Department of Mechanical Engineering, I.I.T Delhi
MEL 140: Engineering Thermodynamics

Major Test

Duration: 2 hours
Total Marks: 40

1. Draw the p-v and T-s diagrams of the Carnot cycle. Derive expressions for energy transfer as heat and work for each process in terms of temperatures and volumes at each state. Derive the expressions for the net work delivered during a cycle and the efficiency of the cycle. (10 Marks)

2. What is the difference between cogeneration and regeneration? Explain with neat figures. (3 Marks)

3. The pressure and temperature at the beginning of compression of an air-standard Diesel cycle are 95 kPa and 300 K, respectively. At the end of the heat addition, the pressure is 7.2 MPa and the temperature is 2150 K. Determine (a) the compression ratio (b) the cut of ratio (c) the thermal efficiency of the cycle (d) the mean effective pressure, in kPa (9 Marks)

4. Consider an ideal refrigeration cycle that uses R134a as the working fluid. The temperature of the refrigerant in the evaporator is -20°C and in the condenser it is 40°C. The refrigerant is circulated at the rate of 0.03 kg/s. Determine the coefficient of performance and the capacity of the plant in rate of refrigeration. (6 Marks)

5. Draw the schematic diagram of a vapour power cycle with reheat operating on Rankine reheat cycle. Draw this cycle in T-s and h-s plots. In a thermal power plant,steam leaves the boiler and enters the turbine at 4MPa, 400°C. After expansion in the turbine to 400 kPa, the steam is reheated to 400°C and expanded in the low pressure turbine to 10 kPa. Determine the cycle efficiency. (6 Marks)

6. Air enters an evaporative cooler at 1 atm, 36°C and 20% relative humidity at a rate of $4m^3$/min, and it leaves with a relative humidity at a rate of 90%. Draw the evaporative cooling process in a psychrometric chart. Determine (i) the exit temperature of the air and (ii) the required rate of water supply to the evaporative cooler. (6 Marks)