Code No: 121AC **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year Examinations, May/June - 2019
ENGINEERING MECHANICS
(Common to CE, ME, AE, MIE, PTM)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.
Illustrate your answer with NEAT sketches wherever necessary

PART- A

(25 Marks)

1.a) With the help of an example explain the Parallelogram law of forces. [2]
b) State and prove Lami's theorem. [3]
c) Distinguish between Static and Dynamic Friction. [2]
d) What is 'Centrifugal Tension', and how does it affect the belt tensions? [3]
e) What is the difference between Centroid and Centre of gravity of a plane? [2]
f) What is 'Polar Moment of Inertia'? Write the expressions for the Polar Moment of Inertia of a circular area with respect to its centre, its M.I. with respect to the diameter of circle, and the M.I. of the quarter circle with respect to the x – axis. [3]
g) What is the difference between the analysis as a Particle and analysis as a Rigid body in Translation? [2]
h) Write the equation of the velocity vector of a particle, having curvilinear motion, in terms of the Rectangular components. From this expression, derive the magnitude and direction of the velocity vector. [3]
i) Write the equation of work – energy for rectilinear motion of a particle. [2]
j) What is the effect of the inertia of mass of the spring on the natural frequency of a vibratory system having a mass suspended freely from the end of a spring? [3]

PART-B

(50 Marks)

2.a) How can you resolve a force into a force and couple? Where is it useful?
b) A 4 kN force is shown in figure 1. Resolve this force into i) two parallel components *P* and *Q*, acting along *aa* and *bb* respectively, and ii) a force *P* at B and a couple. Represent the couple by Forces *F* acting along *bb* and *cc*. [5+5]

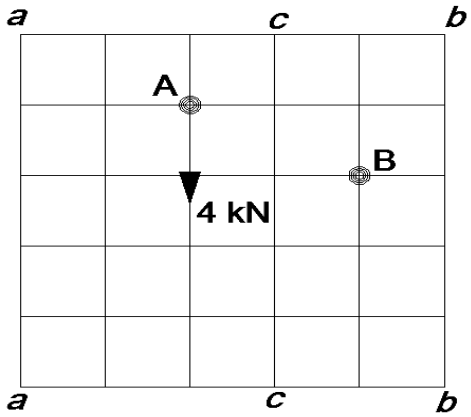

Figure: 1
OR

3.a) A man of weight $W = 712$ N holds one end of a rope that passes over a pulley vertically above his head, and to the other end of which is attached a weight $Q = 534$ N. Find the force with which the man's feet press against the floor.

b) Determine the resultant of two equal parallel forces acting in the opposite directions. [5+5]

4.a) A turnbuckle with right and left hand single start square threads is used to couple two railway coaches. The pitch of threads is 10 mm over a mean diameter of 30mm. The coefficient of friction is 0.15. Find the work to be done in drawing the coaches together a distance of 300 mm against a steady load of 25 kN.

b) Derive an expression for the Angle of Contact in the case of Cross belt drive. [5+5]

OR

5.a) A pulley is driven by a flat belt running at 200 m/minute speed. Find the power transmitted by the belt, if the maximum tension in the belt is 1000 N. Assume the coefficient of friction between the belt and pulley surface as 0.3, and the angle of lap is 160^0.

b) Show that for an ideal screw-jack, the efficiency is independent of the weight lifted. [5+5]

6. Find the centroid of the composite area ABCDEF shown in figure 2. A circle of radius 0.5 units has been cut out. A triangle and a quarter circle have also been cut out in a similar way. [10]

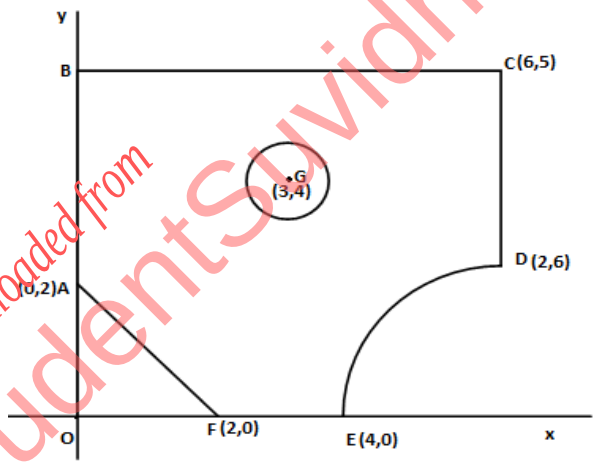

Figure: 2

OR

7.a) Find the centroid of the plane lamina OAB shown in figure 3.

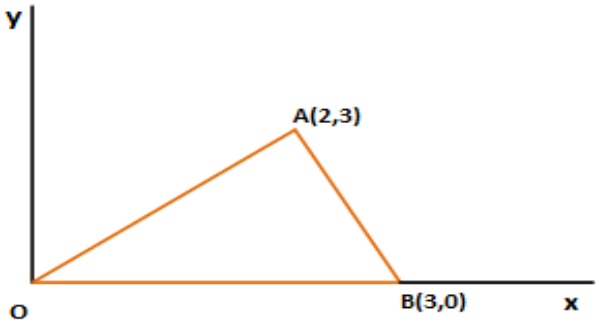

Figure: 3

b) State and explain the first theorem of pappus. [5+5]

8.a) A locomotive of weight W = 534 kN goes around a curve of radius r = 300 m at a uniform speed of 72 kmph. Determine the total lateral thrust on the rails.

b) Write the governing equations for angular velocity and angular rotation of a rigid body rotating about a fixed axis under the action of a constant moment. [5+5]

OR

9.a) The rectilinear motion of a of a particle is defined by the equation $x = x_0(2e^{-kt} - e^{2kt})$, in which x_o is the initial displacement, k is a constant, and e is the natural logarithm base. Sketch the displacement–time and velocity – time curves for this motion, and find the maximum velocity of the particle.

b) Define the normal and tangential accelerations of a particle in curvilinear motion. [5+5]

10.a) State and prove the Work energy theorem.

b) In a spring – mass vibrating system, the natural frequency of vibration is reduced to half the value when a second spring is added to the first spring in series. Determine the stiffness of the second spring in terms of that of the first spring. [5+5]

OR

11.a) A wood block weighing 22.25 N rests on a smooth horizontal surface. A revolver bullet weighing 0.14 N is shot horizontally into the side of the block. If the block attains a velocity of 3 m/s, what was the muzzle velocity of the bullet?

b) Derive the expression for the natural frequency of vibration of a spring – mass system without damping. [5+5]

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