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Question Paper Code : 70044

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Third Semester

Aeronautical Engineering

AE 6301 – AERO ENGINEERING THERMODYNAMICS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

(Steam tables are permitted)

PART A — ($10 \times 2 = 20$ marks)

1. What is a quasi-equilibrium process? What is its importance in engineering?

2. Differentiate the sensible energy and latent energy.

3. What is a thermal energy reservoir? Give some examples.

4. What is meant by the increase of entropy principle?

5. What is the cutoff ratio? How does it affect the thermal efficiency of a Diesel cycle?

6. Define the compression ratio for reciprocating engines.

7. Draw the schematic and T-S diagram for the open feed water regenerative Rankine cycle.

8. What is the effect of reducing condenser pressure on the turbine in the steam power plant?

9. Why the thermal conductivity decreases as temperature increases for pure metals?

10. How flight velocity does affect the thrust and propulsive efficiency?

PART B — (5 × 13 = 65 marks)

11. (a) Explain the adiabatic process. Derive an expression for the work done during the adiabatic compression and expansion of an ideal gas.

Or

(b) A system contains 0.15 m^3 of a gas at a pressure of 3.8 bar and 150°C. It is expanded adiabatically till the pressure falls to 1 bar. The gas is then heated at a constant pressure till its enthalpy increases by 70 kJ. Determine the work done. Take C_p = 1 kJ/kg K and C_v = 0.714 kJ/kg K.

12. (a) (i) Show that heat transfer through a finite temperature difference is irreversible. (6)

(ii) Which is the more effective way to increase the efficiency of a Carnot engine: to increase T_1 keeping T_2 constant: or to decrease T_2, keeping T1 constant? (7)

Or

(b) A fluid undergoes a reversible adiabatic compression from 4 bar, 0.3 m^3 to 0.08 m^3 according to the law, $pv^{1.25}$= constant. Determine: (6+5+2)

(i) Change in enthalpy and Change in internal energy

(ii) Change in entropy and Heat transfer

(iii) Work transfer.

13. (a) Calculate the decrease in available energy when 25 kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and the temperature of the surroundings being 15°C Cp of water is 4.8 kJ/kg K.

Or

(b) (i) Show that the efficiency of the Brayton cycle depends only on the pressure ratio. (7)

(ii) What is a compression ignition engine? Why is the compression ratio of such an engine more than that of an SI engine? (6)

14. (a) Steam at 7 bar and dryness fraction 0.95 expands in a cylinder behind a piston isothermally and reversibly to a pressure of 1.5 bar. The heat supplied during the process is found to be 420 kJ/kg. Calculate per kg (5+5+3)

(i) The change of internal energy

(ii) The change of enthalpy

(iii) The work done.

Or

(b) A simple Rankine cycle works between pressures 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption.

15. (a) Derive an expression for thrust generated by an aircraft engine. And discuss the factors affecting the thrust.

Or

(b) How does the thermodynamics differ from heat transfer? Explain the different modes of heat transfer with suitable examples. And discuss how does the heat conduction takes place in solid, liquid and gas phases.

PART C — ($1 \times 15 = 15$ marks)

16. (a) In an engine working on Dual cycle, the temperature and pressure at the beginning of the cycle are 90°C and 1 bar respectively. The compression ratio is 9. The maximum pressure is limited to 68 bar and total heat supplied per kg of air is 1750 kJ. Determine:

(i) Pressure and temperatures at all salient points

(ii) Air standard efficiency

(iii) Mean effective pressure

Or

(b) A gas turbine unit receives air at 1 bar and 300 K and compresses it adiabatically to 6.2 bar. The compressor efficiency is 88%. The fuel has a heating valve of 44186 kJ/kg and the fuel-air ratio is 0.017 kJ/kg of air. The turbine internal efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and thermal efficiency.

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