



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. $3 \times 5 = 15$

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. $3 \times 15 = 45$

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

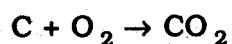
Ambient air temperature = 25°C

Specific heat of flue gas = $0.25 \text{ kcal.kg}^{-1}.\text{C}^{-1}$

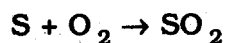
Specific heat of steam = $0.48 \text{ kcal.kg}^{-1}.\text{C}^{-1}$.

Combustion Reaction

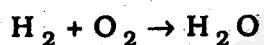
Heat of Combustion



8705 kcal.kg^{-1}



2220 kcal.kg^{-1}



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, $C_p = 1.005 \text{ kJ/kg-K}$, $C_v = 0.718 \text{ kJ/kg-K}$ and $R = 0.287 \text{ kJ/kg-K}$).

- 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