

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER, 2006

Third Semester

Electrical and Electronics Engineering

ME 251 — THERMODYNAMICS

Time : Three hours

Maximum : 100 marks

Use of steam table, mollier chart, HMT databook, permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define "Thermodynamic system". Name various types of system.
2. State Kelvin Planck statement of second law of thermodynamics.
3. Sketch Dual cycle on P-V diagrams and name the processes.
4. State the meaning of SI and CI engines. Why they are called so?
5. Name any four boiler accessories.
6. Name various types of compounding of steam turbines.
7. State few uses of compressed air.
8. State the condition of refrigerant as it enters the evaporator and condenser in a vapour compression refrigeration system.
9. What are fins? Name few types.
10. State how convection is different from radiation?

PART B — (5 × 16 = 80 marks)

11. (i) A quantity of gas has a volume of  $0.14 \text{ m}^3$ , pressure 1.5 bar and temperature  $100^\circ \text{C}$ . If the volume at the end of constant pressure process is  $0.112 \text{ m}^3$  find final temperature, work done, change in internal energy, heat given out. Take  $C_p = 1.005 \text{ kJ/kg K}$ ;  $C_v = 0.712 \text{ kJ/kg K}$ ,  $R = 285 \text{ J/kg K}$ . (10)

(ii) Write expressions for change in entropy of perfect gas during

(1) constant volume process in terms of pressure and in terms of temperature.

(2) constant pressure process in terms of volume and in terms of temperature. (6)

12. (a) (i) Sketch Diesel cycle on P-V and T-S diagrams and write the expression for its "Air standard efficiency". Name all processes. (6)

(ii) An engine working on Otto cycle has cylinder diameter 150 mm and stroke 225 mm. The clearance volume is  $1.25 \times 10^{-3} \text{ m}^3$ . Find Air standard efficiency assuming  $\gamma = 1.4$ . What is temperature at the end of compression if initial temperature is  $40^\circ \text{C}$ . (10)

Or

(b) (i) Explain in detail with simple illustrations the working principle of a 4-stroke SI engine. (12)

(ii) Draw a simple layout of components of an open cycle gas turbine. (4)

13. (a) (i) Determine the quantity of heat required to produce 1 kg of steam at a pressure of 6 bar from water, at a temperature of  $25^\circ \text{C}$ , under the following conditions

(1) When the steam is 90% dry

(2) When it is heated to a temperature of  $250^\circ \text{C}$ .

Assume  $C_p$  for super heated steam as  $2.3 \text{ kJ/kg K}$ . (6)

(ii) A steam power plant is supplied with dry saturated steam at 12 bar. The condenser pressure is 0.1 bar, calculate Rankine efficiency. (10)

Or

- (b) (i) Explain with simple illustration the working of any modern high pressure boiler. (12)
- (ii) Sketch the inlet and outlet velocity triangles for an impulse blade. (2)
14. (a) (i) With simple illustration for suction and delivery, explain the working principle of a single stage reciprocating air compressor. (10)
- (ii) List at least four important differences between reciprocating and rotary compressors. (6)

Or

- (b) (i) Sketch a simple layout of vapour compression refrigeration system and explain the working principle. (12)
- (ii) Represent the theoretical vapour compression cycle on T-S and p-h diagrams. (4)
15. (a) The wall of a cold room is of three layers. Outside layer is brick of 200 mm thick. Middle layer is cork of 100 mm thick. Inside layer is cement of 50 mm thick. Outside air is at 25° C and inside air is -20° C. Film coefficient for outside Air/brick is 45.4 N/m<sup>2</sup>°C and inside film coefficient for air/cement is 17 w/m<sup>2</sup>°C. Values of K for brick, cork and cement respectively are 3.45, 0.043 and 0.294 w/m°C.
- (i) Sketch the cross section of composite wall with temperature profile and an analogous electrical circuit. (6)
- (ii) Find the rate of heat flow under steady state conditions. (5)
- (iii) Determine the temperature on the exposed wall surfaces. (5)

Or

- (b) Write briefly about
- (i) "Critical insulation thickness" of pipes. (6)
- (ii) Forced convection. (5)
- (iii) Concept of black, opaque and white body with the help of absorptivity, reflectivity and transmittivity. (5)