Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 80846

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth/Fifth/Sixth Semester

Mechanical Engineering

ME 2301/ME 1351 A/10122 ME 402/ME 51 – THERMAL ENGINEERING

(Common to Mechanical Engineering (Sandwich))

(Regulations 2008/2010)

(Also common to PTME 2301 for B.E. (Part-Time) Fourth Semester – Mechanical Engineering – Regulations 2009)

Time : Three hours Maximum : 100 marks

(Use of approved thermodynamics tables, Mollier diagram, Psychrometric chart and Refrigerant property tables permitted in the Examinations)

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State any four assumptions through which a mechanical cycle is modelled into an air standard cycle?

2. Plot the general diesel cycle efficiency as a function of compression ratio for various cut off ratios.

3. What is unit injection system?

4. What do you mean by short circuiting in two-stroke engines?

5. What are the effects of friction on steam nozzles?

6. What is the principle of an impulse turbine?

7. Give the expression for work done for a two stage reciprocating compressor with intercooler.

8. Define volumetric efficiency of a reciprocating compressor.

9. What is meant by subcooling in vapour compression system?

10. Define Relative Humidity.

PART B — ($5 \times 16 = 80$ marks)

11. (a) 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 co-efficient is 0.7 and the blades are symmetrical, draw the vector 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%

(iii) Blade efficiency, stage efficiency and maximum blade efficiency

(iv) Heat equivalent of the friction of blading. (16)

Or

(b) Determine the throat area, exit area and exit velocity for a steam nozzle to pass a mass flow of 0.2 kg/s when inlet conditions are 10 bar and 250°C and the final pressure is 2 bar. Assume expansion is isentropic and that the inlet velocity is negligible. Use $pV^{1.3}$ = Constant. Do not calculate from h-s chart. (16)

12. (a) Discuss the construction and working principle of a four stroke engine with sketch. (16)

Or

(b) Explain the construction and working principle of Battery coil ignition system with neat sketch. (16)

13. (a) Derive the condition for maximum discharge and expression for maximum discharge in steam nozzle. (16)

Or

(b) (i) Steam at a pressure of 10.5 bar and 0.95 dry is expanded convergent divergent nozzle. The pressure of steam leaving nozzle is 0.85 bar. Find the velocity of steam at the throat for maximum discharge taken = 1.135. Also find the area at the exit and steam discharge if the throat area is 1.2 cm^2. Assume flow is isentropic and there are no friction losses. (12)

(ii) Distinguish between impulse and reaction turbines. (4)

14. (a) A single-acting two-stage air compressor deals with 4 m^3/min of air at 1.013 bar and 15°C with a speed of 250 rpm. The delivery pressure is 80 bar. Assuming complete intercooling. Find the minimum power required by the compressor and the bore and stroke of the compressor. Assume a piston speed of 3 m/s, mechanical efficiency of 75% and volumetric efficiency of 80% per stage. Assume the polytropic index compression in both the stages to be n = 1.25 and neglect clearance. (16)

Or

(b) Explain with neat sketch the construction and working of Roots blower with two lobe and three lobe rotor and Vane type compressor. (16)

15. (a) A vapour compression machine is used to maintain a temperature of a –23°C in a refrigerated space. The ambient temperature is 37°C. The compressor takes in dry saturated vapour of F-12. A minimum 10°C temperature difference is required at the evaporator as well as at condenser for effective heat transfer. There is no sub-cooling of liquid. If the refrigerant flow rate is 1 kg/mm, find

(i) Tonnage of refrigeration (6)

(ii) Power requirement (6)

(iii) Ratio of C.O.P. of this cycle to C.O.P. of Carnot cycle. (4)

Or

(b) One kg of air at 35°C DBT and 60% R.H is mixed with 2 kg of air at 20°C DBT and 13°C dew-point temperature. Calculate the specific humidity of the mixture.

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