Printed Pages : 7 TME101

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

PAPER ID : 4032 Roll No.

B.Tech

(SEM I) ODD SEMESTER THEORY EXAMINATION 2009-10

MECHANICAL ENGINEERING

Time : 3 Hours] *[Total Marks : 100*

Note : (1) Attempt all questions. Marks are indicated against each question/part.

(2) Assume missing data suitably, if any.

(3) Use of steam table, Mollier's chart is allowed.

1 Answer any four parts of the following : 5×4=20

(a) Give the definition of "Thermal Reservoir". Explain "Thermodynamic Equilibrium".

(b) Derive an expression for the heat transfer for a polytropic process.

(c) Differentiate between displacement work and flow work.

(d) Prove that the entropy is a property.

(e) The efficiency of a Carnot engine can be increased either by decreasing the sink temperature while keeping the source temperature constant, or by increasing the source temperature and keeping the sink temperature constant. Which of the above two possibilities is more effective ? Discuss in detail.

(f) An engine working between a thermal reservoir at $350^{\circ}C$ and the ambient atmosphere at $25^{\circ}C$ drives a refrigerator which operates between the ambient atmosphere and a cold space at $-20^{\circ}C$. Determine the ratio of the energy absorbed as heat by the engine to the energy absorbed as heat from the cold space by the refrigerator.

Anwer any two parts of the followings : **10×2=20**

(a) At the beginning of compression process of an Air-standard Diesel cycle, $P_1=96\,kPa$, $T_1=17^{\circ}C$, $V_1=0.016\,m^3$. The maximum temperature in the cycle is $1017^{\circ}C$, and the compression ratio is 15. Determine heat addition and heat rejection per cycle and thermal efficiency.

(b) A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find the quantity of heat, which must be rejected so as to reduce the quality to 60% dry. Neglect the specific volume of liquid while determining the specific volume of wet vapour.

(c) (i) Derive an expression for the efficiency of Rankine cycle. **6**

(ii) Compare SI engine with CI engine. **4**

3 Answer part (a) and any two more parts from the remaining : **6+7+7=20**

(a) Explain the following : **2×3=6**

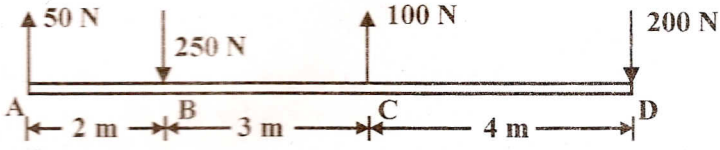
(i) Cone of friction

(ii) Parallelogram law of forces

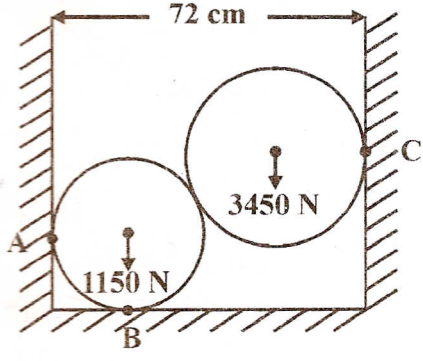
(iii) Lami's theorem.

(b) A long ladder 15 m long resting on horizontal floor and leans against a vertical wall for which $\mu_f = 0.25$ and $\mu_W = 0.15$ respectively. Determine the angle of inclination of ladder with the floor when the ladder is just about to slip.

(c) A system of parallel forces acting on a rigid bar ABCD is shown in figure. Reduce this system to (i) a single force and a couple at A (ii) a single force.

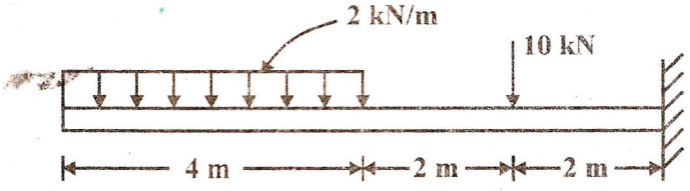


(d) Two spherical balls rest between two vertical walls as shown in figure. The radius of smaller ball is 16 cm and weight is 1150 N. The radius of the larger ball is 24 cm and its weight is 3450 N. The distance between the walls is 72 cm. Assuming the contact surfaces to be smooth, determine the reactions at A, B and C.

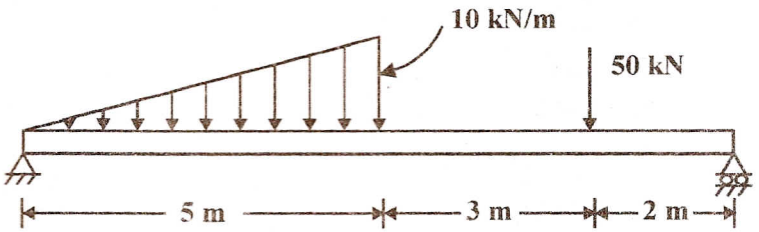


4 Answer any two parts of the following : 10×2=20

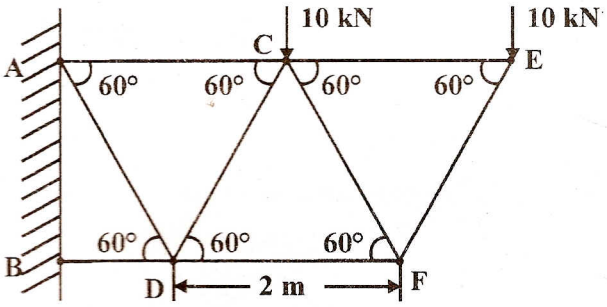
(a) Find the shear force and moment equation for the cantilever beam carrying the uniformly distributed load and concentrated load shown in figure. Also sketch the shear force and bending moment diagram.



(b) Give the shear force and bending moment equation for the beam carrying the uniformly varying load and concentrated loads shown in figure. Also draw the shear force and bending moment diagrams.



(c) For the truss shown in figure, find the force in the members; AC, AD and BD.



5 Answer any two parts of the following : **10×2=20**

(a) (i) Derive an expression for the elongation of a bar due to its own weight.

(ii) Construct Mohr's circle for the case of biaxial stress of a thin plate where $\sigma_x = 10N$, $\sigma_y = -10N$ and $\tau_{xy} = 0$. Determine the angle of plane of maximum shear stress and the value of shear stress.

(b) A simply supported beam, 2 cm wide by 4 cm high and 1.5 m long is subjected to a concentrated load 2 kN (perpendicular to beam) at a point 0.5 m from one of the supports. Determine : (i) the maximum fiber stress and (ii) the stress in a fiber located 1 cm from the top of the beam at mid-span.

(c) (i) Plot tensile test diagram for Mild Steel and explain all salient points.

(ii) Calculate the minimum diameter of a solid steel shaft which is not allowed to twist more than 3^{o} in a 6 m length when subjected to a torque of 12kN-m. Also calculate the maximum shearing stress developed.

Take G=83 GPa.