2313

Reg. No. : .....

Name : .....

Fourth Semester B.Tech. Degree Examination, May 2013
(2008 Scheme)
Mechanical Engineering
08.405 : THERMAL ENGINEERING (MU)

Time : 3 Hours Max. Marks : 100

***Note** : **Use** of steam tables and Mollier chart is **permitted**.*

PART – A

Answer **all** questions. **(4 Marks×10)**

1. Describe Rankine cycle using p-v and T-S diagram and show how it differs from Carnot cycle.
2. What are the advantages of using superheated steam ?
3. Show the effect of friction on steam flow through a nozzle on Mollier diagram and define nozzle efficiency.
4. Discuss the term 'condition line' related to multistage steam turbine with a suitable diagram.
5. Why the economic mixture of fuel and air is normally weak but maximum power mixture is rich for SI engines ?
6. Explain the phenomenon of auto ignition in SI engines.
7. Differentiate between open and closed gas turbine cycles.
8. Draw schematic diagrams of i) annular and ii) can-annular gas turbine combustion chambers.
9. What are the broad classifications of compressors ? Give the application of each type.
10. Write short notes on Vane type compressor. **(10×4=40 Marks)**

P.T.O.

PART – B

Answer **one** question from **each** Module. **(20 Marks×3)**

Module – I

11. a) State and explain the methods of increasing the thermal efficiency of steam power plant working on Rankine cycle.

    b) Steam at a pressure 7 MN/m^2 and temperature 450°C is supplied to a steam turbine of a steam power plant which is working on Rankine cycle. After expanding the steam in the first turbine to 2.5 MN/m^2, it is reheated to the original temperature. The condenser pressure of the plant is 70kN/m^2. Considering the isentropic efficiency of the two turbines as 0.8, calculate

    1) the network output and

    2) the thermal efficiency.

12. a) Prove that the blade speed ratio (ρ) for maximum blade efficiency of single stage impulse turbine is given by $\rho = (\text{Cos } \alpha_1)/2$, where α_1 is the nozzle angle.

    b) Steam expands from 3 bar to 1 bar in a nozzle. The initial velocity is 90 m/sec and the initial temperature is 150°C. The nozzle efficiency is 0.95. Determine the exit velocity and the steam flow rate if the nozzle exit area is 30 cm^2.

Module – II

13. a) Explain the combustion stages of CI engines.

    b) Calculate the amount of theoretical air required for the combustion of 1 kg of Acetylene (C_2H_2) to CO_2 and H_2O.

14. a) With a schematic diagram explain the working of a simple ideal closed cycle gas turbine plant and derive an expression for the thermal efficiency in terms of pressure ratio.

    b) A gas turbine has a pressure ratio of 6 :1 and maximum cycle temperature of 600°C. The isentropic efficiencies of the compressor and the turbine are 0.82 and 0.85 respectively. Calculate the net power output; when the air enters the compressor at 15°C at the rate of 15 kg/sec, compression and expansion index 1.4 and C_p = 1.105 kJ/kgK.

Module – III

15. a) Derive an expression for work done in a single stage reciprocating compressor.

    b) A centrifugal air compressor having a compression ratio of 5 compresses air at the rate of 10kg/s. If the initial pressure and temperature of the air is 1 bar and 20°C, find

    i) the final temperature of the gas and

    ii) power required to drive the compressor

    Take $\gamma = 1.4$, $C_p = 1$kJ/kg K.

16. a) What is centrifugal compressor ? How does it differ from an axial flow compressor ?

    b) A single acting single cylinder with bore and stroke of 15cm and 20cm respectively runs at 220 rpm. Air is drawn at 1 bar and delivered at 6 bar. The law of compression is $PV^{1.3} = C$. Determine the power required to drive the compressor and the mass of air delivered. **(20×3=60 Marks)**
