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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fourth Semester, B.E., - Industrial and Production Engineering

Semester End Examination; June - 2016

Engineering Thermodynamics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.*
ii) Assume missing data suitably.

UNIT - I

1 a. Represent the following on a p-v diagram :
(i) Quasistatic process, indicate also the work done during this process by shading
(ii) Non-Quasistatic process
(iii) A cycle. — 6

b. Derive an expression for the work done during a Quasistatic process governed by the equations of the form Pv = C with usual rotating. — 6

c. A platinum wire is used as a resistance thermometer. The wire resistance was found be 10 ohm and 16 ohm at ice point and steam point respectively and 30 ohm at the sulphur boiling point of 444.6ºC. Find the resistance of the wire at 500ºC, if the resistance varies with the temperature by the relations $R = R_0(1+\alpha T+\beta T^2)$. — 8

2 a. With suitable examples, distinguish between :
(i) System and Control volume (ii) Path functions and point functions (iii) Process and cycle. — 8

b. Represent the following Quasistatic process on p-v diagram. Write expression for PdV work for these; also indicate the PdV work done during these processes by shading, — 6
(i) Process for which PV = constant (ii) Process in which PV^n = constant.

c. A certain fluid at 10 bar is contained in a cylinder behind a piston, the initial volume being 0.05 m^3. Calculate the work done by the fluid when it expands reversibly, — 6
(i) At constant pressure to a final volume of 0.2 m^3
(ii) According to a law PV = constant to a final volume of 0.1 m^3.

UNIT - II

3 a. Write the first law of Thermodynamics as applied to a ;
(i) Cycle (ii) A process (iii) A flow process and explain the terms. — 7

b. Represent Carnot cycle on P-V and T- S diagrams and indicate the various processes. — 5

c. A Carnot engine operates between two reservoirs at temperatures of T_1 and T_2 Kelvin. The work output of the engine is 0.6 times the heat rejected. Given that the difference is temperature between the source and the sink is 200 K, calculate; — 8
(i) The source temperature (ii) The sink temperature (iii) Efficiency of the engine.

Contd….2

4 a. Derive an expression for the first law of thermodynamics as applied to a process involving a change of state and hence prove that energy is a property. 8

b. Fig. Q_n4 (b) represents a heat pump operating between two thermal reservoirs. Write an expression for the COP of the same. If this heat pump is reserved to a function as refrigeration's plant, what will be the COP term? 4

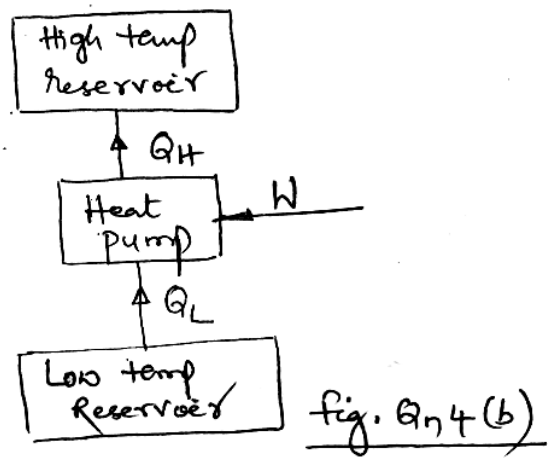

fig. Q_n4 (b)

c. A heat engine drives a refrigerator whose COP is 4.5. If the efficiency of the heat engine is 35% and 1260 kJ of heat is removed per hour by the refrigerator from the cold body, find the rate of heat supplied per hour to the heat engine. 8

UNIT - III

5 a. Define the following : 8

(i) Pure substance (ii) Saturations states

(iii) Critical parameters (iv) Dryness fraction

b. Show that for a reversible adiabatic process extended by an ideal gas pressure and volume are related by PV^n = constant. 6

c. A vessel contains 3 kg of water at 200ºC. If the volume of the vessel is 0.3 m^3. Determine the, 6

(i) Pressure (ii) Quality (iii) Specific enthalpy of the water vapour in the vessel.

6 a. On any isobar represented on a T-S diagram for water, indicate the following conditions : 8

(i) Sub cooled liquid (ii) Saturated liquid (iii) Saturated vapour

(iv) Super heated vapour (v) Wet vapour

b. Show that for an ideal gas $C_P - C_V = R$. 6

c. Steam at 40 bar has a specific volume 0.028 m^3/kg. What is the condition of steam? Find; 6

(i) Temperature of steam (ii) Specific internal energy (iii) Specific enthalpy.

Contd….3

UNIT - IV

7 a. For a given T_2, show that the Rankine cycle efficiency depends on the mean temperature of heat additions. 6

b. Representing the Otto cycle on a T-S diagram, derive an expression for air standard efficiency of the same with usual notations. 6

c. An ideal diesel engine has a diameter of 15 cm and stroke of 20 cm, the clearance volume is 10% of the swept volume. Determine the compression ratio and the air standard efficiency of the engine if the cut-off takes place at 6% of the stroke. 8

8 a. When is reheating of steam is recommended in a steam power plant? Represent a single stage reheat Ranking cycle on a T-S diagram and write expressions for efficiency and steam rate. 8

b. Represent Otto and diesel cycles on P-V and T- S diagrams and name the different processes. 6

c. An engine equipped with a cylinder having a bore of 15 cm and a stroke of 45 cm operates on Otto cycle. If the clearance volume is 2000 cm^3, compute the air standard efficiency. 6

UNIT - V

9 a. Show that the efficiency of the Brayton cycle depends only on the pressure ratio; also represent the cycle on P-V and T- S diagrams. 8

b. Draw the P-V diagram for a two stage compressor with perfect inter cooling between states. Show the saving in work done by shading; also represent the isothermal line. 6

c. A single stage reciprocating compressor takes 1 m^3 of air per minute at 1.013 bar and 15ºC and delivers it at 7 bar. Assuming that the law of compression is $PV^{1.35} = C$ and that clearance is negligible, calculate the indicated power. 6

10 a. With the help of T- S diagram, explain the effect of regeneration on Brayton cycle efficiency. 6

b. Define volumetric efficiency as applied to compressors. Derive an expression for the same with usual notations. 8

c. Which compression process needs minimum work input and which the maximum? Support your answer with the help of a P-V diagram. 6

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