Registration No: | | | | | | | | | | |

Total Number of Pages: 04 **B.TECH**

15BE2104

2nd Semester Back Examination 2016-17

MECHANICS

BRANCH(S): ALL

Time: 3 Hours

Max Marks: 100

Q.CODE: Z927

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 Answer the following questions with correct option: (2 x 10)

a) If two equal forces of magnitude P act at an angle θ, their resultant will be

(i) 2P cos θ/2 (ii) P tan θ/2 (iii) 2P sin θ/2 (iv) 2P tan θ

b) If the resultant of two equal forces has the same magnitude as either of the forces, then the angle between the two forces is

(i) 30^0 (ii) 60^0 (iii) 90^0 (iv) 120^0

c) The coefficient of friction depends on

(i) area of contact (ii)shape of surfaces

(iii) strength of surfaces (iv) nature of surface

d) If j = number of joints and 2j is the number of members, then the frame is

(i) Perfect (ii) Deficient (iii) Redundant

(iv) Cannot decide because of insufficient data.

e) Ratio of M.I. of a circle and that of a square having same area about their centroidal axis is

(i) $\frac{3}{\pi}$ (ii) $\frac{3}{2\pi}$ (iii) $\frac{4}{\pi}$ (iv) $\frac{5}{4\pi}$

f) The tension in the cable supporting a lift moving upwards is twice the tension when the lifts move downwards. The acceleration of the lift is equal to

(i) g (ii) g/2 (iii) g/3 (iv) g/4

g) A jet engine works on the principle of conservation of

(i) angular momentum (ii) Linear momentum (iii)energy (iv) mass

h) A glass marble drops from a height of 5m on to a horizontal floor. If the co-efficient of restitution is 0.85, find the height to which it rises?

(i) 3.6 m (ii) 2.4 m (iii) 2.8 m (iv) 4.2 m

i) A uniform chain of mass *m* and length *l* lies on a smooth table such that one-fourth of its length is hanging vertically down over the edge of the table. Work done to pull the hanging part of the chain on the table is

(i) mgl (ii) $\frac{mgl}{4}$ (iii) $\frac{mgl}{16}$ (iv) $\frac{mgl}{32}$

j) A bullet is fired at an angle of 45^0 to the horizontal with a muzzle velocity of 981 m/s. The horizontal distance covered by the bullet from firing site is

(i) 14144 m (ii) 49050 m (iii) 69377 m (iv) 98100 m

Q2 Answer the following questions: *Short answer type* **(2 x 10)**

a) Write the conditions of equilibrium of coplanar forces.

b) Explain the term 'support reaction'. Sketch the different types of supports and the reactions developed in each type.

c) State and explain the theorem of transmissibility of a force.

d) Define cone of friction. What is the physical significance of cone of friction?

e) Show the differences between 'method of sections' and 'method of joints'.When do you think that 'method of sections' is preferable over 'method of joints'?

f) State and explain the theorems of Pappus.

g) A particle starting from rest from the origin moves in a straight line whose equation of motion is given by $v = 2t^3 - 3t^2$. What will be the displacement of the particle after 3 seconds?

h) State and explain D'Alembert's principle.

i) What do you mean by Impact ? Explain the terms 'Plastic Impact', 'Elastic impact' and 'Semi-elastic Impact'.

j) Write the equations of a freely falling body.

Part – B (Answer any four questions)

Q3 a) Two identical rollers, each of weight Q=150 N are supported by an inclined plane & a vertical wall as shown in fig-1 Assuming smooth surfaces, find the reactions induced at the points of support A, B &C. **(10)**

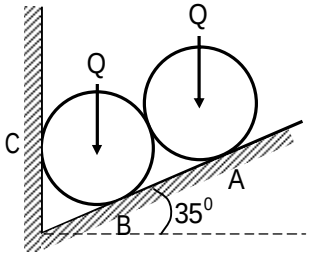

Fig-1

b) The forces 30N, 50 N, 70 N, 90 N and 110 N are acting on one of the angular points of a regular hexagon, towards the other five angular points, taken in order. Find the magnitude and direction of the resultant force. **(5)**

Q4 a) To raise a heavy stone block weighing 8.9 kN, the arrangement shown in fig-2 below is used. What horizontal force P will it be necessary to apply to the wedge in order to raise the block if the coefficient of friction for all contiguous surfaces is $\mu = 0.3$? Neglect the weight of the wedge. **(10)**

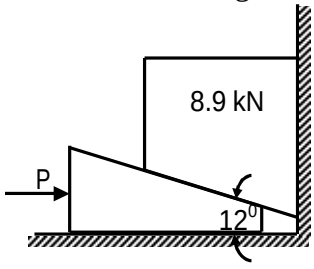

Fig-2

b) A prismatic bar AB of weight Q = 500 N is hinged to a vertical wall at A and supported at B by a cable BC. Determine the magnitude and direction of the reaction R_A at the hinge A and the tension force S in the cable BC. The directions of the bar and cable are shown in the fig- 3. **(5)**

