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May 2025

B.Tech. (ME) (Fourth Semester)

APPLIED THERMODYNAMICS

(PCC-ME-401/21)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Missing data, if any, can be assumed suitably. Steam table and Mollier Diagram is allowed.

Part A

1. (a) What for the Orsat apparatus is used ? 1.5

   (b) What is the range of modern boiler efficiency ? 1.5

(c) Define the overall efficiency. 1.5

(d) What kind of draught is used in a steam locomotive ? 1.5

(e) Why is the Carnot Cycle not considered theoretical cycle for steam power plants ?. 1.5

(f) What is reheat in context of steam power plants ? 1.5

(g) What is Diffuser ? 1.5

(h) Why dynamic action of steam is important in steam turbines ? 1.5

(i) What is airfoil shape ? 1.5

(j) What is iso-thermal compression ? 1.5

Part B

2. (a) Calculate the minimum height of a chimney required to produce a draught of 19 mm of water column if 18 kg of air is required per

kg of fuel burnt on the grate. The mean temperature of the gas inside the chimney is 357°C and that of atmospheric air is 24°C. 5

(b) Explain the working of Orsate apparatus with neat and clean diagram. 10

3. Steam enters a turbine at 60 bar and 600°C. Steam is bled off at 7bar for regenerative feed heating and the remaining steam is condensed in condenser to condenser temperature 30°C. Calculate :

(a) the amount of bled steam

(b) cycle network

(c) the ideal thermal efficiency of cycle. For an ideal turbine and with same states determine

(d) ideal turbine work

(e) ideal efficiency

(f) steam rate in kg/kWh. 15

4. What is critical pressure ? Find out the critical pressure and throat area for a nozzle, if steam expands following $pv^n = c$. 15

5. Steam issues from nozzles of de-Lavel turbine with a velocity of 1200 m/s. The nozzle angle is 20°, the mean blade velocity is 400 m/s, and inlet and outlet angles of blades are equal. The mass of steam flowing through the turbine per hour is 900 kg. 15

Calculate :

(a) Blade angles,

(b) The relative velocity of steam entering to the blades,

(c) Tangential force on the blades,

(d) The power developed

(e) The blade efficiency.

Assume K = 0.8.

6. (a) Explain the working of single stage reciprocating compressor with and without clearance. 5

(b) Explain the working of a multistage reciprocating compressor. 5

(c) Discuss the effect inter-cooling in case of multistage compression. 5

7. (a) What is cooling tower ? Explain the cooling tower used in a steam power plant. 5

(b) 950 kg of steam with 0.9 dry is handled by a condenser. The condenser temperature is 45°C. The amount of air associated with the steam in the condenser is 260 kg/hr. Find the vacuum reading. The barometer reads 75 cm of Hg. Correct this vacuum to standard barometer reading. 10

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