

T 8246

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

Fourth Semester

Mechanical Engineering

ME 1251 — THERMAL ENGINEERING

(Common to B.E. (Part-Time) Third Semester (R 2005))

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

(Use of Steam table/ charts and refrigeration table/ charts is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define air standard efficiency of Dual cycle.
2. Define mean effective pressure of an I.C. engine.
3. What is the function of push rod and rocker arm?
4. What are the basic requirements of a fuel injection system of a diesel engine?
5. What is super saturated flow in a nozzle?
6. Explain the diagram efficiency of steam turbine.
7. What are the advantages of multi-stage air compressor?
8. Define the isothermal efficiency of a compressor.
9. What is the unit of refrigeration and explain.
10. Define degree of saturation and specific humidity.

PART B — (5 × 16 = 80 marks)

11. (a) A dual combustion air standard cycle has a compression ratio of 10. The constant pressure part of combustion takes place at 40 bar. The highest and the lowest temperatures of the cycle are 1727° C and 27° C respectively. The pressure at the beginning of compression is 1 bar. Calculate (i) the pressures and temperatures at key points of the cycle, (ii) the heat supplied at constant volume, (iii) the heat supplied at constant pressure, (iv) the heat rejected, (v) the work output, (vi) the efficiency and (vii) mep.

Or

- (b) (i) Explain the working of 4-stroke cycle Diesel engine. Draw theoretical and actual valve-timing diagram for the engine. Explain the reasons for the difference. (10)
- (ii) Air enters the compressor of a gas turbine at 100 kPa and 25° C. For a pressure ratio of 5 and a maximum temperature of 850° C determine the thermal efficiency using the Brayton cycle. (6)
12. (a) Explain why cooling is necessary in I.C. engine. With neat sketches describe the working of water cooling system used for multi-cylinder engine. Why should a pump and thermostat be provided in the cooling system of an engine?

Or

- (b) Explain with neat sketches the method of lubrication of the following parts of the I.C. Engines.
- (i) Piston and cylinder
- (ii) Crank-pin and Gudgeon pin
- (iii) Cam-shaft.
13. (a) Steam at a pressure of 15 bar with 50° C of superheat is allowed to expand through a convergent-divergent nozzle. The exit pressure is 1 bar. If the nozzle is required to supply 2 kg/sec. of steam to the turbine, then calculate
- (i) The velocities at throat and exit
- (ii) Areas at throat and exit
- Assume 10% frictional loss in divergent part only and percentage taken as % of total heat drop.

Or

(b) The blade speed of a single ring of an impulse turbine is 300 m/s and the nozzle angle is 20° . The isentropic heat drop is 473 kJ/kg and the nozzle efficiency is 0.85. Given that the blade velocity coefficient is 0.7 and the blades are symmetrical, draw the velocity diagrams and calculate for a mass flow of 1 kg/s :

- (i) Axial thrust on the blading.
- (ii) Steam consumption per B.P. hour if the mechanical efficiency is 90 per cent.
- (iii) Blade efficiency and stage efficiency.

14. (a) (i) Define the volumetric efficiency of a reciprocating compressor and explain why it is less than unity.

(ii) Determine the size of the cylinder of a double acting air-compressor of 32 KW I.P. in which air is drawn in at 1 bar and compressed to 16 bar according to the law $pv^{1.25} = \text{constant}$.

R.P.M. = 300, Piston speed = 180 m/min, Volumetric efficiency = 0.8.

Or

(b) A two-stage double acting air compressor, operating at 200 r.p.m, takes in air at 1.013 bar and 27° C. The size of the L.P. cylinder is 350×380 mm, the stroke of H.P. cylinder is the same as that of the L.P. cylinder and the clearance of both the cylinders is 4%. The L.P. cylinder discharges the air at a pressure of 4.052 bar. The air passes through the inter-cooler so that it enters the H.P. cylinder at 27° C and 3.850 bar, finally it is discharged from the compressor at 15.4 bar. The value of n is both cylinders is 1.3. $C_p = 1.0035$ kJ/kg-K and $R = 0.287$ kJ/kg-K.

Calculate :

- (i) The heat rejected in the inter-cooler.
- (ii) The diameter of H.P. cylinder and
- (iii) The power required to drive H.P. cylinder.

15. (a) Freon 12 is compressed from 200 kPa to 1.0 MPa in an 80 percent efficient compressor. The condenser exiting temperature is 40° C. Calculate the COP and the refrigerant mass flux for 100 tons (352 kW) of refrigeration.

Or

- (b) 100 m³ of air per minute at 15° C DBT and 80% R.H. is heated until its temperature becomes 22° C. Find the following
- (i) Heat added to the air per min.
 - (ii) R.H. of the heated air. Assume air pressure is at 1.033 bar.