15019

B. Tech 1st Semester Examination

Basic Mechanical Engineering (NS)

BE-102

Time : 3 Hours   Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question each from section A, B, C & D and all subparts of question in Section-E.

SECTION - A

1. (a) "Show that polytropic index 'n' for air expansion or compression process is given by the relation: $n = 0.2 [7-(2Q/W)]$, where Q is heat interaction and W is work interaction in the process.   (7)

    (b) A piston/cylinder contains argon gas at 140 kPa, 10°C, and the volume is 100 litre. The gas is compressed in a polytropic process to 700 kPa, 280°C. Calculate the heat transfer during the process. Take R=0.20813 kj/kg-K and C_v = 0.3122 kJ/kg-K.   (7)

    (c) Consider $\int p\,dV$, $\int Cv\,dT$, and $\int p\,dV + \int V\,dp$. Segregate these terms as point function, boundary work, path function and also name the term(s) which can be integrated without knowing the relation between p and V?   (6)

2. (a) A system consists of a cylinder and piston machine. The external normal load applied to the piston is given by F = - 7000 + 15000L Newton's, where L is the distance in mts from the closed end of the cylinder to the piston. How much work is done when the piston moves from the position L = 1m to L = 1.5 m.   (10)

    (b) Write down the steady flow energy equation for multi stream system and using it establish for two streams heat exchanger that: Heat loss = Heat gain. Also list the assumptions made to establish above relation.   (10)

SECTION - B

3. (a) A mass of 0.25 kg of an ideal gas has a pressure of 300 kPa, a temperature of 80°C, and a volume of $0.07 m^3$. The gas undergoes an irreversible adiabatic process to a final pressure of 300 kPa and final volume of 0.1 m^3 during which the work done on the gas is 25 kJ. Evaluate the C_p and C_v of the gas and change in entropy of the gas.   (10)

    (b) State the second law of thermodynamics and show the equivalence of two statements of second law of thermodynamics.   (10)

4. (a) Discuss the generation of steam at constant pressure. Show the various processes on temperature- enthalpy diagram. What will be the effect of change in pressure?   (10)

    (b) What is dryness fraction? Describe with neat sketch the working of a combined separating and throttling calorimeter.   (10)

SECTION - C

5. (a) Write difference between two stroke and four stroke cycle engine.   (5)

(b) In a Diesel cycle, the compression ratio is 15. Compression begins at 0.1 Mpa, 40°C. The heat added is 1.675 MJ/kg. Find (a) the maximum temperature in the cycle, (b) work done per kg of air (c) the cycle efficiency (d) the temperature at the end of the isentropic expansion (e) the cut-off ratio and (f) the MEP of the cycle.   (15)

6. (a) For the same constant maximum pressure and heat input, which cycle is more efficient: Otto, Diesel or Dual cycle? Explain with P-V and T-S diagrams.   (10)

(b) An engine working on otto cycle in which salient points are 1, 2, 3, 4 and has upper and lower temperature limits T_3 and T_1. For the optimum work, show that the intermediate temperature is given by $T_2=T_4= (T_1.T_3)^{1/2}$.   (10)

SECTION - D

7. (a) What are psychrometric chart? What is its use in air conditioning system?   (7)

(b) Differentiate between dry bulb temperature and wet bulb temperature. What is the significance of wet bulb depression?   (6)

(c) Define different modes of heat transfer? If on a gas burner some container having water is placed, explain how the heat will reach to water from the gas flame.   (7)

8. (a) What is the convection mode of heat transfer? Derive an expression for the heat conduction through a pipe of given material.   (10)

(b) A cylindrical tank of 3 m height and 5cm^2 cross-sectional area is filled with water up to a height of 2 m and remaining with oil of specific gravity 0.8. The vessel is open to atmosphere. Calculate:

(i) Pressure intensity at the interface (absolute and gauge)

[P.T.O.]

(ii) Pressure intensity at the base of the tank (absolute and gauge)

(iii) Net force experienced by the base of tank.

Take atmospheric pressure as 1.0132 bar.   (10)

SECTION - E

9. (a) Why work is boundary phenomenon?

(b) Is it possible that in case of internal energy net change can be zero over a complete thermodynamic cycle? Explain reason.

(c) Why specific properties are defined on the basis of extensive properties only, not on the basis to intensive properties.

(d) What is the by-product given by second law of thermodynamics? Define the same.

(e) What is Clausius inequality?

(f) If an engine is running at 1000 rpm, then what will be the count of working strokes in two stroke and four stroke engines? Give reason.

(g) What is indicated horse power for reciprocating engines? Why it is named so?

(h) Why wet bulb temperature is measured along constant enthalpy line on psychometric chart?

(i) Can heat energy flow through vacuum? Name the mode if any.

(j) What is surface tension?   (2×10=20)