

II B. Tech I Semester, Supplementary Examinations, May – 2013**FLUID MECHANICS AND HYDRALICS MACHINES**

(Com. to EEE, ME, MM)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks

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1. a) What is viscosity? Derive Newton's law of viscosity? What are the units of measurement of viscosity?
b) Find the height through which a fluid of specific gravity 0.8, raises in a capillarity tube of 1.5 mm diameter. The surface tension of the fluid is 0.09N/m. Angle of contact between water and glass is 10 degrees. (7M+8M)
 2. a) State the Bernoulli's equation and discuss significance and units of different terms in the equation.
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 liters/Sec. Find the direction of flow. (7M+8M)
 3. a) Derive the Darcy Weisbach equation.
b) Two reservoirs are connected by a pipe line ABC which consists of two pipes of AB and BC joined in series. Pipe AB is 10cm in diameter, 20m long and has a value of $f=0.02$. Pipe BC is of 16cm diameter, 25m long and has $f=0.018$. The junctions with the reservoirs and between the pipes are abrupt. What difference in water levels shall exist to maintain a discharge of 15 l/sec. (7M+8M)
 4. a) Determine the force exerted by a jet striking at the centre of a fixed symmetric curved plate.
b) Derive the momentum equation and discuss its use in finding the impact exerted by jets on flat plates. (8M+7M)
 5. a) What are the important elements of a hydropower plant? Discuss with neat sketches.
b) What are the heads and efficiencies associated with working of hydropower plants or turbines? (8M+7M)
 6. a) How are the turbines classified? Bring out four major comparisons between reaction and impulse turbines.
b) Show the different components of a Francis turbine and explain its working. Write the equation for work done and discuss. (7M+8M)
 7. a) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is $9 \text{ m}^3/\text{sec}$. If the overall efficiency is 90%, determine i) Power generated ii) Specific speed of the turbine b) What is governing of turbines? Explain how the governing mechanism works for a Pelton wheel turbine with a neat sketch. (8M+7M)
 8. a) Determine the number of impellers required for a multistage centrifugal pump to lift 4200 litres/minute against a total head of 185m, at a speed of 750 rpm. The specific speed is not to exceed 700.
b) Explain the working of a reciprocating pump with a neat diagram. Derive the expressions for discharge and work done (8M+7M)



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1. a) Define the following fluid properties and derive appropriate equations.  
i) Specific Weight ii) Viscosity iii) Surface tension iv) Vapour pressure  
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? (7M+8M)
  
2. a) State and derive the Bernoulli's equation from fundamentals  
b) Explain how the fluid flows are classified? Explain the sketches where necessary. Find the equation of stream line passing through (2,2) for the fluid flow  $V = -y^2i - 6xj$  (7M+8M)
  
3. a) What is a venturimeter? Explain its working with a neat sketch and derive the required equation.  
b) A reservoir discharges water into the atmosphere through a compound horizontal pipe line ABC. The compound pipe consists of two pipes as noted below. A is junction point with the reservoir.  
AB: Diameter = 10cm, length =25m,  $f = 0.02$   
BC: Diameter = 12cm, length = 35m,  $f = 0.02$   
The water level in the tank is 10m above the centre line of the pipe. Calculate the discharge considering all the minor losses. (7M+8M)
  
4. 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.  
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 (8M+7M)
  
5. a) What are the elements of hydro power plants? Explain in detail with neat sketches.  
b) What is a mass curve? Explain its use in simple terms. (9M+6M)
  
6. a) What is the type of Pelton Wheel? Explain its working with neat sketches.  
b) Discuss the significance and uses of the draft tubes? Derive the equation for the efficiency of a draft tube. How are they classified? (7M+8M)
  
7. a) What are types of similarities between models and prototypes? Explain in detail  
b) Explain the following in detail  
i) Selection of type of turbine ii) Surge tank iii) Cavitation (6M+9M)
  
8. a) What is a manometric head of a centrifugal pump? How do you define the specific speed of a centrifugal pump?  
b) 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? (7M+8M)

