Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (CE)/NEW/SEM-4/CE-401/2013

2013
FLUID MECHANICS

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 for any *ten* of the following :

$10 \times 1 = 10$

i) The unit of kinematic viscosity is

a) gm/cm-sec^2 b) dyne-sec/cm^2

c) gm/cm^2-sec d) cm^2/sec.

ii) A turbine is a device which converts

a) Hydraulic energy into mechanical energy

b) Mechanical Energy into hydraulic energy

c) Kinetic energy into mechanical energy

d) Electrical energy into mechanical energy.

iii) Flow has Froude number less than one

a) if normal depth is less than critical depth

b) if normal depth is more than critical depth

c) if normal depth is equal to critical depth.

iv) Water hammer is a phenomenon which is caused by

a) sudden opening of a valve in a pipeline

b) sudden closure (partial or complete) of a valve in pipe flow

c) incompressibility of fluid

d) the pipe material being elas ic.

v) The condition of stable equilibrium for a floating body is

a) the metacentre M coincides with the centre of gravity G

b) the metac ntr M is below the centre of gravity G

c) the metacentre M is above the centre of gravity G

d) the centre of buoyancy B is above the centre of gravity G.

vi) Euler's number is the ratio of

a) inertia force to pressure force

b) inertia force to elastic force

c) inertia force to gravity force

d) inertia force to viscous force.

vii) A boundary is known as hydrodynamically smooth if

a) $\frac{k}{\delta'} = 0.3$ b) $\frac{k}{\delta'} > 0.3$

c) $\frac{k}{\delta'} < 0.25$ d) $\frac{k}{\delta'} = 6.0.$

viii) Repeating variables in a dimensional analysis should

a) Be equal in number to that of fundamental dimensions involved in the problem variabl s

b) Include the dependant variables

c) Have at least one variable containing all the fundamental dimensions

d) Collectively contain all the fundamental dimensions.

ix) The sheet of water flow ng over a weir is called

a) Sill b) Nappe

c) Crest d) None of these.

x) The cavi ation can take place in case of

a) pelton wheel b) Francis turbine

c) reciprocating pump d) hydraulic ram.

xi) The discharge through a triangular notch is given by

a) $Q = \frac{2}{3} C_d \tan \theta/2 \sqrt{2gH}$

b) $Q = \frac{2}{3} C_d \tan\frac{\theta}{2} \sqrt{2g}\ H^{5/2}$

c) $Q = \frac{8}{15} C_d \tan \frac{\theta}{2} \sqrt{2g}\ H^{3/2}$

d) None of these.

xii) The loss of head due to sudden expansion on a pipe is given by

a) $h_L = (V_1^2 - V_2^2)/2g$ b) $h_L = (0.5\, V_1^2)/2g$

c) $h_L = (V_1 - V_2)^2/2g$ d) none of these.

GROUP – B

(Short Answer Type Questions)

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

2. What is draft tube ? Where is it used ? Draw a neat sketch of straight divergent draft tube and label the different parts

2 + 1 + 2

3. What are the different types of turbine ? Explain the differences between a pelton wheel turbine and a reaction turbine. Show the differ nt parts of reaction turbine with neat sketch. 2 + 3

4. A single recip ocating pump, running at 50 r.p.m, delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and strok leng h 400 mm. Determine

a) The theoretical discharge of the pump

b) Co-efficient of discharge

c) Slip and the percentage slip of the pump. 2 + 2 + 1

5. Derive the expression for the most economical trapezoidal section in case of open channel flow, if the side slope is given as 1 vertical to n horizontal. 5

6. a) Define the terms Hydraulic Gradient Line and Total Energy Line.

   b) What do you understand by the terms major energy losses and minor energy losses ?

GROUP – C

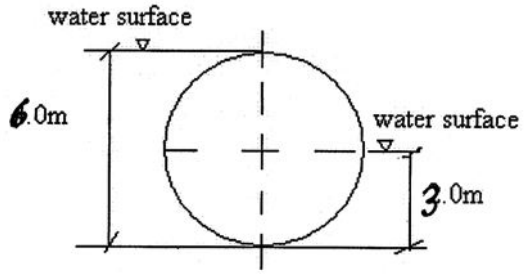
(Long Answer Type Questions)

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

7. a) What do you mean by similitude and what are the different types of similarities that must exist between a model and a prototype ?

   b) Using Buckingham's theorem, derive a relationship for the discharge Q over a small rectangular weir. The discharge depend upon the head H over the weir, the weir height P, gravity g, width of the weir L and fluid properties : density ρ, dynamic viscosity μ and surface tension σ. 5 + 10

8. a) A cylindrica ga e of 6m diameter and 3 m long has water on its both sides as shown in the in Fig. below. Determine the magnitude, location and direction of the resultant force exerted by the water on the gate. Find also the least weight of the cylinder so that it may not be lifted away from the floor.



b) With neat sketches, explain the conditions of equilibrium for floating and submerged bodies. 10 + 5

9. a) Derive the expression for loss of head due to friction in pipes (Darcy-Weisbach equation).

b) The rate of flow of water through a horizontal pipe is 0.3 m^3/sec. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 10 N/cm^2. Determine

i) Loss of head due to sudden enlargem nt,

ii) Pressure intensity in the large pipe,

iii) Power lost due to enlargement 6 + 9

10. a) A Francis turbine has inlet and outlet diameters of 1.2 m and 0.6 m respectively. The breadth at inlet is 0.25 m and at outlet it i 0.35 m. at a speed of rotation of 350 rpm, the relative velocity at entrance is 4.5 m/sec and i radial. Calculate the (i) absolute velocity at entrance and the inclination to the tangent of the runn r (ii) discharge and (iii) the velocity of flow at the outlet

b) A centrifugal pump has an outer diameter of 30 cm and an inner diameter of 15 cm. The pump runs at 1500 rpm. The impeller vanes are set at a blade angle of 30° at the outlet. If the velocity of flow is constant at 3m/Sec, calculate (i) the velocity and direction of water at outlet, (ii) the head developed, by assuming a manometric efficiency of 0.85 and (iii) the blade angle at the inlet. 6 + 9

11. A trapezoidal channel has side slope 1 in 1. It is required to discharge 15 m^3/s of water with a bed gradient 1 in 1000. If unlined the value of Chezy's C is 44. If lined with concrete its value is 60. The cost per m^3 of excavation is three times the cost of lining. The channel is to be most efficient one. Find whether the lined canal or the unlined canal will be cheaper. What will be the dimension of that most economic channel.

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