Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – NOV / DEC 2024

Mechanical Engineering

ME503 - TURBO MACHINERY

(Regulation –2004)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART- A (10 x 2 = 20 Marks)

Q.No	Questions	Marks
1.	How do you classify turbomachines.	2
2.	What is the usefulness of specific speed.	2
3.	List some of the attractive aspects of centrifugal fan.	2
4.	What are the main causes of fan noise.	2
5.	What is slip factor.	2
6.	Write the stage work equation for centrifugal compressor with and without IGV.	2
7.	Show the variation of pressure and velocity in axial compressor stage.	2
8.	Compare the merits and demerits of pressure producing machines.	2
9.	Draw the velocity diagram of axial flow turbine.	2
10.	Define degree of reaction for radial turbine.	2

PART- B (5 x 16 = 80 Marks)

(Q. No 11 is Compulsory)

Q.No	Questions	Marks
11.	(i) Draw and explain the part of a general turbo machine.	6
	(ii) Draw the stage velocity triangles of a Turbomachine and hence deduce the relation for their work transfer and efficiency.	10
12.	a) The inner and outer diameter of centrifugal fan impeller are 18 cm and 20 cm respectively, and speed of fan is 1450 rpm. The relative and absolute velocities are: at entry 20 m/s and 21 m/s; at exit 17 m/s and 25 m/s. flow rate is 0.5 kg/s and motor efficiency is 78%. Determine (i) the stage pressure rise (ii) degree of reaction, (iii) The power required to drive a fan. Take density of air =1.25 kg/m^3.	16
	OR	
	b) Describe the criteria of selection for fans and blowers and explain their performance and the methods of noise reduction.	16
13.	a) (i) Draw the outlet velocity triangles for various vanes of centrifugal compressor and explain their differences.	8
	(ii) A single sided centrifugal flow compressor is to deliver 15 kg/s of air when operating at a pressure ratio of 6:1 and a speed of 12000 rpm. The inlet stagnation pressure is 1 bar and temperature 15°C. The number of vanes in the impeller is 20. The power input factor is 1.05. Find the overall diameter of the impeller.	8
	OR	
	b) (i) Explain the performance curves of the centrifugal flow compressors.	8

	(ii) A centrifugal flow compressor has a total pressure ratio of 4:1 when drawing air from atmosphere at 3.6 km altitude; where ambient temperature and pressure are 264.5 K and 64448N/m^2. The inlet eye to the compressor impeller is 0.30 m in diameter, where the axial velocity is 122 m/s and the mass flow 8.86 kg -of air per sec; the velocity in the delivery duct of the compressor is 107 m/s. The tip speed of the impeller is 440 m/ s and runs at 16500 rpm with an adiabatic efficiency of 0.78, pressure co-efficient of 0.72. Calculate the total static pressure ratio, Mach no of the flow over the tip of the inlet vane where the radius is 0.15 m.	8
14.	a) (i) Explain the geometric features and working of axial flow compressor	8
	(ii) The entry of an axial flow compressor has a stagnation temperature of 300 K and initial pressure of 101 kPa. At the inlet to the stage, the air velocity vector is inclined at an angle of 12° to the axial direction and the axial component to the velocity has constant value of 110 m/s throughout the stage. The rotor blade speed at mid-radius is 225 m/s and the outlet blade angle is 32° less than the inlet blade angle. The work done factor is 0.9. Calculate the air and blade angles and stage work.	8
	OR	
	b) (i) Draw the enthalpy - entropy diagram for axial flow compressor.	8
	(ii) Discuss various losses in the compressors with their reasons and possible remedies.	8
15.	a) Why some axial turbines are designed by compounding method. Explain (i) multi stage velocity compounding (ii) multi stage pressure compounding.	16
	OR	
	b) An inward flow radial turbine has the following data. Power = 150 kW, speed= 533 rps, outer diameter of the impeller = 20 cm, inner diameter of the impeller= 8 cm, absolute velocity of gas at entry= 387 m/s, absolute velocity of gas at exit= 193 m/s (radial). The gas enters the impeller radially. Construct the velocity triangles at the entry and exit of the impeller. Determine (i) mass flow rate, (ii) percentage energy transfer due to change of radius.	16