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Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, November 2014
(2013 Scheme)
13.307 : THERMAL ENGINEERING (MU)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions.

1. Describe Rankine cycle using p-v and T-S diagram and show how it differs from Carnot cycle.
2. Discuss with the help of T-S diagram, the effect of the following variables on the efficiency and power output of a Rankine cycle.
   a) Inlet pressure and
   b) Inlet temperature with inlet pressure maintained constant.
3. Define mean effective pressure and distinguish between brake mean effective pressure and indicated mean effective pressure.
4. Distinguish between power and specific output.
5. What is meant by stoichiometry ? Define equivalence ratio.
6. Define calorific value of fuel. Differentiate between HCV and LCV of fuel.
7. What is delay period and what are the factors affecting delay period ?
8. What are the causes of knock in CI engines ?
9. What are the assumptions made for the analysis of overall efficiency of closed gas turbine cycle ?
10. Discuss the methods of improving the performance of simple open cycle gas turbine plant. **(10×2=20 Marks)**

P.T.O.

PART – B

Answer **any one** full question from **each** Module. **Each full** question carries **20** marks.

Module – I

11. a) Derive an expression for the critical pressure ratio for the maximum flow rate of steam through nozzle. **8**

    b) A stream engine operates on ideal Carnot cycle using dry saturated steam at 17.5 bar. The exhaust takes place at 0.07 bar into a condenser. Assuming that the expansion and compression are isentropic and liquid enters the boiler as saturated liquid; find the

    a) Power developed by the engine if the steam consumption is 20 kg/min and

    b) The efficiency of the operating cycle. **12**

12. a) Derive an expression for maximum blade efficiency in a single stage impulse turbine. **8**

    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. **12**

Module – II

13. a) In what respect four stroke cycle CI engine differ from that of SI Engine. **8**

    b) A four cylinder SI engine delivers a brake power of 441.6 kW with a mechanical efficiency of 85%. The measured fuel consumption is 160 kg of fuel in one hour and air consumption is 410 kg during one sixth of an hour. The heating value of the fuel is 42000 kJ/kg. Calculate indicated power, frictional power, air fuel ratio, indicated thermal efficiency and brake thermal efficiency. **12**

14. a) Explain the effect of the following factors on the performance of an SI engine :

    i) compression ratio ii) air fuel ratio

    iii) spark timing iv) engine speed

    v) mass of inducted charge and vi) heat losses. **12**

    b) Schematically explain the use of the study of the heat balance of an engine. **8**

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Module – III

15. a) A fuel oil has the following analysis by mass: C 85%, H_2 12.5%, O_2 2% and the residue 0.5%. The dry fuel has the following composition by volume : CO_2 9%, CO 1% O_2 7.77% and N_2 82.23%, determine the air fuel ratio. 10

    b) Explain the phenomenon of knock in a CI engine and compare it with SI engine knock. 10

16. a) Describe the different types of combustion chambers of CI engines. 10

    b) Explain the phenomenon of knocking in SI engines. What are the different factors which influence the knocking ? 10

Module – IV

17. a) Derive an expression for optimum pressure ratio for maximum specific work output of a gas turbine cycle. 8

    b) A closed cycle gas turbine consists of a two-stage compressor and a two-stage turbine. All the components are mounted on the same shaft. The pressure and temperature at the inlet of the first stage compressor is 2 bar and 25°C. The maximum cycle temperature and pressure are limited to 850°C and 8 bar. A perfect inter cooler is used between the two compressors and a reheater is used between the two turbines. Gases are heated in the reheater to 850°C before entering in to the L.P. turbine.

    Assuming the compressor and turbine efficiencies as 0.83, find ;

    a) the cycle efficiency and

    b) if the I.P developed by the plant is 310 kW. Find the mass of the fluid circulated. 12

18. a) Discuss the different methods for improvement of the performance of simple open cycle constant pressure gas turbine plant. 10

    b) Compare between open cycle gas turbine and closed cycle gas turbine. 10
