

17ME43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023 Applied Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. Use of Thermodynamics data hand book and Mollier chart is permitted.

Module-1

- a. State the assumptions made in the air standard cycles. Derive the expression for the air standard efficiency of Otto cycle. (10 Marks)
 - b. The compression ratio of a Diesel cycle is 14 and the cut-off ratio is 2.2. At the beginning of cycle, air is at 0.98 bar and 100°C. Find the temperature and pressure at all salient points and also Air Standard efficiency. (10 Marks)

OR

2 a. Explain briefly with T-S diagram for the following Gas Turbine cycle:

(i) Regeneration (ii) In

- (ii) Intercooling
- (iii) Reheating.

(10 Marks)

- b. Air enters the compressor of an ideal air standard Brayton cycle at 100 KPa, 300 K with a volumetric flow rate of 6 m³/s. The compressor pressure ratio is 10. The turbine inlet temperature is 1500 K. Determine:
 - (i) Thermal efficiency
- (ii) Work ratio
- (iii) Power developed.

(10 Marks)

Module-2

- 3 a. With T-S diagram and schematic diagram explain the working of ideal regenerative Rankine cycle. (10 Marks)
 - b. In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Calculate:
 - (i) Pump work (ii) Turbine work (iii) Rankine efficiency (iv) Condenser heat flow. Assume mass flow rate = 9.5 kg/s. (10 Marks)

OR

- 4 a. Sketch the flow diagram and T-S diagram of a reheat Rankine cycle. Briefly explain the working principle and derive the cycle efficiency for reheat Rankine cycle. (10 Marks)
 - b. Steam enters the turbine of a steam power plant operating an Rankine cycle at 10 bar and 300°C. The condenser pressure is 0.1 bar. Steam leaving the turbine is 90% dry. Calculate the adiabatic efficiency of the turbine and also cycle efficiency. Neglecting pump work.

(10 Marks)

Module-3

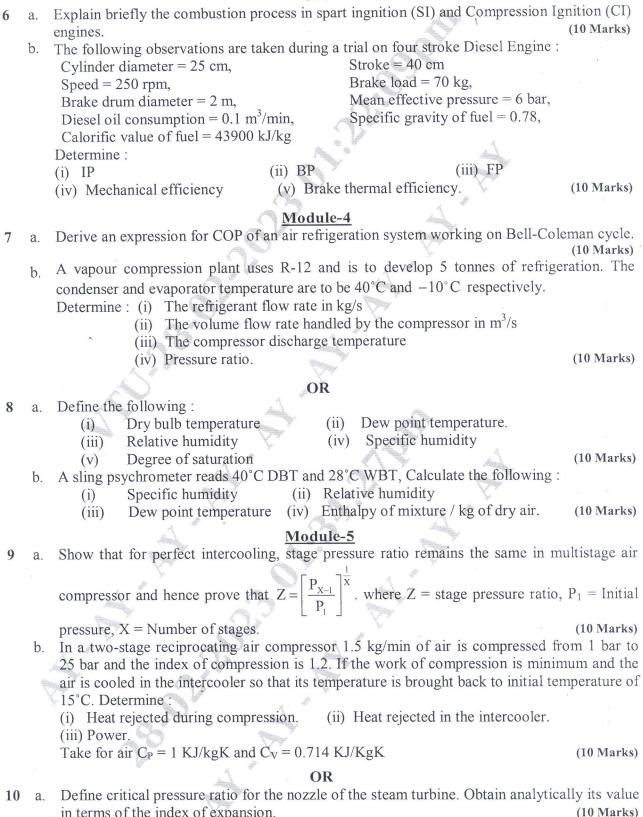
- 5 a. Explain the following with reference to combustion process:
 - (i) Percent excess air
- (ii) Enthalpy of formation
- (iii) Enthalpy of combustion
- (iv) Internal energy of combustion.

(10 Marks)

b. Calculate the air-fuel ratio for burning of propane (C₃H₈) with 130% theoretical air.

(10 Marks)

OR



(10 Marks) in terms of the index of expansion.

b. Steam is allowed to expand in a set of nozzles from 10 bar and 200°C to final pressure of 5 bar what type of nozzle is it. Neglecting the initial velocity of steam, calculate the minimum area of the nozzle required to allow a flow of 3 kg/s under the given conditions. Assume that expansion of steam to be Isentropic. (10 Marks)

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