Reg. No. : .....

Name : .....

Fourth Semester B.Tech. Degree Examination, April/May 2012

(2008 Scheme)

Branch : Mechanical Engineering

08.405 : THERMAL ENGINEERING (MU)

Time : 3 Hours Max. Marks : 100

***Instructions** : 1) **Use** of steam tables and Mollier chart are **permitted**.*

*2) Assume **suitable** values **wherever** necessary.*

PART – A

Answer **all** questions :

1. Define triple point and critical point of water. Show these points on P-T diagram.
2. Discuss the limitations of maximum and minimum temperature in a steam power cycle.
3. Describe the physical significance of super saturation in steam nozzle.
4. Explain volumetric and gravimetric analysis of fuels.
5. Discuss some alternate fuels for IC engines.
6. What are the advantages of reheating and intercooling in a gas turbine cycle ?
7. Discuss the relative advantages and disadvantages of reciprocating IC engines and gas turbine.
8. What are the advantages of using multistage compressors ?
9. What do you mean by 'surging' and 'choking' in compressors ?
10. Compare axial flow compressor with centrifugal compressors. **(10×4=40 Marks)**

PART – B

Answer **three** questions selecting **one** from **each** Module.

Module – I

11. a) Describe with neat sketch working of Benson Boiler.

    b) A power generating plant uses steam as working fluid and operates at a boiler pressure of 50 bar, dry saturated and a condenser pressure of 0.05 bar. Calculate for these limits (i) the cycle efficiency (ii) specific steam consumption.

12. a) Derive an expression for maximum blade efficiency in a single stage impulse turbine.

    b) A simple impulse turbine has a mean blade speed of 200 m/s. The nozzles are inclined at 20° to the plane of rotation of the blades. The steam velocity from nozzles is 600 m/s. The turbine uses 3500 kg/hr of steam. The absolute velocity at exit is along axis of the turbine. Determine (i) the inlet and exit angles of the blades (ii) the power output of the turbine (iii) the diagram efficiency (iv) the end thrust (per kg steam per second) and its direction.

Module – II

13. a) Describe with suitable sketches the phenomenon of knocking in SI engines.

    b) A fuel ($C_{10}H_{22}$) is burnt using on air fuel ratio of 13 : 1 by mass. Determine the complete volumetric analysis of the products of combustion, assuming that the whole amount of hydrogen burns to form water vapour and there is neither any free oxygen nor any free carbon. The carbon burning to CO_2 and CO.

14. a) Disuss the various types of combustion chambers used in gas turbines.

b) In a simple gas turbine plant air enters the compressor at 1 bar and 27°C and leaves at 6 bar. It is then heated in the combustion chamber to 700°C and then enters the turbine and expands to 1 bar. The isentropic efficiency of compressor and turbine are 0.80 and 0.85 respectively and the combustion efficiency is 0.98. The fall in pressure through the combustion chamber is 0.1 bar. Determine (a) the thermal efficiency (b) the work ratio (c) the air rate in kg/kW (d) the specific fuel consumption (e) the air-fuel ratio for air Cp = 1.005 kJ/kg.k, $\gamma = 1.4$. For combustion gas, Cp = 1.147 kJ/kgK, $\gamma = 1.333$, calorific value of fuel = 42700 kJ/kg.

Module – III

15. a) Derive an expression for shaft work required to run a single stage reciprocating air compressor with clearance volume when the compression process follow the law $Pv^n = c$ in terms of pressure ratio and volume of air handled.

b) A centrifugal compressor delivers 580 m^3 of free air when running at 800 rpm. Using the following data :

Inlet pressure and temperature of air = 1.013 bar and 20°C

Compression ratio = 3.5

Isentropic efficiency = 83%

Flow velocity throughout the impeller = 62 m/s

The blades are radial at outlet of impeller

Tip diameter = 2 × eye diameter

Blade area coefficient = 0.94

Find :

i) the power required to run the compressor

ii) impeller diameters at inlet and outlet

iii) breadth of impeller at inlet and

iv) impeller blade angle at inlet

16. a) Describe with a neat sketch, the working of vane type compressor and show its p-v diagram. For what application it is used ?

b) Estimate the power required to drive a single-stage single-acting air compressor to compress 8 m^3 of free air per minute at 1 bar and 20°C to 7 bar. The index of compression is 1.3. Also determine the percentage saving in the indicated power by compressing the same mass of air (i) in two stages with optimum intercooler pressure and perfect intercooling, (ii) in two stages, with imperfect intercooling to 27°C, the intercooler pressure remaining same as in case (i) and (iii) in three stages, with optimum intercooler pressure and perfect cooling. **(3×20=60 Marks)**