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Paper Code : ME (EE)-411

THERMAL POWER ENGINEERING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

i) Natural circulation type boiler runs on the principle of

a) differential density of hot and cold water

b) differential density of hot and cold gases at the chimney

c) natural draught system with chimney

d) none of these.

ii) Water required for attemperation is taken from

a) boiler drum b) feed pump

c) economizer d) either (a) or (b).

iii) On mollier chart, flow through turbine is represented by

a) horizontal straight line

b) vertical straight line

c) straight inclined line

d) none of these.

iv) A carburetor is used to supply the mixture of

a) petrol, air and lubricating oil

b) air and diesel

c) petrol and lubricating oil

d) petrol and air.

v) In SI engine, high voltage for spark plug is developed using

a) battery b) distributer

c) ignition coil d) carburetor.

vi) Regenerator in a gas turbine plant is used for

a) improving specific work output

b) improving thermal efficiency

c) improving work ratio

d) none of these.

vii) Bomb calorimeter is used to determine the calorific value of

a) solid fuels only

b) liquid fuels only

c) solid as well as liquid fuels

d) gaseous fuel.

viii) A safety valve mainly used with locomotive and marine boilers is

a) lever safety valve

b) high pressure and low water safety valve

c) dead weight safety valve

d) spring loaded safety valve.

ix) The commonly used method of governing in steam turbines is by

a) throttle governing

b) nozzle control governing

c) bypass governing

d) hydraulic governing.

x) The main function of condenser is to

a) create vacuum

b) condense steam to water for reuse

c) maintain vacuum

d) all of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is the function of the Air pre-heater ? How does it save the fuels ?
3. When the top dryness fraction becomes zero then there will be no natural circulation and forced circulation is used. Justify it.
4. Differentiate between boiler accessories and boiler mountings with example.

5. How much air is required per kg of coal in a boiler having chimney height 35 m to create a draught of 20 mm of water ? Temperature of flue gas in chimney 370°C and boiler house temperature is 34°C.

6. What is degree of reaction ? Why persons's turbine is called 50% reaction turbine. 2 + 3

GROUP – C
(Long Answer Type Questions)

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

7. a) What factors are considered in the selection of boiler in a power plant ?

   b) Describe with a neat sketch the working of Cochran boiler. Show the position of different mountings.

   c) Steam is generated in a boiler at 30 bar. 300°C at the rate of 11 kg/s with feed water entering economizser at 27°C and leaving at 100°C. During one hour test, 500 kg fuel is used in boiler. CV on fuel is 35000 kJ/kg. Find :

      i) the equivalent evaporation per kg of fuel

      ii) the efficiency of boiler. 2 + 5 + 8

8. a) A chimney of height 32 m is used for producing a draught of 16 mm of water. The temperatures of ambient air and the flue gases are 27°C and 300°C respectively. The coal burned in the combustion chamber contains 81% carbon, 5% moisture and remaining ash. Find the percentage of excess air supply.

   b) A dual cycle engine takes heat addition in constant pressure process is half of that at constant volume process. If the compression ratio is 12, Maximum pressure in cycle is 43·5 bar, Air intake at 1·032 bar and 16·4°C, $C_v = 0 \cdot 701$, $C_p = 1 \cdot 2$.

   Calculate :

      i) the temperature of the five mean point of the cycle.

      ii) the efficiency of the engine. 7 + 8

9. a) What are ultimate analysis and proximate analysis of coal ?

   b) The analysis of coal used in boiler trial is as follows : 82 % carbon, 6% hydrogen, 4% oxygen, 2% moisture and 6% ash. Determine the theoretical minimum air required for complete\combustion of 1 kg of coal. If the actual air supplied is 18 kg per kg of coal, the hydrogen is completely burnt and 80% of carbon is burnt to CO_2, the remainder to CO, determine the volumetric analysis of the dry products of combustion. 6 + 9

10. a) Derive the efficiency of Brayton Cycle.

b) An engine working on the dual cycle has a cylinder bore of 20 cm and stroke of 40 cm. The compression ratio is 14·5 and the pressure ratio of the constant volume heat addition process is 1·5. The constant pressure heat addition cut-off takes place at 4·9 per cent of the stroke. Determine the air-standard efficiency. (Assume $\gamma = 1.4$) 6 + 9

11. a) What is the object of supercharging ? Why is it more beneficial in a CI engine compared to a SI engine ?

b) In an air standard diesel cycle, the compression ratio is 16 and at the beginning of isoentropic compression the temperature is 15°C and the pressure is 0·1 MPa. Heat is added until the temperature is 1480°C at the end of constant pressure process.

Calculate :

i) the cut-off ratio

ii) the heat supplied per kg of air

iii) the cycle efficiency

iv) the mep. 7 + 8