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

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

15BE2104

1ST Semester Back Examination 2016-17
MECHANICS
BRANCH(S): ALL

Time: 3 Hours

Max Marks: 100

Q.CODE: Y676

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: *multiple type or dash fill up type*** **(2 x 10)**

a) Two non-collinear parallel forces acting in opposite direction constitute a

(i) resultant couple (ii) moment (iii) couple (iv) moment of couple

b) Two forces are acting at an angle of 120°. The bigger force is 40N and the resultant is perpendicular to the smaller one. The smaller force is

(i) 10 N (ii) 20 N (iii) 30 N (iv) None of these

c) A framed structure is perfect if it contains members equal to

(i) 2n-3 (ii) n - l (iii) 2n - l (iv) 3n - 2 .

where n = number of joints in a frame

d) The coefficient of friction depends on

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

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

e) The M.I. of hollow circular section about a central axis perpendicular to section as compared to its M.I. about horizontal axis is

(i) same (ii) double (iii) half (iv) four times

f) A person standing on a moving elevator feels 20 % heavier than when at rest. The elevator is accelerating upward at

(i) 2 m/s^2 (ii)1 2 m/s^2 (iii) 3 m/s^2 (iv) 6 m/s^2

g) The angular momentum of a system is conserved if there

(i) are no forces present (ii) are no magnetic forces present

(iii) is no net force on the system (iv) are no torques present

h) A ball is dropped from a height of 2.25 m on a smooth floor and it rises to a height of 1 m after the first bounce. The co-efficient of restitution between the ball and the floor is _____.

(i) 0.57 (ii) 0.44 (iii) 0.33 (iv) 0.67

i) **4.** A force f acts for one second on a body of mass 1 kg moving with an initial velocity u .Then which of the following statement is/are not true?

(i) Body covers a distance $(u + \frac{f}{2})$ (ii) Final velocity of the body is $(u + f)$

(iii) Change in K.E. of body is 0.5 m f^2 (iv) Momentum of the body increased by f

j) For a projectile, the maximum horizontal range R_m and the maximum height H attained during the course of flight conform to the identity

(i) $R_m = H$ (ii) $R_m = 2H$ (iii) $R_m = 3H$ (iv) $R_m = 4H$

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

a) Explain free body diagram with suitable examples.

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

c) State the law of superposition of forces.

d) Define angle of repose and prove that it is equal to angle of friction in magnitude.

e) What are the assumptions made in the analysis of the truss?

f) Differentiate between centroid and centre of gravity.

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 4 seconds?

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

i) State the work-energy theorem. Derive the equation of work-energy for rectilinear motion of a particle.

j) If a ball which is dropped from a height of 4.25 m on a smooth floor attains the height of bounce equal to 2.25 m. Find the coefficient of restitution.

Part – B (Answer any four questions)

Q3 **a)** Two smooth circular cylinders each of weight W = 200 N and radius r = 152 mm, are connected at their centers by a string AB of length L = 406 mm and rests upon a horizontal plane, supporting above them a third cylinder of weight Q = 400 N and radius r = 152 mm as shown in the figure-1. Find the force S in the string and the pressures produced on the floor at the point of contacts. **(10)**

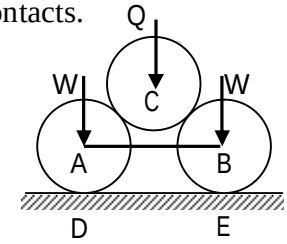

Fig-1

b) A right circular roller of weight 5000 N rests on a smooth inclined plane and is held in position by a cord *AC* as shown in fig-2 . What is the tension in the cord if there is a horizontal force of magnitude 1000 N acting at *C*. **(5)**

