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Question Paper Code : P 1412

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Fourth Semester

Mechanical Engineering

ME 1251 — THERMAL ENGINEERING

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

(Regulation 2004)

Time : Three hours Maximum : 100 marks

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

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define mean effective pressure.

2. Compare actual and ideal PV diagram of a four stroke compression ignition engine.

3. What do you understand by knocking?

4. What is the fuel economy of two stroke engines when comparing with four stroke engines? Why?

5. What do you mean by compounding of steam turbine?

6. How is the speed of the steam turbine regulated?

7. What is the effect of clearance volume in reciprocating air compressor?

8. What is the effect of inter-cooling in multi stage compressors?

9. Name any four commercial Non-CFC refrigerants?

10. What are the components used in winter air conditioning system?

PART B — (5 × 16 = 80 marks)

11. (a) The minimum pressure and temperature in an otto cycle are 100 kPa and 27° C. The amount of heat added to the air per cycle is 1500 kJ/kg.

(i) Determine the pressures and temperatures at all points of the air standard otto cycle.

(ii) Also calculate the specific work and thermal efficiency of the cycle for a compression ratio of 8:1.

Take for air : Cv = 0.72 kJ/kg K and γ = 1.4.

Or

(b) In an engine working on dual cycle, the temperature and pressure at the beginning of the cycle are 90° C and 1 bar respectively. The compression ratio is 9. The maximum pressure is limited to 68 bar and the total heat supplied per kg of air is 1750 kJ. Determine,

(i) Pressure and temperature at all salient points.

(ii) Air standard efficiency.

(iii) Mean effective pressure.

12. (a) (i) Explain the working principle of a simple carburettor and discuss its merits and demerits.

(ii) Discuss the lubrication system used in a two stroke and four stroke SI engines.

Or

(b) Air consumption for a four stroke petrol engine is measured by means of a circular orifice diameter 3.2 cm. The co-efficient of discharge for the orifice is 0.62 and the pressure across the orifice is 150 mm of water. The barometer reads 760 mm of Hg. The temperature of air in the room is 20°C. The piston displacement volume is 0.00178 m^3. The compression ratio is 6:5. The fuel consumption is 0.135 kg/min and the calorific value is 43,900 kJ/kg. The brake power developed at 2500 rpm is 28 kW. Determine,

(i) The volumetric efficiency on the basis of air alone.

(ii) The air fuel ratio.

(iii) The brake mean effective pressure.

(iv) The relative efficiency on the brake thermal efficiency basis.

13. (a) (i) Define critical pressure ratio of a nozzle and discuss why attainment of sonic velocity determines the maximum mass rate of flow through steam nozzle.

(ii) In a steam nozzle, the steam expands from 4 bar to 1 bar. The initial velocity is 60 m/s and the initial temperature is 200° C. Determine the exit velocity if the nozzle efficiency is 92%.

Or

(b) A single row impulse turbine develops 132.4 kW at a blade speed of 175 m/s, using 2 kg of steam per sec. Steam leaves the nozzle at 400 m/s. Velocity coefficient of the blades is 0.9. Steam leaves the turbine blades axially. Determine nozzle angle, blade angles at entry and exit, assuming no shock.

14. (a) The following data relate to a performance test of a single acting 14 cm × 10 cm reciprocating compressor :

Suction pressure = 1 bar, Suction temperature = 20° C, Discharge pressure = 6 bar, Discharge temperature = 180° C, Speed of the compressor = 1200 rpm, Shaft power = 6.25 kW, Mass of air delivered = 1.7 kg/min. Calculate,

(i) The actual volumetric efficiency.

(ii) The indicated power.

(iii) The isothermal efficiency.

(iv) The mechanical efficiency.

(v) The overall isothermal efficiency.

Or

(b) (i) How the volumetric efficiency of the reciprocating air compressor is affected by the following parameters.

(1) The speed of the compressor.

(2) The delivery pressure.

(3) Throttling across the valves.

(ii) Discuss positive and non-positive displacement rotary compressors.

15. (a) (i) Explain the working principle of vapour absorption refrigeration system and compare it with vapour compression refrigeration system.

(ii) A Freon vapour compression system operating at a condenser temperature of 40° C and an evaporator temperature of –5° C develops 15 tons of refrigeration. Using the p-h diagram for Freon 12, determine,

(1) The mass flow rate of the refrigerant circulated.

(2) The theoretical piston displacement of the compressor and piston displacement per ton of refrigeration.

(3) The theoretical horse power of the compressor and horse power per ton of refrigeration.

(4) The heat rejected in the condenser.

Or

(b) (i) Explain the working principle of year round air conditioning system.

(ii) An air conditioned space is maintained at 27° C DBT and 50 percent RH. The ambient conditions are 40° C DBT and 27° C WBT. The space has a sensible heat gain of 14 kW. Air is supplied to the space at 7° C saturated. Calculate,

(1) Mass of moist air supplied to the space in kg/h.

(2) Latent heat gain of space in kW.

(3) Cooling load of the air washer in kW if 30 percent of the air supplied to the space is fresh, the remainder being recirculated.

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