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Question Paper Code : 51038

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Fifth Semester

Mechanical Engineering

080120023 — THERMAL ENGINEERING

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the P-V diagram compare the Otto, diesel cycle and dual cycle to at same compression ratio.
2. How does a two stroke engine differ from a four stroke cycle engine?
3. What is the effect of combustion knock in CI engine?
4. What is super charging?
5. Define nozzle efficiency.
6. Draw the block diagram simple ranking cycle with process.
7. Compare the reciprocating and rotary compressor.
8. Why intercooler is used in a multistage compressor?
9. What do you understand by cytogenesis?
10. Define sensible heat factor.

PART B — (5 × 16 = 80 marks)

11. (a) Explain the diesel cycle with P-V and T-S diagrams and derive the expression of thermal efficiency and mean effective pressure. (16)

Or

(b) An oil engine works on a duel cycle. The compression ratio is 10 and expansion ratio is 5.5. The initial pressure and the temperature of the air are 1 bar and 300 K. The heat liberated at constant pressure is twice the heat liberated at constant volume.

The expansion and the compression follow the law $pv^{1.3} = C$. Find the following:

(i) Pressure and temperature at all salient points.

(ii) Mean efficiency pressure of the cycle.

(iii) Efficiency of the cycle.

(iv) The power if working cycles are 500/min and d = 24 cm and L = 40 cm. (16)

12. (a) Explain briefly the stages of combustion in SI engines elaborating the flame front propagation. (16)

Or

(b) A gasoline engines working on four stroke develops a break power of 20.9 kW. A Morse Test was conducted on this engine and the break power (kW) obtained when each cylinder was made inoperative by short circuiting the spark plug are 14.9, 14.3, 14.8 and 14.5 respectively. The test was conducted on constant speed. Find the indicate power, mechanical efficiency and bmep when all the cylinders are firing. The bore of the engine is 75 mm and the stroke is 90 mm. The engine is running at 3000 rpm. (16)

13. (a) The inlet condition of the steam to a convergent-divergent nozzle is 2.2 MN/m^2 and 260°. The exit pressure is 0.4 MN/m^2. Assuming frictionless flow up to the throat and a nozzle efficiency of 85 percent. (i) Determine the flow rate for a throat area of 32.2 cm^2 (ii) Also determine the exit area. (16)

Or

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

Isentropic nozzle enthalpy drop = 210 kJ/kg. Nozzle efficiency = 90% Nozzle angle = 25°, Ratio of blade speed to whirl component of steam speed = 0.5, Blade velocity coefficient = 0.9. The velocity of steam engine the nozzle = 30 m/sec.

Find (i) the blade angles at inlet and outlet if the steam enters the blades without shock and leaves the blades in an axial direction, (ii) Blade efficiency, (iii) power developed and (iv) axial thrust if the steam flow is 10 kg/sec. (16)

14. (a) A multi stage compressor takes in air at 1 bar, 25°C and compresses it to 20 bar. Assume perfect intercooling and that the amount of energy rejected at intercooler is equal to the energy rejected during compression due to the cooling of cylinder. The compressor runs at 900 r.p.m. and delivers 3 kg per minute of air. All pistons have a stroke of 170 mm. Calculate: (i) the index of compression, (ii) the number of stages if the temperature at the end of compression is not to exceed 400 K: (iii) The temperature and pressure at the end of each stage, (iv) the total power input to the compressor if $\eta_{mech.}$ = 80% for each stage: and (v) cylinder dimensions if η_{vol} = 0.8 for each stage. (16)

Or

(b) (i) Differentiate between rotary and reciprocating compressors. (8)

(ii) Write short notes on :

(1) Centrifugal compressor.

(2) Screw compressor. (8)

15. (a) For a sample of air having 22° DBT, relative humidity 30 per cent at barometric pressure of 760 mm of Hg, calculate:

(i) Vapour pressure,

(ii) Humidity ratio,

(iii) Vapour density and

(iv) Enthalpy.

Verify your results by psychometric chart. (16)

Or

(b) A vapour compression machine is used to maintain a temperature of –23°C in a refrigerated space. The ambient temperature is 37°C. The compressor takes in a dry saturates vapour of F_{-12}. A minimum 10°C temperature difference is required at the evaporator as well as condenser. There is no of liquid subcooling of liquid. If the refrigerant flow rate is 1 kg/mm, find (i) tonnage of refrigeration. (ii) Power requirement. (iii) Ratio of COP of this cycle to COP of Carnot cycle. (16)