AE 8301 Aero Engineering Thermodynamics

Important 13mark questions

Unit I

1. In an air compressor air flows steadily at the rate of 0.5 kg/s through an air compressor. It enters the compressor at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg and leaves at 5 m/s with a pressure of 7 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 60 kJ/s. Calculate
   (i) The power required to drive the compressor
   (ii) The inlet and output pipe cross-sectional areas.
2. Three grams of nitrogen at 6 atm and 160^0C in a frictionless piston cylinder device is expanded adiabatically to double its initial volume, then compressed at constant pressure to its initial volume and then compressed again at constant volume to its initial state. Calculate the net work on the gas. Draw the P-V diagram for the process. Molecular weight of N is 28.

Unit II

1. Prove that the Kelvin Plank Statement of Second law of thermodynamics is equivalent to the Clausius statement.
2. Show that the efficiency of all reversible heat engines operating between the same temperature levels is the same.

Unit III

1. An I. C. engine operating on the dual cycle (limited pressure cycle) the temperature of the working fluid (air) at the beginning of compression is 27^0C. The ratio of the maximum and minimum pressures of the cycle is 70 and the compression ratio is 15. The amounts of heat added at constant volume and at constant pressure are equal. Compute the air standard thermal efficiency of the cycle. Take ɣ = 1.4.
2. Illustrate the working of an ideal dual combustion cycle with the use of P-v and T-s plots and Derive its thermal efficiency.

Unit IV

1. A simple Rankine cycle works between pressures 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculated the cycle efficiency, work ratio and specific steam consumption.
2. Steam is initially at 1.5MPa, 300^0C expands reversibly and adiabatically in a steam turbine to 40^0C. Determine the ideal work output of the turbine per kg of steam. Sketch the process in T-s and h-s diagrams.

Unit V

1. An aircraft flies at a speed of 520 kmph at an altitude of 8000 m. The diameter of the propeller of an aircraft is 2.4 m and flight to jet speed ratio is 0.74. Find the following:
   (i) The rate of air flow through the propeller
   (ii) Thrust produced
   (iii) Specific thrust

(iv) Specific impulses
(v) Thrust power

2. 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.