Code No: R05210202 **Set No. 1**

II B.Tech I Semester Supplimentary Examinations, November 2008
FLUID MECHANICS AND HYDRAULIC MACHINERY
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Why does the viscosity of a gas increases with the increasing temperature while that of liquid decreases with increasing temperature.

   (b) Glycerin has a density of 1260 Kg/m^3 and kinematic viscosity of 0.00183 m^2/sec. What shear stress is required to deform this fluid at a strain rate of $10^4 sec^{-1}$?

   (c) A thin plate is placed between two flat surfaces 'h' cm a part such that the viscosity of liquids on the top and bottom of the plate are μ_1 *and* μ_2 respectively. Determine the position of the thin plate such that the viscous resistance to uniform motion of the thin plate is minimum. Assume ?h? to be very small. - [4+4+8]

2. (a) What do you mean by turbulence ?

   (b) What do you mean by one, two, three dimensional flow?

   (c) Derive the continuity equation for one dimensional fluid flow. [2+6+8]

3. (a) Derive the Darcy-weisbach equation for friction head loss in a pipe.

   (b) Water is flowing through a horizontal pipe line 1500m long and 200mm in diameter. Pressures at the two ends of the pope line are respectively 12Kpa and 2Kpa. If f = 0.015, determine the discharge through the pipe in litres per minute. Consider only frictional loss. [8+8]

4. (a) Derive the expressions for force and work done per second by the jet when it strikes a curved plate moving in the direction of the jet.

   (b) A jet of water 20cm in diameter and moving with a velocity of 20m/sec impinges normally on a series of flat vanes mounted on the periphery of a wheel. If the velocity of the vanes is 8m/sec, determine

      i. the force exerted by the jet on the wheel
      ii. work done by the jet on the wheel per second and
      iii. hydraulic efficiency. [7+9]

5. (a) What are the elements of hydro electric power plants? Describe about water ways and penstocks with neat sketches if necessary.

   (b) The catchment area at a proposed site for a hydropower plant is 200 Km^2 and possible head of water is 140 m. The average annual rainfall is 145 cm and the losses are 16%. How much power can be developed? [8+8]

6. (a) Why is the end of a draft tube immersed below the tail water level. Explain with a neat sketch. Define draft tube efficiency and derive its equation

   (b) A Kaplan turbine has the following details about its draft tube. Find the pressure at inlet of the draft tube.
   Inlet diameter of draft tube = 2m
   Out let diameter of draft tube = 3m
   Velocity of water at outlet = 4.2 m /sec
   Atmosphere pressure = 10.1 m of water
   Height of draft tube above tail race = 3.5m
   Loss of head in draft tube = 0.2 times the velocity head at outlet. [8+8]

7. (a) Define unit power and unit speed and derive the equations for the same. What are their uses ?

   (b) What is a surge tank and what are the uses of it in a hydropower turbine installation ? Explain where and how it is located with the help of a neat sketch. [8+8]

8. (a) What equation is employed to find the work done by the impeller of a centrifugal pump. Derive the equation for work done.

   (b) What are the equations for work done and discharge of a reciprocating pump? Define the slip and coefficient of discharge of a reciprocating pump. [8+8]

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Code No: R05210202 **Set No. 2**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Obtain an expression for capillary rise of a liquid.
   (b) The velocity distribution over a plate is given by V = 1/3 y -y^2 in which v is the velocity in m/sec at adistance y metres obve the plate. Determine the stress at y = 0 and y = 0.1 m. Take $\mu = 0.835 N - s/m^2$ [8+8]

2. A pipeline is 15 cm in diameter and is at an elevation of 100 m at section A. At section B, it is at an elevation of 107.0 m and has a diameter of 30 cm. When a discharge of 50 lit/sec of water is passed through this pipe, the pressure at section A is observed to be 30 KPa. The energy loss in the pipe is 2 m. Calculate the pressure at B when the flow is (i) from A to B, (ii) from B to A. [16]

3. (a) Explain how the following flow problems are analyzed.
      i. Series pipe connection
      ii. Parallel pipe connection
      iii. Equivalent pipe connection.
   (b) Water flows through a 10cm diameter, 30m long pipe at a rate of 1400 rpm. What percent of head would be gained by replacing the central one third length of pipe by another pipe of 20cm diameter. Assume that the changes in section are abreept and f = 0.008 for all pipes. Neglect entrance and exit losses but consider major loss and losses due to sudden contraction and sudden expansion. [9+7]

