Code No: R050210201 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2006
FLUID MECHANICS & 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) Define surface tension. Discuss the factors affecting surface tension.
   (b) A piston 9.95 cm diameter works in a cylinder 10 cm diameter, 12 cm long. The space between the two is filled with a lubricating oil of viscosity 0.65 poise. Calculate the speed of the piston through the cylinder under the action of an axial force of 5.0 N. [8+8]

2. (a) Distinguish between:
      i. Steady and Un-steady flow.
      ii. Uniform and Non-uniform flow.
      iii. Compressible and incompressible flow.
   (b) A 400 m long pipe has a slope of 1 in 100 and tapers from 1.2 m dia at high end to 0.6 m dia at the low end. The discharge is 100 lit/sec. If the pressure at high end is 100 kN/m^2, find the pressure at the low end. Neglect friction. [8+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 do you understand by pumped storage type of power station ? What are its merits and demerits when compared with other types ? Use sketches if necessary.
   (b) The gross head and discharge of a hydro electric plant are 40m and 200 m^3 / sec respectively. The losses in Penstock are 12%. If the turbine works with an efficiency of 92%, what will be the power developed. [10+6]

6. (a) How can the turbines be classified based on their specific speeds ? Bring out the differences between reaction turbines and impulse turbines.

   (b) A Pelton wheel has a mean bucket speed of 12m /sec and is supplied with water at a rate of 750 liters per second under a head of 35m. If the bucket deflects the jet through an angle of 1600, find the power developed by the turbine and its hydraulic efficiency. Take the coefficient of velocity as 0.98. Neglect the friction in the bucket. [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) Write a detailed account about the classification of pumps. Explain the working of a centrifugal pump with a neat diagram and showing all the components.

   (b) Prove that the work done by a single acting reciprocating pump is given by $P = wALN(h_s+h_d)/60$. Define slip and write its equation. [8+8]

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Code No: R050210201 **Set No. 2**

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

Answer any FIVE Questions
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1. (a) State the Newtons law of viscosity and give examples of its applications?
   (b) U gives the Velocity distribution near the solid wall at a section in laminar flow = 5 Sin(5πY)forY ≤ 0 . Compute the shear stress at a section (i) Y=0, (ii)Y=0.05m and (iii) Y=0.1m.The dynamic viscosity of fluid is 5 poise.[8+8]

2. (a) Derive the equation of continuity for one dimensional flow of an incompressible fluid.
   (b) Explain the terms:
      i. Path line
      ii. Stream line
      iii. Streak line. [8+8]

3. (a) What do you mean by compound pipe and pipes in parallel connection. What purpose is served by using pipes in parallel connection.
   (b) What do you mean by equivalent pipe.
   (c) Water flows through a pipe at the rate of $1.1m^3/sec$. For certain length of the pipe, the diameter is 200mm and for remaining length of the pipe diameter is 400mm. Pressure of water at the larger diameter part is 1Mpa. Determine head lost due to sudden enlargement of cross sectional area and the pressure of water in the smaller diameter part of the pipe. [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) What are the types of hydroelectric power plants ? Describe elaborately about pumped storage plants.
   (b) The following details pertain to a hydropower plant. What is power developed in Kw.Available head = 130 m, Catchment area = $220Km^2$,Annual average rainfall = 150 cmPercolation and evaporation losses = 18% , Turbine efficiency = 86%,Generator efficiency = 91% [8+8]

6. (a) Explain why a Pelton wheel turbine is called an Impulse turbine with a neat sketch. Define draft tube and what are its functions.

   (b) A Pelton wheel turbine develops 9000 Kw under a head of 300m. The turbine speed is 550 rpm and ratio of jet dia to wheel dia is 1/10. The hydraulic, volumetric and mechanical efficiencies are 0.98, 0.95 and 0.92 respectively. The speed ratio is 0.46 and coefficient of velocity is 0.98. Calculate the no of jets to be provided. [8+8]

7. (a) Explain the terms specific speed and unit speed as applied to hydraulic turbines. Deduce their expressions. What are their practical uses.

   (b) A Francis turbine operates at 163.5 rpm, under 54m head and develops 19900 Kw at an efficiency of 87%.Find the characteristics if this turbine is operated under 60m head. [8+8]

8. (a) How can head added to the water be increased in centrifugal pumps ? Explain with neat sketch.. What is NPSH and what are its uses.

