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Total No. of Pages: 02
Total No. of Questions: 09

B. Tech. (Sem.-1st)

ELEMENTS OF MECHANICAL ENGINEERING

Subject Code: BTME-101
Paper ID: [A-1107]

Time: 3 Hrs. **Max. Marks: 60**

INSTRUCTION TO CANDIDATES

1. Section-A is compulsory. Each question carry Two marks.
2. Attempt any Four question Section-B. Each question carry Five marks.
3. Attempt any Two question Section-C. Each question carry Ten marks.

Section –A (10x2=20)

Q.1.

(a) Define a quasistatic process and state its salient characteristics.

(b) What is meant by fixed points of a thermometric scals ?

(c) How is polytropic exponent determined and within what limits it can rang ?

(d) State the Carnot Theorem in the context of a heat pump / refrigerator.

(e) State the requirements of a process to be isentropic.

(f) For the same compression ratio and heat input, which cycle is more efficient: Otto, Diesel, or Dual. Explain with T – s diagram.

(g) Mention the relative merits and demerits of two stroke engines when compared with four stroke engines.

(h) Compare and contrast elastic and plastic deformation of metals.

(i) Explain the working of piezoelectric ceramics.

(j) Write the position of centre of gravity for cylinder, hemisphere, sphere, and right circular cone.

Section –B (4x5=20)

Q.2.(a) Differentiate between temperature, heat and internal energy. (3)

(b) An ineal gas requires 1150 *kj /kg* lf heat to raise its temperature from 20 ^{0}C to 100 ^{0}C. When heated at constant pressure. When heat is supplied to the same gas at constant volume, the heat requirement is 825 *kj* for the same temperature range. Determine specific heat at constant pressure, specific heat at constant pressure, specific heart at volume and adiabatic exponent. (5)

Q.3. A cylinder contains 045m^3 of a gas at 1 bar and 253k The gas is compressed to a volume of 0.13m^3, the final pressure is 5 bar Find, a) the mass of gas, b) polytrophic index n, c) change in internal energy, d) heat transfer during compression. Take g =1.4, R = 294.2 *j /Kg –K*. (8)

Q.4.(a) Make an energy analysis of a centrifugal pump. (2)

(b) A pump is used to raise the pressure of water from 1 bar to 25 bar and delivers 2000 *kg/hr* of water.Neglect changes in volume, elevation and changes in velocity. The specific volume of water is $0.00145 m^3/kg$. Calculate the power required to drive the pump. (6)

Q.5.(a) Demonstrate using second law that free expansion is irreversible. (3)

(b) A Domestic food refrigerator maintains a temperature of -10^0 C while ambient temperature is -30^0 C The heat leakage into the freezer is estimated to be at a continuous rate of $2kj/s$. Determine the least power required to pumpout this heat continuously. (5)

Q.6. In an air standard Otto cycle, the pressure and temperature at the start of compression is 1 *bar* and 310*K.* The pressure at the end of compression is 28 *bar* and at the end of heat addition is 75 *bar*. Calculate a) the compression ratio, b) the maximum temperature in the cycle, c) work ratio, d) thermal efficiency. (8)

Section –C (2x10=20)

Q.7. (a) A mass m of the fluid at temperature T1 is mixed with an equal mass of the same fluid at temperature T2 Find the expression for resultant change in entropy of the universe and comment whether it is positive or negative (5)

(b) Find an expression for entropy change for an open system. (3)

Q.8. (a) A sold right circular cylinder has its base scooped out so that the hollow is a right circular cone on the same base and having the same high as the cylinder Find the centre of gravity of reminder (4)

(b) A hemisphere and cone have their basis joined together the two bases being of the same size. Find the ratio of height of cone to the radius of the base, so that their common centre of gravity many be at the centre of the common base. (4)

Q.9. (a) Give a neat sketch of the theoretical and actual pV diagrams for a four stroke petrol engine. Describe briefly the factors which account for deviations between these plots. (4)

(b) Explain briefly, particle reinforced, fiber reinforced and structural composites. (4)

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