Printed Pages : 4 TMT302

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4072 Roll No.

B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10

THERMAL ENGG.

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt all questions. Steam tables and Mollier charts may be used.*

1 Attempt any **two** parts of the following : 2×10=20

(a) 90 kJ of heat is supplied to a system at a constant volume. The system rejects 95 kJ of heat at constant pressure and 18 kJ of work is done on it. The system is brought to original state by adiabatic process. Calculate :

(i) The adiabatic work

(ii) The values of internal energy at all end states if its initial value is 105 kJ.

(b) What do you mean by 'Claussus inequality ? Show that change in entropy of the universe will never be negative.

(c) In an air turbine the air expands from 7 bar and 460°C to 1.012 bar and 160°C. The heat loss from the turbine can be assumed to be negligible :

(i) Show that the process is irreversible

(ii) Calculate the change of entropy per kg of air.

Attempt any **two** parts of the following : **2×10=20**

(a) Show that the compression ratio for the maximum work to be done per kg of air in an Otto cycle between upper and lower limit of absolute temperatures T_3 and T_1 is given by

$$r = \left(\frac{T_3}{T_1}\right)^{\frac{1}{2(\gamma-1)}}$$

(b) The following results refer to a test on a petrol engine :

Indicated power = 30 kW

Brake power = 26 kW

Engine speed = 1000 rpm

Fuel consumption / brake power = 0.35 kg/kw

Calorific value of the fuel used = 43900 kJ/kg

Determine :

(i) The brake thermal efficiency and

(ii) The mechanical efficiency

(iii) Torque developed.

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

Take R = 287 J/kg-K.

3 Attempt any **two** parts of the following : **2×10=20**

(a) A stream of gases at 7.5 bar, 750°C and 140 m/s is passed through turbine of jet engine. The stream comes out of the turbine at 2.0 bar, 550°C and 280 m/s. The process may be assumed adiabatic. The enthalpies of gas at the entry and exit of the turbine are 950 kJ/kg and 650 kJ/kg of gas respectively.
Determine the capacity of the turbine of the flow rate of gas is 5 kg/s.

(b) For isentropic flow through a nozzle prove that area on p-v diagram gives the heat drop during expansion. Also show the process on T-S and H-S diagram.

(c) State the fundamental differences between the jet propulsion and rocket propulsion with the help of neat diagrams.

4 Attempt any **two** parts of the following : **2×10=20**

(a) Define refrigeration, air-conditioning, unit of refrigeration and coefficient of performance (COP). Also show that
$(OP)_{Heat\ pump} = 1 + (OP)_{refrigerator}$

(b) Give the comparison between a vapour compression system and a vapour absorption system with the help of neat sketch.

(c) Compare the refrigerants R - 11, R - 12, R - 22 and ammonia in regard to the following :
(i) Normal boiling point.
(ii) Range of refrigeration temperatures for which used.
(iii) Types of compressors used and their special features.

Attempt any **two** parts of the following : **2×10=20**

(a) An exterior wall of a house may be approximated by 0.1 m layer of common brick ($K = 0.7$ W/m°C) followed by a 0.04 m layer of gypsum plaster ($K = 0.48$ W/°C). What thickness of loosely packed rock wool insulation ($K = 0.065$ W/m°C) should be added to reduce the heat loss or (gain) through the wall by 80% ?

(b) In a counter flow heat exchanger if $\Delta T_i = \Delta T_e$ show that $\Delta T_{cm} = \Delta T_e$ where, ΔT_i = temperature difference at inlet ΔT_e = temperature difference at exit of heat exchanger ΔT_{cm} = logarithimic mean temperature.

(c) (i) What is gray body ? How it differs from real surface ?

(ii) Explain the Kirchhoff's law of thermal radiation.
