Code No: 09A52401 | R09 | SET-1

B. Tech III Year I Semester Examinations, December-2011
MECHANICS OF FLUIDS AND HYDRAULIC MACHINES
(AUTOMIBILE ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) State and explain Newton's law of viscosity with a neat sketch and give examples of its application.
b) In a stream of glycerine in motion, at a certain point, the velocity gradient is 0.25 metre per sec per metre. The mass density of fluid is 1268.4 kg per cubic metre and kinematic viscosity is 6.30×10^{-4} square metre per second. Calculate the shear stress at the point. [7+8]

2.a) Define stream line, path line and streak line. Derive mathematical expressions for each of these lines.
b) A 75 cm diameter uniform pipe bend turns the directions of flow of gasoline of Sp.gr. 0.79 through an angle of 120° in the horizontal plane. The constant pressure and velocity through the bend are 90 KPa and 3 m/s respectively. Find the magnitude and direction of the force to be exerted on the bend to achieve the directional change. [7+8]

3.a) Derive an expression for the loss of head due to friction in pipes.
b) The water is flowing through a pipe of diameter 30 cm. The pipe is inclined and a venturimeter is inserted in the pipe. The diameter of venturimeter at throat is 15 cm. The difference of pressure between the inlet and throat of the venturimeter is measured by a liquid of specific gravity 0.8 in an inverted U-tube which gives a reading of 40 cm. The loss of head between the inlet and throat is 0.3 times the kinetic head of the pipe. Find the discharge. [7+8]

4.a) Show that when a jet of water impinges on a series of curved vanes, maximum efficiency is obtained when the vane is semi-circular in section and the velocity of a vane is half that of jet.
b) A 7.5 cm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45^0 to the axis of the jet. Find the normal force exerted on the plate.
i) When plate is stationary
ii) When plate is moving with a velocity of 15 m/s in the direction of jet away from the jet. Also determine the power and efficiency of system when the plate is moving. [7+8]

5.a) Distinguish between
i) Base load power plant and a Peak load power plant
ii) Firm power and Secondary power.

b) A run-off- river plant is installed on a river having a minimum flow of $11 m^3/sec$. If the plant is used as a peak load plant operating only for 5 hours a day, determine the firm capacity of the plant (a) without pondage (b) with pondage but allowing 10% of the water to be lost in evaporation and other losses. Head at the plant is 16m and the plant efficiency may be assumed as 75%. [7+8]

6.a) Compare and contrast impulse and reaction turbines.

b) The following data refers to a Pelton wheel installation: net head = 250 m, speed ratio = 0.45, nozzle coefficient = 0.98, jet ratio = 18, overall efficiency = 76%, frequency of generation = 50 Hz and pairs of poles of alternator = 6. Compute the wheel diameter, jet diameter and the power output in KW. [7+8]

7.a) Derive expressions for the following unit quantities of a hydraulic turbine:
i) unit speed, ii) unit discharge and iii) unit power.

b) A prototype Kaplan turbine develops 7500 KW under a head of 10 m. The speed is 100 rpm. The head on a 1:10 reduced scale model is 4 m. Assuming the same efficiency of 85% for both model and prototype, find Q, P, N and N_s of the model. [7+8]

8.a) Draw the following characteristic curves for a centrifugal pump.
Head, Power and Efficiency versus discharge with constant speed.

b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1200 r.p.m. works against a total head of 75m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle of 30^0 at outlet. If the outer diameter of the impeller is 600 mm and width at outlet is 50 mm, determine:
a) Vane angle at inlet,
b) Work done per second by impeller,
c) Manometric efficiency. [7+8]

--ooOoo--

Code No: 09A52401	R09	SET-2

B. Tech III Year I Semester Examinations, December-2011
MECHANICS OF FLUIDS AND HYDRAULIC MACHINES
(AUTOMIBILE ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Explain briefly the working principle of Bourdon Pressure Gauge with a neat sketch.

b) A simple manometer (U-tube) containing mercury is connected to a pipe in which an oil of sp.gr.0.8 is flowing. The pressure in the pipe is vacuum. The other end of the manometer is open to the atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 20 cm and height of oil in the left limb from the centre of the pipe is 15 cm below. [7+8]

2.a) Derive Bernoulli's equation for the flow of an incompressible frictionless fluid from consideration of momentum.

b) A 45° reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 40 cm and 20 cm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet of bend is 21.58 N/cm^2. The rate of flow of water is 500 litres/s. [7+8]

3.a) What do you understand by pipes in series, pipes in parallel and equivalent pipe. Explain with neat sketches.