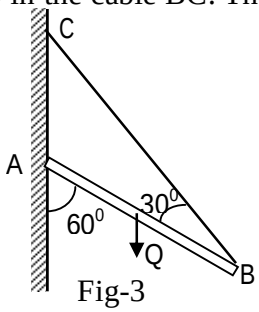

Fig-3

Q5 a) Find the moment of inertia about centroidal X and Y axis of the section shown in Fig- 4 below. The thickness of the section is 20 mm. **(10)**

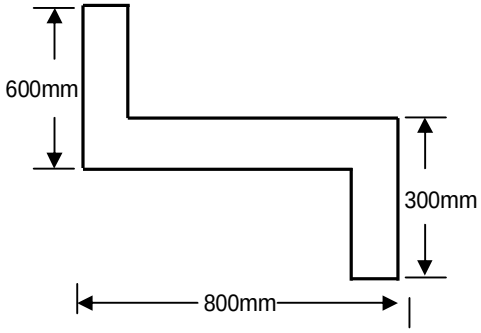

Fig- 4

b) Using theorem of Pappus-Guldinus, find the volume generated by revolving a quarter ellipse about its major semi-axis. The major and minor semi-axes of the quarter ellipse are 20 cm and 16 cm respectively. **(5)**

Q6 a) Find the forces in all the members of the pin jointed truss as shown in Fig- 5 by method of joints**.** Check your result for the member 3 and 4 by method of sections. **(10)**

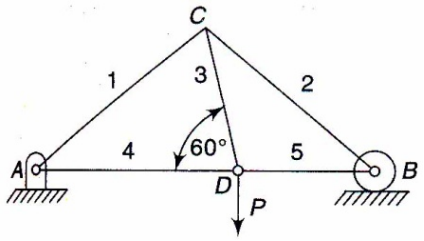

Fig-5

b) Define plane truss .What are the assumptions made in the analysis of the truss? Differentiate between the plane truss and the space truss ? **(5)**

Q7 a) The track repair-works are going on a 2 km length of a railway track. The maximum speed of the train is 90 km/h. The speed over the repair track is 36 km/h. If the train decelerates uniformly from the full speed 90 km/h to 36 km/h within a distance of 200 m. and after covering the repair track 2 km, the train again accelerates uniformly to 90 km/h from 36 km/h in a distance of 1600 m. Determine the time lost due to reduction of the speed in the repair track. **(10)**

b) The masses of two balls are in the ratio 2:1 and their respective velocities are in the ratio 1:2, but in the opposite direction before impact. If the coefficient of restitution be 5/6, prove that after impact each ball will move back with 5/6th of its original velocity. **(5)**

Q8 a) A small block starts from rest at point A and slides down the inclined plane AB shown in fig-6 below. What distance s along the horizontal plane BC will it travel before coming to rest? The coefficient of kinetic friction between the block and either plane is $\mu = 0.35$. Assume the initial velocity with which it starts to move along BC is of the same magnitude as that gained in sliding from A to B. **(10)**

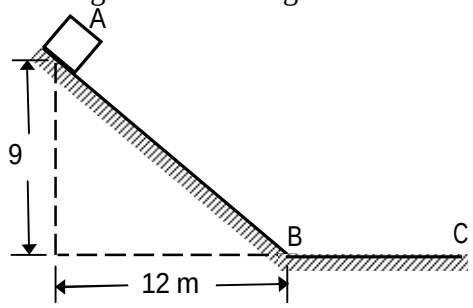

Fig-6

b) From bottom of a cliff 122.625 m high a stone is thrown vertically up with a velocity that would carry it just to the top. After one second another stone is dropped from the top. When and where will the two bodies meet? Take $g = 9.81$ m/s^2. **(5)**

Q9 a) A small car of weight W starts from rest at A and rolls without friction along an inclined plane to B where it strikes a block also of weight W and initially at rest. Assuming a plastic impact at B, the car and block will move from B to C as one particle. If the coefficient of friction between block and plane is $\mu = 0.4$, calculate the distance x to point C where the bodies come to rest. **(10)**

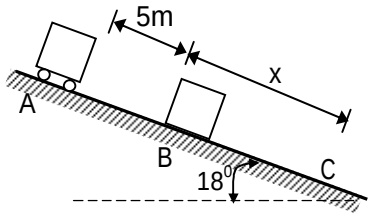

Fig-7

b) On a level ground, a projectile is projected such that it just clears a wall of 5m height and strikes the ground at a distance of 4 m beyond the wall. If it is projected at a distance of 7m from the wall, determine the angle of projection and least initial velocity of projection. **(5)**