

Thermal Engineering (313310)

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

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, logarithmic tables and Mollier 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 intensive and extensive properties with one example each.
- b) Define universal gas constant. State its value and SI unit.
- c) Define: i) Dryness fraction of steam ii) Degree of superheat.
- d) State Dalton's law of partial pressures.
- e) State any four applications of steam nozzles.
- f) Define: i) Black body ii) Gray body.
- g) Define for an I.C. engine: i) Compression ratio ii) Swept volume.

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

- a) Explain the concept of heat engine, heat pump and refrigerator with neat block diagrams.
- b) State the Kelvin–Planck and Clausius statements of the second law of thermodynamics.
- c) Represent the isothermal process on P–V and T–S diagrams. Write the expression for work done during the process.
- d) 1.5 kg of air at 30 °C is heated in a closed rigid vessel until its pressure becomes 2.5 times the initial pressure. Determine: i) final temperature ii) change in internal energy iii) heat supplied. Take $C_v = 0.718 \text{ kJ/kg K}$.

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

- a) Explain the formation of steam at constant pressure with the help of temperature–enthalpy (T–H) diagram.
- b) Classify steam boilers on the basis of: i) relative position of water and hot gases ii) position of furnace iii) method of circulation of water iv) steam pressure.

- c) Explain the construction and working of a surface condenser with a neat labelled sketch.
- d) Differentiate between impulse turbine and reaction turbine. (Any four points)

Q.4 Attempt any THREE of the following:

12

- a) State Fourier's law of heat conduction and Newton's law of cooling.
- b) A boiler wall is 20 mm steel ($k = 50 \text{ W/m K}$) covered by 6 mm insulation ($k = 0.1 \text{ W/m K}$). Inner and outer surface temperatures are 320°C and 45°C . Find the heat flow per m^2 and the interface temperature.
- c) Represent the Otto cycle on P–V and T–S diagrams and name the processes.
- d) Differentiate between two stroke and four stroke engines. (Any four points)
- e) 0.05 m^3 of air at 1 bar and 27°C is compressed to 0.008 m^3 according to the law $pV^{1.25} = \text{constant}$. Find the final pressure, final temperature and the work done. Take $R = 0.287 \text{ kJ/kg K}$.

Q.5 Attempt any TWO of the following:

12

- a) Write the steady flow energy equation per unit mass and state the meaning of each term. Apply it to: i) steam boiler ii) steam turbine.
- b) Steam at 12 bar is i) 0.88 dry ii) superheated to 250°C . Using the steam table extract below, find the enthalpy and specific volume in each case, and the heat required to convert 2 kg of the wet steam into superheated steam at 250°C at the same pressure. Take $C_{ps} = 2.1 \text{ kJ/kg K}$.

p (bar)	$t_s (^\circ\text{C})$	$v_g (\text{m}^3/\text{kg})$	$h_f (\text{kJ/kg})$	$h_{fg} (\text{kJ/kg})$	$h_g (\text{kJ/kg})$
12	188.0	0.1632	798.5	1985.3	2783.8

- c) Explain the construction and working of a forced draught cooling tower with a neat sketch.

Q.6 Attempt any TWO of the following:

12

- a) Explain the construction and working of the Lamont boiler with a neat labelled sketch.
- b) Classify heat exchangers. Explain the construction and working of a shell and tube heat exchanger with a neat sketch.
- c) Explain the working of a four stroke C.I. (diesel) engine with neat sketches.

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