CBCS 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.*

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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. $C_p = 1$ kJ/kg°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% , H_2 – 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

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-stoke oil engine.
Bore = 20 cm, stroke = 30 cm, speed = 350 rpm. Indicated mean effective pressure = 275 kN/m^2. 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 m^3 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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