Power Engineering (315371)

MSBTE Diploma · K-Scheme · Model Question Paper — Set B

Time: 3 Hours **Max. Marks: 70**

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. Use of steam tables, refrigerant tables and psychrometric chart is permitted.
8. Mobile phone, pager and any other electronic communication devices are not permissible in the examination hall.

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

a) Define coefficient of performance (COP) of a refrigerator. Why is the term COP used instead of efficiency?

b) Define dew point temperature and relative humidity.

c) Define indicated power and indicated thermal efficiency of an I.C. engine.

d) Define isothermal efficiency and capacity of an air compressor.

e) List any four effects of I.C. engine exhaust emissions on human health and the environment.

f) Name the components of a simple vapour absorption (aqua-ammonia) refrigeration system.

g) Sketch the psychrometric chart and show on it: i) constant relative humidity lines ii) constant wet bulb temperature lines.

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

a) Explain the Bell-Coleman air refrigeration cycle with a neat schematic and its p–v and T–s diagrams. Write the expression for its COP.

b) Select a suitable air compressor for the following applications with justification: i) spray painting in a small garage ii) blast-furnace air supply in a steel plant iii) aircraft gas turbine engine iv) turbocharging of an automobile engine.

c) Explain any four factors affecting comfort air conditioning.

d) "Clearance volume is purposely provided in a reciprocating compressor." Justify the statement. Is a large clearance volume desirable? Explain with a p–V diagram.

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

a) Explain Willan's line method of finding the friction power of a diesel engine. State its limitation.

b) State the function of any four sensors used in an Engine Control Unit (ECU).

c) Explain with a neat sketch the construction and working of an axial flow compressor.

d) Explain with a neat sketch the construction and working of a 4-way ceiling-mounted cassette air conditioner.

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

a) Compare reciprocating and rotary air compressors on the basis of: i) construction ii) efficiency iii) noise level iv) air flow v) pressure level vi) application vii) maintenance viii) connection with prime mover.

b) Explain the role of the main components of a compressed air system with a neat layout.

c) A 100 litre storage-type water cooler is provided in your institute. Prepare a checklist of energy saving opportunities for it.

d) Explain the working of a three-way catalytic converter with a neat sketch.

e) A single-acting two-stage reciprocating air compressor with perfect intercooling delivers 4 kg/min of air at 12 bar. Suction conditions are 1 bar and 20 °C, and the compression follows $pV^{1.25} = C$ in both stages. Find the intermediate pressure, the indicated power and the isothermal efficiency. Take R = 0.287 kJ/kg·K.

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

a) A refrigerator of 15 TR capacity works on the reversed Carnot cycle between −8 °C and 30 °C. Determine (i) COP, (ii) the mass of ice produced per day from water at 20 °C, and (iii) the power required. Take latent heat of ice = 335 kJ/kg, specific heat of water = 4.187 kJ/kg·K and 1 TR = 3.5 kW.

b) A seminar hall of 15 m × 8 m × 3.5 m (height) is used by 60 persons. Suggest a suitable air-conditioning system for it. Draw the layout and explain its working.

c) A single-cylinder two-stroke oil engine was first motored at the test speed and the power input to the motor was 2.2 kW. The engine was then run for one hour and the following observations were recorded: brake torque = 150 N·m, speed = 700 rpm, fuel used = 3.1 kg, calorific value = 41 MJ/kg, cooling water = 700 kg with a temperature rise of 12 °C, exhaust gas temperature = 360 °C, room temperature = 28 °C, air–fuel ratio = 30 : 1, specific heat of exhaust gas = 1.05 kJ/kg·K. Determine (i) brake power, (ii) indicated power and mechanical efficiency, (iii) heat balance sheet on minute basis and in percentage.

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

a) Sketch the refrigeration system used in a 100 litre water cooler and explain its working.

b) Air at 12 °C DBT and 85 % RH flows at the rate of 1.2 m^3/s (measured at inlet) over a heating coil and leaves at 32 °C DBT. Show the process on the psychrometric chart and find (i) relative humidity and wet bulb temperature at the exit, (ii) dew point temperature, (iii) the heat added in kW.

c) A four-cylinder petrol engine running at 1500 rpm develops a brake power of 30 kW. When one cylinder is cut off (at the same speed), the average torque is 130 N·m. The engine uses 300 g of fuel per kWh (brake) and the calorific value of the fuel is 44 MJ/kg. Assuming all cylinders develop equal power, find (i) brake power with one cylinder cut off, (ii) indicated power of the engine, (iii) mechanical efficiency, (iv) indicated thermal efficiency.

Note: This is a **model question paper prepared by Ananda Technologies** only for practice and exam preparation, based on the pattern of previous MSBTE question papers and the K-scheme syllabus. It is **not an official MSBTE paper**, and it does **not** mean that these questions will come in the exam. Answers follow standard textbook points; marks shown are indicative. Free for students — anandatechnologies.in