ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE - 2009

THERMAL POWER ENGINEERING

SEMESTER - 4

Time : 3 Hours] [Full Marks : 70

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) A closed cycle gas turbine works on

a) Carnot cycle b) Rankine cycle

c) Ericsson cycle d) Brayton's cycle. ☐

ii) The draught is produced by

a) mechanical fan b) chimney

c) steam jet d) all of these

e) none of these. ☐

iii) Water required for attemperation is taken from

a) Boiler drum b) Economizer

c) Feed pump d) Any one of (a) and (b). ☐

iv) In the Curtis stage of a turbine

a) velocity remains constant

b) pressure remains constant

c) velocity and pressure both remain constant

d) volume of steam remains constant. ☐

v) Locomotive boiler is a

a) fire tube boiler b) water tube boiler

c) bent tube boiler d) none of these.

vi) During suction stroke of C.I. engine, intake in cylinder is

a) air b) air-fuel mixture

c) fuel d) water vapour.

vii) Air-fuel mixture in an SI engine is prepared by

a) feed injection pump b) carburetor

c) injector d) none of these.

viii) Efficiency of a gas turbine can be increased by

a) reheating and regeneration

b) increasing pressure ratio

c) increasing compression ratio.

ix) The circulation ratio of once through boiler is

a) unity b) $\frac{1}{2}$

c) 3 to 10 d) 4 to 30.

x) The main function of condenser is to

a) create vacuum

b) maintain vacuum

c) condense steam to water for reuse

d) all of these

e) none of these.

xi) The gas turbine with regenerator improves

a) thermal efficiency b) work ratio

c) avoid pollution d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following questions. 3 × 5 = 15

2. What are the pollutants in the automotive engine exhaust ? How are they controlled ?

3. a) Draw neat diagrams to represent schematically :
   i) Natural circulation
   ii) Forced multiple circulation
   iii) Open hydraulic system
   iv) Combined circulation.
   b) What is the combustion efficiency of PFBC boilers ? 4 + 1

4. a) How are fuels classified ?
   b) How can you distinguish secondary fuels from the primary ones ?
   c) How does the volatile matter content determine the rank of coal ?
   d) How does sulphur occur in coal ?
   e) What is the effect of volatile matter in the combustion process ?

   1 + 1 + 1 + 1 + 1

5. Derive an expression of power required at the blade to run a steam turbine.

6. Describe briefly the working principle of an ESP with a neat sketch.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following questions. 3 × 15 = 45

7. a) What is the principle of a steam turbine ?
   b) How can steam turbines be classified ?
   c) What is the difference between impulse and reaction turbines ?
   d) With neat sketches explain velocity, pressure and pressure-velocity compoundings.
   e) What are the losses in steam turbines ?
   f) What factors are responsible for turbine blade failure ? 2 + 2 + 2 + 6 + 2 + 1

8. a) The nozzle angle for a simple impulse turbine is 20° and the steam leaves the nozzle at 400 m/s. The blade velocity is 180 m/s. What should be the inlet and outlet angles for the blades so that the blade experience no axial thrust ?

Due to friction the velocity of steam as it passes over the blades is reduced by 15%.

Also determine the power developed in the steam when flow is 10 kg/s and the kinetic energy of the steam finally leaving the turbine.

b) A boiler is fired with coal having following percentage composition by mass :

C — 85% ; H — 5% ; S — 1% ; O — 2·5% ; Non-combustible — 6·5%.

Determine the boiler efficiency from the given data :

Excess air supplied = 40%

Flue gas temperature at boiler exit = 170°C

Ambient air temperature = 25°C

Specific heat of flue gas = 0·25 $kcal.kg^{-1}.°C^{-1}$

Specific heat of steam = 0·48 $kcal.kg^{-1}.°C^{-1}$.

Combustion Reaction	***Heat of Combustion***
$C + O_2 \rightarrow CO_2$	8705 $kcal.kg^{-1}$
$S + O_2 \rightarrow SO_2$	2220 $kcal.kg^{-1}$
$H_2 + O_2 \rightarrow H_2O$	34500 $kcal.kg^{-1}$.

Unaccounted heat loss = 18%. 7 + 8

9. a) Derive an expression for the efficiency of Diesel cycle.

b) An engine working on the Otto cycle is supplied with air at 0·1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum pressure and temperature of the cycle efficiency and the mean effective pressure.

(For air, C_p = 1·005 kJ/kg-K, C_v = 0·718 kJ/kg-K and R = 0·287 kJ/kg-K).

c) What are the main characteristics of SI engine fuel ? 4 + 6 + 5

10. An engine working on Otto cycle is supplied with air at 1 bar, 35°C. The compression ratio is 8·0. Heat is supplied at 1500 kJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and mean effective pressure.

(For air, C_p = 1·005 kJ/kg-K, C_v = 0·718 kJ/kg-K and R = 0·287 kJ/kg-K).

Derive any expression used in solving the problem. 15

11. Write short notes on any *three* of the following : 3 × 5

i) Morse test

ii) Knocking in I.C. engine

iii) Lancashire boiler

iv) Velocity compounding

v) Fluidized bed boilers.

END