Total No. of Questions : 5] [Total No. of Printed Pages : 3

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ME–404

B. E. (Fourth Semester)
EXAMINATION, June, 2012

(Grading/Non-Grading System)

(Mechanical Engg. Branch)

THERMAL ENGINEERING AND GAS DYNAMICS

(ME—404)

Time : Three Hours

Maximum Marks : $\begin{cases} GS : 70 \\ NGS : 100 \end{cases}$

Note : Attempt all questions. Internal choice is given with all the questions. Use of Steam table and Mollier charts is permitted in Examination Hall.

1. A boiler is to generate 7000 kg/h steam with 40°C of superheat at a pressure of 20 bar. The temperature of the feed water is 60°C. If the thermal efficiency of the boiler is 75%, how much fuel oil will be consumed in one hour ? The calorific value of the fuel oil used is 45000 kJ/kg; take C_p of superheated steam = 2·093 kJ/kg°K.

Or

A boiler with superheater generates 8000 kg/h of steam at a pressure of 25 bar, 0·95 dry at exit from the boiler and a temperature of 350°C on leaving the superheater. If the

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feed water temperature is 75°C and the overall efficiency of the combined boiler and superheater is 85%, determine :

(a) the amount of the coal used per hour, if the calorific value of coal used = 30000 kJ/kg.

(b) the equivalent evaporation from and at 100°C for combined unit.

2. The steam at 100 bar, 600°C enters the first stage turbine of an ideal Rankine cycle with reheat. The steam leaving the reheat section of the steam generator is at 500°C, and the condenser pressure is 0·06 bar. If the quality at the exit of the second stage turbine in 90% determine the cycle thermal efficiency.

Or

Steam at 320 bar, 520°C leaves the steam generator of an ideal Rankine cycle modified to include three turbine stages with reheat between the stages. The reheat pressures are 40 bar and 5 bar, respectively. The steam enters the second stage turbine at 440°C and third stage turbine at 360°C. The condenser pressure is 0·08 bar. Determine for the cycle :

(a) the net work per unit mass of steam flowing in kJ/kg.

(b) the thermal efficiency.

3. Air flows with a velocity of 360 m/s through a duct. At a particular section of the duct, the static pressure and temperature are 85 kPa and 290°K. Assuming the flow to be reversible adiabatic, estimate :

(i) MACH number at a given section.

(ii) MACH number, temperature and velocity at another section, where the static pressure is 125 kPa.

Or

Air has a velocity of 1000 km/hr. at a pressure of 10 kPa vacuum and a temperature of 47°C. Compute its stagnation

properties and the local MACH number. Take atmospheric pressure = 100 kPa, R = 287 J/kg°K and $\gamma = 1 \cdot 4$.

4. A single stage single cylinder reciprocating compressor has 60 m^3/hr. entering at 1·013 bar, 15°C and air leaves at 7 bar. Compression follows polytropic process with index of 1·35. Considering negligible clearance determine mass of air delivered per minute, delivery temperature, indicated power and isothermal efficiency.

Or

A reciprocating compressor of single stage and double acting type has free air delivered at 14 m^3/min. measured at 1·0132 bar and 288 K, pressure and temperature at suction are 0·95 bar and 305 K. The cylinder has clearance volume of 5% of swept volume. The air is delivered at pressure of 7 bar and expansion and compression follows the same index of 1·3. Determine the indicated power required and volumetric efficiency with respect to free air delivered.

5. (a) Differentiate between surface condenser and jet condenser.
   (b) Discuss the effect of air leakage upon the performance of condenser.
   (c) What do you understand by cooling towers ? Explain their utility.
   (d) Discuss the relevance of Dalton's law of partial pressure in condenser calculation.

Or

Write short notes on the following :
(a) Various types of cooling towers
(b) Types of condensers
(c) Classification of heat exchangers