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Mechanical - Mechatronics Engineering

ENGINEERING THERMODYNAMICS

End Term Examination

Time : 180 minutes **Date:**04/12/2017 **Max. Marks: 50**

Instruction: *i) All questions are compulsory, ii) Write all steps while answering the problems, iii) No data book is allowed, iv) Assume suitable data whenever necessary.*

Q.1 What is an absorption refrigeration cycle? How does it differ from a vapour compression cycle? [5]

Q.2 Explain with neat diagram the principle of Linde-Hampson system for liquefaction of air? [5]

Q.3 In a gas turbine plant the ratio of T_{max}/T_{min} is fixed. Two arrangements of components are to be investigated: (a) Single- stage compression followed by expansion in two turbines of equal pressure ratios with reheat to the maximum cycle temperature, and (b) compression in two compressors of equal pressure ratios, with intercooling to the minimum cycle temperature, followed by single stage expansion. If η_c and η_t are the compressor and turbine efficiencies, show that the optimum specific output is obtained at same overall pressure ratio for each arrangement. [10]

If η_c is 0.85 and η_t is 0.9 and T_{max}/T_{min} is 3.5, determine the above pressure ratio for optimum specific output and show that with arrangement (a) the optimum output exceeds that of arrangement (b) by about 11%.

Q.4 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, and (d) the m.e.p. [5]

Q.5 A certain factory has an average electrical load of 1500 kW and requires 3.5 MJ/s for heating purposes. It is proposed to install a single extraction passout steam turbine to operate under the following conditions: [5]

Initital pressure 15 bar
Initial temperature 300° C
Condenser pressure 0.1 bar

Steam is extracted between the two turbine sections at 3 bar, 0.96 dry, and is isobarically cooled without subcooling in heaters to supply the heating load. The

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Department Name: Mechanical-Mechatronics Engineering

Engineering Thermodynamics MME?

Exam Type (Mid Term)

Time: 90 minutes **Date:**28/09/2017 **Max. Marks:** 30

Instruction: *Answer must be brief and to the point. All questions carry equal weightage. Attempt all the questions. Suitable assumptions may be taken for any data required.*

Q1. (a) Define the second law efficiency and explain its physical significance.

(b) Explain the term exergy and exergy destruction. Derive the expression for the exergy of a fixed mass i.e. closed system exergy. **[3+7]**

Q2. (a) Differentiate between the Refrigerator and Heat Pump with neat sketches. Define the Coefficient of Performance (COP) of the refrigerator and Heat Pump.

(b) A reversible heat engine receives heat from two thermal reservoirs maintained at constant temperatures of 750K and 500K. The engine develops 100 KW and rejects 60 kJ/s of heat to a sink at 250 K. Determine thermal efficiency of the engine and heat supply rate (kJ/s) by each thermal reservoirs. **[4+6]**

Q3 (a) What is the physical significance of the entropy? Prove that the entropy is a property.

(b) Derive the following equation

$$\left(\frac{\partial C_p}{\partial p}\right)_T = -T\left(\frac{\partial^2 V}{\partial T^2}\right)_P$$

and prove that C_p of an ideal gas is a function of Temperature (T) only. **[4+6]**