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

PAPER ID : 199218 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. II) THEORY EXAMINATION 2013-14

ENGINEERING MECHANICS

Time : 3 Hours *Total Marks : 100*

Note :– (1) Attempt **all** questions.

(2) Assume missing data suitably, if any.

SECTION–A

1. Attempt **all** parts : **(2×10=20)**

(a) Write the equilibrium condition for co-planer non-concurrent force system.

(b) Define the terms : Free vector, Fixed vector and Sliding vector. Give one example for each.

(c) Show that moment about a point is two times the area of triangle formed by the force and that point.

(d) Why are members of a truss two-force members (Tensile or compressive) ? Explain.

(e) When is parallel axis theorem used ?

(f) Define Polar moment of inertia and radius of gyration.

(g) Give two examples of curvilinear motion.

(h) If the instantaneous centre of a Rigid body lies at infinity, what will be the relation between velocities at any two points of the body ?

(i) A body of mass 10 kg is moving with variable acceleration a = 10 t, where 't' is time in seconds, from rest. What will be its kinetic energy after 8 seconds ? 'a' is in meter per square seconds.

(j) A body is moving with constant linear velocity of 18 m/s and its mass is 5 kg. What will be the value of inertia force on it ?

SECTION–B

2. Attempt any **three** parts : **(3×10=30)**

(a) (i) Explain Law of Polygon.

(ii) A 800 N cylinder is supported by the frame BCD as shown in diagram. The frame is hinged at D. Determine the reactions at A,B, C and D. (Figure-1). Take r = 150 mm.

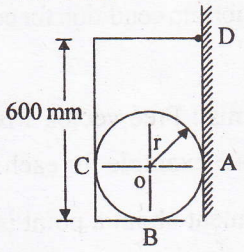

Figure-1

(b) Find the reaction at supports of the beam as shown in Figure–2 :

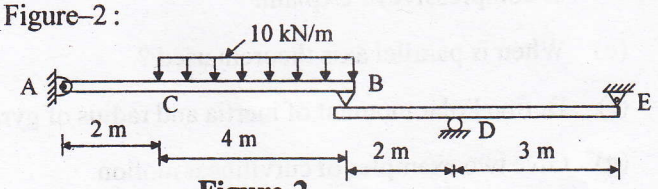

Figure-2

(c) Find the moment of inertia of plane lamina about x-axis and also find its radius or gyration k_x (Figure–3) :

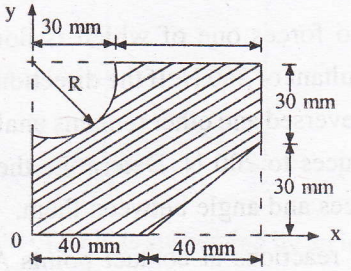

Figure-3

(d) A bar AB is placed in a semi-circular trough of radius 20 cm and released to slide in it such that at an instant when bar makes an angle 45° with diametral axis, the end A has the velocity of 5 m/s. Determine velocity of sliding of bar at point P. (Figure-4) :

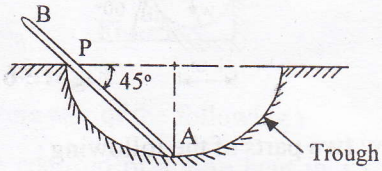

Figure-4

(e) In Figure-5, a force of 30 N is applied on the lower block of mass 5 kg, over which another block of 3 kg mass rests. Determine the acceleration of the blocks and tension in the string assuming it to be inextensible. The coefficient of kinetic friction for all surfaces is 0.15 and co-efficient of static friction is 0.20 for all surfaces.

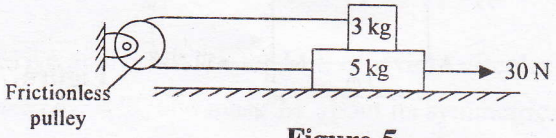

Figure-5

SECTION–C

3. Attempt any **one** part of the following : **(1×10=10)**

(a) (i) State and prove principle of transmissibility of a force.

(ii) Two forces one of which is double the other has resultant of 260 N. If the direction of the larger force is reversed and other remains unaltered, the resultant reduces to 200 N. Determine the magnitude of the forces and angle between them.

