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Question Paper Code : 91380

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Fourth Semester

Mechanical Engineering

ME 3451 — THERMAL ENGINEERING

(Common to Mechanical Engineering (Sandwich))

(Regulations 2021)

Time : Three hours Maximum : 100 marks

(Steam table to be permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the relationship between C_p and C_v.
2. Distinguish between Otto Cycle and Diesel cycle.
3. Classify steam nozzles.
4. What is metastable flow in a steam nozzles?
5. Draw the pressure-velocity compounding diagram.
6. Mention the purpose of intercooler in gas turbines.
7. Define crankshaft.
8. Classify the engines based on ignition.
9. Write any two limitations of Common Rail Direct Injection (CRDI) system.
10. State the benefits of Turbo Charging.

PART B — (5 × 13 = 65 marks)

11. (a) A gas engine working on Otto cycle has cylinder diameter 0.2 m and stroke length of 0.25 m. The clearance volume is 1580 cc. Find the Air standard efficiency of the cycle. Assume C_p = 1.004 kJ/kgK and C_v = 0.717 kJ/kgK for air.

Or

(b) Air at 1.01 bar and 20 °C is admitted into an oil engine which is working on the dual cycle. The maximum cycle pressure is 69 bar. The compression ratio is 18. Assuming that heat addition at constant volume is equal to heat addition at constant pressure, calculate the following.

(i) Temperature at all salient points (3)

(ii) Total heat supplied (3)

(iii) Heat rejected (3)

(iv) Air Standard efficiency. (4)

12. (a) Derive the expression for critical pressure ratio.

Or

(b) Steam initially dry and saturated is expanded in a nozzle from 15 bar at 300 °C to 1.0 bar. If the frictional loss in the nozzle is 12% of the total heat drop, Calculate the mass of steam discharged when the exit diameter of nozzle is 15 mm.

13. (a) With a neat layout, explain the construction and working of a reaction turbine.

Or

(b) The following data relates to a single stage impulse turbine :

(i) Steam Velocity = 600 m/s

(ii) Blade Speed = 250 m/s

(iii) Nozzle angle = 20°

(iv) Blade Outlet Angle = 25°

Neglecting the effect of friction, calculate the work developed by the turbine for the steam flow rate of 20 kg/s. Also calculate axial thrust on the bearing.

14. (a) Explain the combustion phenomena of stages of combustion in SI engine with a neat sketch.

Or

(b) With a neat sketch describe the working principle of 4 stroke cycle CI engine and also draw the valve timing diagram of an CI engine and explain it.

15. (a) Explain the working of multi point fuel injection system with a neat sketch.

Or

(b) Explain the working of water cooling system with a neat sketch.

PART C — (1 × 15 = 15 marks)

16. (a) One kg of air is taken through a diesel cycle. Initially the air is at 25 °C and 1 bar. The compression ratio is 14 and the heat added is 1850 kJ. Calculate the ideal efficiency and mean effective pressure.

Or

(b) The following observations were recorded in a test of 1 hour, on a single cylinder oil engine working on four strokes cycle.

Bore diameter = 300 mm = 0.3 m

Stroke length = 450 mm = 0.45 m

Mass of fuel used = 8.8 kg

Calorific value = 41800 kJ/kg

Average speed = 200 rpm

MEP = 5.8 bar

Brake friction load = 1860 N

Temperature rise = 22 °C

Mass of cooling water = 650 kg

Diameter of brake drum = 1.22 m

Calculate the Mechanical Efficiency, Brake Thermal efficiency, and Draw the Heat Balance Sheet.

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