Q.5	i.	Define a boiler and give its classification.	**4**
	ii.	Explain the working of any one high pressure boiler with diagram.	**6**
OR	iii.	Differentiate between condenser and cooling tower. Also explain the design of a cooling tower.	**6**
Q.6		Attempt any two:	
	i.	Derive an expression for efficiency of a reciprocating compressor.	**5**
	ii.	Explain the working of a reciprocating compressor.	**5**
	iii.	An aeroplane is flying at 1000 km/h through still air having a pressure of 78.5 kN/m^2 (abs.) and temperature – 8°C. Calculate on the stagnation point on the nose of the plane: (a) Stagnation pressure (b) Stagnation temperature (c) Stagnation density. Take for air : R = 287 J/kg K and γ = 1.4.	**5**

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering
End Sem Examination Dec-2023
AU3CO44 / ME3CO44 Engineering Thermodynamics

Programme: B.Tech. Branch/Specialisation: AU/ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.
Use of Steam table is permitted.

Q.1	i.	What is the value of the absolute zero thermodynamic temperature scale? (a) 3 K (b) 0 K (c) 1 K (d) 4 K	**1**
	ii.	Which of the following is the standard fixed point of thermometry? (a) The steam point (b) The triple point of water (c) The ice point (d) All of these	**1**
	iii.	Which of the following represents the specific volume during phase transition. (a) Vf-Vg (b) Vg-Vf (c) Vf+Vg (d) None of these	**1**
	iv.	Which of the following is a property of a pure substance? (a) It has constant chemical composition throughout its mass (b) It is a one-component system (c) It may exist in one or more phases (d) All of these	**1**
	v.	For a fluid undergoing cycle process, (a) There is no net change in its internal energy (b) Energy transfer as heat is equal to the energy transfer as work (c) Both (a) and (b) (d) None of these	**1**

vi. Rankine cycle operating on low pressure limit of p1 and high pressure limit of p2 _____. **1**

(a) Has higher thermal efficiency than the Carnot cycle operating between same pressure limits

(b) Has lower thermal efficiency than Carnot cycle operating between same pressure limits

(c) Has same thermal efficiency as Carnot cycle operating between same pressure limits

(d) May be more or less depending upon the magnitudes of p1 and p2

vii. Which one of the following is not correct about the condensation regimes in a condenser? **1**

(a) If a condensing liquid does not wet a surface, then drop wise condensation will not take place on it

(b) Drop-wise condensation gives a higher heat transfer rate than film wise condensation

(c) Reynolds number of condensing liquid is based on its mass flow rate of the outgoing condensed fluid

(d) Suitable coating or vapour additive is used to promote film wise condensation

viii. The following listed are some factors on which boiler efficiency depends. Which of the following is a variable factor? **1**

(a) Excess air fluctuations (b) Rated rate of firing

(c) Boiler design (d) Heat recovery equipment

ix. Which among the following are not the accurate selection criteria for air compressors? **1**

(a) Free air delivery (b) Air receiver capacity

(c) Power supply (d) Speed

x. What is the use of Intake air filters? **1**

(a) To reduce the temperature of the air

(b) Used as storage and smoothened

(c) To prevent dust from entering the compressor

(d) To remove the traces of moisture

Q.2 i. Give the Kelvin Planck and Clausius statements for 2nd law of thermodynamics. **2**

ii. Derive an expression for PdV work in a closed system. **3**

iii. A gas in piston-cylinder assembly undergoes a polytropic **5**

expansion. The initial pressure is 3 bar, the initial volume is 0.1 m^3, and the final volume is 0.2 m^3. Determine the work for the process, in kJ, if

(a) n=1.5 (b) n=1.0 (c) n=0.

OR iv. Derive an expression for Steady Flow Energy Equation for an open system. **5**

Q.3 i. Define Critical Point & Triple Point of Water. **2**

ii. A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Find the following: **8**

(a) The specific volume (b) The specific enthalpy

(c) The specific entropy (d) The specific internal energy.

OR iii. (a) Explain the phase transformation process of a pure substance from -20^0C ice to 120^0 C superheated steam at 1 bar. **8**

(b) 1000 kg of steam at a pressure of 16 bar and 0.9 dry is generated by a boiler per hour. The steam passes through a superheater via boiler stop valve where its temperature is raised to 380°C. If the temperature of feed water is 30°C, determine:

I. The total heat supplied to feed water per hour to produce wet steam.

II. The total heat absorbed per hour in the superheater.

Take specific heat for superheated steam as 2.2 kJ/kg K.

Q.4 i. Derive the expression for efficiency of a Rankine Cycle. **3**

ii. Steam at a pressure of 15 bar and 250°C is expanded through a turbine at first to a pressure of 4 bar. It is then reheated at constant pressure to the initial temperature of 250°C and is finally expanded to 0.1 bar. Using Mollier chart, estimate the work done per kg of steam flowing through the turbine and amount of heat supplied during the process of reheat. Compare the work output when the expansion is direct from 15 bar to 0.1 bar without any reheat. **7**

Assume all expansion processes to be isentropic.

OR iii. Why Carnot Cycle is not used practically? Explain the effects of superheating and sub cooling with diagram on the performance of a Rankine cycle. **7**