

Printed Pages—4

EME401

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3989

Roll No.

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B. Tech.**(SEM. IV) THEORY EXAMINATION 2010-11****APPLIED THERMODYNAMICS***Time : 3 Hours**Total Marks : 100*

Note : (i) Attempt all questions. All questions carry equal marks.

(ii) Use of steam table and Mollier chart is permitted.

(iii) Assume suitably, any missing data.

I. Attempt any two of the following : **(10×2)**

(a) Define mathematical condition for exact differential and derive Maxwell's equation.

(b) What do you understand by standard heat of reaction and heat of formation? Carbon reacts with oxygen to form carbon dioxide in a steady flow chamber. Reactants and products are at 25°C and 1 atm. Find the energy involved and type of reaction. Assume enthalpy of formation of CO₂ gas as (-) 393520 kJ/kmol.

(c) Answer the following :

(i) What is Joule-Thompson coefficient? Why is it zero for an ideal gas?

- (ii) Methane is burned with dry air. Find the theoretical air fuel ratio for complete combustion and dew point temperature of products of combustion.

2. Attempt any two of the following :

(10×2)

(a) Answer the following :

(i) A boiler generates steam at 10 bar and 200°C from feed water at 37°C. Calorific value of fuel is 8050 kcal/kg. Steam capacity is 10kg/kg of coal. Find equivalent evaporation.

(ii) State the function of economizer and air preheater. Also indicate suitable location of superheater, economizer and air preheater in the path of flue gases in a boiler with line diagram.

(b) What do you understand by boiler draught ? Also name the various systems for producing draught in the boiler. Determine the quantity of air required per kg of coal burnt in a boiler fitted with 30 meters high chimney. Draught produced is 18.5 mm of water column when the temperature of the flue gases in the chimney is 370°C and that of the ambient is 303 K.

(c) Answer the following :

(i) Discuss the effect of air leakage upon the performance of condenser.

(ii) Make comparison between fire tube and water tube boilers.

3. Attempt any two of the following : (10×2)
- (a) If 8 kg/sec air at 9 bar & 200 °C expands through the nozzle in a space at 1.1 bar. Find the diameter at the throat and exit of nozzle. Neglect the approach velocity.
 - (b) Dry and saturated steam at a pressure of 12 bar is supplied to a double acting steam engine cylinder. The cutoff occurs at 40% of stroke and the exhaust pressure is 1.2 bar. The clearance is 10% of the stroke. Find the mean effective pressure. If the brake power of the engine is 21 kW running at 120 rpm, mechanical efficiency is 80%, mean piston speed is 70 m/min. Find the cylinder dimensions.
 - (c) Discuss :
 - (i) Supersaturated flow through nozzle
 - (ii) Missing quantity of steam in steam engines.
4. Attempt any two of the following : (10×2)
- (a) Steam is supplied by steam generator at 90 bar and 500°C. After expansion in turbine to 10 bar a portion of steam is bled for regeneration in open heater and remaining steam is reheated to 500°C. Condensor pressure is 0.07 bar. Draw schematic diagram of the system and show the cycle on T-s chart. Find thermal efficiency and steam rate in kg/kW-hr. Neglect pump work.
 - (b) Steam flows from the nozzles of a single row impulse turbine with a velocity of 450 m/s at a direction which is inclined at an angle of 16° to the blade velocity. Steam comes out of the moving blades with a velocity of 100 m/s in the direction of 110° with the blade velocity. The blades are equiangular.

Steam flow rate is 6 kg/s. Determine the power developed by the wheel and power loss due to friction.

(c) Answer the following :

- (i) Discuss, the governing of steam turbine.
- (ii) Show the variation of pressure and velocity along the axial direction through the different stages of reaction turbine.

5. Attempt any two of the following : (10×2)

(a) Air at temperature of 15°C enters a gas turbine plant working at pressure ratio of 5. Turbine inlet temperature is 800°C. Isentropic efficiency of compression and expansion is 0.85 and calorific value of fuel used is 42 MJ/kg. Find thermal efficiency, Air fuel ratio and specific fuel consumption of the gas turbine plant.

(b) Answer the following :

- (i) Discuss the effect of intercooling and regeneration on the performance of Brayton Cycle.
- (ii) Discuss combined cycle power plants.

(c) Write short notes on :

- (i) Propulsive power and propulsive efficiency
- (ii) Turbojet and turboprop engines.