4. (a) Derive an expression for the force exerted by a jet striking the curved plate at one end tangentially when the plate is symetrical.
   (b) A jet of water 120 mm in diameter and moving with a velocity of 25m/sec strikes normally on a flat plate. Determine the power developed and the efficiency of the system when
      i. the plate is stationary
      ii. the plate is moving with a velocity of 8m/sec in the direction of the jet. And
      iii. the plate is moving with a velocity of 8m/sec towards the jet. [7+9]

5. (a) What is the name of hydroelectric power station that uses the flow of stream as it is available ? How do you compare this with reservoir or storage type of power station ? Explain with neat sketches if necessary.

(b) The hydro power plant has a turbine with the following details. Find the power developed and what is the specific speed of the turbine. Hydraulic efficiency = 90%. Net head =$65m_1$ discharge=$15m^3$/s, speed=100 rpm [8+8]

6. (a) What is the classification of turbines ? How do you differentiate among low head, medium head and high head turbines ?

   (b) A Pelton wheel is working under a head of 45m and the discharge is $0.8m^3/sec$. The mean bucket speed is 14m/sec. Find the power produced if the jet is deflected by the blades through an angle of 165^0. The coefficient of velocity is 0.985 [10+6]

7. (a) What is specific speed of a turbine ? Derive its expression and compare it with unit speed. What are its applications ?

   (b) An Impulse turbine has to maintain the same efficiency under different working conditions. By what percentage shall the discharge increase if the head changes from 50m to 75m. [10+6]

8. (a) What is manometric efficiency of a centrifugal pump? Define with the help of a sketch. Differentiate it from volumetric efficiency and mechanical efficiency.

   (b) A single acting reciprocating pump has a plunger of diameter 0.3m and stroke of length 0.4m. If the speed of the pump is 60 rpm and coefficient of discharge is 0.97, determine the percentage slip and actual discharge of the pump. [8+8]

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Code No: R05210202 **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Distinguish between ideal fluids and real fluids. Explain the importance of compressibility in fluid flow.
   (b) The velocity distribution in a flow of thin film of oil down an inclined channel is given by $u = \frac{\gamma}{2\mu} Sin\alpha * (d^2 - y^2)$. Where d=depth of flow, α = angle of inclination of that channel to the horizontal, u = velocity at a depth 'y' below the free surface, γ = unit weight of oil and ν= dynamic viscosity oil. Calculate the shear stress
      i. on the bottom of channel,
      ii. at mid depth and
      iii. at the free surface. [8+8]

2. (a) State the momentum equation. How will you apply momentum equation for determining the force exerted by a flowing fluid on a pipe bend?
   (b) The top and bottom diameters of a 2.0 m long vertical tapering pipe are 10 cm and 5 cm respectively. Water flows down the pipe at a rate of 30 lit/sec. Find the pressure difference between the two ends of the pipe. [8+8]

3. (a) Derive an expression for head loss due to sudden enlargement of a pipe
   (b) An oil of specific gravity 0.85 and viscosity 5CP flows through a pipe of diameter 400mm at the rate of 50 lit/sec. Find the head lost in friction in this pipe of length 1000Km. Assume that f = $0.079/R_N$ *where* R_N is Reynolds Number. [8+8]

4. (a) What do you mean by impact of jet. Explain
   (b) Derive an expression for force exerted by the jet on a stationary vertical plate.
   (c) A 10cm diameter jet of water exerts a force of 2 KN in the direction of flow against a stationary flat plate which is inclained at an angle of 30^0 with the axis of the stream. Find
      i. Force normal to the plate
      ii. velocity of the jet
      iii. mass flow rate of water Kg/sec. [2+6+8]

5. (a) Define mass curve. Explain how the storage capacity of a reservoir is estimated using a mass curve.
   (b) Differentiate between net head and gross head of a turbine with a neat sketch. List out the efficiencies of a turbine and define them. [8+8]

6. (a) Define a turbine and bring out the differences between reaction turbine and impulse turbine in a tabular form.

