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3 Hours / 70 Marks Seat No. ☐☐☐☐☐☐☐☐

Instructions – (1) All Questions are *Compulsory.*

(2) Illustrate your answer with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if necessary.

(5) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(6) Use of Steam tables, logarithmic, Mollier's chart is permitted.

Marks

1. **Attempt any FIVE of the following:** 10

   a) State Zeroth Law of Thermodynamics.

   b) Draw P-V and T-S diagram for isobaric process.

   c) Define LCV of fuel and write it's unit.

   d) Define :–

      i) Dryness Fraction

      ii) Degree of superheat

   e) Write uses of compressed air. (Any four)

   f) State four limitations of solar energy.

   g) List different renewable energy sources.

Marks

2. **Attempt any THREE of the following:**   **12**

a) Describe working of two pass surface condenser with a neat sketch.

b) An engine working on Otto cycle has volume of 0.5 m^3, pressure of 1 bar and temperature of 27°C at the beginning of compression. If at the end of compression, pressure is 10 bar. Find :–

   i) Mass of air

   ii) Volume and temperature at the end of compression.

c) State various factors affecting volumetric efficiency of air compressor.

d) Calculate the enthalpy of 1 kg of stem at a pressure of 7 bar and dryness fraction 0.8. How much heat would be required to raise 2 kg of this steam from water at 30°C? Take C_{pw} = 4.187 kJ/kg°C.
   hfg at 7 bar = 2065.8 kJ/kg h_f = 697.00 kJ/kg
   Ts = 167.7°C.

3. **Attempt any THREE of the following:**   **12**

a) Write various modes of heat transfer. Give one example of each mode.

b) A coal has following composition by mass : C = 85%, H_2 = 4%, S = 1%, O_2 = 2% and N_2 = 1% and remaining is ash. Find HCV and LCV of fuel.

c) Draw P-V and T-S diagram of diesel cycle. Also write formula for air standard efficiency with meaning of each term involved in it.

d) Suggest energy conservation techniques used in air compressor.

Marks

4. **Attempt any THREE of the following:** **12**

    a) Differentiate between open system and closed system.

    b) Explain the combustion chemistry of carbon with incomplete combustion and complete combustion.

    c) Explain cogeneration system on the basis of sequence of energy use.

    d) Explain construction and working of Axial Flow Compressor with neat sketch.

    e) Explain the importance of energy conservation. Also state it's impact on environment and economy.

5. **Attempt any TWO of the following:** **12**

    a) Describe with neat sketch construction and working of Bomb Calorimeter. Write Dulong's formula and state it's use.

    b) List the sources of air leakage in condenser. Explain it's effect on condenser performance.

    c) Explain the use of solar energy to generate electricity with neat sketch. Write the two places where solar energy power plants are based.

6. **Attempt any TWO of the following:** **12**

    a) Define following terms related to air compressor;

       i) I.P.

       ii) B.P

       iii) Volumetric efficiency

       iv) Compressor efficiency

       v) Isothermal efficiency

       vi) Capacity of compressor.

    b) A steam engine obtains steam from a boiler at a pressure of 15 bar and 0.98 dry. It was observed that the steam lost 21 KJ of heat per kg as it flows through the pipeline, pressure remains constant. Calculate dryness fraction of steam, at the engine end of the pipeline. (Take hf = 844.6 KJ/kg and hfg = 1945.3 KJ/kg at 15 bar pressure).

    c) Describe government policy (MNRE) for harnessing the potential power of renewable energy sources.

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