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Total No. of Questions : 09

B.Tech. (Mechanical Engineering)   (Sem.–4)
APPLIED THERMODYNAMICS
Subject Code : BTME-401-18
M.Code : 77546
Date of Examination: 20-11-2023

Time : 3 Hrs.   Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :
1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Write briefly :

   a) What are the main applications of compressors?

   b) Define superheated steam. Discuss the advantages of superheated steam.

   c) What are various stages of combustion in I.C. Engines?

   d) Define the term "degree of reaction" for a turbine.

   e) What is a vapour power cycle? Draw any one vapour power cycle.

   f) What is steady flow energy equation as applied to steam nozzles? Explain its use in the calculation of steam velocity at the exit of a nozzle.

   g) Explain the effect of friction on the performance of a steam nozzle.

   h) Distinguish between impulse and reaction turbines.

   i) What is significance of finding calorific value of fuels?

   j) Why intercooling is carried out in air compressors?

SECTION-B

2.   A steam power plant is supplied with dry saturated steam at a pressure of 10 bar and exhausts into a condenser at 0.1 bar. Calculate the Rankine efficiency by using (a) Steam table and (b)Mollier chart.

3.   a)   What is the function of condenser? Write two merits of surface condenser.

     b)   Define the followings :

          i)   Minimum air

          ii)   Excel air

          iii) Products of combustion

          iv)   Volume analysis

4.   Explain in details, the Rankine steam power cycle with the help of p-v and T-S diagrams.

5.   A single acting reciprocating compressor with cylinder of 15 cm diameter and 18 cm stroke has a clearance volume of 4% of swept volume. It takes in air at 1 bar, 25°C and delivers at 8 bars while running at 1200 rpm. The actual power input is 18 kW. Estimate (a) the power required to drive the unit, (b) the isothermal efficiency and (c) the mechanical efficiency when the mass flow rate in 4kg/min.

6.   Dry saturated steam enters a steam nozzle at a pressure of 15 bars and is discharged at a pressure of 2 bars. If the dry fraction of discharge steam is 0.96, what will be the final velocity of steam? Neglect initial velocity of steam. If 10% of heat drop is lost in friction, find the percentage reduction in the final velocity.

SECTION-C

7.   In a De Laval turbine steam issues from nozzle with a velocity of 1200 m/s. The nozzle angle is 20°, the mean blade velocity is 400 m/s, and the inlet and outlet angles of blades are equal. The mass of steam flowing through the turbine per hour is 1000 kg.

     Calculate :

     a)   Blade angles

     b)   Relative velocity of steam entering the blade

     c)   Tangential force on the blade

d) Power developed

e) Blade efficiency

Take Blade velocity co-efficient as 0.8.

8. Explain the principles of operation of different types of jet condensers. Describe with a sketch a low-level jet condenser of the counter flow type.

9. Explain the followings :

a) Multi-compression and its advantages.

b) Cooling towers and their operation.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.