(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 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.

(4) Notations used have usual meanings.

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

(a) What do you understand by "Thermometric properties" ? Discuss their use.

(b) A metal block of 5 kg and 200 °C is cooled in a surrounding air at 30 °C. If specific heat of metal is 0·4 kJ/kg. K, calculate the following :

(i) entropy change of block

(ii) entropy change of surrounding and universe.

(c) Explain the concept of continuum, with suitable examples.

(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) A system receives 400 kJ of energy as heat at constant volume. Then it is cooled at constant-pressure. During the constant-pressure process 100 kJ of work was done on the system while it rejects 140 kJ of energy as heat.

Finally the system is restored to the initial state by an adiabatic process, how much work is done by the system ?

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

(a) The pressure and temperature at the beginning of compression of an air-standard Diesel cycle are 95 kPa and 290 K, respectively. At the end of the heat addition, the pressure is 6·5 MPa and the temperature is 2000 K. Determine : Compression ratio, Cutoff ratio and Thermal efficiency. Take ratio of specific heats as 1·4.

(b) A domestic pressure cooker of 8 litres capacity is initially filled with one kg of water at 30 °C. Then it is heated on a stove. The weight placed on the steam vent releases the steam if the pressure inside the cooker exceeds 200 kPa. Determine the conditions of the steam inside the cooker just before the weight is about to release

the steam. Also calculate the amount of energy transferred as heat to the steam until the weight is about to release the steam.

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

(ii) Compare 4 stroke engine with 2 stroke engine. **(4)**

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

(a) Explain the following :

(i) Angle of Repose

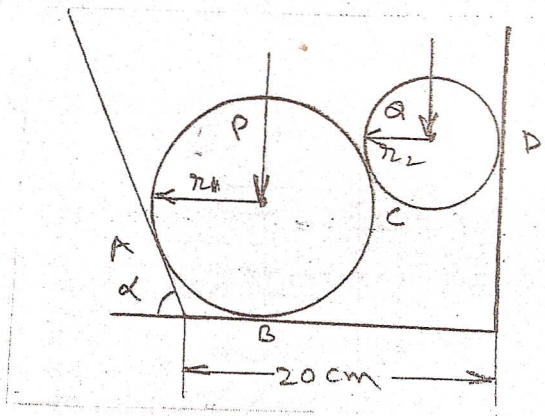
(ii) Concept of free body diagram

(iii) Why kinetic coefficient of friction is always less than static coefficient of friction ?

(b) A belt is running over a pulley with a diameter of 1·2 m at 300 rpm. The angle of contact is 150° and coefficient of friction is 0·35. If the maximum tension in the belt is 500 N, determine the power transmitted by it.

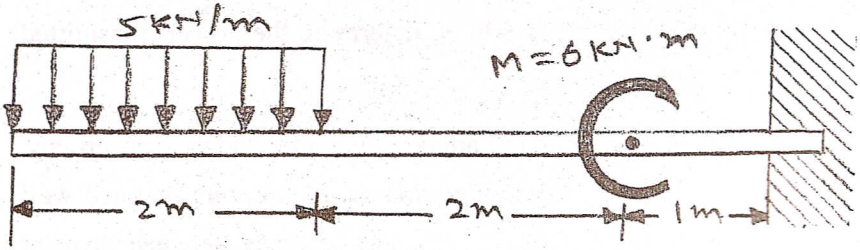
(c) Two smooth cylinders of weight P and Q, respectively, rest in a horizontal channel having one inclined wall and one vertical wall, the distance between them at the bottom is 20 cm (see fig). Find the pressures exerted on the walls and floor at the points of contact A, B

and D. The following numerical data are given : P = 2000 N and Q = 800 N; $r_1$ = 10 cm, $r_2$ = 5 cm and $\alpha = 60°$.

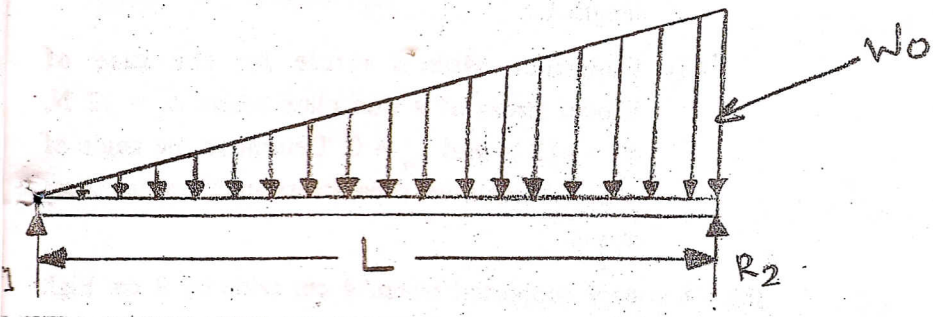



4. Answer any two parts of the following :— (10×2=20)

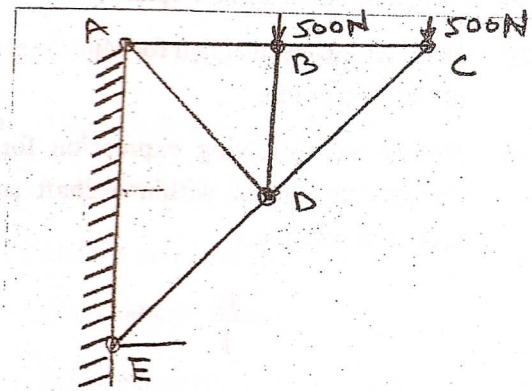
(a) Find the shear force and moment equation for the cantilever beam shown in figure. Also sketch the shear force and bending moment diagram.



(b) Give the shear force and bending moment equation for the beam shown in figure. Also draw the shear and bending moment diagrams.




(c) For the truss shown in figure, find the force in the members.




AB = BC = 1m

AE = 2 m, BD = 1 m.

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 $\sigma_x$ = 12 N, $\sigma_y$ = –12 N and $\tau_{xy}$ = 0. Determine the angle of plane of maximum shear stress and the value shear stress.

(b) A simply supported beam, 4 cm wide by 8 cm high and 3 m long is subjected to a concentrated load of 20 kN (perpendicular to beam) at a point 1 m from one of the supports. Determine (i) the maximum fiber stress and (ii) the stress in a fiber located 2 cm from the top of the beam at mid-span.

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

(ii) Derive the following expression for the shear stresses developed within a shaft subjected to torsional loading :

$$\tau = \frac{Tr}{J}.$$