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

PAPER ID : 4039 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. II) THEORY EXAMINATION 2010-11

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. Attempt any **four** parts of the following : **(5×4=20)**

(a) Prove that the two statements of Second Law of thermodynamics are equivalent.

(b) A scientist claims to have developed a refrigerator which maintains a freezer temperature of -15°C in a room whose temperature is 35°C and have a COP of 6.5. Justify whether his claim is true or false.

(c) State the principle of working of a gas thermometer. How a constant volume gas thermometer is used to establish the

absolute temperature scale ? What correction need to be applied for correct estimate of temperature by such thermometers ?

(d) Prove that the internal energy 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) What do you understand by "Thermometric properties" ? Discuss their use.

2. Attempt any **two** parts of the following : **(10×2=10)**

(a) The displacement volume of an I.C. Engine, running on Diesel Cycle is 3 L (Liter). The cutoff ratio is 2.5. The state of the air at the beginning of compression is fixed by P_1=95 kPa, T_1= 22°C and V_1=3.2 L. Determine the net work per cycle, in kJ, the power developed by the engine,

in kW, and the thermal efficiency, if the cycle is executed 2000 times per min.

(b) A thermal power plant operates on a Rankine cycle with reheat modification. Superheated steam enters the turbine at 3.0 MPa and 350°C. After expansion to 500 kPa, the steam is reheated to 350°C and expanded in a second turbine to the condenser pressure of 5 kPa. Calculate the thermal efficiency of the plant if the isentropic efficiency of each turbine is 0.85, and the isentropic efficiency of pump is 0.75.

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

(ii) Compare SI engine with CI engine. 4

3. Attempt any two parts of the following : **(10×2=20)**

(a) Explain the following :

(i) Necessary and sufficient condition of equilibrium of a system of coplanar concurrent forces.

(ii) Concept of free body diagram with the help of suitable examples.

(iii) Angle of repose and its applications

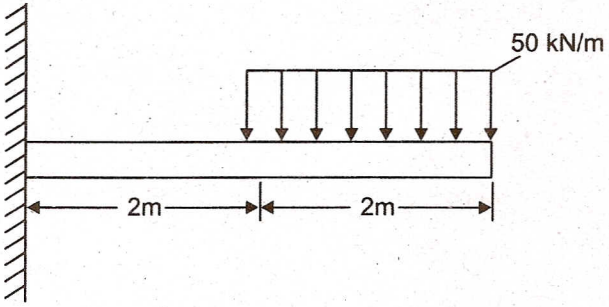
(iv) Belt friction and its applications.

(b) A ladder 3 m long and weighing 250 N is placed against a wall with end B at floor level and A on the wall. In addition to self weight, the ladder supports a man weighing 1200 N at 2.5 m from from B on the ladder. If co-efficient of friction at wall is 0.25 and at floor is 0.35 and if ladder makes an angle 60° with the floor, find the minimum horizontal force which if applied at B will prevent the slipping of the ladder.

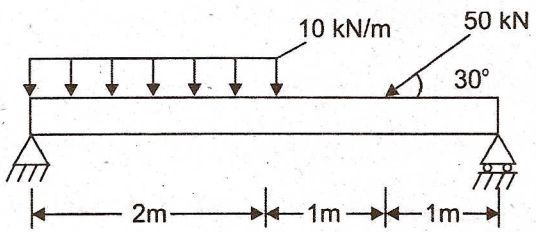
(c) ABCD is a regular Hexagon. Forces 90 N, P, Q, 240 and 180 N act along AB, CA, AD, AE and FA respectively. Find the forces P and Q so that the system is in equilibrium.

4. Attempt any **two** parts of the following : **(10×2=20)**

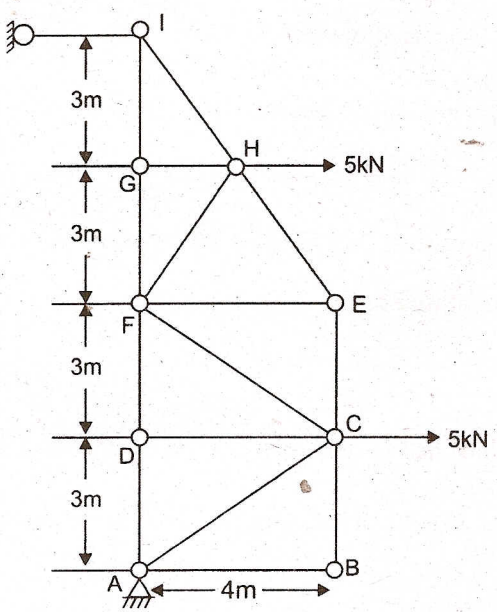
(a) Find the shear force and moment equation for the beam shown in figure. Also sketch the shear force and bending moment diagram.



(b) Give the shear force and bending moment equation for the beam carrying the uniformly distributed load and concentrated load 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 HE, FH, FE and FC.



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

(a) (i) Derive an expression for the elongation caused by a tensile load P applied to a flat bar of thickness t, tapering from a width of w_1 to w_2 in a length L.

(ii) Construct Mohr's circle for the case of biaxial stress of a thin plate where $\sigma_x = 20N$, $\sigma_y = -20N$ and $\tau_{xy} = 0$. Determine the angle of plane of maximum shear stress and the value shear stress.

(b) A simply supported beam, 5 cm wide by 10 cm high and 5 m long is subjected to a concentrated load of 50 kN (perpendicular to beam) at a point 5 m from one of the suppports. Determine (i) the maximum fiber stress and (ii) the stress in a fibre located 2 cm from the top of the beam at mid-span.

(c) A shaft has to transmit 100 kW at 200 rpm. If the shear stress is not to exceed 65 N/mm^2, and the twist in a length

of 3.50 meter must not exceed 1°. Find a suitable diameter.

Take $C=8x10^4N/mm^2$.