

Code No: 113BX

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**B.Tech II Year I Semester Examinations, November - 2015****FLUID MECHANICS AND HYDRAULIC MACHINERY****(Electrical and Electronics Engineering)****Time: 3 Hours****Max. Marks: 75****Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A.

Part B consists of 5 Units. Answer any one full question from each unit.

Each question carries 10 marks and may have a, b, c as sub questions.

PART- A**(25 Marks)**

- 1.a) Explain the phenomenon of capillarity. [2M]
- b) A soap bubble of radius r has a liquid-vapour surface tension coefficient of σ . What is the pressure difference between the inside and outside of the bubble? [3M]
- c) Name the different forces present in a fluid flow. For the Euler's equation of motion, which forces are taken into consideration? [2M]
- d) Define potential head, velocity head and datum head. [3M]
- e) A jet of water 80 mm diameter having a velocity of 20 m/s strikes normally a vertical flat plate. Find the force exerted by the jet on the plate. [2M]
- f) A jet of water of 50 mm diameter strikes a symmetrical stationary curved vane at its center with a velocity of 30 m/s and is deflected through an angle of 150° . Neglecting friction find the force exerted on the plate in the direction of the jet. [3M]
- g) Classify hydraulic machines and give one example for each. [2M]
- h) Write a short note on Governing of Turbines. [3M]
- i) How the centrifugal pumps are classified? [2M]
- j) Explain the working principle of a centrifugal pump with the help of a line sketch, naming all the parts. [3M]

PART- B**(50 Marks)**

2. Differentiate between:
 - a) Absolute pressure and gauge pressure,
 - b) Piezometer and simple manometer,
 - c) U-tube differential manometer and inverted U-tube differential manometer.[3+3+4]

OR

- 3.a) Explain the terms:
 - i) Streamline
 - ii) Streak line
 - iii) Path line.
- b) A plate having an area of 0.4 m^2 is sliding down the inclined plane at 30° to the horizontal with a velocity of 0.25 m/s. There is a cushion of fluid 2 mm thick between the plane and the plate. Find the viscosity of fluid if the weight of the plate is 25 N. [5+5]

- 4.a) Derive Bernoulli's equation through Euler's equation of motion.
 b) State the momentum equation. How will you apply momentum equation for determining the force exerted by a flowing liquid on a pipe bend? [5+5]

OR

- 5.a) Water at 20°C flows through a pipe of diameter 20 cm at a rate of 0.3 lit/s. Find the pressure drop in the pipe of length 1 km. Density and dynamic viscosity of water at 20°C are 1000kg/m³ and 0.001 N-s/m², respectively.

- b) Show that the energy transmitted by a long pipe is maximum when $\frac{1}{3}rd$ of energy put into the pipe is lost in friction. [5+5]

6. A two dimensional jet of water carrying a discharge of q with velocity u strikes a stationary plate at an angle θ with a normal to the plate. Show that the discharge divides in the two directions as $q_1 = \frac{q}{2}(1 - \sin \theta)$ and $q_2 = \frac{q}{2}(1 + \sin \theta)$. What will be the force exerted by the plate on the fluid? [10]

OR

7. A jet of water having a velocity of 20 m/s impinges on a curved vane which is moving in the same direction as that of the jet with a velocity of 5 m/s. The jet makes an angle of 30° with the direction of motion of vane at entry and leaves the vane at an angle of 90° to the direction of motion of vane at outlet. If the water enters and leaves the vane without shock, find the vane angles at inlet and outlet. Also find the work done per second per unit weight of water striking the vane. [10]

8. Show that the hydraulic efficiency of a Pelton wheel is maximum when peripheral wheel velocity is half the absolute velocity of jet at inlet. Also show that

$$\eta_{h \max} = \frac{1 + K \cos \beta}{2}$$

Where K is the friction factor and β is the outlet angle of bucket. [10]

OR

9. The following data refer to a Pelton wheel:

Generator output	= 8000 KW
Head	= 450 m
Generator efficiency	= 96%
Overall efficiency	= 86%
Coefficient of velocity	= 0.98
Speed ratio	= 0.46
Jet ratio	= 12
Number of poles	= 16

Determine (a) quantity of water required, (b) diameter of jet, (c) diameter of runner, and (d) synchronous speed of wheel. [2+2+3+3]

- 10.a) Define cavitation. What are the effects of cavitation? Give the necessary precaution against cavitation.
- b) A centrifugal pump lifts 100 litres/s water under a static head of 20 m. The suction and delivery pipes are both of 30 cm diameter. The lengths of suction and delivery pipes are 10 m and 70 m respectively. If the overall efficiency is 70%, find the power required to drive the pump. Assume Darcy's friction factor $f = 0.03$. [5+5]

OR

11. The following data refer to a centrifugal pump which is designed to run at 1200rpm against a head of 40 m.
The diameter of impeller at inlet and outlet = 200mm and 400mm respectively
The width of impeller at inlet and outlet = 80mm and 40mm respectively
Vane angle at outlet = 40°
Discharge = 300 litres/s
Find (a) the vane angle at inlet, (b) theoretical head developed, (c) manometric efficiency and (d) power required to drive the pump if the overall efficiency is 70%. Also find the corresponding mechanical efficiency. [2+2+3+3]

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