Registration No: | | | | | | | | | | |

Total Number of Pages: 03 **B.Tech**

PME3I102

3rd Semester Regular/Back Examination 2017-18

FLUID MECHANICS AND HYDRAULICS MACHINES

BRANCH: MECH

Time: 3 Hours

Max Marks: 100

Q.CODE: B1182

Answer Question No.1 and 2 which are compulsory and any four from the rest.

The figures in the right hand margin indicate marks.

Q1 Answer the following questions: *Multiple type :* **(2 x 10)**

a) If the surface tension of water –air interface is 0.073 N/m, the gauge pressure inside a rain drop of 1mm diameter will be

i) 0.146N/m^2 ii) 73 N/m^2 iii) 146 N/m^2 iv) 292 N/m^2

b) A rectangular full water tank, has its length, breadth and height in the ratio of 2:1:2. The ratio of hydrostatic forces at the bottom to that at any larger vertical surface is

i) 1/2 ii) 1 iii) 2 iv) 4

c) If 'P' is the gauge pressure within a spherical droplet, then gauge pressure within a bubble of same fluid and of same size will be

i) P/4 ii) P/2 iii) P iv) 2P

d) The term ……..means the study of pressure exerted by the fluid at rest

i) Hydrostatics ii) Fluid mechanics

iii) Continuum iv) Kinetics

e) Navier stoke's equation represents the conservation of

i) Energy ii) Mass iii) Pressure iv) Momentum

f) Existence of velocity potential implies that

i) Fluid is in continuum

ii) Fluid is irrotational

iii) Fluid is ideal

iv) Fluid is compressible

g) A pitot tube is used for measuring

i) Velocity of flow

ii) Pressure of flow

iii) Flow rate

iv) Total energy

h) Which one of the following statement is correct

i) HGL and EGL are the same in fluid flow problems

ii) EGL lies above the HGL and is always parallel to it

iii) EGL lies above the HGL and they are separated from each other by a vertical distance equal to the velocity head

iv) The HGL slopes upwards meeting the EGL only at the exit of flow

i) A draft tube is used in a reaction turbine

i) To guide water downstream without splashing

ii) To convert residual pressure energy into kinetic energy

iii) To convert residual kinetic energy into pressure energy

iv) To streamline the flow in the tail race

j) Why is a minimum of NPSH required for a hydraulic pump?

i) To prevent cavitaion

ii) To increase discharge

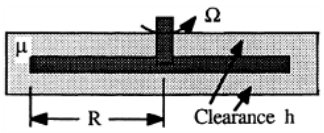
iii) To increase suction head

iv) To increase efficiency

Q2 **Answer the following questions: *Short answer type :*** **(2 x 10)**

a) A thin blade of steel can be made to float on water. Explain how it is possible.
b) State the conditions of equilibrium of a floating body.
c) State relation between rotation, shear strain, vorticity and circulation.
d) Why there is rapid converging passage and gradual diverging passage are provided in venturimeter.
e) Write Navier Stoke's Equation and highlights each term.
f) Why is C_d of an orifice meter much smaller than that of venturimeter?
g) What is the significance of Kinematic viscosity and why we study it though we have dynamic viscosity?
h) What do you mean by cavitation in turbine? Where it occurs?
i) What are the Non-Dimensional factors adopted in the analysis of centrifugal pumps by principle of similarity
j) Draw an indicator diagram for reciprocating pump for pump without air vessel and pump without air vessel