(b) Find the reactions at contact points A, B, C and D for following system (Figure-6), if w_2 = 5 kN, w_1 = 2 kN, r_1 = 1 m and r_2 = 1.5 m.

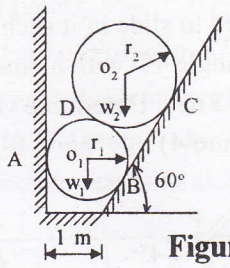

Figure-6

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

(a) Four forces and a couple are acting on a rectangular plate as shown in figure-7. Find their resultant and its position from corner 'A'.

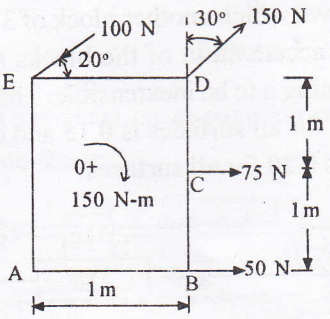

Figure-7

(b) Find the forces in members EC, CD and BD of the truss as given in figure-8 :

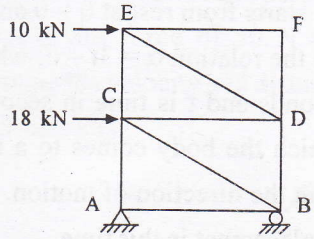

Figure-8

(c) A weight of 5 kN is suspended by an inextensible string on a circular bar as shown in Figure-9. If co-efficient of friction between bar and string is 0.2, what will be the value of force 'P' to hold the weight ? String is wrapped three and half round on the bar :

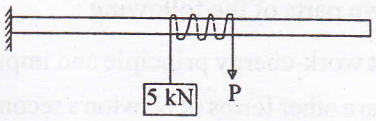

Figure-9

5. Attempt any **one** part of the following : **(1×10=10)**

(a) Find the centroid of a wire bent in a shape ABCDA as shown in Figure-10 :

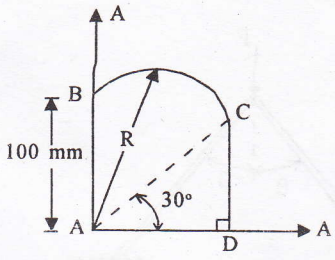

Figure - 10

(b) Derive an expression for M.I. of a right circular cone of base radius 'R' and mass 'M' about its symmetrical axis.

6. Attempt any **one** part of the following : **(1×10=10)**

(a) A circular disc starts from rest at $\theta = 0$ and accelerates at a rate given by the relation $\alpha = 3t - t^2$, where 'α' is in rad per square seconds and t is time in seconds. Determine the time at which the body comes to a momentary rest before changing the direction of motion. Also determine the angular displacement in this time.

(b) A motorist is driving his car at 80 kmph. He observes red light 200 m ahead turn red. The traffic light is timed to remain red for 12 s. If the motorist wishes to pass the light without stopping, find the required minimum acceleration.

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

(a) Show that work-energy principle and impulse-momentum principle are other forms of Newton's second law of motion.

(b) Two links of Equal lengths 'ℓ' are hinged and arranged vertically as shown in Figure-11. They are connected at their lower ends by a spring of unstreched length 's'. When a vertical force 'P' is applied, determine the spring constant 'k' to maintain equilibrium at the position shown :

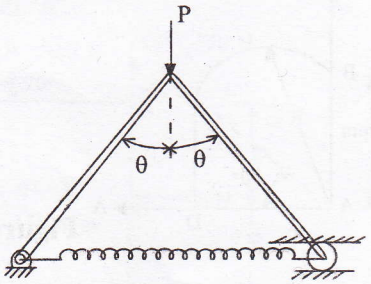

Figure-11

(c) A block of 10 kg mass rests on a rough horizontal surface, whose co-efficient of kinetic friction is 0.2. It is being pulled by a constant force of 50 N as shown in Figure-12. Determine the velocity and distance travelled by the block after 5 seconds.

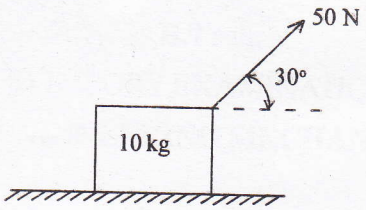

Figure-12