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

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

   (b) Sketch a centrifugal pump by showing the main parts.

   (c) The internal and external diameter of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angles of the impeller at inlet and outlet are 20° and 30°respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water.

9. (a) The diameters of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. Determine the minimum starting speed of the pump if it works against a head of 30 m. (6+8=14)

   (b) A single-stage centrifugal pump with impeller diameter of 30 cm rotates at 2000 rpm and lifts 3 $m^3$ of water per second to a height of 30 m with an efficiency of 75% . Find (i) the number of stages and (ii) diameter of each impeller of a similar multistage pump to lift 5 $m^3$ of water per second to height of 200 metres when rotating at 1500 rpm.

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

    (b) The water is supplied at a pressure of 14 $N/cm^2$ 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, and
    (ii) Total weight placed on the ram.

    (c) A centrifugal pump is to discharge 0.118 $m^3/s$ at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and the vane angle at the outer periphery of the impeller is 30°. Determine the work done by the impeller per unit weight of water.

11. (a) Draw a neat sketch and explain the principle and working of a hydraulic press.

    (b) A hydraulic press has a ram of 200 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. (4+4+6=14)

    (c) A single-acting reciprocating pump running at 30 rpm, delivers 0.012 $m^3/sec$ of water. The diameter of the piston is 25 cm and stroke length is 50 cm. Determine: (i) The theoretical discharge of the pump,
    (ii) Co-efficient of discharge, and
    (iii) Slip and percentage of slip of the pump.

Ex/Prod/T/224/2

# JADAVPUR UNIVERSITY

## Bachelor in Production Engineering Examination - 2017

## 2nd Year – 2nd Semester

## Fluid Machines

Time : 3 Hours Full Marks : 10

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

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

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

   (i) A turbine is called reaction turbine if at the inlet of the turbine
   (a) Total energy is only kinetic energy
   (b) Total energy is only pressure energy
   (c) Total energy is the sum of kinetic energy and pressure energy

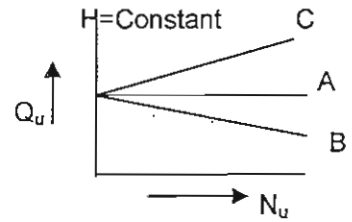
   (ii) A turbine is called impulse turbine if at the inlet of the turbine
   (a) Total energy is only kinetic energy
   (b) Total energy is only pressure energy
   (c) Total energy is the sum of kinetic energy and pressure energy

   (iii) Unit speed is the speed of a turbine when it is working
   (a) Under unit head and develops unit power
   (b) Under unit head and discharge one $m^3/sec$
   (c) Under unit head

   (iv) Governing of a turbine means
   (a) The head is kept constant under all condition of working
   (b) The speed is kept constant under all condition of working
   (c) The discharge is kept constant under all condition of working

   (v) If the head on the turbine is more than 300 m, the type of turbine
   (a) Pelton, (b) Francis, (c) Kaplan, (d) None of the above

   (vi) The unit discharge($Q_u$ ) and unit speed ($N_u$) curves for different turbi are shown in figure, curve A is for
   (a) Pelton
   (b) Francis
   (c) Kaplan
   (d) Propeller



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

viii) Air vessel in a reciprocating pump is used
(a) To obtain a continuous supply of water at uniform rate
(b) To reduce suction head
(c) To increase the delivery head
(d) None of the above

ix) Kaplan turbine is a propeller turbine in which the vanes fixed on the hub are
(a) Non-adjustable
(b) Adjustable
(c) Fixed
(d) None of the above

x) 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

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

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

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

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

) Design a Pelton wheel for a head of 80 m when running at 300 rpm. The Pelton wheel develops 103 kW shaft power. The velocity of the buckets is 0.45 times the velocity of the jet. Overall efficiency is 85% and coefficient of velocity is 0.98.



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 148.25 kW power with overall efficiency 75%. It is working under a head of 7.62 m with a peripheral velocity of 3.179 m/s and radial velocity of flow of 11.738 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 11772 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°, $\eta_h$ =88% and $\eta_o$ = 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 conical draft-tube having diameter at the top as 2.0 m and pressure head at 7 m of water(vacuum), discharges water at the outlet with a velocity of 1.2 m/s at the rate of 25 $m^3$/s. If atmospheric pressure head is 10.3 m of water and losses between the inlet and outlet of the draft-tube are negligible, Find the length of draft-tube immersed in water. Total length of tube is 5 m.

7. (a) A Pelton wheel is revolving at a speed of 190 rpm and develops 5150 kW when working under a head of 220 m with an overall efficiency of 80%. Determine the speed, discharge and power when this turbine is working under a head of 140 m. (6+8=14)

(b) 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:
(i) Power generated,
(ii) Specific speed of the machine, and
(iii) Type of turbine.

[Turn Over]