b) A venturimeter is used for measurement of discharge of water in horizontal pipe line. If the ratio of upstream pipe diameter to that of throat is 2 : 1, upstream diameter is 300 mm, the difference in pressure between the throat and upstream is equal to 3 m head of water and loss of head through meter is one-eighth of the throat velocity head, calculate the discharge in the pipe. [7+8]

4.a) Derive an expression for the force exerted by a jet of water on an inclined fixed plate in the direction of the jet.

b) A jet of water of diameter 50mm moving with a velocity of 20m/sec strikes a fixed plate in such a way that the angle between the jet and the plate is 60^0. Find the force exerted by the jet on the plate.
i) In the direction normal to the plate
ii) In the direction of the jet. [7+8]

5.a) Distinguish between
i) Gross head and effective head
ii) Installed capacity and dependable capacity
iii) Utilization factor and capacity factor.

b) A hydropower plant is having an installed capacity of 30 000 KW. The annual output of the plant is 160 x 10^6KW- hr. The Peak load is 24000 KW. Determine
a) Annual load factor
b) Plant use factor and
c) Capacity factor. [7+8]

6.a) What are the uses of a draft tube. Describe with neat sketches, different types of draft tubes.

b) A Kaplan turbine working under a head of 15 m develops 7357.5 kW shaft power. The outer diameter of the runner is 4 m and hub diameter 2 m. The guide blade angle at the extreme edge of the runner is 30°. The hydraulic and overall efficiencies of the turbine are 90% and 85% respectively. If the velocity of whirl is zero at outlet, determine:
i) Runner vane angles at inlet and outlet at the extreme edge of the runner and
ii) Speed of the turbine. [7+8]

7.a) What are the requirements of a good turbine governor. Explain with a sketch, the governing mechanism of a reaction turbine.

b) A 1:4 reduced scale model of a hydraulic turbine is tested under a head of 2 m. It develops a power of 4.4 KW and runs at 500 rpm. What is the power generated by the prototype when it works under a head of 10 m. [7+8]

8.a) How will you obtain an expression for the minimum speed for starting a centrifugal pump.

b) A three-stage centrifugal pump has impeller 40 cm in diameter and 2.5 cm wide at outlet. The vanes are curved back at the outlet at 30^0 and reduce the circumferential area by 15%. The manometric efficiency is 85% and overall efficiency is 75%. Determine the head generated by the pump when running at 12000 r.p.m. and discharge is 0.06 m^3/s. Find the shaft power also. [7+8]

--ooOoo--

Code No: 09A52401 | R09 | SET-3

B. Tech III Year I Semester Examinations, December-2011
MECHANICS OF FLUIDS AND HYDRAULIC MACHINES
(AUTOMIBILE ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Distinguish between manometers and mechanical gauges. What are the different types of mechanical pressure gauges?

b) A simple manometer is used to measure the pressure of oil (sp.gr.= 0.8) flowing in a pipe line. It's right limb is open to the atmosphere and left limb is connected to the pipe. The centre of the pipe is 9 cm below the level of mercury (sp.gr.13.6) in the right limb. If the difference of mercury level in the two limbs is 15 cm, determine the absolute pressure of the oil in the pipe in N/cm^2. [7+8]

2.a) Define the equation of continuity. Obtain an expression for continuity equation for a one dimensional flow.

b) Water is flowing through a pipe having diameters 30 cm and 15 cm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 29.43 N/cm^2 and the pressure at the upper end is 14.715 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 50 lit/s. [7+8]

3.a) What do you understand by the terms : major energy loss and minor energy losses in pipes.

b) Find the velocity of flow of an oil through a pipe, when the difference of mercury level in a differential U-tube manometer connected to the two tappings of the Pitot-tube is 15 cm. Take specific gravity of oil = 0.8 and co-efficient of Pitot-tube as 0.98. [7+8]

4.a) Derive an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet.

b) A jet of water moving at 12 m/s impinges on a concave shaped vane to deflect the jet through 120^0 when stationary. The vane is moving at 5m/s. Find:
i) The angle of jet so that there is no shock at inlet.
ii) The absolute velocity of the jet at exit both in magnitude and direction and
iii) The work done per second per N of water.
Assume that vane is smooth. [7+8]

5.a) Enumerate the principal components of a hydroelectric scheme along with their locations and purposes.

b) Explain in detail, how do you assess the water potential of a hydroelectric scheme. [7+8]

6.a) What are the uses of a draft tube. Describe with neat sketches, different types of draft tubes.

