

GBCS SCHEME



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17ME43

Fourth Semester B.E. Degree Examination, July/August 2022 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 handbook is permitted.

Module-1

- 1 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of diesel-cycle. (10 Marks)
b. An air standard diesel cycle has a compression ratio of 18 and the heat transferred to the working fluid per cycle is 2000 kJ/kg. At the beginning of the compression stroke, the pressure is 1 bar and temperature is 300°K. Calculate the thermal efficiency. (10 Marks)

OR

- 2 a. With a neat sketch, explain the working principle of Ramjet engine. (10 Marks)
b. A gas turbine plant works between the temperature limits of 300°K and 1000°K and a pressure of 1 bar and 16 bar. The compression is carried out in two stages with perfect inter-cooling in-between. Calculate the netpower of the plant per kg of air circulation. $C_p = 1 \text{ kJ/kg}^\circ\text{K}$; $\gamma = 1.4$ for air. (10 Marks)

Module-2

- 3 a. Discuss the effect of :
(i) Condenser pressure (ii) Boiler pressure performance of Rankine cycle. (10 Marks)
b. In a Rankine cycle, the maximum pressure of steam supplied is 6 bar. The dryness fraction is 0.9. The exhaust pressure is 0.7 bar. Find the theoretical work-done and Rankine efficiency. (10 Marks)

OR

- 4 a. With a schematic diagram, explain the working principle of reheat vapour cycle. (10 Marks)
b. Steam enters a steam turbine using reheat cycle at 150 bar, 350°C, the reheat pressure is 25 bar and exhaust pressure is 0.05 bar. The temperature of reheated steam is 300°C. Calculate the cycle efficiency and power developed for a steam flow rate is 3000 kg/hr. Consider the pump work. (10 Marks)

Module-3

- 5 a. Define the following terms with reference to a combustion process:
(i) Stiochiometric air (ii) Excess air (iii) Air-fuel ratio
(iv) Enthalpy of formation (v) Combustion efficiency (10 Marks)
b. A fuel has following composition by mass. C – 82% , H₂ – 13% and remaining is oxygen. Calculate the minimum air required per kg of fuel for its complete combustion. Also calculate mass of product of combustion per kg of fuel. (10 Marks)

OR



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- 6 a. Define the following:
- (i) Indicated power (ii) Brake power (iii) Friction power
(iv) Mechanical efficiency (v) Specific fuel consumption (10 Marks)
- b. The following particulars refer to a 2-stroke oil engine.
Bore = 20 cm, stroke = 30 cm, speed = 350 rpm. Indicated mean effective pressure = 275 kN/m². Net brake load = 610 N, dia of brake drum = 1 m, oil consumption = 4.25 kg/hr, calorific value of fuel is 44,000 kJ/kg.
Determine: (i) I.P. (ii) B.P. (iii) η_{mech} (iv) Indicated thermal efficiency
(v) Brake thermal efficiency (10 Marks)

Module-4

- 7 a. With a neat sketch, explain the working principle of vapour absorption refrigeration system. (10 Marks)
- b. In an air-standard refrigeration cycle, air enters the compressor at 1 bar and 10°C and leaves at 5.1 bar. Air enters the expander at 30°C. Find COP for the cycle. Calculate the rate at which air must enter the compressor to produce a refrigerating effect of 1 ton refrigeration. (10 Marks)

OR

- 8 a. Define the following:
- (i) Dry bulb temperature (ii) Wet bulb temperature (iii) Dry air
(iv) Saturated air (v) Moisture (10 Marks)
- b. Explain the following:
- (i) Sensible heating or cooling (ii) Dehumidification
(iii) Psychrometric chart (iv) Relative humidity (10 Marks)

Module-5

- 9 a. Derive the expression, condition for minimum work-done in a 2-stage compressor with perfect intercooling. (10 Marks)
- b. A single stage reciprocating compressor takes 1 m³ of air per minute at 1.013 bar and 15°C and delivers it at 7 bar. Assuming that the law of compression is $PV^{1.35} = C$ and clearance is negligible. Calculate the indicated power. (10 Marks)

OR

- 10 a. Explain the following:
- (i) Isentropic flow
(ii) Flow with friction
(iii) Super saturated flow (10 Marks)
- b. Air expands reversibly and adiabatically in a nozzle from 15 bar and 150°C to pressure of 7 bar. The inlet velocity of nozzle is very small and process occurs under steady state flow condition. Calculate the exit velocity of nozzle. (10 Marks)

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