

II B. Tech II Semester Regular Examinations, May/June - 2015
FLUID MECHANICS AND HYDRALIC MACHINERY
 (Com. to ME, AME)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answer **ALL** the question in **Part-A**
 3. Answer any **THREE** Questions from **Part-B**

PART-A

- 1 a) How does the viscosity of air vary with temperature? (4)
- b) Differentiate between stream function and velocity potential (4)
- c) What is a dimensionless number (4)
- d) What is velocity diagram for a turbine blade? What is its use (4)
- e) Define specific speed of a centrifugal pump (3)
- f) Briefly explain the working of a hydraulic lift (3)

PART-B

- 2 a) List all fluid properties and derive Newton's law of viscosity. (8)
- b) Find the height through which water rises by capillary action in a glass tube of 2mm bore if the surface tension at the prevailing temperature is 0.075 N/m. (8)
- 3 a) Define stream function and velocity potential. What are their uses? (10)
- b) Determine whether the following velocity components satisfy the continuity equation. i) $u = cx, v = -cy$ ii) $u = -cx/y, v = c \log xy$ (6)
- 4 a) Explain the development of boundary layer formation over a flat plate. (6)
- b) Discuss displacement thickness, energy thickness and momentum thickness (10)
- 5 a) A jet of oil of specific gravity strikes a fixed curved symmetrical plate at its center and leaves at the outlet tips. The diameter of the jet is 62 mm and the velocity of the jet is 45 m/sec. If the jet is deflected by 100 degrees, calculate the force exerted on the curved plate. (8)
- b) How do you estimate the impact of a jet striking a moving normal plate in the direction of the jet (8)
- 6 a) A centrifugal pump while running at 800 rpm discharges 100 L/s against a net head of 14m. The manometric efficiency of the pump is 78%. If the vane angle at the outlet is 35 degrees and the velocity of flow is 2m/sec, determine the outer diameter of the impellor. (10)
- b) What is a reciprocating pump ? What are its types ? Explain its working with a neat sketch. (6)
- 7 a) Explain the classification of turbines ? Explain the working of Francis turbine with a neat sketch. (8)
- b) What is governing of turbines? How is it achieved? (8)



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PART-A

- 1 a) What are the applications of surface tension? (4)
- b) What is a flow net? What are its uses (4)
- c) Explain any one application of momentum equation (4)
- d) Differentiate between radial flow and tangential flow in turbines. (4)
- e) Define NPSH for a centrifugal pump (3)
- f) Explain the importance of governing of turbines (3)

PART-B

- 2 a) Derive the equation for capillarity depression when a small glass tube is inserted in mercury. (6)
- b) A piston of 7.95 cm diameter and 30 cm long works in a cylinder of 8.0 cm diameter. The annular space of the piston is filled with an oil of viscosity 2 poise. If an axial load of 10N is applied to the piston, calculate the speed of movement of the piston. (10)
- 3 a) Derive the Bernoulli's equation and discuss its significance. (10)
- b) A Water pipe changes in diameter from 400mm at section A to 800mm at section B which is 7 m above. The pressures at A and B are 100 KPa and 75 KPa respectively. The discharge is 400 litres/Sec. Find the direction of flow. (6)



- 4 a) What do you understand by Boundary Layer ? Explain the development of Boundary layer over a flat plate. (8)
- b) What are the dimensionless numbers in dimensional analysis. Discuss a few of them (8)
- 5 a) A nozzle of size 10 cm diameter issues a jet of water with a velocity of 50m/sec. The jet strikes a moving flat plate perpendicularly at the centre. The plate is moving with a velocity of 15m/sec in the direction of the jet. Calculate (8)
- The force exerted on the plate
 - The work done
 - Efficiency of the jet
- b) Derive the equation for the impact of jet striking a moving inclined plate in the direction of the jet (8)
- 6 a) A centrifugal pump delivers water against a net head of 10 m at a design speed of 800 rpm. The vanes are curved backwards and make an angle of 30 degrees with the tangent at the outer periphery. The impeller diameter is 30 cm and has a width of 5 cm at the outlet. Determine the discharge of the pump if the manometric efficiency is 85% (8)
- b) What is indicator diagram for a reciprocating pump? Explain slip and coefficient of discharge of a reciprocating pump. (8)
- 7 a) How are turbines classified? Explain the working of Pelton wheel turbine with a neat sketch. (8)
- b) What is a draft tube? What are its functions? (8)

