Ex/BESUS/ME-405/06

B.E. (EE) Part-II 4th Semester Examination, 2006

Heat Power-II

(ME-405)

Time : 3 hours   Full Marks : 100

Use separate answerscript for each half.
Answer SIX questions, taking THREE from each half.
The questions are of equal value. Use of Steam
table, Mollier diagram permitted.

FIRST HALF

1. a) What do you mean by steam rate and heat rate of a steam power plant?

   b) A single regenerative feed water heating is used in a steam turbine power plant. The steam at 15 bar and 300°C is supplied to the turbine and is exhausted at the condenser pressure of 0.06 bar. Steam is bled for feed heating at 1.8 bar. Assuming that the expansion through the turbine is isentropic, find the improvement in thermal efficiency due to regenerative feed-heating. Also mention any assumption made for solving the problem.

2. a) What is the function of fusible plug? Explain its location in the steam boiler.

   b) Define equivalent evaporation and thermal efficiency of a boiler.

   c) The equivalent evaporation of a boiler is 10 kg of steam per kg of fuel used. The boiler produces 5000 kg/h of steam at 10 bar from feed water at 32°C and consumes 550 kg/h of fuel having C.V. of 32000 kJ/kg. Determine i) The boiler efficiency and ii) The quality of steam produced by the boiler.

3. a) Prove that maximum flow rate per unit area through a nozzle occurs when the ratio of pressure at throat to inlet pressure is equal to (------ J   , where n is the isentropic index of expansion.

   b) An adiabatic steam nozzle is to be designed for a discharge rate of 1 Okg/s of steam from 10 bar and 400°C to a back pressure of 1 bar. The nozzle efficiency is 0.92 and the frictional loss is assumed to take place in the diverging portion of nozzle only. Assume a critical pressure ratio of 0.5457. Determine the throat and exits areas.

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4. a) Explain the difference between impulse turbine and reaction turbine. Derive the expression for maximum blade efficiency in a single stage impulse turbine.

   b) A single-wheel impulse turbine has blades whose inlet angle is 40° and exit angle 37°. The mean blade speed is 230m/s and the nozzles are inclined at an angle of 27° to the plane of rotation of the blades. There is a 10% loss in relative velocity due to friction in the blades. The turbine uses 550kg/hr of steam. Determine

   i) the steam velocity at nozzle out let.
   ii) the power out put of the turbine.
   iii) the diagram efficiency.

5. Write short notes on <u>any three</u> :

   a) Benson boiler.

   b) Compounding of steam turbine.

   c) Off-design ratio performance of convergent-divergent nozzle.

   d) Heat balance of a boiler plant.

   e) Losses in a convergent-divergent nozzle.

SECOND HALF

6. a) Define isothermal efficiency and volumetric efficiency of a reciprocating compressor. Derive an expression of the volumetric efficiency of a reciprocating compressor assuming free air-condition same as suction condition of air.

   b) 5.4m^{3}of free air per minute at 0.98 bar and 30°C is compressed by a single stage double acting compressor to 8 bar. Speed of the compressor is 300 r.p.m, L/D is 1.2 and clearance ratio (K) is 0.04. Estimate the power required to operate the compressor, volumetric efficiency of of the compressor as 88% and index of compression as 1.3. Assume suction condition of air same as free air-condition.

7. a) What is meant by I.C. and E.C. engines? Compare between the spark ignition and compression ignition engines.

   b) Explain with sketch the working of a two-stroke spark ignition engine.

8. a) What do you understand by steam condenser? How does it improve the performance of steam power plant?

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    b)   With neat sketch show the different parts of a surface condenser and explain the process of condensing steam in it.

9.   a)   What is Morse test? Explain how it is carried out.

    b)   In a test on a two-stroke engine the following observations are made:

        Bore and stroke = 20cm, 25cm respectively

        Brake drum radius = 60cm. Speed = 360r.p.m.

        Brake load = 500N. Fuel consumption =

        0.06kg/min. Calorific value of fuel -

        42000kJ/kg Area of the indicator diagram

        =2.8cm^2 Length of indicator diagram = 10cm.

        Spring constant = 1000 kPa/cm.

Determine indicated, Power, break power, mechanical efficiency and brake thermal efficiency.

10. Write short notes on <u>any three</u> :

a) Cooling method of I.C. engines.

b) Sources of air leakage and effects of it on the performance of a condenser.

c) Rope brake dynamometer.

d) Knocking in S.I. engines.

e) Ideal intermediate pressure of a two stage reciprocating compressor.