Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(NEW)/SEM-1/ME-101/2012

2012
ENGINEERING MECHANICS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct answers of the following : $10 \times 1 = 10$

   i) For stable equilibrium the potential energy will be

      a) maximum b) minimum

      c) zero d) none of these.

   ii) Lami's theorem is applicable for

      a) three collinear forces

      b) three coplanar and concurrent forces

      c) three parallel forces

      d) all of these.

   iii) $\overline{A}.(\overline{A} \times \overline{B})$ is equal to (when, $\overline{A}$ and $\overline{B}$ are vector)

      a) zero b) A^2B

      c) 1 d) none of these.

iv) D' Alembert's principle is used for

a) reducing the problem of kinetics to equivalent static problem.

b) determining stresses in truss

c) stability of floating bodies

d) solving kinematic problem.

v) Condition for static equilibrium (when, F = force and M = moment) is

a) $\sum F = 0$ b) $\sum M = 0$

c) $\sum F = 0$ and $\sum M = 0$ d) None of these.

vi) Co-efficient of friction depend upon,

a) area of contact surface

b) nature of contact surface

c) inclination of contact surface

d) none of thee.

vii) The area moment of inertia of a circular section of diameter 'd' about an axis perpendicular to the area passing through its center is given by,

a) $\sum M = \frac{\pi d^4}{64}$ b) $\sum M = \frac{\pi d^4}{32}$

c) $\sum M = \frac{\pi d^4}{12}$ d) none of these.

viii) If a momentum of a body is doubled, its kinetic energy will,

a) increase by two times

b) increase by four times

c) reduced by four times.

d) reduced by two times.

ix) If the velocity of projection is u m/sec and the angle of inclination is $\alpha°$, the maximum height of the projectile on a horizontal plane is,

a) $\frac{u^2 \cos^2 \alpha}{2g}$ b) $\frac{u^2 \sin^2 \alpha}{2g}$

c) $\frac{u^2 \tan^2 \alpha}{2g}$ d) $\frac{u \sin \alpha}{2g}$.

x) Material having same elastic properties in all directions are called

a) ideal material b) uniform material

c) elastic material d) isotropic material.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. A circular roller of weight 100 N and radius 10 cm hangs by a ties rod *AB* = 20 cm and rests against a smooth vertical wall at *C* as shown in the Figure 1. Determine the force *F* in the rod and normal reaction at *C*.

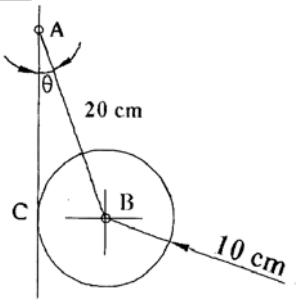

Figure : 1

3. Referring to Figure 2, where radius of roller is *r* = 12 cm, *h* = 6 cm and weight of the roller is 5000 N. find the magnitude of *P* required to start the roller over curb.

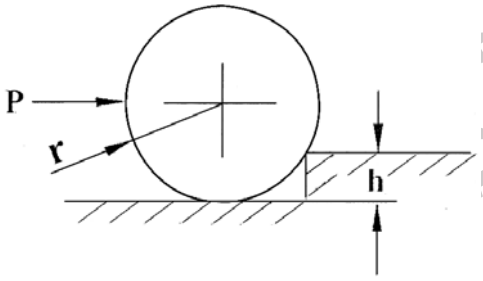

Figure : 2

4. A block of weight 1600 N is in contact with a plane inclined at 30° to the horizontal. A force '*p*' parallel to the plane is applied on the body as shown in Figure 3. The coefficient of static friction between the contact surfaces is 0.20. Find the value of *P* to just cause the motion to impending up the plane.

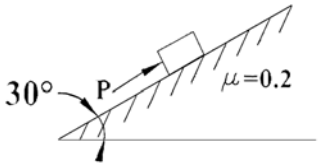

Figure : 3

5. State and explain D' Alembert's principle. What is the advantage of using the principle ? How does it differ from Newton's second law of motion ?

