Register No:

Dhanalakshmi Srinivasan Engineering College

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)

(Accredited with 'A' Grade by NAAC)

Perambalur – 621 212

Internal Assessment Test I

Department of Aeronautical Engineering

AE 8301 | Aero Engineering Thermodynamics

(Common to Aeronautical and Aerospace Engineering)

Year | Semester	: II | III	**Date**	: 27.07.2019
Duration	: 1 ½ hour	**Max. Marks**	: 50 Marks

Answer all the Questions

Part – A (5 X 2 = 10)

1. What are point and path functions? Give examples.
2. Define Zeroth law of thermodynamics.
3. Indicate the practical application of steady flow energy equation.
4. Write the Clausius statement of second law of Thermodynamics.
5. What are the important characteristics of entropy?

Part – B (2 X 13 = 26)

6. a) 85 kJ of heat is supplied to a system at constant volume. The system rejects 90 kJ of heat at constant pressure and 20 kJ of work is done on it. The system is bought to its original state by adiabatic process. Determine the adiabatic work. Determine also the value of internal energy at all end states if initial value is 100 kJ.

(Or)

b) A turbine operating under steady flow conditions receives steam at the following state: pressure 13.8 bar; specific volume 0.143 m^3/kg; internal energy 2590 kJ/kg; velocity 30 m/s. The state of the steam leaving the turbine is: pressure 0.35 bar; specific volume 4.37 m^3/kg; internal energy 2360 kJ/kg; velocity 90 m/s. Heat is lost to the surroundings at the rate of 0.25 kJ/s. If the rate of steam flow is 0.38 kg/s. What is the power developed by the turbine?

7. a) An air turbine forms part of an aircraft refrigerating plant. Air at a pressure of 295 kPa and a temperature of 58 $^\circ$C flows steadily into the turbine with a velocity of 45 m/s. The air leaves the turbine at a pressure of 115 kPa, a temperature of 2 $^\circ$C, and a velocity of 150 m/s. The shaft work delivered by the turbine is 54 kJ/kg of air. Neglecting changes in elevation, determine the heat transfer per unit mass of air flowing. For air, take c_p = 1005 J/kg-K and the enthalpy $h = c_pT$.

(Or)

b) 1 m^3 of air is heated reversibly at constant pressure from 15 °C to 300 °C, and is then cooled reversibly at constant volume back to the initial temperature. The initial pressure is 1.03 bar. Calculate the net heat flow and overall change of entropy, and sketch the process on a T-s diagram.

Part – C (1 X 14 = 14)

8. a) A fish freezing plant requires 50 tons of refrigeration. The freezing temperature is -40 ºC while the ambient temperature is 35 ºC. If the performance of the plant is 15 % of the theoretical reversed Carnot cycle working within the same temperature limits, calculate the power required. Take 1 ton = 210 kJ/min.

(Or)

b) A heat engine works between two reservoirs at temperature of 953 K and 343 K. A reversible refrigerator driven by the engine operates between reservoirs at 343 K and 233 K. Heat transfer to the engine plant is 2.6 MJ and the net work output of the combined engine and refrigerator plant is 366 kJ. Calculate efficiency of engine, COP of refrigerator and net heat transfer to the reservoir.

Prepared by

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Answer all the Questions

Part – A (5 X 2 = 10)

1. Compare Heat and Work.
2. What is thermodynamic temperature scale and why is it significant?
3. What are the limitations of the first law of thermodynamics?
4. State Carnot theorem.
5. What is Perpetual motion machine of the second kind?

Part – B (2 X 13 = 26)

6. a) Three grams of nitrogen gas at 6 atm and 160 °C in a frictionless piston cylinder arrangement 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 done on the gas. Draw the p-V diagram for the processes.

(Or)

b) Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg, and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 88 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 59 kJ/s. Calculate the power required to drive the compressor and the inlet and outlet pipe cross sectional areas.

7. a) A reversible heat engine operating between thermal reservoirs at 800 ºC and 30 ºC drives a reversible refrigerator which refrigerates a space at -15 ºC and delivers heat to a thermal reservoir at 30 ºC. the heat input to the heat engine is 1900 kJ and there is a net work output from the combined plant (heat engine and refrigerator) of 290 kJ. Determine the heat transfer to the refrigerant and the total heat transfer to the 30 ºC thermal reservoir.

(Or)

b) A rigid cylinder containing 0.006 m^3 of nitrogen (molecular weight 28) at 1.04 bar, 15 ºC is heated reversibly until the temperature is 90 ºC. Calculate the change of entropy and the heat supplied. Sketch the process on T-s diagram. Take the isentropic index γ for nitrogen as 1.4, and assume that nitrogen is a perfect gas.

Part – C (1 X 14 = 14)

8. a) An insulated rigid tank having 5 kg of air at 3 atm and 30 °C is connected to an air supply line at 8 atm and 50 °C through a valve. The valve is now slowly opened to allow the air from the supply line to flow into the tank until the tank pressure reaches 8 atm, and then the valves is closed. Determine the final temperature of the air in the tank and find the amount of air added to the tank.

(Or)

b) A reversible heat engine operates between two reservoirs at temperature of 600 °C and 40 °C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40 °C and -20 °C. The heat transfer to the heat engine is 2000 kJ and the network output of the combined engine refrigerator plant is 360 kJ. i. Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40 °C. ii. Reconsider i. given that the efficiency of the heat engine and the COP of the refrigerator are each 40 % of their maximum possible values.

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