Code No: 07807

FACULTY OF ENGINEERING

B. E. 3/4 (Prod.) II-Semester (**Old**) Examination, December 2009/Jan., 2010

Subject : **Turbo Machinery**

Time : 3 Hours Max. Marks: 75

Note: Answer all questions of Part-A and any **Five** questions from Part-B.
Use of steam tables and mollier charts permitted.

Part – A (25 Marks)

1. Explain the principle of working of hydraulic reaction turbine.
2. Explain on energy transfer in turbomachines.
3. Sketch an ideal velocity diagram at exist of a centrifugal compressor having Forward curve vanes.
4. Define a centrifugal pump and differentiate between volute casing and vortex casing for the centrifugal pump.
5. Explain the term compounding in steam turbines and what are the various methods of compounding steam turbines.
6. Explain the working of a simple impulse steam turbine.
7. What do you understand by the characteristic curves of a hydraulic turbine?
8. Define the specific speed of a hydraulic turbine and what is the significance of the specific speed?
9. Show that ideal Brayton cycle on P-V and T-S diagrams labeling the compressor and turbine work.
10. Give the advantages of gas turbines over steam turbines.

Part – B (5 x 10 = 50 Marks)

11.a) Explain the losses in turbomachinery passages.

b) Prove that the workdone per second on a series of moving curved vanes by jet of water striking at one of the tips of the vane is given by

work done/sec = $\rho a V_1 [V_{w_1} \pm V_{w_2}] u$, where letters carry usual meaning.

12.a) Describe the function of the impeller and the diffuser in a centrifugal compressor.

b) Explain with sketches, the working of axial flow and centrifugal compressors.

13.a) Define the terms manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump.

b) A centrifugal pump is to discharge 0.11m^3/s at a speed of 1450 rpm against a head of 25m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.

14.a) Prove that maximum flow rate per unit area through a nozzle occurs when the ratio of pressure at throat to inlet pressure is equal to $\left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$, where 'n' is an isentropic index of expansion.

b) Steam initially dry and saturated is expanded in a nozzle from 12 bar to 0.95 bar. If the frictional loss in the nozzle is 10% of the total heat drop, calculate the mass of steam discharged when exit diameter of the nozzle is 12mm.

15. A steam jet enters the row of blades of a impulse turbine with a velocity of 380 m/s at an angle of 22° with the direction of motion of the moving blades. If the blade speed is 180 m/s and there is no thrust on the blades, determine the inlet and outlet angles. Velocity of steam while passing over the blades Is reduced by 10 percent. Also determine the power developed by turbine when the rate of flow of steam is 1000 kg per minute.

16. A Kaplan turbine develops 24647.6 KW power at an average head of 39 meters. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine.

17. In a gas turbine plant air is compressed through a pressure ratio of 5:1 from 15°C and 1 bar. It is then heated to 800°C in a combustion chamber and expanded back to atmospheric pressure. The isentropic efficiency of turbine and compressor units is 0.85 each. Calculate the cycle efficiency. If a heat exchanger allows the heating of compressed air through 70 percent of maximum possible range, calculate new cycle efficiency.

- - - - - - -