Code No: R21021

**R10**

**SET - 3**

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1. a) Explain the working of a device to measure atmospheric pressure.
b) Define surface tension property of a fluid. If the surface tension at air water interface is 0.073 N/m, what is the pressure difference between inside and outside of an air bubble of diameter 0.01 mm? (7M+8M)
2. a) State momentum equation and discuss its applications
b) Derive the continuity equation from fundamentals. Determine whether the following velocity components satisfy the continuity equation.
i) $u = cx, v = -cy$ ii) $u = -cx/y, v = c \log xy$ (7M+8M)
3. a) Explain the working of a venturi meter with a neat sketch.
b) Two reservoirs with a difference in water surface elevations of 10m are connected by a pipe line ABC which consists of two pipes of AB and BC joined in series. Pipe AB is 10cm in diameter, 20m long and has a value of $f=0.02$. Pipe BC is of 16cm diameter, 25m long and has $f=0.018$. The junctions with the reservoirs and between the pipes are abrupt. Calculate the discharge considering all minor losses. (6M+9M)
4. 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
i) The force exerted on the plate ii) The work done iii) Efficiency of the jet
b) Derive the equation for the impact of jet striking a moving inclined plate in the direction of the jet (8M+7M)
5. a) List the elements of hydro electric power station and explain their functioning. What are the different heads and efficiencies associated with hydroelectric power plants?
b) How do you estimate the power developed from a given catchment area? (10M+5M)
6. a) What is draft tube? What are different types? Why is it a part of reaction turbines?
b) Explain the working of a Francis turbine with a neat sketch. State the equations for work done and efficiency and discuss (7M+8M)
7. a) A hydraulic turbine develops 8000 KW under a head of 30 m at 250 rpm. What is the specific speed of the turbine? What would be the speed and power under a head of 18m.
b) What are the types of similarities between a prototype and a model? (8M+7M)
8. a) Explain the working of a reciprocating pump with a neat sketch. What is the significance of indicator diagram.
b) How many impellers are required in a multistage pump to lift 5000 litres/minute against a head of 200m, at a speed of 800 rpm. The specific speed of the impeller is not to exceed 700. (7M+8M)

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1. a) Explain how pressure is present at a point in a fluid. Write about the working of manometers and bourdon pressure gauges.  
b) A cylindrical shaft of 90mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm and 95 mm internal diameter. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity 2.0 pose, determine the power required to overcome viscous resistance when the shaft is rotated at a speed of 240 rpm. (7M+8M)
2. a) For steady incompressible flow verify whether the following values of u and v are possible.  
(i)  $u = 4xy + y^2$ ,  $v = 6xy + 3x^2$  (ii)  $u = 2x^2 + y^2$ ,  $v = -4xy$   
(iii)  $u = -x/(x^2 + y^2)$ ,  $v = -y/(x^2 + y^2)$   
b) What are different types of fluid flows? What is the use of stream tube concept? (8M+7M)
3. a) Differentiate between major loss and minor losses. List out the minor losses in closed conduit flow and discuss their significance  
b) A 6 cm diameter pipe has a discharge of 450 l/min. At a section the pipe has a sudden expansion to a size of 9 cm diameter. If the pressure just upstream of the expansion is 20 KN/ m<sup>2</sup>, calculate the pressure just after the expansion. Assume the pipe to be horizontal. (8M+7M)
4. a) How do estimate the impact of a jet striking a moving normal plate in the direction of the jet  
b) 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. (7M+8M)
5. a) What are the pumped storage hydro power plants? Define mass curve and write about its use.  
b) What are different heads and efficiencies associated with hydro power plants? (7M+8M)
6. a) Explain the working of a Pelton wheel turbine with neat sketches.  
b) What is a draft tube? What are its types? Explain its use and derive the equation for its efficiency. (7M+8M)
7. a) What is governing of a turbine? Explain about surge tank.  
b) A reaction turbine develops 7000 KW under a head of 45m with a speed of 150 rpm. What is the specific speed of the turbine? What will be the power and speed when the turbine works under a head of 20m. (7M+8M)
8. a) What is indicator diagram of a reciprocating pump? Explain the working of a reciprocating pump with neat sketches.  
b) Determine the number of the impellers required for a multistage centrifugal pump to deliver 3000 litres per minute to a height of 200m at a speed of 800 rpm. The specific speed value is not to exceed 600. (7M+8M)