6. With a neat sketch explain stress-strain diagram for a ductile material.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Two inclined rollers, each of weight 100 kgf are supported by an inclined plane and a vertical wall as shown in the Figure 4 below. Assuming smooth surfaces. find the reaction induced at the point *A*, *B* and *C*. 7

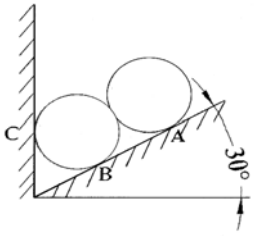

Figure : 4

b) In the Figure 5 shown, find the minimum value of P applied on the lower block that will keep the system in equilibrium. Given coefficient of friction between lower block and floor = 0.25, between the upper block and the vertical wall = 0.30, between two blocks = 0.20. 8

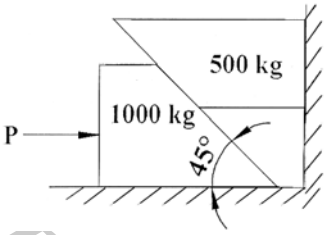

Figure : 5

8. a) Determine the forces exerted on the cylinder at B and C by the spanner wrench shown in the Figure 6. due to the vertical force of 250 N applied to the handle as shown. Neglect friction at B. 8

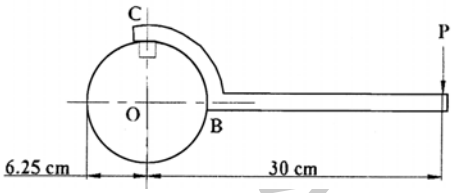

Figure : 6

b) Determine the moment of inertia for the T section (as shown in Figure 7) with respect to a centroidal axis parallel to x-axis. 7

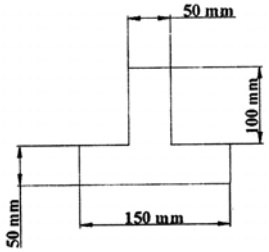

Figure : 7

9. a) A projectile is launched with an initial speed of 200 m/s at an angle 60° (shown in Figure 8.) with respect to horizontal. Compute the range R as measured up the incline. 7

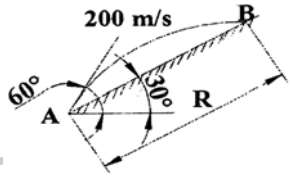

Figure : 8

b) Find the acceleration of a falling weight W_1 hanging over a pulley by a string connecting a block W_2 as shown in Figure 9. the coefficient of friction between block W_2 and the horizontal plane if slides, is μ. Neglect the inertia of the pulley and friction on its axis. Where W_1 = 10kgf W_2 = 12 kgf, μ = 0.5. 8

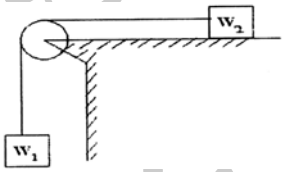

Figure 9

10. a) A system of weight and pulleys is arranged in a vertical plane as shown in Figure 10. Neglecting friction and the inertia of the pulleys. Find the acceleration of each weight if their magnitude are in the ratio $W_a : W_b : W_c$ = 6:5:1 10

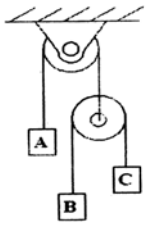

Figure 10

b) State and prove Lami's theorem. 5

11. a) Locate the centroid of the quadrant of a circle of radius '*r*', shown in the Figure 11. 7

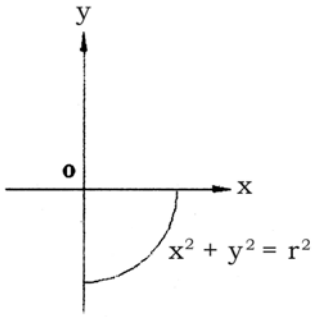

Figure : 11

b) In Figure 12, a load of 5000 kg hang from a rod having different cross-section at the position '*a*', '*b*' and '*c*'. The cross-sections are 500 mm^2, 200 mm^2 and 100 mm^2 at the position '*a*', '*b*' and '*c*' respectively; find the stress in each section. If the stress is not to exceed 700 N/mm^2, what is the safe load ? 8

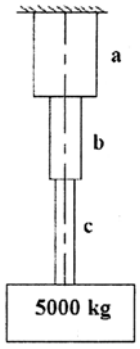

Figure : 12