Printed Pages – 6   TME–101

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4032   Roll No. 0 5 0 9 6 1 0 0 2

B.Tech.

FIRST SEMESTER EXAMINATION, 2005-2006

MECHANICAL ENGINEERING

Time : 3 Hours   *Total Marks : 100*

Note :   (i)   *Answer **ALL** questions.*

(ii)   *Use of steam Table and Mollier's chart is permitted.*

(iii)   *Assume missing data if any.*

(iv)   *Be precise in your answer.*

1.   Attempt *any four* parts of the following :   **(4x5=20)**

(a)   Explain the following :

(i)   Thermodynamic Equilibrium

(ii)   Quasi-Static Process

(b)   An engine cylinder has a piston area of $0.12m^2$ and contains gas at a pressure of 1.5 MPa. The gas expands according to a process which is represented by a straight line on a pressure-volume diagram. The final pressure is 0.15 MPa. Calculate the workdone by the gas on the piston if the stroke is 0.3m.

(c)   A system undergoes a cyclic process through four states 1-2, 2-3, 3-4 and 4-1. Find the values of $x_1, x_2, y_1, y_2,$ and $y_3,$ in the following table :

Process	Heat Transfer KJ/min	Work Transfer KW	Change of Internal Energy
1 - 2	800	5.0	y_1
2 - 3	400	x_1	600
3 - 4	-400	x_2	y_2
4 - 0	0	3.0	y_3

(d) A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C and −20°C. The heat transfer to the heat engine is 2000 KJ and net work output of combined engine-refrigerator plant is 360 KJ. Evaluate the heat transfer to the refrigerator and the net heat transfer to the reservoir at 40°C.

(e) 5 Kg of ice at -10°C. is kept in atmosphere which is at 30°C. Calculate the change of entropy of universe when if melts and comes into thermal equilibrium with the atmosphere. Take latent heat of fusion as 335 KJ/Kg and sp.heat of ice is half of that of water.

(f) Explain :

(i) Zeroth Law of thermodynamics and its application in temperature measurement

(ii) Clausius inequality

2. Attempt *any two* of the following questions : (10x2=20)

(a) (i) With the help of neat sketches explain working of two-stroke CI engine

(ii)   Define the following terms with reference to phase change for water : Saturation state, triple point, critical point, dryness fraction, compressed or subcooled liquid

(b)   Explain the Rankine cycle with the help of flow diagram of water/steam in various components. Also draw the cycle on p-v and T-s diagram. Obtain the net output and thermal efficiency of a theoretical Rankine cycle in which boiler pressure is 40 bar and it is generating steam at 300°C. Condenser pressure is 0.1 bar.

(c)   Air enters at 1 bar and 230°C in an engine running on Diesel cycle whose compression ratio is 18, Maximum temperature of the cycle is limited to 1500°C. Calculate

    (i)   cut-off ratio

    (ii)   heat supplied per Kg of air

    (iii)   cycle efficiency.

3.   Attempt *any two* of the following questions :   **(10x2=20)**

(a)   Explain the following :

    (i)   Principle of transmissibility of a force

    (ii)   Necessary and sufficient conditions of equilibrium of a system of coplanar force system.

    (iii)   Laws of static friction

    (iv)   Useful uses of friction.

(b)   Two smooth spheres each of weight W and each of radius 'r' are in equilibrium in a horizontal channel of width 'b' (b< 4r) and vertical sides as shown in figure :
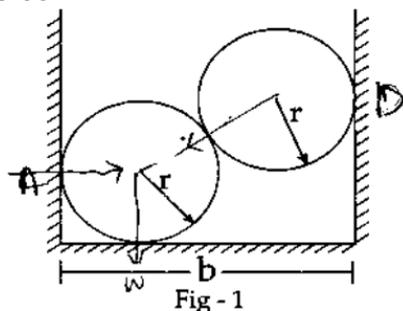
Fig - 1

Find the three reactions from the sides of channel which are all smooth. Also find the force exerted by each sphere on the other.