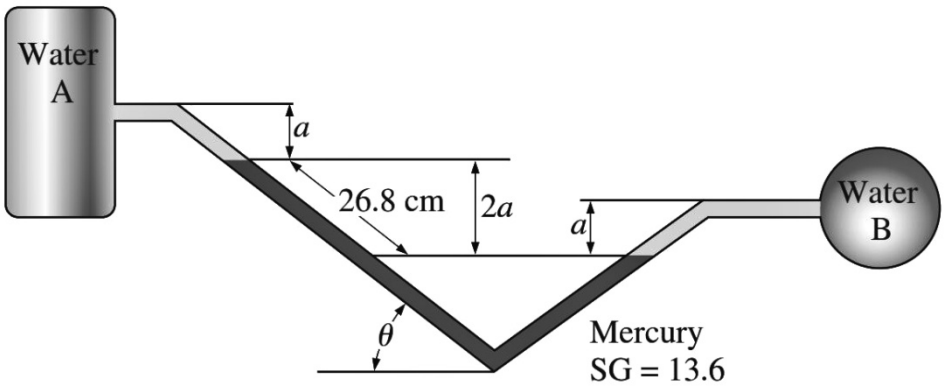
Q3 **a)** A disk of radius R rotates at angular velocity Ω inside an oil container of viscosity μ as in fig. Assuming a linear velocity profile and neglecting shear on the outer disk edges, derive an expression for the viscous torque on the disk. **(10)**



b) Find the density of metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water. **(5)**

Q4 **a)** A tank 8 m deep and 2m wide is layered with 3 m of oil of SG=0.7 on top , 3 m of water in middle , and 2 m of mercury at bottom. Compute (*a*) the total hydrostatic force and (*b*) the resultant centre of pressure of the fluid on the right-hand side of the tank. **(10)**

b) **(5)**



Two water tanks are connected to each other through a mercury manometer with inclined tubes, as shown in Fig. If the pressure difference between the two tanks is 20 kPa, calculate a and θ.

Q5 **a)** i) In three dimensional incompressible fluid flow field is given by expression $v=(x^2+y^2z^3)i+(xy+yz+zx)j+(w)k$. find the w component of velocity so that the case is possible for steady incompressible flow **(10)**
ii) For a two dimensional potential flow, the velocity potential ig given by $\psi = 4x(3y-4)$. Determine the velocity at point (2,3). Determine also the stream function and its value at a point(2,3)

b) A fluid is flowing at constant volume flow rate of Q trough a divergent pipe having inlet and outlet diameter D_1 and D_2 respectively and a length of L. assuming the velocity to be axial and uniform at any section. Find the acceleration at inlet and outlet **(5)**

Q6 **a)** A pipeline carrying water has a diameter of 0.5m and 2.0km long. To increase the delivery another pipeline of the same diameter is introduced parallel to the first pipe in the second half of its length. Find the increase in discharge if the total head loss in both the case is 15m. Assume f=0.02 for all the pipes **(10)**

b) Derive Euler's Equation and from there Bernoulli's equation. mention all the assumption and restrictions **(5)**

Q7 **a)** A Pelton wheel turbine running at 250 rpm under a head of 200 m develops 10000 kW. Coefficient of velocity of the nozzle= 0.98, Hydraulic efficiency =87%, Mechanical efficiency = 75%, Speed ratio = 0.45, Wheel diameter / jet diameter = 10 **(10)**

Determine

a) Flow rate required
b) Wheel diameter
c) Diameter of jet
d) Number of jet
e) Specific speed

b) Draw a neat sketch of velocity diagram showing all components for a jet striking tangentially an unsymmetrical moving curved vane. Draw all three cases of velocity diagram at outlet. **(5)**

Q8 **a)** A double acting reciprocating pump has a plunger 150 mm in diameter and stroke of 450 mm. the suction lift is 3.5 m, the length of the suction pipe is 6, the pipe diameter being 100 mm. calculate the maximum speeds at which the pump could run under the following conditions : **(10)**

a) no air vessel on the suction side
b) a very large air vessel ion the suction side close to pump

b) A centrifugal pump 1.3m in diameter delivers $3.5m^3$/min of water at a tip speed of 10 m/sec and the flow velocity of 1.6 m/sec. The outlet blade angle is 30° to the tangent at the impeller periphery. Assuming zero whirl at inlet, and zero slip, calculate the torque delivered by the impeller. **(5)**

Q9 **Write short note on :** **(5x3)**

a) Compressible fluid and compressible flow
b) Cavitation and NPSH
c) Specific speed of turbine Vs Specific speed of Pump