

Total No. of Questions : 12]

SEAT No. :

P2937**[5058]-17**

[Total No. of Pages : 4]

T.E. (Mech. / Mech. S/W)**TURBO MACHINES****(2008 Course) (Semester - II) (302049)***Time : 3 Hours]**[Max. Marks : 100**Instructions to the candidates:*

- 1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 of Section I and Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12 of Section II.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of electronic pocket calculator is allowed.*
- 6) *Assume suitable data if necessary.*

SECTION - I

- Q1) a)** A jet of water having a velocity 40 m/s impinges without shock on a series of vanes moving at 12 m/s. The jet is making an angle of 20° with the direction of motion of the vane. Relative velocity at outlet is 0.9 times the relative velocity at the inlet and absolute velocity of water at the exit is normal to the direction of motion of the vane. **[12]**

Find:

- i) Vane angles at inlet and outlet
 - ii) Work done on the vane per kg of water
 - iii) Efficiency
- b) Sketch a Pelton wheel bucket and explain the effect of its size, shape and number on its function. **[6]**

OR

- Q2) a)** Show that when a jet of water impinges on a series of curved vanes, maximum efficiency is obtained when the vane is semicircular in section and the velocity of the vane is half of that at the jet. **[8]**
- b) Pelton wheel works under a head of 300 m and is supplied with water at the rate of 200 liters/second. If the bucket deflects jet through an angle of 165° , find the power and efficiency of the turbine. Assume suitable data. **[10]**

P.T.O.

- Q3) a)** State the purpose of draft tube and sketch some typical draft tubes. Also show that pressure at the runner exit drops below atmospheric pressure, if the draft tube is of diverging section and suction head H_s is positive. [6]
- b)** A propeller turbine runner has an outer diameter of 5 m and inner diameter of 2.2 m and develops 25 MW, when running at 150 rpm under a head of 20 m. Hydraulic efficiency is 95% and overall efficiency is 85%. Find the discharge through the runner, the guide blade angle at inlet and runner outlet angle. Assume zero whirl at the runner exit. [10]

OR

- Q4) a)** Explain difference between propeller turbine and Kaplan turbine. [4]
- b)** Design a Francis turbine runner with the following data. Net head = 68 m, speed 750 rpm, Power output = 300 kW, Hydraulic efficiency 94%, Overall efficiency = 85%, flow ratio = 0.15 Ratio of breadth to diameter 0.1, inner diameter of runner is 1/2 of the outer diameter of the runner, 6% of the circumferential area of the runner is occupied by the thickness of the vanes. Assume the velocity of flow remains constant and the flow is radial at exit. [12]

- Q5) a)** Define the following terms for a turbine: [6]
- Carry over coefficient
 - Stage efficiency
 - Blade efficiency
- b)** In a Parsons stage, the steam inlet velocity is 200 m/s at an angle of 18° to the plane of the rotor. The rotor diameter is 0.75 m and the speed is 3000 rpm. Calculate the blade angle and specific work. [10]

OR

- Q6) a)** What is reaction turbine? Why the blade passages are made converging type? Explain with neat sketch the variation of pressure and velocity in a stage of reaction turbine. [10]
- b)** Explain the method of throttle governing with the help of neat sketch. What are its advantages and disadvantages? [6]

SECTION - II

- Q7)** a) What are the different methods used to improve efficiency of the gas turbine? Explain any one method with a neat sketch. [6]
- b) A gas turbine power plant operates between the temperature limits of 300 K and 1200 K. Determine the following: [10]
- The optimum pressure ratio for the cycle if the plant is to operate for maximum power output.
 - Turbine work, compressor work, shaft work and work ratio.
 - Power output if the mass flow rate of air is 20 kg/s.
- Assume, $\gamma = 1.4$, $C_p = 1.005$ kJ/kg.

OR

- Q8)** a) Explain the effect of below mentioned operating variables on the thermal efficiency of an actual open cycle gas turbine power plant. [8]
- Pressure ratio
 - Turbine inlet temperature
 - Turbine efficiency
 - Compressor efficiency
- b) Explain the working of Ramjet Engine by means of a sketch. What are its advantages, disadvantages and applications? [8]
- Q9)** a) What do you mean by manometric head, manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump? [8]
- b) A centrifugal pump has an impeller diameter of 30 cm and runs at 1080 rpm. The vanes are radial at exit and 75 mm wide. The radial velocity of flow through the impeller is 3.5 m/s. The velocity in delivery pipe is 2.5 m/s. Neglecting frictional losses, calculate: [8]
- Height through which water is lifted.
 - Theoretical power required.

OR

Q10)a) The following observations were recorded during a test on a centrifugal pump dealing with water. [12]

Vacuum gauge reading on the suction side	= 400 mm of Hg
Pressure gauge reading on the delivery side	= 2.3 bar
Vertical distance between the gauges	= 40 cm
Output of electric motor	= 31.6 kW
Diameter of suction pipe	= 20 cm
Diameter of delivery pipe	= 15 cm
Size of sump	= 10 m × 6 m × 2.5 m
Time required to empty the sump	= 30 minutes
Evaluate the overall efficiency of the pump.	

b) Draw and explain operating characteristics of centrifugal pump. [4]

Q11)a) A compressor draws air from atmosphere at 1 bar and 290 K at a velocity of 70 m/s. The isentropic efficiency of the compressor is 72%. The stagnation pressure is 3. Find the stagnation pressure at the exit and the power of the driving motor if mechanical efficiency is 95% for a flow rate of 30 kg/min. [10]

b) What are the three main types of centrifugal compressor impellers? Draw the exit velocity diagrams for these three types. [8]

OR

Q12) Write short notes on any three: [18]

- Slip factor and pressure coefficient.
- Surging and choking of compressor.
- Degree of reaction in case of axial flow compressor.
- Pre-whirl of centrifugal compressor.

