COLLEGE OF ENGINEERING, PUNE
2013-2014
End Semester Examination
ME-9009: Steam Engineering

Programme: T.Y. B. Tech   Branch: Mechanical

Time: ____to ____am/pm   Date __/11/2013   Max. Marks: 60

Instructions:
1. **All questions are compulsory.**
2. Make suitable assumptions and use suitable standard data wherever necessary.
3. **Illustrate your answers with neat sketches.**
4. Use of steam table, Mollier diagram and non-programmable calculator is permitted.
5. Figures to right indicate full-marks.

Q1   Answer any TWO

a   Explain the importance of feed water quality and how it is maintained.   5

b   A certain fuel has the following composition by mass: 5
C 80 %, H_2 10 % and S 10%.
The volumetric analysis of the flue gas is : CO_2 =10 %, CO= 1 %, O_2 =10 % and N_2 =79 %. Find per kg of coal:
(i) the minimum air required, (ii) the actual air supplied, and (iii) the excess air supplied (iv) Quantity of flue gases produced.

c   Write a short note on "From and At Rating".   3
A boiler has a 'from and at' rating of 2000 kg/h and operates at 15 bar gauge   2
pressure. The feed-water temperature is 68°C. Calculate boiler evaporation rate.

Q2 a   "Steam is generated in the boiler at a high pressure and also distributed at a high   3
pressure but for process heating application used at lower pressure." Justify the
statement. Why the process steam boilers usually generate the steam at a pressure
of at least 7 bar g?

OR

a   Explain the concept of critical thickness of insulation and economic thickness of   4
insulation.

Why overhead HT electric cables are un-insulated.   1

b   A steam pipe of 10 cm inner diameter and 11 cm outer diameter is insulated with   5
magnesia insulation of 2 cm thick. The pipe carries the saturated steam at 10 bar
absolute pressure and exposed to atmosphere at 20 °C. The outer heat transfer coefficient
before & after insulation is 15 W/m^2-K. If the pipe is 10 m long & carries steam at a
velocity of 1 m/sec, find out:

(a) Heat loss from base pipe and percentage reduction in heat loss after insulating the
pipe.

(b) The quality of steam coming out of pipe.

Neglect inside convective resistance and assume there is no pressure loss of steam
passing through the pipe.

Q3 a   What is quality of steam? State the methods for determination of quality of steam.   2

b   Explain how flash steam is generated.   2

c   Hot condensate is at a pressure of 5 bar (g). It is then passed through the flash chamber   2
and the pressure was then reduced down to atmospheric pressure 0 bar (g). If condensate

flow rate is 100 kg/hr, determine the flash steam generated.

d State the considerations for steam trap selection.   2

e State different types of traps and write corresponding working principle.   2

Q4 a In a process plant a coal-fired boiler of 78% efficiency is proposed to be replaced with   5
paddy husk fired boiler of 68% efficiency. Calculate the cost savings for changing over
to paddy husk.

Calorific value of coal = 4800 kcal / kg , Cost of coal = Rs. 2500 / MT , GCV of paddy
husk (Kcal/kg) = 3568, Cost of Paddy Husk = Rs. 1100 / MT , Quantity of steam
requirement = 15 TPH, Enthalpy of steam = 770 kCal / kg, Enthalpy of feed water = 120
kCal / kg, Annual operating hours of boiler = 8000 hrs

b State the various (at least six) energy efficiency opportunities in a boiler system. Briefly   5
explain any two of them.

<div align="center">OR</div>

b Explain in brief the indirect method of boiler efficiency measurement. Draw the format   5
of "Boiler Heat Balance" showing all possible losses.

Q5 a What is waste heat?   1

b What are different sources of waste heat and corresponding quality?   3

c Explain the importance of condensate recovery. Explain with a neat sketch working of   4
condensate recovery system.

d Calculate the recoverable waste heat (Q, in kCal/hour) from flue gases using following   2
parameters :

V (flow rate of the substance) 2000 m^3/hr, ρ(density of the flue gas): 0.9 kg/m^3;

Cp (specific heat of the substance): 0.20kCal/kg°C; ΔT (temperature difference): 120°C;

η(recovery factor): 50%

Q6 a State different methods of flow measurement with a one line working principle. Explain   5
with neat sketch working principle of vortex shedding flow-meter.

b Explain with a neat sketch the working of "Pressure Powered Pump."   5

<div align="center">OR</div>

b Explain with a neat sketch the working of "Steam Pressure reducing Valve."   5