(c)   A ladder of length 'l' rests against a wall, the angle of inclination being 45°. If the coefficient of friction between the ladder and the ground and that between the ladder and the wall be 0.5 each what will be the maximum distance on ladder to which a man whose weight is 1.5 times the weight of ladder may ascend before the ladder begins to slip ?

4.   Attempt *any two* of the following questions :   (10x2=20)

(a)   (i)   Define a beam. What are the different types of beams and different type of loading ? What do you understand by the term 'point of contraflexure' ?

(ii)   How the trusses are classified· ? What assumptions are made while determining stresses in a truss ?

(b)   Each member of following truss given in Fig 2. is 2m long. The truss is simply supported at the ends. Determine forces in all members clearly showing whether they are in tension or compression.

Fig - 2
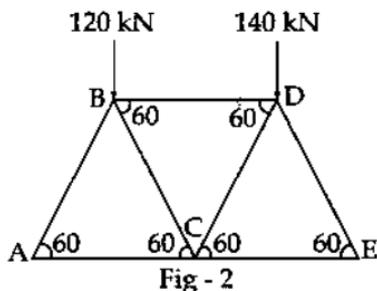
(c)   A simply supported beam is subjected to various loadings as shown in fig 3. Sketch the shear force and bending moment diagrams showing their values at significant locations.

Fig - 3
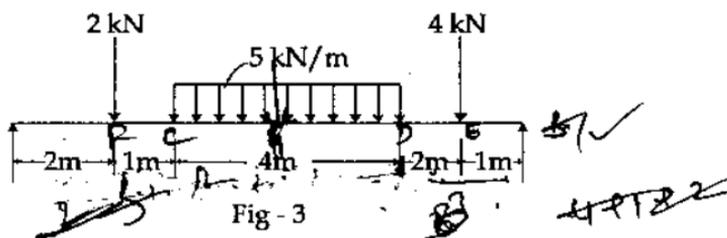
5.   Attempt *any four* of the following questions :   (4x5=20)

(a)   Explain the following :

   (i)   Poisson's's ratio and its significance

   (ii)   Complementary shear stress

(b)   A steel bar is subjected to loads as shown in fig 4. If young's modulus for the bar material is 200 kN/mm^2 determine the change in length of bar. The bar is 200mm in diameter.

Fig - 4

TME–101   *[Turn Over*
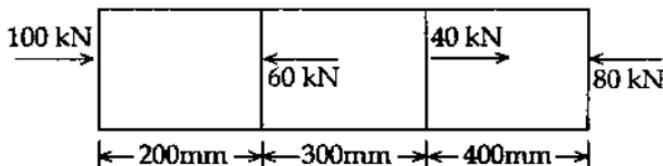
(c) In an elastic material the direct stresses of 100 MN/m^2 and 80MN/m^2 are applied at a certain point on planes at right angle to each other in tension and compression respectively. Estimate the shear stress to which material can be subjected, if the maximum principal stress is 130MN/m^2. Also find the magnitude of other principal stress and its inclination to 100 MN/m^2 stress. „

(d) (i) What do you mean by simple bending ? What assumptions are made in simple bending stress analysis ?

   (ii) What do you mean by polar modulus and torsional rigidity ? .

(e) A wooden beam of rectangular cross-section is subjected to a bending moment of 5 KNm. If the depth of the section is to be twice the breadth and stress in wood is not to exceed 60 N/cm^2. find the dimension of the cross-section of the beam.

(f) The diameter of a shaft is 20cm. Find the safe maximum torque which can be transmitted by the shaft if the permissible shear stress in the shaft material be 4000 N/cm^2 and permissible angle of twist is 0.2 degree per meter length. Take $G = 8 \times 10^6 \text{ N/cm}^2$. If the shaft rotates at 320 r.p.m what maximum power can be transmitted by the shaft ?

-oOo-