Instructions:
(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.
(6) Use of psychrometry chart is allowed.

1. Attempt any FIVE of the following: [10]
   (a) Write uses of compressed air?
   (b) State the Unit of Refrigeration.
   (c) State the functions of Catalytic Converter.
   (d) Define the term ‘Compressor capacity’.
   (e) Name the essential components used in Gas turbine.
   (f) Classify gas turbines.
   (g) State the any two advantages of ‘Turbo Charging’.

2. Attempt any THREE of the following: [12]
   (a) Represent Diesel Cycle on P-V and T-S diagram.
   (b) State the effect of ‘Air-Fuel Ratio’ on exhaust emission.
   (c) Explain the working of ‘Lobe type Air Compressor’ with neat sketch.
   (d) Represent Brayton Cycle on P- V and T- S diagram.

3. Attempt any THREE of the following: [12]
   (a) List the pollutants in exhaust gases of I.C engines and state their effects on the environment and human–being.
   (b) Explain the term
       (i) Octane Number       (ii) Knock Resistance
   (c) Explain with neat sketch the working of Household Refrigerator.
   (d) Differentiate between Two Stroke and Four Stroke I. C Engine (any four points).

4. Attempt any THREE of the following: [12]
   (a) Explain the term ‘Exhaust Gas Recirculation’ with neat sketch.
   (b) Draw the labeled Valve Timing Diagram of typical 4– stroke Diesel Engine.
   (c) Explain the concept of following terms with respect to refrigerants
       (i) GWP         (ii) ODP
   (d) Explain the effect of clearance volume on multi stage Air compressor without intercooling by using P V diagram.
   (e) Explain the working of ‘Turbo Prop’ with neat sketch.

5. Attempt any TWO of the following: [12]
   (a) Following observations were recorded during a trial on single cylinder four stroke oil engine:
       Cylinder bore = 15 cm
       Length of stroke = 25 cm
       Mean effective pressure = 7.35 bar
       Engine speed = 400 rpm
       Brake torque = 225 N.m.
       Fuel consumption = 3 kg/hr
Calorific value of fuel = 44200 kJ/kg
Determine:
(i) Mechanical efficiency
(ii) Brake thermal efficiency
(iii) Brake specific fuel consumption

(b) A single stage reciprocating air compressor has swept volume of 2000 cm³ and runs at 600 rpm. It operates on pressure ratio of 8 and clearance 5% of swept volume. Assume NTP room condition at inlet (P = 101.3kPa, T = 15°C) and polytropic compression and expansion with n = 1.25 calculate:
(i) Indicated power
(ii) Volumetric efficiency
(iii) Mass flow rate
(iv) Isothermal efficiency

(c) A simple saturation vapour compression cycle using R-12 is designed for 10 TR capacity. The vapour is dry saturated at the start of compression. For the 268°C evaporator temperature and 308°C condenser temperature, Represent process on P-H and T-S diagram. Find:
(i) Mass flow rate of refrigerant
(ii) Power required in kW
(iii) C.O.P.
Given enthalpy values:
(i) at the start of compression = 185 kJ/kg
(ii) at the end of compression = 206 kJ/kg
(iii) at the start of expansion = 70 kJ/kg

6. Attempt any TWO of the following:

(a) An IC engine uses 6 kg of fuel per hour having CV of 43,000 kJ/kg. The brake power developed is 21 kW. The temperature rise of cooling water is 23°C. Rate of water flow is 11 kg/min. The temperature rise of exhaust gas is 250°C. Rate of flow of exhaust gases is 4.6 kg/min specific heat of water 4.187 kJ/kg °C specific heat of exhaust gas are 1 kJ/kg °C Prepare heat balance sheet on minute basis.

(b) State the methods to improve efficiency of air compressor. Explain working of Two stage air compressor with perfect intercooling with the help of P-V diagram

(c) The air is at 24°C DBT and 40% Relative humidity. With the help of psychrometric chart find following properties of air with units and plot the same on psychrometric chart.
(i) Dew point temperature
(ii) Wet bulb temperature
(iii) SP volume of air
(iv) Enthalpy of air
(v) SP humidity of air

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