe, if the value of 'f'=0.006. 4+6

5. a) Derive an expression for the power transmission through pipes. Also find the condition for maximum power transmission.  
 b) A 5 km long pipeline is used to transmit 200 KW of hydraulic power. If the pressure at the inlet is 6 MPa and the pressure drop across the pipe length is 2 MPa. Determine the pipe diameter and its transmission efficiency. Take friction factor = 0.04. 5+5
6. a) An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 lts./sec. Find the head lost due to friction for a 500 m length of pipe. Find the power required to maintain this flow.  
 b) A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressure at the points A and B are given as 29.43 N/cm<sup>2</sup> and 22.563 N/cm<sup>2</sup> respectively while the datum head at a and B are 28 m and 30 m. find the loss of head between A and B. 5+5
7. a) Differentiate between impulse and reaction turbines.  
 b) Explain the different efficiencies of a hydraulic turbine.  
 c) Discuss the working principle of Francis turbine with a neat sketch. 3+3+4
8. a) Explain the working of a centrifugal pump. State the various efficiencies associated with Centrifugal pump. sp. Gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/sec. Find the head lost due to friction for a pipe length of 1000 m. Take kinematic viscosity=0.29 stokes.  
 b) Derive Darcy's equation for loss of head due to friction in pipeline. 4+6
9. a) Draw a neat sketch of a hydraulic intensifier and explain its working principles.  
 b) What is the function of non-return valve? Explain with neat sketch. 5+5
10. a) With a diagram explain the working of hydraulic accumulator.  
 b) An accumulator has a ram of area 4 m<sup>2</sup> and a lift of 10 m. Find the capacity of the accumulator if the water is supplied at a pressure of 136 KPa. 6+4
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