BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : V**
BRANCH: ME **SESSION : MO/2024**

SUBJECT: ME349 TURBOMACHINERY

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	What are the differences between turbomachine and positive displacement machines?	[4]	1	1
Q.1(b)	A model of a centrifugal pump absorbs 5 kW at a speed of 1500 rpm, pumping water against a head of 6 m. The large prototype pump is required to pump water to a head of 30 m. The scale ratio of diameter is 4. Assuming the same efficiency and similarities, find (i) the speed, (ii) the power of prototype and (iii) the ratio of discharge of prototype and model.	[6]	4	4
Q.2(a)	Explain pressure and velocity compounding on impulse turbine with velocity and pressure variation across blades.	[4]	1	2
Q.2(b)	An impulse turbine has a mean rotor diameter of 0.55 m and runs at 3300 rpm. The speed ratio is 0.45 and the nozzle angle at the rotor inlet is 20°. The blade velocity coefficient is 0.91. Assuming equiangular blades, find the rotor blade angles at the inlet and outlet. If m = 10 kg/s, find the power output and the axial thrust.	[6]	4	4
Q.3(a)	A centrifugal compressor runs at a speed of 15000 rpm and delivers 30 kg of air per second. Exit radius is 0.35 m, relative velocity at exit is 100 m/s at an exit blade angle of 75°. Assume axial inlet and T_{01} = 300 K and P_{01} = 1 bar. Calculate (i) the torque, (ii) the power required to drive the compressor, (iii) the ideal head developed, (iv) the work done.	[6]	3	4
Q.3(b)	Explain the indicated diagram of a reciprocating compressor with and without clearance	[4]	2	2
Q.4(a)	Explain the compression process in the rotor and stator in an axial flow compressor with the temperature-entropy diagram.	[2]	2	3
Q.4(b)	Air enters a two-stage axial flow compressor at 1 bar and 300 K. The energy input is 25 kJ/kg per stage. The stage efficiency is 0.86. Calculate (i) the exit static temperature and (ii) the static pressure ratio.	[6]	3	4
Q.4(c)	Describe stalling in the axial flow compressor.	[2]	1	1
Q.5(a)	Explain the power requirement of a fan or blower depending on the blade shape such as forward-swept, radial, and backward-swept.	[6]	1	5
Q.5(b)	Explain fan laws for fans of the same size and different sizes and performance curves.	[4]	2	2

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