

PRN No.	
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PAPER CODE	U315-2111 (RE)
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(AY: 2025-26) December 2025 (ENDSEM) EXAM

TY (SEMESTER - I)

COURSE NAME: Applied Thermodynamics BRANCH: Mechanical COURSE CODE: ME31231
T.Y (Pattern 2023)

Time: [1Hr 30 Min]

[Max. Marks: 40]

(*) Instructions to candidates:

- 1) Figures to the right indicate full marks. Use of scientific calculator is allowed
- 2) Use suitable data wherever required
- 3) All questions are compulsory. Solve any two sub question each from Questions 1 , 2 ,3 and 4

Q. No.	Question Description	Max. Marks	CO mapped	BT Level
Q.1	a) It is required to design an air-conditioning plant for a small office room for following winter conditions : Outdoor conditions : 12°C DBT and 10°C WBT Required conditions : 24.5°C DBT at R.H. 60% Amount of air circulation: 0.30 m ³ /min./person. Seating capacity of office: 60. Determine the following : 1) Heating capacity of the coil in kW 2) Surface temperature required if the bypass factor is 0.4. Take, h ₁ = 29.3 KJ/kg, h ₂ = 42.3 KJ/kg, V _s = 0.817 m ³ /kg	[5]	1	Apply
	b) Develop an expression of Relative humidity and Specific humidity by using principle of Dalton's law of pressure.	[5]	1	Apply
	c) A cooling tower used in power plant consists of 10 big fans, m _{water} = 1000 kg/min. It is cooled from 35°C to 30°C. Atmospheric conditions are 35°C DBT, 25°C WBT. Air leaves the tower at 30°C, 90% RH. Find out heat lost by water and the quantity of air handled per fan hour. Take Cp = 4.186 KJ/Kg K, h ₁ = 76.5 KJ/kg, h ₂ = 92.5 KJ/kg,	[5]	1	Apply
Q2	a) The steam is supplied to a De-Laval turbine at a velocity of 1000 m/s at an angle of 20°. The blade velocity is 300 m/s and blades are symmetrical. The mass flow rate of the steam 0.5 kg/s. Allowing friction factor 0.8. Determine following:	[5]	2	Apply
	i) Blade efficiency ii) Power developed iii) Stage efficiency. b) Show that velocity at the exit of the nozzle is given by expression $V_2 = 44.72 (\sqrt{h_1} - \sqrt{h_2})$ where h ₁ and h ₂ are the enthalpies at inlet and exit of the nozzle. Also elaborate in brief the effect of friction on nozzle by h-s diagram.	[5]	2	Apply

	c) A Parson's reaction turbine running at 400 rpm with 50 % reaction turbine develops 75 kW per kg of the steam. The exit angle of the blade is 20° and steam velocity is 1.4 times the blade velocity. Determine blade velocity and blade inlet angle.	[5]	2	Apply
Q3	a) A single stage reciprocating air compressor takes in 1.4 kg of air per minute at 1 bar and 17° C and delivers it at 6 bar. Assuming compression process follows the law of $pV^{1.35} = C$, calculate delivery temperature and Indicated power input to compressor.	[5]	3	Apply
	b) Develop an equation of volumetric efficiency of single stage reciprocating compressor with clearance volume with the help of P-V diagram. Also elaborate the effects of clearance volume on the performance of compressor.	[5]	3	Apply
	c) A single-acting 2-stage air compressor with perfect intercooling delivers 15 kg/min of air at 25 bar pressure. Air from atm is sucked in compressor at 1 bar and 15°C. Compression process follows $pV^{1.25} = C$. Calculate : i) Indicated power ii) Free air delivered iii) Isothermal efficiency	[5]	3	Apply
Q4	a) In a centrifugal compressor, the air enters at 27° C and leaves at 105° C. The air is compressed through a pressure ratio of 2. Calculate the Isentropic efficiency and Power required by the compressor, if 30 kg of air is compressed per minute. Take $C_p = 1.00$ kJ/kg K, $C_v = 0.716$ kJ/kg K.	[5]	4	Apply
	b) Develop an expression of isentropic efficiency of centrifugal compressor with proper T-S diagram. Also illustrate losses occurs in centrifugal compressor.	[5]	4	Apply
	c) A centrifugal compressor compresses air from 1 bar at 15 ° C to 2.15 bar, 95 ° C. The mass of air delivered is 2.2 kg/s and no heat is added to the air from the external sources during compression. Determine the Isentropic efficiency and power required to drive the compressor.	[5]	4	Apply