

Ganpat University
M.Tech SEM III Mechanical Engineering (CAD/CAM)
Nov-Dec 2013 Regular Examination
3ME312 Dynamics of Mechanical System

Duration: 3hr

Total Marks: 70

Instructions:

1. Write your answer precisely and to the point.
2. Assume proper engineering data.

SEC. I

1. Attempt following questions

- (a) What are generalized coordinates and generalized velocity in analytical mechanics. Explain with examples.
- (b) Derive the velocity constraint for following figure (A).

[12]

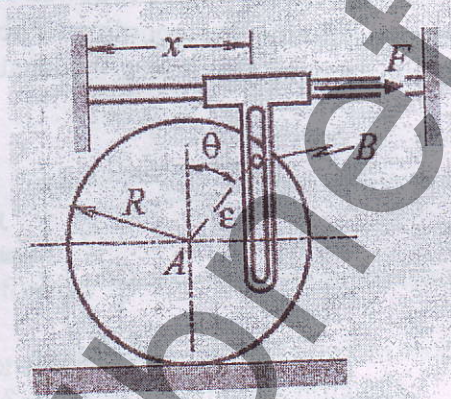


Figure A

OR

1. Attempt following questions

- (a) Derive the velocity and acceleration formulae for rectangular coordinate system.
- (b) At the instant when the 5-kg particle is at position A, it has a velocity of 500 m/s directed from point A to point B and an acceleration of $10g$ directed from point A to point O. Determine the corresponding rate of change of the speed, the radius of curvature of the path, and the location of the center of curvature of the path.

[12]

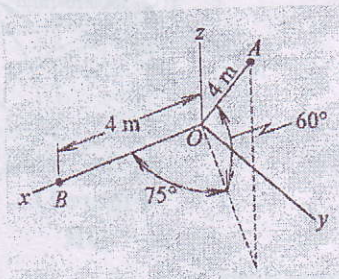


Figure B

Also determine the tangent, normal, and binormal components of the resultant

- force acting on the particle. Refer figure (B) [11]
2. **Attempt following questions**
- (a) Explain the tangent and normal component in path variables with diagram.
- (b) What is the importance of mixed kinematical description? Elaborate by an example. [11]

OR

2. **Attempt following questions**
- (a) Derive the rotational and translation transformation in Dynamics of mechanical system.
- (b) Explain the concept of Body fixed transformation system with diagram. [12]
3. **Attempt all questions.**
- (a) Write a short note on Analytical angular velocity
- (b) Derive kinematical description for cylindrical coordinate system
- (c) The xyz coordinate system is attached to the box as shown in figure (C), and XYZ is a parallel stationary coordinate system. The box undergoes a pair of rotations: First, $\theta_1 = 65^\circ$ about the y axis, followed by $\theta_2 = -145^\circ$ about the z axis. For this rotation determine the coordinates relative to xyz in its final orientation of the stationary point that was at the location of point E prior to the rotations.

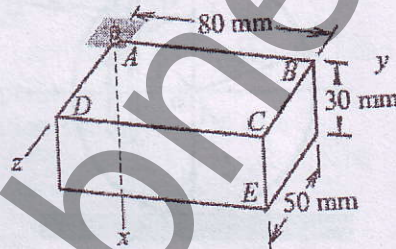


Figure C

SEC - II

4. **Attempt following questions** [12]
- (a) Write down the procedure for finding the angular velocity in Dynamic system.
- (b) The disk rotates about shaft AB at 3600 rev/min as the system rotates about the vertical axis at 20 rad/s as shown in figure (D). Determine the angular velocity of the disk.

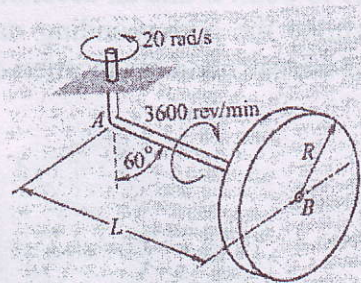


Figure D.

OR

4. **Attempt following questions** [12]
- (a) Explain the concept of velocity and acceleration analysis in moving reference frame.

(b) Explain in detail how to obtain displacement quantity in moving reference frame.

5. Attempt following questions

[11]

(a) Write a short note on Non holonomic constraint.

(b) Derive the most general form of Lagrange's equation.

OR

5. Attempt following questions

[11]

(a) Write a short note on constrain equations.

(b) A disk of a radius R rolls without slipping on a rod of length L pivoted at end, as shown in figure (E). Denoting the pivot angle by θ the angular displacement of the disk by Φ , find the virtual displacement of the center of the disk.

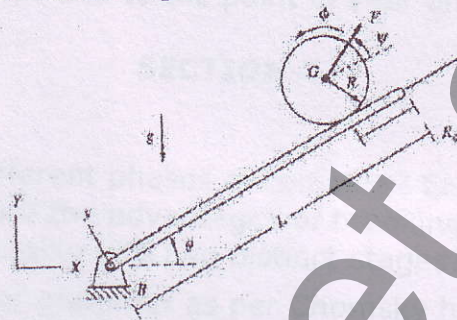


Figure E.

6. Attempt All Questions.

[12]

(a) Prove that work performed by any holonomic constraint force in any virtual displacement is zero.

(b) Explain different approaches to find virtual work in mechanical system.

(c) Derive an equation of extended Hamilton's principle.

All the best