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B. Tech

BENG 1208 (O) / PCME 4201 (N)

Third Semester Examination – 2011

FLUID MECHANICS AND HYDRAULIC MACHINES
(Old and New Course)

Full Marks – 70

Time – 3 Hours

(Students are required to give their answer any one Course according to the Syllabus)

(OLD COURSE)

*Answer Question No. **1** which is compulsory and any **five** from the remaining. The figures in the right-hand margin indicate marks.*

1. Answer in brief all the following questions : 2×10

(a) Draw the stress-velocity gradient diagram of ideal fluid, Newtonian fluid, Non Newtonian fluid and plastic fluid in one diagram.

(b) Define Mach number. Define its importance with respect to fluid compressibility.

(c) Does a velocity field given by [$U = 5x^3 i - 15x^2yj + tk$] represent a possible fluid motion of an incompressible fluid ?

(d) What is the difference between centre of pressure and centre of buoyancy?

(e) Explain Archimedes's principle.

(f) Define the terms speed ratio, flow ratio and jet ratio in case of hydraulic turbine.

(g) What do you mean by positive displacement of pump ?

(h) Define slip and percentage of slip.

(i) What do you mean by governing of turbine ?

(j) Mention three possible ways to increase the sensitivity of manometer.

P.T.O.

2. (a) What do you mean by surface tension? Calculate surface tension for : 5

(i) a liquid drop let

(ii) a hollow bubble.

(b) Explain capillarity and describe capillary rise and fall. 5

3. (a) What is the use of manometers ? 2

(b) Describe Bourdon tube pressure gauge. 4

(c) The pressure between two points A and B in a pipe conveying oil of specific gravity 0.8 is measured by an inverted U-tube. The column connected to point B stands 1.6m higher than that at point A. A commercial pressure gauge attached directly to the pipe at A reads 1.125 Kg (f)/ cm^2. Determine its reading when attached directly to the pipe at B. 4

4. A rectangular pontoon 10m long, 7 m board and 2.5 m deep weighs 686.7 KN. It carries an empty boiler of 5m diameter weighing 588.6 KN on its upper deck. The center of gravity of the boiler and the pontoon are their respective centers along a vertical line. Find the meta-centric height. Sp. Weight of sea water is 10.104 KN/m^2. 10

5. Describe venturimeter and calculate actual discharge. 10

6. The following data refer to a radial flow reaction turbine : 10

Overall efficiency = 80%, Power to be developed = 150 KW,

Available head = 8 m, Speed ratio = 0.96, Flow ratio = 0.36,

Speed of turbine = 150 rpm, Hydraulic losses equal to 22% of available energy.

Draw neat sketches and find :

(a) Angle of guide blade at inlet

(b) Wheel vane angle at inlet

(c) Diameter of wheel

(d) Width of wheel at inlet.

7. A centrifugal pump running at 1000rpm. discharges 250 lit/sec of water against a head of 30m. At the outlet, the vanes are curved back at 30^0 and the velocity of flow is 3m/s. If the manometric efficiency is 80%, determine the diameter and width of the impeller at the outlet. Draw velocity triangles. 10

8. Write short notes on any *two* : 5×2

   (a) Draft tube

   (b) Siphon

   (c) Pascal's Law.

(NEW COURSE)

Answer Question No. ***1*** *which is compulsory and any* ***five*** *from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Differentiate between Newtonian and non-Newtonian fluid.

   (b) A plate of 0.0254 mm distant from a fixed plate moves at 61 cm/sec and requires a force of 0.2 kg(f)/m^2 to maintain this speed .Determine the dynamic viscosity of the fluid between the plates.

   (c) What is metacentric height of a body ? Why is it a important consideration for a body ?

   (d) Distinguish between *stream line* and *streak line*.

   (e) What is a *flownet* and what is its significance ?

   (f) Write the expression for *equation of continuity* in differential form.

   (g) Differentiate between *reaction* and *impulse* turbine.

   (h) What is *cavitation* in turbine ?

   (i) What is *Reynolds number* and what is its significance ?

   (j) What do you mean by overall efficiency of turbine ?

2. (a) State and explain Pascal's law with an appropriate mathematical proof. 5

(b) Through a very narrow gap of height h, a thin plate of large extent is pulled at a velocity V. On one side of the plate is oil of viscosity μ_1, and on other side oil of viscosity μ_2. Calculate the position of the plate so that the shear force on the two sides of the plate is equal and pull required to drag the plate is minimum. 5

3. (a) The vertical side of a reservoir has a rectangular opening of 2.75 m long and 1.2 m high. It is closed by a plate using 4 bolts placed at the corners of the opening. What would be the tension in the bolts if water stands to a height of 1.8 m above the top edge of the opening which is horizontal? 5

(b) A wooden cylinder of diameter d and length 2d floats in water with axis verical .Is the equilibrium stable ? Locate the metacentre with reference to water surface. Specific gravity of wood is 0.6. 5

4. (a) Explain and provide a mathematical derivation of Bernoulli's theorem. Justify that it follows from the conservation of energy principle. 5

(b) A venturimeter has its axis vertical the inlet and throat diameter being 150mm and 75mm respectively. The throat is 225 m above inlet and k (coefficient of actual discharge) = 0.96. petrol of specific gravity 0.78 flows up through the meter at a role of $0.029 m^3/s$. Find the pressure difference between inlet and the throat. 5

5. (a) A pipeline 0.225 m in diameter and 1580m long has a slope of 1 in 200 for the first 790 m and 1 in 100 for the next 790 m.The pressure at the upper end of the pipe line is 107.91 kpa and the lower end is 53.955 kpa. Taking f = 0.032, determine the discharge through the pipe. 6

(b) State and explain laws of fluid friction and Archimedis principle. 4

6. (a) Explain in brief about performance characteristic curves of turbine. 3

(b) How model testing of turbines are done. 3

(c) A francis turbine working a under head of 5m at a speed of 210 rpm develops 75 kw when the rate of flow of water is 1.8m^3/s. The runner diameter is 1m. If the head on this turbine is increased to 16m, determine its new speed, discharge and power. 4

7. (a) What are the various types of losses occurring during the operation of a centrifugal pump. 5

(b) A pump operates at a maximum efficiency of 82% and delivers 2.25 m^3/s speed under a head of the 18 m while running at 3600 rpm speed. Compute specific speed of the pump. Also determine the discharge head and power input to pump at a shaft speed of 2400 rpm. Cite the assumptions made if any. 5

8. Write short notes on : 2×5

(a) Steady flow and unsteady flow

(b) Uniform flow and non uniform flow

(c) Rotational flow and irrotational flow

(d) Laminar flow and turbulent flow

(e) Eulerian analysis of fluid kinematics.