   (b) The details of a Pelton wheel turbine installation are given below. Find the power developed and hydraulic efficiency.
   Gross head = 510 m
   Loss of head in penstock = 30%
   Discharge through nozzle = 2.2 m^3 / sec
   Angle of deflection of jet = 165^0
   Coefficient of velocity $C_v = 1$
   Speed ratio K_u= 0.45 [8+8]

7. (a) Define and write about characteristic curves of hydraulic turbines ? With the help of neat sketches explain their practical uses.

   (b) A turbine develops 10000 Kw with an overall efficiency of 90%. The head of water is 90 m and the speed of turbine is 120 rpm. What is the flow rate of water for the turbine ? Find unit power, unit discharge, unit speed and specific speed of the turbine. What is the type of turbine. [8+8]

8. (a) Why does a centrifugal pump get its name ? Explain the working of a centrifugal pump with a neat diagram showing different parts.

   (b) Explain clearly the effect of acceleration of piston on velocity and pressure in suction pipe and delivery pipe. Define slip and coefficient of discharge and write their equations. [6+10]

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Code No: R05210202 **Set No. 4**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) State Newton's equation of viscosity and give examples of its application.
   (b) An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of shaft is 0.5 m and it rotates at 200 rpm. Calculate the horse power lost in the oil for a sleeve length of 100 mm. The thickness of the oil film is 1.0 mm. [8+8]

2. (a) Explain what is meant by stream tube. What is the use of concept of stream tube?
   (b) At a point in the pipe line where diameter is 20 cm, the velocity of water is 4 m/s and the pressure is 343 kN/m^2. At a point 15 cm downstream, the diameter reduces to 10cm. Calculate the pressure at this point, if the pipe is vertical with flow downward. Neglect the losses. [8+8]

3. (a) Define Major Energy Loss and Minor Energy Loss.
   (b) Briefly explain Hydraulic Gradiant Line and Total Energy Line.
   (c) The rate of flow of water through a horizontal pope is $0.3m^3/sec$. The diameter of the pipe is suddenly enlarged fron 25cm to 50cm. The pressure intensity in the smaller pipe is $1.4Kgf/cm^2$. Determine loss of head due to sudden enlargement, pressure intensity in the large pipe and power lost due to enlargement. [4+4+8]

4. (a) Derive the expressions for force and work done per second by the jet when it strikes a flat vertical plate moving in the direction of the jet and away from the jet.
   (b) A jet of water of 75mm diameter strikes a curved vane at its center with a velocity of 20m/sec. The curved vane is moving with a velocity of 8m/sec in the direction of jet. Find the force exerted on the plate in the direction of the jet power and efficiency of the jet. Assume the plate to be smooth. [8+8]

5. (a) List and write elaborately about the elements of Hydroelectric station with neat sketches .
   (b) The head and discharge of a hydro electric plant are 28m and $330m^3/sec$ respectively. The installed turbine works with an efficiency of 86%. Find the power developed. [10+6]

6. (a) How are the turbines classified under different heads ? Give sketches wherever necessary.

(b) A Pelton wheel turbine works with the following details. Determine the water power available at the nozzle and hydraulic efficiency
Net head = 700 m
Speed of runner = 950 rpm
Diameter of runner = 1.2 m
Discharge through the nozzle = 0.15 m^3/ sec
Side clearance angle = 150
Coefficient of velocity C_v = 0.9
Blade friction coefficient K = 1 [8+8]

7. (a) What is meant by cavitation ? What is Thoma,s cavitation factor and what is its significance for turbines ? Elaborate what you understand by water hammer phenomenon in turbines.

   (b) A turbine works under a head of 25m at 200 rpm and the discharge is $9m^3$ / sec. If the overall efficiency is 90%, determine Power generated, Specific speed of the turbine and Type of turbines. [10+6]

8. (a) What is manometric efficiency of a centrifugal pump? Define with the help of a sketch. Differentiate it from volumetric efficiency and mechanical efficiency.

   (b) A single acting reciprocating pump has a plunger of diameter 0.3m and stroke of length 0.4m. If the speed of the pump is 60 rpm and coefficient of discharge is 0.97, determine the percentage slip and actual discharge of the pump. [8+8]

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