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

CLASS: BTECH **SEMESTER : V**
BRANCH: ME **SESSION : MO/2025**

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	Using Buckingham's π theorem, show that the fluid velocity through a circular orifice is given by $V = \sqrt{gH}\, \boldsymbol{f}\left[\frac{D}{H},\ \frac{\mu}{\rho\sqrt{g}H^{\frac{3}{2}}}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the density and g is the acceleration due to gravity.	[10]	2	3
Q.2(a)	Explain the differences between impulse and reaction turbines.	[4]	1	2
Q.2(b)	The mean diameter of the blades of an impulse turbine is 85 cm, and the speed is 3200 rpm. The nozzle angle is 20° and the ratio of blade speed to steam speed is 0.45. The blade velocity coefficient is 0.85. The outlet blade angle is 2° less than the inlet blade angle. The steam flow is 9 kg/s. calculate i) tangential and axial thrust on blades ii) power developed by the turbine in kW.	[6]	3	5
Q.3(a)	Explain the working principle of a multistage reciprocating compressor with p-v diagram.	[4]	2	1
Q.3(b)	A reciprocating air compressor cylinder has 15 cm bore and 15 cm stroke, and the clearance volume is 5% of the stroke volume. The machine operates between 100 kPa, 27°C and 500 kPa. The polytropic exponent is 1.3. Find the i) air volume after compression, ii) clearance volume, iii) volumetric efficiency of the compressor, and iv) work done per kg of air.	[6]	3	4
Q.4(a)	Draw and explain the velocity triangles of a stage of an axial flow compressor	[5]	1	2
Q.4(b)	An axial compressor stage has the following data. Stagnation temperature and pressure at entry are 20°C and 1 bar. Flow coefficient (v_f/u) = 0.5. mean blade ring diameter= 35 cm. Speed = 18000 rpm. Air angles at rotor (α_1) and stator exit (β_1) are both 60°. Blade height at entry = 5 cm. Work done factor = 0.88. Calculate i) air angles at the rotor and stator entry ii) mass flow rate of air iii) power required to drive the compressor. Take c_p= 1.005 kJ/kg.K and R = 0.287 kJ/kg.K	[5]	4	5
Q.5(a)	Explain the main causes of noise in the fan and some methods of reducing fan noise.	[6]	1	2
Q.5(b)	Draw and explain the performance characteristic curves of a centrifugal fan.	[4]	2	1

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