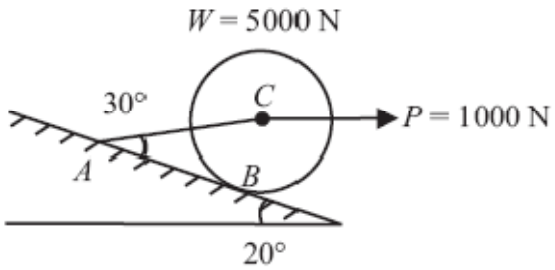

Fig-2

Q4 **a)** A smooth right circular cylinder of radius r rests on a horizontal plane and is kept from rolling by an inclined string AC of length 2r as shown in the fig-3. A prismatic bar AB of length 3r and weight Q is hinged at point A and leans against the roller as shown. Find the tension S that will be induced in the string AC. **(10)**

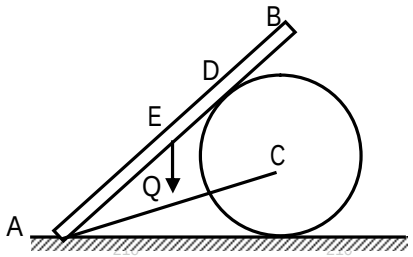

Fig-3

b) A ladder 5 m long rests on a horizontal ground against a smooth vertical wall at an angle of 60^0 with the horizontal. The weight of the ladder is 500 N. The ladder is on the verge of sliding when a man weighing 850 N stands on a rung 1.5 m high. Calculate the coefficient of friction between the ladder and the floor. **(5)**

Q5 **a)** Find the polar moment of inertia of the symmetrical 'I' section having following dimensions about the centroidal axis.Top flange: 100 mm × 10 mm; Web:100 mm × 10 mm; Bottom flange:200 mm × 20 mm. **(10)**

b) Locate the centroid of the area enclosed between a straight line y = 4x and the parabola $y = 2x^2$. **(5)**

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

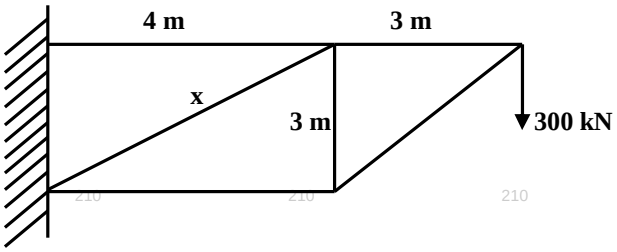

Fig-4

b) Define plane truss .What are the assumptions made in the analysis of the truss? In method of joints and method of sections which one is preferable and why ? **(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) A mass m_1 hanging at the end of a string moves a mass m_2 along the surface of a smooth table. If the mass m_2 on the table is doubled ,tension in the string is increased by one-half .What is the ratio of m_1/m_2 . **(5)**

Q8 **a)** Find the velocity of the falling weight **P** after moving h = 5 m down when the system in fig-5, is released from rest using D'Alembert's principle. Neglect friction and inertia of the step - pulley and assume , P = 35.6 N and Q = 53.4 N and $r_1 = 3\ r_2$. **(10)**

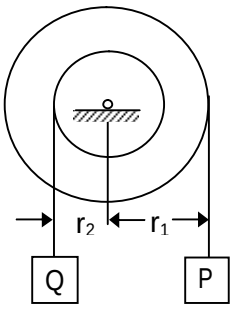

Fig-5

b) A body starts rolling down on an inclined plane (angle of plane = 30^0) the top half of which is perfectly smooth and the lower half rough. If the body is brought to rest before it reaches the bottom, what is the ratio of the force of friction and the weight of body? **(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 μ = 0.4, calculate the distance x to point C where the bodies come to rest. **(10)**

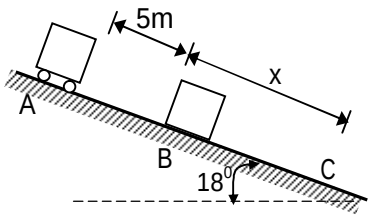

Fig-6

b) A man of height 1.5 m wishes to project a ball over the flat roof of a school house having 7.5 m height and 12 m width on the level plane. Determine at what distance from the wall he should through the ball so as to clear the roof with the least velocity. **(5)**