   (b) A single acting reciprocating pump having a bore of 150mm and a stroke of 300 mm is raising water to height of 20m above the sump level. The pump has an actual discharge of 0.0052 m^3/sec. The efficiency of the pump is 70%. If the speed of the pump is 60 rpm, determine

      i. Theoretical discharge
      ii. Theoretical power
      iii. Actual power and
      iv. Percentage slip. [8+8]

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Code No: R050210201 **Set No. 3**

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(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
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1. (a) State Newtons 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) Write three important basic equations of fluid flow. Explain them.
   (b) What are the different types of fluid flow? Explain. [8+8]

3. (a) Describe the principle and working of orifice meter with the help of a neat sketch.
   (b) In a calibration test of an orifice meter of with orifice diameter 4cm is inserted in a pipe of 10cm diameter the mercury differential U-guage connected to the meter gives a reading of 38cm when 7.5 lit/sec of water flows through the meter. Compute the coefficient of discharge. [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) Write what you understand by hydroelectric power station? What are its types ? Discuss the type where water is recycled.
   (b) What power can be developed at a hydropower plant site given the following details.Drainage area = 600 Km^2
   Uniform rainfall over drainage area = 200 cm.
   Water loss in run off = 15 cm
   Expected net head at the plant = 50m.
   Efficiency of turbine = 98%
   - [8+8]

6. (a) Differentiate among radial flow, axial flow and mixed flow turbines with neat sketches. Give examples of each type.

   (b) Define and explain the following associated with working of turbines. Draw neat sketches

   i. Stay ring
   ii. Guide vane wheel
   iii. Hub
   iv. Nozzle and spear
   v. Casing [6+10]

7. (a) What do you mean by selection of turbines ? What are scale ratios ? Explain with neat sketches when geometric similarity is achieved between model and prototype?

   (b) A Pelton wheel turbine develops a power of 1000 Kw under a head of 75m. If the head becomes 25m, what will be the power developed by the turbine.
   - [10+6]

8. (a) Explain the following of a reciprocating pump with neat sketches

   i. Suction stroke
   ii. Delivery stroke
   iii. Air vessel
   iv. Slip

   (b) What is the suction lift of a reciprocating pump if the following details are available ?
   Stroke length = 40 cm
   Piston diameter = 20 cm
   Suction pipe diameter = 10 cm
   Length of suction pipe = 5m
   Speed of the pump = 30 rpm
   Atmospheric pressure = 10 m of water (absolute)
   Vapour pressure of water = 2.5 m of water (absolute) [8+8]

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Code No: R050210201 **Set No. 4**

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(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
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1. (a) State Newtons 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) Under what conditions a stream line coincides with a streak line.
   (b) Flow of water in a river during floods varies with time. How is the flow described?
   (c) Water flows through a horizontal conical pipe, with diameter at the larger end as 1.3 m and that at the smaller end as 0.70 m. the pressure head at the smaller head is 5 m of water, and the discharge is 3.5 m3 /sec. Calculate the velocities at the two ends and the pressure head at the larger end. Neglect losses. [4+4+8]

3. (a) What do you mean by compound pipe and pipes in parallel connection. What purpose is served by using pipes in parallel connection.
   (b) What do you mean by equivalent pipe.
   (c) Water flows through a pipe at the rate of $1.1 m^3/sec$. For certain length of the pipe, the diameter is 200mm and for remaining length of the pipe diameter is 400mm. Pressure of water at the larger diameter part is 1Mpa. Determine head lost due to sudden enlargement of cross sectional area and the pressure of water in the smaller diameter part of the pipe. [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) 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) Why is the end of a reaction turbine always kept below the tail water when compared with an impulse turbine ? Compare the functions of casings of impulse turbine and reaction turbine.

(b) A reaction turbine is 2m above the tail water level and works under a head of 25 m. The draft tube records a vacuum gauge reading of 5.3 m of water and its inlet diameter is 2.2 m. The efficiency of the draft tube is 80%. What is the power developed by the turbine with an efficiency of 90%. [8+8]

7. (a) Explain unit speed, unit discharge and unit power of a hydraulic turbine. Derive expressions for each of them.

(b) A turbine develops 7355 Kw under a head of 24.7m at 210 rpm. What is its specific speed? If this turbine is tested in the laboratory where the head available is only 7.5m, what power will it develop and at what speed ? [8+8]

8. (a) What does an indicator diagram of a reciprocating pump represent ? Show different parts of indicator diagram with a neat sketch and explain.

(b) The following details refer to working of a reciprocating pump. What is the maximum speed of the pump without cavitation.Diameter of the piston = 20 cm
Radius of crank = 40 cm
Water delivery lift = 40 m
Diameter of delivery pipe = 10 cm
Length of delivery pipe = 45 m
Water vapour pressure = 2.75 m (absolute)
Atmosphere pressure = 9.75 m (absolute) [8+8]

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