

Instructions to candidates

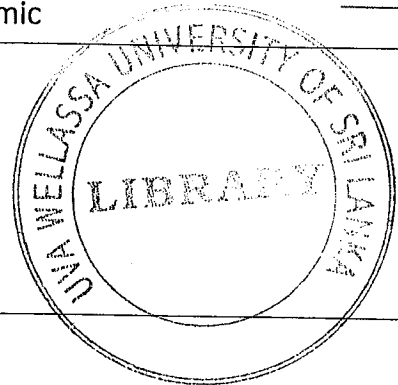
Duration: Two (02) hours

Number of questions: Four (04) Essays

Mark allocation: 100

Answer all questions

Thermodynamic property tables will be provided



1. The condition at the beginning of the compression in an air standard Diesel cycle are fixed by $P_1=200\text{KPa}$, and $T_1=380\text{K}$. The compression ratio is 20 and the heat addition per unit mass is 900 kJ/kg. Determine
 - i. The maximum temperature in K.
(10 marks)
 - ii. The cutoff ratio.
(3 marks)
 - iii. The net work per unit mass of air, in kJ/kg.
(8 marks)
 - iv. The thermal efficiency.
(4 marks)

2.
 - a. State the Kelvin – Planck Statement related to the second law of thermodynamics by giving one practical example (Maximum 100 words)
(8 marks)

 - b. Water is the working fluid in a Carnot vapor power cycle. Saturated liquid enters the boiler at a pressure of 8 MPa, and saturated vapor enters the turbine. The condenser pressure is 8 KPa. Determine
 - i. The thermal efficiency.
(6 marks)
 - ii. The back work ratio.
(5 marks)

- iii. The heat transfer to the working fluid per unit mass in the boiler. (3 marks)
- iv. The heat transfer from the working fluid per unit mass in the condenser. (3 marks)
3. Steam at 10 MPa, 600° C enters the first-stage turbine of an ideal Rankine cycle with reheat. Steam at the first stage expands to 0.7 MPa and then reheated to 480° C before entering the second-stage turbine, where it expands to the condenser pressure of 0.008 MPa. The net power output is 100 MW. Determine
- i. The rate of heat transfer to the working fluid passing through the steam generator, in MW. (10 marks)
- ii. The thermal efficiency. (10 marks)
- iii. The rate of heat transfer to cooling water passing through the condenser, in MW. (5 marks)
4. Refrigerant 134a is the working fluid in an ideal vapor-compression refrigeration cycle that communicates thermally with a cold region at 0° C and a warm region at 22° C. Saturated vapor enters the compressor at 0° C and saturated liquid leaves the condenser at 22° C. The mass flow rate of the refrigerant is 0.08 kg/s. Determine
- i. The compressor power, in kW. (10 marks)
- ii. The refrigeration capacity, in kW. (10 marks)
- iii. The coefficient of performance. (5 marks)

