

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V • EXAMINATION – SUMMER 2013****Subject Code: 152003****Date: 21-05-2013****Subject Name: Fluid Mechanics and Machines****Time: 10.30 am - 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Define and distinguish between following fluid properties **07**
 (1) Dynamic Viscosity and Kinematic viscosity
 (2) Cohesion and Adhesion
 (3) Surface tension and Capillarity
- (b) (1) Calculate the Capillary effect in mm in a glass tube of 4 mm diameter, when immersed in (i) water and (ii) in mercury. The values of surface tension of water and mercury are 0.0735 N/m and 0.48N/m resp. The contact angle of water, $\theta = 0^\circ$ and for mercury $\theta = 130^\circ$. **03**
 (2) A dash pot 100 mm diameter and 125 mm long slides vertically down in a 100.5 mm diameter cylinder. The oil filling the annular space has a viscosity of 0.80 poise. Find the speed with which the piston slides down if load on the piston is 10 N. **04**
- Q.2** (a) (1) State and derive Hydrostatic law. **03**
 (2) A rectangular plate 0.6 m wide and 1.2 m deep is submerged in an oil bath of specific gravity 0.8. The maximum and minimum depths of the plate are 1.6 m and 0.75 m from the free surface. Calculate the hydrostatic force on one face of the plate, and the depth of centre of pressure. **04**
- (b) (i) Determine the Metacentric height by analytical method. **03**
 (ii) A wooden block of width 1.25 m, depth 0.75 m and length 3.0 m is floating in water. Specific weight of the wood is 6.4 kN/m³. Find (i) Volume of water displaced, and (ii) Position of centre of buoyancy. **04**
- OR**
- (b) (i) Explain Boundary layer theory. **03**
 (ii) Derive relation of head loss due to sudden expansion of flow in pipe. **04**
- Q.3** (a) Give differences between following flows **07**
 (1) Steady and Unsteady flow.
 (2) Uniform and non-uniform flow
 (3) Laminar and Turbulent flow.
- (b) (i) Derive continuity equation in Cartesian coordinates. **03**
 (ii) The velocity vector in a fluid flow is given by: **04**

$$\mathbf{V} = xy^2\mathbf{i} + 2yz^2\mathbf{j} + [zy^2 - 2z^3/3]\mathbf{k}.$$
 Is it a case of possible steady incompressible fluid flow?
- OR**
- Q.3** (a) (i) State and derive moment of momentum equation **03**
 (ii) Explain Hydraulic gradient line and Total energy line with neat sketch. **04**

- (b) During the test of a centrifugal pump, water was drawn steadily from a reservoir through a vertical 300 mm diameter suction pipe, and the pump discharged the water into a horizontal 250 mm diameter delivery pipe. A pressure gauge just outside the casing on the suction pipe read- 0.4 bar gauge while the discharge pressure gauge indicated a pressure of 2.8 bar gauge. A vertical distance of 1.5 m intervened between the pipe centres at the sections where the gauges were attached. If the water discharge is $0.1 \text{ m}^3/\text{s}$, Compute the power expended in running the pump if overall efficiency is 70%. **07**
- Q.4 (a)** (i) Draw the main characteristics of the Francis turbine. **03**
(ii) Prove that hydraulic efficiency of Pelton turbine is maximum when $u/V = 0.5$. **04**
- (b)** (i) Define the term Head coefficient C_H , Flow coefficient C_Q and Power coefficient C_P applicable to hydraulic machines. **03**
(ii) A hydraulic turbine is to develop 1015 kW when running at 120 rpm under a net head of 12 m, Find the flow rate if the overall efficiency is 92 %. In order to predict its performance, a 1:10 scale model is tested under a head of 7.2 m. What would be the speed, power output and water consumption of the model? **04**
- OR**
- Q.4 (a)** (i) Describe major components of Kaplan turbine. **03**
(ii) Give major difference between Pelton and Francis turbine. **04**
- (b)** (i) State different types of draft tube and its function **03**
(ii) A Twin jet Pelton wheel operates under a head of 400 m and develops 735 kW brake power when running at 450 rpm. Find the flow rate and jet diameter. Assume overall efficiency = 0.85 and coefficient of velocity = 0.97. **04**
- Q.5 (a)** (i) Describe backward, radial and forward curved blades of pump impeller. **03**
(ii) Describe different shape and type of centrifugal pump impeller. **04**
- (b)** A centrifugal pump having 350 mm outlet diameter and 180 mm inlet diameter is to deliver water against a net head of 25 m at the design speed of 1200 rpm. The width of impeller at outlet is 60 mm and the flow velocity is constant from inlet to outlet. The entry is radial and the impeller vanes are bent back at 30° to the tangent at outlet. Assuming manometric efficiency of 90 %, Calculate the width of the impeller at inlet, the angle of vane tip at inlet and the discharge from the pump. **07**
- OR**
- Q.5 (a)** (i) Compare multistage pump impellers in series and parallel. **03**
(ii) What is cavitation? Explain with respect to pump. **04**
- (b)** (i) What is three flow pump? **03**
(ii) A three flow pump has cylinders of 250 mm diameter and stroke of 500 mm each. The pump is required to deliver $0.1 \text{ m}^3/\text{s}$ at the head of 100 m. Friction losses are estimated to be 1 m in suction and 19 m in delivery pipe. Velocity of water in delivery pipe is 1 m/s, overall efficiency is 85% and the slip is 3%. Determine: (i) Speed of the pump, and (ii) Power required to run the pump. **04**
