Group - C (Answer any two) [14x2=28]

8. (a) Discuss the working principle of a centrifugal pump. (2+4+8=14)

   (b) What is the function of volute casing of a centrifugal pump? Differentiate between volute casing and vortex casing with a neat sketch for the centrifugal pump.

   (c) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vane angle at outlet is 40°. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine:
   (i) Vane angle at inlet, (ii) Work done by impeller on water per second, and
   (iii) Manometric efficiency.

9. (a) A centrifugal pump whose specific speed is 31 can delivers water against a head of 35 m. The atmospheric pressure head is 10.3 m of water and vapour pressure head is o.303 m water of water. The head loss in suction pipe is 2.5 kPa (abs). Determine (i) minimum net positive suction head and (ii) maximum allowable height of the pump from free surface of water in the sump; (8+6=14)

   (b) A centrifugal pump discharges water at the rate of 0.167 m^3/s at 200 rpm under a head of 100 m. It consumes 300 kW power. A 1:4 scale model is to run at 150 rpm. Find the power consumed by the model.

10. (a) Describe the principle and working of a reciprocating pump with a neat sketch. (4+4+6=14)

    (b) What is an air vessel? Describe with neat sketch the function of the air vessel for reciprocating pumps.

    (c) The water is supplied at a pressure of 15 N/cm^2 to an accumulator, having a ram of diameter 1.5 m . If the total lift of the ram is 8 m, determine:
    (i) The capacity of the accumulator, (ii) Total weight placed on the ram.

11. (a) Draw a neat sketch and explain the principle and working of a hydraulic press. (4+4+6=14)

    (b) A hydraulic press has a ram of 250 mm diameter and a plunger of 30 mm diameter. It is used for lifting a weight of 3 kN. Find the force required at the plunger.

    (c) A single-acting reciprocating pump running at 30 rpm, delivers 0.012 m^3/sec of water. The diameter of the piston is 30 cm and stroke length is 50 cm. Determine: (i) The theoretical discharge of the pump, (ii) Co-efficient of discharge, and (iii) percentage of slip of the pump.

Ex/Prod/T/224/2018

JADAVPUR UNIVERSITY

Bachelor in Production Engineering Examination - 2018

2nd Year – 2nd Semester

Fluid Machines

Time : 3 Hours Full Marks : 100

*Answer **Group – A (Compulsory), any three** from **Group – B** and **any two** from **Group – C*** *(30+42+28=100)*

Group – A (Compulsory) [(10x1)+(5x4)=30]

1. Select the most appropriate statement from the multiple answers:

   (i) Cavitation will take place if the pressure of the flowing fluid at any point is
   (a) More than the vapour pressure of the fluid.
   (b) Equal to the vapour pressure of the fluid.
   (c) Less than the vapour pressure of the fluid.

   (ii) A turbine is a device which converts
   (a) Hydraulic energy into mechanical energy
   (b) Mechanical energy into hydraulic energy
   (c) Electrical energy into mechanical energy

   (iii) Main characteristic curves of a turbine means
   (a) Curves at constant speed.
   (b) Curves at constant efficiency.
   (c) Curves at constant head.
   (d) None of the above

   (iv) An impulse turbine
   (a) Is most suited to low head installation
   (b) Makes use of a draft tube
   (c) Converts pressure head into velocity head throughout the vanes
   (d) Operated by initial conversion to kinetic energy
   (e) Is high specific speed turbine

   (v) Kaplan turbine is
   (a) An impulse turbine, (b) A radial flow impulse turbine, (c) An axial flow reaction turbine, (d) A radial flow reaction turbine

   (vi) The relation between hydraulic efficiency (η_h), mechanical efficiency (η_m) and overall efficiency (η_o) is
   (a) $\eta_h = \eta_o \times \eta_m$
   (b) $\eta_o = \eta_h \times \eta_m$
   (c) $\eta_m = \eta_o \times \eta_h$

(vii) To produce a high discharge by multistage centrifugal pumps, the impellers are connected in
  (a) parallel
  (b) series
  (c) parallel and series both

(viii) Efficiency of a Pelton wheel will be maximum when the velocity of wheel is
  (a) Equal to the velocity of jet of water at inlet.
  (b) Half the velocity of jet of water at inlet.
  (c) Twice the velocity of jet of water at inlet.
  (d) None of the above

(ix) The overall efficiency of a turbine is the ratio of
  (a) Power at the inlet of turbine to the power at the shaft
  (b) Power at the shaft to the power given to the runner
  (c) Power at the shaft to the power at the inlet of turbine
  (d) None of the above

(x) A shaft transmits 147.2 kW at 600 rpm. Find the torque in kN.

2. Define the following terms: (5x4=20)
  (i) Muschel Curves of a centrifugal pump.
  (ii) (a) Specific speed of a pump
    (b) Priming
  (iii) Derivation of Euler's equation in relation to fluid machine
  (iv) Hydraulic accumulator
  (v) Air lift pump

Group - B (Answer any three) [14x3=42]

3. (a) Differentiate between Turbine and Pump. (2+4+8=14)

(b) Draw a neat sketch of a Pelton Turbine by showing the main parts.

(c) A Pelton wheel has a mean bucket speed of 15 m/s with a jet of water flowing at the rate of 680 lit/s under a head of 30 m. The bucket deflect the jet through an angle of 165°.
Calculate: (i) Power given by water to the runner,
(ii) Efficiency of the turbine.

4. (a) Differentiate between the Kaplan turbine and Francis turbine.

(b) Draw a neat sketch of a Francis Turbine by showing the main parts. (2+4+8=14)

(c) A Francis turbine is required to produce 150 kW power with overall efficiency 75%. It is working under a head of 7.5 m with a peripheral velocity of 3.15 m/s and radial velocity of flow of 11.6 m/s. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Determine : (i) Guide blade angle,
(ii) Runner vane angle at inlet,
(iii) Diameter of the wheel at inlet, and
(iv) Width of the wheel at inlet.

5. (a) Explain the difference between Kaplan turbine and Propeller turbine.

(b) Draw a neat sketch of a Kaplan Turbine by showing the main parts. (2+4+8=14)

(c) A Kaplan turbine working under a head of 20 m develops 12000 kW shaft power. The outer diameter of the runner is 3.5 m and hub diameter is 1.75 m. The guide blade angle at the extreme end of the runner is 35°, η_h =88% and η_o = 84%. Determine: (i) Runner vane angles,
(ii) Turbine speed.

6. (a) Why draft tube is used in a reaction turbine? (2+4+8=14)

(b) Define cavitation. How will you determine the possibility of the cavitation to occur in the installation of a turbine or a pump?

(c) A water turbine has a velocity of 10 m/s at the entrance to the draft-tube and a velocity of 2.5 m/s at the exit. For friction losses of 0.15 m of water and a tail water 3 m below the entrance to the draft-tube. Find the pressure head at the entrance section of the draft-tube.

7. (a) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 cumec. If the efficiency is 90%, determine the performance of the turbine under a head of 20 m. (8+6=14)

(b) A reaction turbine discharges 35 m^3/s under a head of 9 m and with an overall efficiency of 91%. Find the power developed in kW.