

315371

25226

3 Hours / 70 Marks

Seat No.

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- 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) Use of Non-programmable Electronic Pocket Calculator is permissible.
- (6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.
- (7) Use of Psychrometric chart is permitted.

Marks

1. **Attempt any FIVE of the following:** **10**
- a) State the unit of refrigeration. Derive its value in SI unit.
- b) Define the terms:
- i) Wet Bulb Temperature
- ii) Dew Point Temperature.
- c) Define the terms:
- i) Indicated Power
- ii) Indicated thermal Efficiency
- d) Define the following terms related to air compressor.
- i) Volumetric Efficiency
- ii) Isothermal Efficiency

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- e) List any four effects of polluting emissions on environment in case of S.I. engine.
- f) Represent the Bellcoleman Air Refrigeration cycle on PV and TS chart.
- g) Sketch the psychrometric chart and show the following lines on it:-
 - i) Relative Humidity
 - ii) Wet bulb Temperature.

2. Attempt any THREE of the following: 12

- a) List any eight desirable properties of ideal refrigerant.
- b) List any four factors affecting on comfort airconditioning.
- c) State the need of heat balance sheet. Plot the heat balance sheet and mention the various items to be determined to complete it.
- d) Explain with indicator diagram the effect of intercooling in a multistage reciprocating compressor.

3. Attempt any THREE of the following: 12

- a) Compare the vapour compression refrigeration with vapour absorption system on following basis:
 - i) Components
 - ii) Refrigerant used
 - iii) Energy input
 - iv) COP
 - v) Noise and maintenance
 - vi) Flexibility
 - vii) Pressure ratio
 - viii) Application.

- b) Represent the following psychrometric processes on psychrometric chart:-
- i) Sensible cooling
 - ii) Cooling with dehumidification
 - iii) Heating with dehumidification
 - iv) Latent heating.
- c) Explain the method of determining the Indicated Power of a multicylinder engine without using an indicator.
- d) "Clearance volume is purposely provided in each reciprocating compressor". Justify the statement. Is it desirable to have a high clearance volume in cylinder?

4. Attempt any THREE of the following:

12

- a) Compare the reciprocating compressor with rotary compressor on following basis:
- i) Construction
 - ii) Efficiency
 - iii) Noise level
 - iv) Air flow
 - v) Pressure level
 - vi) Application
 - vii) Maintenance
 - viii) Connectivity with prime mover.
- b) List the factors affecting efficient management in compressed air system.
- c) An airconditioning system installed in your institutes metrogy laboratory is proposed for energy audit. Prepare the checklist for energy saving opportunities in this system.
- d) A 100 litre storage type water cooler is provided for cooling of drinking water in your institute. Prepare the checklist for energy saving opportunities in this system.

- e) A single acting two stage compressor with perfect intercooling delivers 5 kg/min of air at 15 bar pressure. Assuming an intake condition of 1 bar and 15°C and compression process as polytropic with index $n = 1.3$ Calculate the indicated power required and isothermal efficiency of compressor.

Take $R = 287 \text{ kJ/kgK}$ for air.

5. Attempt any TWO of the following:

12

- a) Sketch a refrigeration system used in 100 liter capacity water cooler and explain its working.
- b) A $12' \times 20'$ hall is required to be air-conditioned. Suggest the air-conditioning system for this purpose. Draw the layout of it and explain its working.
- c) A two stroke engine was motored when the meter reading was 1.5 kW. Then the test on the engine was carried out for one hour and the following observations were recorded:

Brake torque = 120 N.m, Speed = 600 rpm, Fuel used = 2.5 kg.
Calorific value of fuel = 40.3 MJ/kg, Cooling water used = 818 kg.
Rise in temperature of cooling water is 10°C, Exhaust gas temperature 345°C, Room temperature = 25°C, A/F = 32:1.

Determine:

- i) Brake Power
- ii) Indicated Power
- iii) Draw heat balance sheet on minute basis and also in percentage.

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

- a) The capacity of a refrigerator is 200 TR, when working between -6°C and 25°C . Determine the mass of ice produced per day from water at 25°C . Also find the power required to drive the unit. Assume that the cycle operates on reversed Carnot cycle and a latent heat of ice is 335 kJ/kg.
 - b) 200 m^3 of air per minute is passed through the adiabatic humidifier. The condition of air at inlet is 40°C dry bulb temperature and 15% relative humidity and the outlet condition is 25°C dry bulb temperature and 20°C wet bulb temperature. Plot the process on psychrometric chart and find:
 - i) Dew point temperature at outlet
 - ii) Amount of water vapour added
 - iii) Change in sensible heat.
 - c) A four cylinder engine running at 1200 rpm delivers 20 kW. The average torque when one cylinder was cut is 110N.m. Find:
 - i) Indicated Power
 - ii) Brake power
 - iii) Indicated thermal efficiency if the calorific value of the fuel is 43 MJ/kg and the engine uses 360 gm of fuel per kW. hr.
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