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Question Paper Code : 20810

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth Semester

Mechanical Engineering

ME 6404 — THERMAL ENGINEERING

(Common to Automobile Engineering, Manufacturing Engineering, Mechanical and Automation Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Use of Std. refrigerant data book, steam tables, Mollier diagram and Psychrometric chart permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define air standard cycle efficiency.
2. What is cutoff ratio?
3. Mention the use of a camshaft.
4. Mention the use of a carburetor.
5. Define nozzle efficiency.
6. Define critical pressure ratio.
7. Define clearance ratio.
8. What is the purpose of intercooler?
9. What do you mean by refrigeration?
10. Define RSHF and ESHF.

PART B — (5 × 13 = 65 marks)

11. (a) A gas turbine works on an air standard Brayton cycle. The initial condition of the air is 25°C and 1 bar. The maximum pressure and temperature are limited to 3 bar and 650°C. Determine the following:

(i) Cycle efficiency

(ii) Heat supplied and heat rejected per kg of air

(iii) Work output

(iv) Exhaust temperature.

Take Cp = 1.005 kJ/kg K, Cv = 0.718 kJ/kg K. (13)

Or

(b) Brief the working of Otto cycle with the help of p-V diagram, T-s diagram and derive the air standard efficiency of the cycle. (13)

12. (a) Describe the working of a four stroke diesel engine with neat sketches. (13)

Or

(b) Brief the working of a battery coil ignition system with neat sketch. (13)

13. (a) Dry saturated steam at 2.8 bar is expanded through a convergent nozzle to 1.7 bar. The exit area is 3 cm^2. Calculate the exit velocity and mass flow rate for,

(i) Isentropic expansion.

(ii) Super saturated flow. (13)

Or

(b) In a steam nozzle, the steam expands from 4 bar to 1 bar. The initial velocity is 60 m/s and initial temperature is 200°C. Determine the exit velocity if nozzle efficiency is 92%. (13)

14. (a) A single stage single acting air compressor delivers 0.6 kg of air per minute at 6 bar. The temperature and pressure at the end of suction stroke are 30°C and 1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3% of the swept volume. Assuming index of compression and expansion to be 1.3, find,

(i) Volumetric efficiency of the compressor,

(ii) Power required if the mechanical efficiency is 85%. (13)

Or

(b) Explain in detail the working of a multistage compressor with help of p-V diagram. (13)

15. (a) Explain the working of a vapour compression refrigeration system with neat sketch. (13)

Or

(b) Differentiate between window A/c system and split A/c system and explain the working of split A/c system with neat diagrams. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A two-stage, single-acting air compressor for a Diesel engine runs at 250 r.p.m. and takes in 6 m^3 of air per minute at a pressure of 1 bar and temperature of 15°C. It delivers the air at 70 bar and compression is carried out in each cylinder according to the law $pv^{1.3}$ constant. Assuming complete intercooling and mechanical efficiency of 80 percent, determine the minimum power required to drive the compressor. Calculate also the cylinder diameters and common stroke, if the average piston speed is 170 metres per minute. Neglect clearance effects and wire-drawing losses.

Or

(b) A convergent-divergent nozzle for a steam turbine has to deliver steam under a supply condition of 11 bar with 100°C superheat and a back pressure of 0.15 bar. If the outlet area of the nozzle is 9.7 cm^2, determine using steam tables, the mass of Steam discharged per hour. If the turbine converts 60% of the total enthalpy drop into useful work, determine the power delivered by the turbine. Neglect the effect of friction in the nozzle. Take C_p of superheated steam as 2.3 kJ/kg K.

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