b) A Kaplan turbine working under a head of 15 m develops 7357.5 kW shaft power. The outer diameter of the runner is 4 m and hub diameter 2 m. The guide blade angle at the extreme edge of the runner is 30°. The hydraulic and overall efficiencies of the turbine are 90% and 85% respectively. If the velocity of whirl is zero at outlet, determine: (i) runner vane angles at inlet and outlet at the extreme edge of the runner and (ii) speed of the turbine. [7+8]

7.a) What are the requirements of a good surge tank so that the efficiency of hydropower installation is maximum.

b) How is the Kaplan turbine governed? Explain with a neat diagram. [7+8]

8.a) What is priming. Why is it necessary? Explain in detail.

b) A centrifugal pump discharges 1200 lit/minute against a head of 16.5m when the speed is 1500 rpm. The diameter of the impeller is 35 cm and the power required is 6 h.p. A geometrically similar pump of 45 cm is to run at 1750 rpm. Assuming equal efficiencies, find.

i) The head developed
ii) The discharge
iii) Power developed by 45 cm pump. [7+8]

--ooOoo--

Code No: 09A52401 | R09 | SET-4

B. Tech III Year I Semester Examinations, December-2011
MECHANICS OF FLUIDS AND HYDRAULIC MACHINES
(AUTOMIBILE ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Distinguish between (a) dilatant and pseudo-plastic, (b) thixotropic and rheopectic fluids and (c) dynamic and kinematic viscosities.

b) A thin flat plate of size 60 cm X 60 cm moves centrally between two large stationary boundaries. The plane of the plate is parallel to the two boundaries which are 7 cm apart. The space between the plate and one boundary is filled with a fluid of viscosity twice that of another fluid which fills the space on the other side of the plate. If the plate moves with a uniform speed of 20 cm/s by the application of a force of 6 N parallel to the plane of the plate, determine the fluid viscosities. [7+8]

2.a) Define the following and give one practical example for each:
i) Laminar flow, ii) Turbulent flow,
iii) Steady flow, and iv) Uniform flow.

b) The water is flowing through a pipe having diameters 20 cm and 15 cm at sections 1 and 2 respectively. The rate of flow through pipe is 40 litres/s. The section 1 is 6 m above datum line and section 2 is 3 m above the datum. If the pressure at section 1 is 29.43 N/cm^2, find the intensity of pressure at section 2. [7+8]

3.a) Obtain expression for head loss in a sudden expansion in the pipe. List all the assumptions made in the derivation.

b) A liquid of specific gravity 0.8 is flowing upwards at the rate of 0.08 m^3/s, through a vertical venturimeter with an inlet diameter of 200 mm and throat diameter of 100 mm. The C_d = 0.98 and the vertical distance between pressure tappings is 300 mm. Find the difference in readings of the two pressure gauges, which are connected to the two pressure tappings, and the difference in the level of the mercury columns of the differential manometer which is connected to the tappings, in place of pressure gauges. [7+8]

4.a) Derive an expression for the force exerted by a jet of water on a moving inclined plate in the direction of the jet.

b) A jet of water of 60 mm diameter strikes a curved vane at its center with a velocity of 18 m/s. The curved vane is moving with a velocity of 6 m/s in the direction of the jet. The jet is deflected through an angle of 165^0. Assuming the plate to be smooth find:
i. Thrust on the plate in the direction of jet
ii. Power of the jet and
iii. Efficiency of the jet. [7+8]

5.a) What are power canals. How these are different from irrigations canals.

b) What are the main points of difference between a differential surge tank and a compound surge tank? Discuss the relative advantages of a compound surge tank. [7+8]

6.a) How will you classify the turbines. Explain in detail.

b) A Pelton wheel is to be designed for the following specifications.
Power = 735.75 kW S.P, Head = 200 m, Speed = 800 r.p.m., $\eta_{\circ}$ = 0.86 and jet diameter is not to exceed one-tenth the wheel diameter.
Determine: (i) Wheel diameter, (ii) The number of jets required, and (iii) Diameter of the jet. Take C_v = 0.98 and speed ratio = 0.45. [7+8]

7.a) What do you understand by specific speed of a turbine. What is its use?

b) What is the necessity of governing the turbines?

c) How do you say that geometrically similar velocity triangles assure kinematic similarity? [15]

8.a) What is the difference between single-stage and multistage pumps. Describe multistage pump with (a) impellers in parallel and (b) impellers in series.

b) Find the number of pumps required to take water from a deep well under a total head of 156 m. Also the pumps are identical and are running at 1000 r.p.m. The specific speed of each pump is given as 20 while the rated capacity of each pump is 150 litre/s. [7+8]

--ooOoo--