

22562

22232

3 Hours / 70 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Answer each next main Question on a new page.
  - (3) Illustrate your answers with neat sketches wherever necessary.
  - (4) Figures to the right indicate full marks.
  - (5) Assume suitable data, if necessary.
  - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.
  - (8) Use of Steam tables, logarithmic, Mollier's chart and psychrometric chart is permitted.

**Marks**

1. Attempt any FIVE of the following :

10

- (a) Define the terms 'Swept Volume' and 'Clearance Volume' for an I.C. Engine.
- (b) Define one ton of refrigeration.
- (c) Define BSFC.
- (d) State any two applications of compressed air.
- (e) State two applications of gas turbines.
- (f) State two important differences between turbojet and turboprop engines.
- (g) State two advantages of supercharging.



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

- (a) Compare SI and CI engines on the basis of following points :
  - (i) Method of ignition
  - (ii) Fuel used
  - (iii) Compression ratio
  - (iv) Noise and Vibrations
- (b) Explain the working of catalytic convertor with neat sketch.
- (c) Define the terms “volumetric efficiency” and “isothermal efficiency” for air compressor.
- (d) Represent Brayton cycle on P-V and T-S diagrams. Name the processes.

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

- (a) Represent Otto cycle and Diesel cycle on P-V and T-S diagrams.
- (b) State the purpose of conducting Morse Test. Explain its procedure.
- (c) Define DBT, WBT, Relative humidity and Specific humidity.
- (d) Differentiate between two stroke and four stroke I.C. engines. (Any Four Points)

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

- (a) Draw the neat sketch of Common Rail Direct Injection (CRDI) system. Label all parts.
- (b) Name any four sensors used in I.C. engines and state their functions.
- (c) Draw the neat sketch of ice plant. Label all the components.
- (d) Explain working of centrifugal compressor with neat sketch.
- (e) Differentiate between open cycle and closed cycle gas turbine.

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

- (a) Following observations are recorded during a trial on four stroke diesel engine :

Fuel supplied = 0.1 kg/min.

Calorific value of fuel : 41,840 kJ/kg

Engine speed : 400 rpm

Effective diameter of brake drum = 1 m

Net load on the brake drum = 1000 N

Mass flow rate of cooling water = 10 kg/min

Rise in cooling water temperature = 25 °C

Air supplied : 6 kg/min

Exhaust gas temperature : 200 °C

Specific heat of water : 4.186 kJ/kg °k

Specific heat of exhaust gas : 1 kJ/kg °k

Room temperature = 30 °C

Prepare heat balance sheet on minute basis.

- (b) A single stage air compressor delivers air at 5 bar. Suction temperature is 20 °C. Suction pressure is 1 bar. The volume of air entering into compressor is 3 m<sup>3</sup>/min. The index of compression is 1.2. Calculate power required and isothermal efficiency.

- (c) A refrigeration system works on vapour compression cycle. Enthalpies at various points are given below :

Compressor inlet : 1460 kJ/kg

Compressor outlet : 1796 kJ/kg.

Inlet to expansion valve : 322 kJ/kg.

Calculate : (i) COP (ii) Power required for one kg of refrigerant circulated per min.

The refrigerant is superheated by 15 °C before it enters the compressor and subcooled by 3 °C before expansion. Sketch the cycle on P-H and T-S diagrams.

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

- (a) A single cylinder four stroke diesel engine gave the following results :

Speed of the engine : 400 rpm

Load on the brake : 370 N

Diameter of the brake Drum : 1.2 m

Fuel consumption : 2.8 kg/hr

Calorific value of fuel : 41,800 kJ/kg

Cylinder diameter : 160 mm

Piston stroke : 200 mm

Calculate : (i) Brake Power (ii) bsfc (iii) Brake thermal efficiency

- (b) It is desired to compress  $16 \text{ m}^3$  of air per minute from 1 bar to 10.5 bar.

Calculate minimum power required to drive the compressor with two stage compression and compare it with power required for single stage compressor.

Assume the value of index of compression 1.35 in both cases. Also, assume the condition for maximum efficiency.

- (c) With the help of psychrometric chart find following properties of air at  $25^\circ\text{C}$

DBT and 50% relative humidity :

(i) Dew point temperature

(ii) Wet bulb temperature

(iii) Specific volume of air

(iv) Enthalpy of air

(v) Specific humidity of air

Draw psychrometric chart showing all above properties.

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