PVP 19

Code: 19ME4501A

III B.Tech - I Semester – Regular Examinations – JANUARY 2022

TURBO MACHINERY
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 5 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each question carries 12 marks.
4. All parts of Question paper must be answered in one place

PART – A

1. a) Write the importance of unit quantities in turbo machines.
   b) Define Mach number and Give classification of fluid flow based on Mach number.
   c) How is the degree of reaction of an axial turbine stage defined?
   d) What is Draft tube? What are its functions?
   e) Explain the need for priming in Centrifugal pumps.

PART – B

UNIT – I

2. a) What are the steps in dimensional analysis using Buckingham π theorem? 8 M
   b) A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 m^3/s. If the efficiency is 90%, determine: (i) Specific speed of the machine, (ii) Power generated. 4 M

OR

3. a) Define specific speed of a pump. Derive an expression for specific speed of a pump from fundamentals. 6 M

b) A turbine develops 9000 kW when running at 10 r.p.m. The head on the turbine is 30m. If the head on the turbine is reduced to 18 m, determine the speed and power developed by the turbine. 6 M

UNIT – II

4. a) Explain the following: (i) adiabatic efficiency and (ii) mechanical efficiency for power generating and power absorbing turbo machines. 6 M

b) With the help of T-s diagram, derive an expression for polytropic efficiency during the compression process. 6 M

OR

5. a) Derive an expression for an overall isentropic efficiency for multistage expansion in terms of pressure ratio, polytropic efficiency, number of stages and ratio of specific heats for a turbine. 6 M

b) Define the term infinitesimal stage efficiency of a turbine. Derive an expression for polytropic efficiency during the expansion process. 6 M

UNIT-III

6. a) Define and Explain hydraulic efficiency, mechanical efficiency and overall efficiency of a turbine. 6 M

b) An axial compressor has a mean diameter of 60m and runs at 15,000 RPM. Actual temperature rise of 30°C and pressure ratio developed is 1.3. Calculate i) the power required to drive the compressor while delivering 60 kg/sec of air, if initial temperature is 35°

C and mechanical efficiency as 88 %, ii) stage efficiency and degree of reaction if the temperature at the rotor exit is 56°C. 6 M

OR

7. Derive an expression for the work output of a turbo machine in terms of properties at inlet and outlet. 12 M

UNIT – IV

8. A pelton wheel has a mean bucket speed of 10 metres per second with a jet of water flowing at the rate of 700 litres/s under a head of 30 metres. The buckets deflect the jet through an angle of 160^{o}. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. 12 M

OR

9. a) With a neat sketch explain the working of Francis turbine. Draw the velocity triangles of Francis turbine. 6 M

b) A Francis turbine with an overall efficiency of 75% is required to produce 148.25 kW power. It is working under a head of 7.62 m. The peripheral velocity = 0.26 $\sqrt{2gH}$ and the radial velocity of flow at inlet is 0.96 $\sqrt{2gH}$. The wheel runs at 150 r.p.m. and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine: (i) The guide blade angle, (ii) The wheel vane angle at inlet, (iii) Diameter of the wheel at inlet and (iv) Width of the wheel at inlet. 6 M

UNIT – V

10. a) Explain the working of centrifugal pump. Why are centrifugal pumps used sometimes in series and sometimes in parallel? 8 M

    b) An axial flow compressor, with a compression ratio of 4, draws air at 20°C and delivers it at 97°C. The blade velocity and flow velocity are constant throughout the compressor. The blade velocity is 300 m/s. Air enters the blade at an angle of 12°. Calculate the flow velocity; work done per kg of air and degree of reaction. Take the inlet stagnation temperature of 305 K. 4 M

OR

11. a) Find the number of pumps required to take water from a deep well under a total head of 89 m. All the pumps are identical and are running at 800 r.p.m. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m^3/s. 4 M

    b) Explain the working principle of axial flow compressor with neat sketch. 8 M