KERALA AGRICULTURAL UNIVERSITY

B.Tech.(Food Engg) 2017 Admission

II Semester Final Examination-July 2018

Meen.1203 **Engineering Thermodynamics (2+1)**

Marks: 50

Time:2 hours

I **Fill up the following blanks:** **(10x1=10)**

1 Work is a ..... function.

2 Work done in free expansion process is .....

3 If the temperature of the source is increased, the efficiency of the carnot engine .....

4 Adiabatic curve is ..... than isothermal curve.

5 If index of compression for first stage of compression is higher than second stage, then for perfect inter-cooling and minimum total work, the first stage shares ..... work than second.

State whether the following statements are true or false:

6 It is possible to construct an engine on a cyclic process whose sole purpose is to convert the heat energy into work.

7 In a throttling process entropy remains constant.

8 Volume is an intensive property of a thermodynamics system

9 For an isolated system matter is not fixed.

10 Work input to compressor is minimum when the law of compression followed is isothermal.

II **Write Short notes on any FIVE of the following** **(5x2=10)**

1 Prove that Otto cycle is more efficient than diesel cycle for same heat input and compression ratio

2 Show that entropy is a property of a system.

3 Prove that volumetric efficiency decreases as pressure ratio is increased in case of reciprocating compressor

4 Draw diesel cycle on pv and Ts diagrams.

5 Define critical point and triple point.

6 Define volumetric efficiency of reciprocating air compressor

7 What are the four processes which constitute the stirling cycle?

III **Answer any FIVE of the following.** **(5x4=20)**

1 Starting from 1st law of thermodynamics, for a polytropic process,

Prove that $(s_2 - s_1) = R \left(\frac{\gamma - n}{\gamma - 1}\right) \log_e \left(\frac{v_2}{v_1}\right)$

P.T.O

2 State and explain the equivalence of Kelvin Plank and Clausius statement of second law of thermodynamics.

3 Apply steady flow energy equation to boiler, condenser and turbine.

4 An axial flow compressor of a gas turbine plant receives air from atmosphere at a pressure 1 bar, temperature 300 K and velocity 60 m/s. At the discharge of compressor the pressure is 5 bar and the velocity is 100 m/s. The mass flow rate through the compressor is 20 kg/s. Assuming isentropic compressor, calculate the power required to drive the compressor.

5 Calculate the thermal efficiency of an engine working on the otto cycle. The bore and stroke of the cylinder are 17 & 30 cm. Clearance volume is 0.002025 m^3. $\gamma = 1.4$.

6 In a Brayton cycle based power plant, the air at the inlet is at 27°C, 0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800°C. Find (a) the compressor work per kg of air (b) the turbine work per kg of air (c) the heat supplied per kg of air, and (d) the cycle efficiency.

7 Find the dryness fraction, specific volume and internal energy of steam at 7 bar and enthalpy of 2550 kJ/kg.

IV **Write an essay on any ONE of the following** **(1x10=10)**

1 Draw otto cycle on pv and Ts diagrams. Prove that its thermal efficiency 'η' is given by the following formula

$$\eta = 1 - r_v^{(1-k)}$$

where k is adiabatic index for compression/expansion and r_v is compression ratio.

2 Describe with a neat sketch the working of a combined separating and throttling calorimeter.

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