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**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING  
END TERM EXAMINATION - JUN 2023**

**Semester :** Semester IV - 2021

**Course Code :** MEC4003

**Course Name :** Sem IV - MEC4003 - Applied Thermodynamics

**Program :** MEC

**Date :** 23-JUN-2023

**Time :** 9.30AM - 12.30PM

**Max Marks :** 100

**Weightage :** 50%

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**Instructions:**

- (i) Read all questions carefully and answer accordingly.
  - (ii) Question paper consists of 3 parts.
  - (iii) Scientific and non-programmable calculator are permitted.
  - (iv) Do not write any information on the question paper other than Roll Number.
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**PART A**

**ANSWER ALL THE QUESTIONS**

**(10 X 2 = 20M)**

1. Define Heat rate in Rankine cycle. (CO3) [Knowledge]
2. Write all 4 parts of a refrigerator. (CO4) [Knowledge]
3. Calculate the thermal efficiency of Brayton cycle. The pressure ratio of the cycle is 6. (CO2) [Knowledge]
4. As the number of reheat stages in Rankine cycle are increased, the reheat process approaches \_\_\_\_\_ process at maximum temperature. Write the T-S diagram for it. (CO1) [Knowledge]
5. Write the functions of air in gas turbine in Brayton cycle. (CO2) [Knowledge]
6. Define Mean Effective Pressure and write the equation for Mean Effective Pressure. (CO1) [Knowledge]
7. Define one ton of refrigeration. (CO4) [Knowledge]
8. What is steam rate in Rankine cycle? (CO3) [Knowledge]
9. Write T-S and P-h diagrams for vapor compression refrigeration cycle. (CO2) [Knowledge]
10. Write the T-S diagram for comparison of Otto cycle and Diesel cycle when maximum cycle pressure and heat input are same. Also write comparison of thermal efficiencies of Otto, Diesel and Dual cycle. (CO1) [Knowledge]

## PART B

ANSWER ALL THE FOUR QUESTIONS

4 X 10 = 40M

11. Carnot cycle is one of the cycle which has highest efficiency among all cycles. Write the T-S diagram for Reverse Carnot Cycle for refrigeration and derive the Coefficient of performance for the same. Also write 3 reasons why this reverse Carnot cycle practically suitable. Write all processes involved in it.  
(CO4) [Comprehension]
12. Explain about the Rankine cycle along with P-V and T-S diagrams. Write all 4 processes involved in Rankine cycle. Also derive the thermal efficiency of Rankine cycle.  
(CO3) [Comprehension]
13. The gas turbines are classified into Open cycle gas turbine and closed cycle gas turbine. The closed cycle gas turbines are widely used in most of the gas power plants. Write any 6 differences between Open cycle gas turbine and Closed cycle gas turbine.  
(CO2) [Comprehension]
14. Write the principle of refrigeration and explain the refrigeration process with all 4 parts of it. Also calculate one ton of refrigeration in terms of kW. Write any 4 applications of refrigeration.  
(CO4) [Comprehension]

## PART C

ANSWER ALL THE FOUR QUESTIONS

4 X 10 = 40M

15. Refrigerator uses R-134a as the working fluid in an ideal vapor-compression refrigeration cycle that operates thermally between a cold region at 5°C and a warm region at 28°C. Saturated vapor enters the compressor at 5°C and saturated liquid leaves the condenser at 28°C. The mass flow rate of the refrigerant is 0.05 kg/s. Determine (a) the compressor power, in kW, (b) the refrigeration capacity, in tons, (c) the coefficient of performance, and (d) the coefficient of performance of a Carnot refrigeration cycle operating between warm and cold regions at 26 and 0°C, respectively. Data given is enthalpy of saturated vapor is 242.04 kJ/kg, enthalpy of superheated is 277.05 kJ/kg. Enthalpy of saturated liquid is 94.12 kJ/kg.  
(CO4) [Analysis]
16. In an air-standard Diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15 C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480 C. Calculate (a) the cut-off ratio, (b) the heat supplied per kg of air, (c) the cycle efficiency. Also draw the P-V and T-S diagrams for diesel cycle.  
(CO1) [Application]

17. Consider a steam power plant operating on the Simple Ideal Rankine cycle. Steam enters the turbine at 3 MPa and 350 C and is condensed in the condenser at the pressure of 75 kPa. Determine (a) thermal efficiency of the cycle, (b) dryness fraction of steam at the end of expansion, (c) amount of heat rejected in condenser.

Data is Enthalpy and entropy of superheated steam at turbine inlet are 3116 kJ/kg and 6.7450 kJ/kg-K respectively, enthalpy and specific volume of saturated liquid water at 75 kPa are 384.4 kJ/kg and 0.001037 m<sup>3</sup>/kg respectively,  $h_{fg} = 2278$  kJ/kg,  $S_f = 1.2132$  kJ/kg-K,  $S_{fg} = 6.2426$  kJ/kg-K.

(CO3) [Application]

18. 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 26°C. Saturated vapor enters the compressor at 0°C and saturated liquid leaves the condenser at 26°C. The mass flow rate of the refrigerant is 0.08 kg/s. Determine (a) the compressor power, in kW, (b) the refrigeration capacity (c) the coefficient of performance, and (d) the coefficient of performance of a Carnot refrigeration cycle operating between warm and cold regions at 26 and 0°C, respectively. Data is Enthalpy of Saturated vapor is 247.3 kJ/kg, Enthalpy of superheated vapor is 264.7 kJ/kg, Enthalpy of saturated liquid is 85.75 kJ/kg.

(CO4) [Application]