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PART-A

- 1 a) Derive the equation for capillary rise in a small tube dipped in a liquid (4)
- b) Explain the concept of stream tube in Fluid Mechanics & Hydraulic Machinery (4)
- c) Explain Boundary layer separation with a neat sketch (4)
- d) What is a velocity diagram? Explain with a sketch (4)
- e) When do you connect centrifugal pumps in series? (3)
- f) Explain the use of draft tube of a turbine (3)

PART-B

- 2 a) What is metacentric height? Explain how the same is calculated (8)
- b) What are the modes of measuring pressure? How can you convert the pressure in KPa into the liquid columns and vice versa. (8)
- 3 a) What are the different types of flow ? State and Explain Bernoulli's equation. (8)
- b) A pipe line 300 m long has a slope of 1 in 100 and tapers from 1.2m diameter at the high end to 0.6m at the low end. The discharge through the pipe is 5.4 m³/minute. If the pressure at the high end is 70 kpa, find the pressure at the low end. Neglect the losses. (8)
- 4 a) What are the characteristics of boundary layer formation over a flat plate ? (6)
- b) Explain how the boundary layer thickness is defined in different ways. (10)
- 5 a) A jet of water strikes with a velocity of 50 m/sec a flat fixed plate inclined at 30 degrees with the axis of the jet. The cross sectional area of the plate is 100 cm². Find the force exerted by the jet on the plate and the ratio in which the jet gets divided after striking. (8)
- b) Derive the equation for the impact of jet striking a curved plate at the centre when the plate is stationary. (8)
- 6 a) A fluid is to be lifted against a head of 120m . The pumps that run at a speed of 1200 rpm with rated capacity of 300 litres per second are available. How many pumps are required to pump the water if specific speed is 700. (8)
- b) What is the working principle of a reciprocating pump ? Explain its working with the help of an indicator diagram. (8)
- 7 a) Differentiate between impulse turbine and reaction turbine. What is a draft tube and what are its functions? (10)
- b) What is geometric similarity? How do we maintain it (6)



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PART-A

- 1 a) What is Pascal's law? Explain with an example (4)
- b) What is centre of pressure? Where does it lie in relation to centre of gravity (4)
- c) What is stream lined body? (4)
- d) How do you find the force when a jet is striking a fixed vertical plate with a velocity v . (4)
- e) Define cavitation in centrifugal pump. (3)
- f) Explain the working of a hydraulic ram (3)

PART-B

- 2 a) List all the fluid properties and explain why water rises in a small glass tube when inserted in water. (6)
- b) The space between two parallel plates kept 3mm apart is filled with an oil of dynamic viscosity 0.2 Pa.s. What is the shear stress on the lower fixed plate, if the upper one is moved with a velocity of 1.50m/sec? (10)
- 3 a) Differentiate between laminar flow and turbulent flows, and rotational and irrotational flows. (6)
- b) Derive the continuity equation from fundamentals. (10)
 Determine whether the following velocity components satisfy the continuity equation. i) $u = cx, v = -cy$ ii) $u = -cx/y, v = c \log xy$



- 4 a) What is a boundary layer ? Differentiate between a laminar and turbulent boundary layer. (8)
- b) Explain how a boundary layer separates from boundary. What are the conditions under which separation takes place ? (8)
- 5 a) A jet of water of diameter 40 mm moving with a velocity of 30m/sec strikes a curved fixed symmetrical plate at the center. Find the force exerted by the water on the plate, if the jet is deflected through an angle of 120 degrees at the outlet of the curved plate. (8)
- b) Derive the equation for impact of jet striking a curved plate at one tip and leaving at the other tip, when the plate is stationary (8)
- 6 a) Water is to be pumped to a height of 90m . The pumps that run at a speed of 1000 rpm with rated capacity of 200 litres per second are available. How many pumps are required to pump the water if specific speed is 800. (8)
- b) What is a manometric head of a centrifugal pump ? How do you define the specific speed of a centrifugal pump ? (8)
- 7 a) What type of turbine is Kaplan turbine? Explain how it works with a neat diagram. Discuss the importance of draft tube in reaction turbines. (10)
- b) What are the unit quantities to study the performance of turbines? (6)