Exam No:_____

Ganpat University
M.Tech SEM III Mechanical Engineering (CAD/CAM)
Nov-Dec 2014 CBCS Regular Examination
3ME312 Dynamics of Mechanical System

Duration: 3hr **Total Marks: 70**

Instructions:
1. **Write you answer precisely and to the point.**
2. **Assume Suitable Engineering data.**

SECTION I

1. **Attempt following questions** **[12]**

(a) Derive Frenet's formulas for a spatial curve

(b) A 10-mg dust particle is injected into an electrostatic precipitator with an initial velocity of 20 m/s, as shown in figure A. The z axis is vertical and the attractive force on the particle is $1.6 - 4y$ mN acting in the positive y direction, where y is measured in meters. Determine the location and velocity at which the dust particle will strike a collector plate that is situated in the vertical plane defined by $y = 400$ mm.

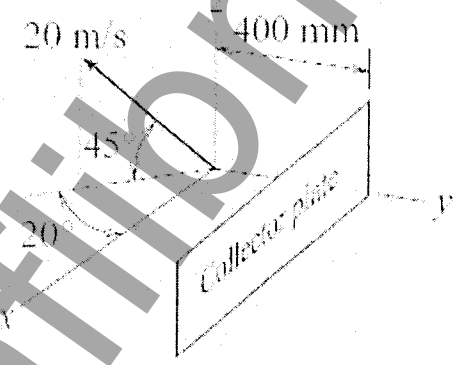

Figure A

OR

1. **Attempt following questions** **[12]**

(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.

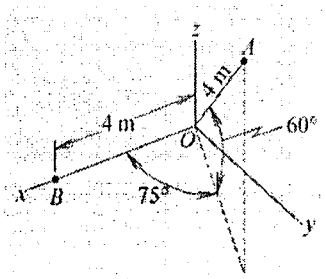

Figure B

Also determine the tangent, normal, and binormal components of the resultant force acting on the particle. Refer figure (B)

2. **Attempt following questions** [11]

(a) Derive kinematical description for cylindrical coordinate system

(b) What is the importance of mixed kinematical description? Elaborate by an example.

OR

2. **Attempt following questions** [11]

(a) An airplane climbs at a constant speed v and constant climb angle β. The airplane is being tracked by a radar station at point A on the ground. Determine the radial velocity R and the angular velocity θ as functions of the tracking angle θ.

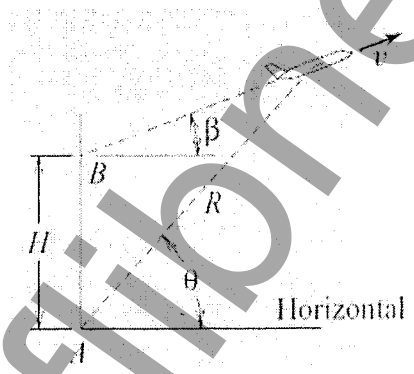

Figure C.

(b) Explain the concept of Space fixed transformation system with diagram.

3. **Attempt following questions.** [12]

(a) Write a short note on Analytical angular velocity

(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.**

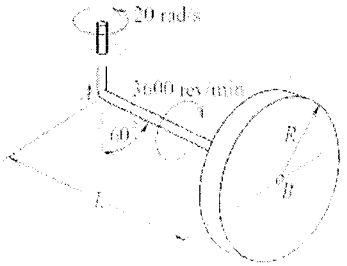

Figure D.

SECTION II

4 **Attempt following questions**

(a) The crankshaft AB is given a virtual rotation $\delta\varphi$ when it is at an arbitrary orientation φ. Determine the corresponding virtual displacement of the piston. [06]

(b) The horizontal distance x between pin A and roller B is selected as the generalized coordinate for the parallelogram linkage. Describe the virtual displacement of pin F and the virtual rotation of bar EF resulting from a virtual increment δx. [06]

OR

4 **Attempt following questions**

(a) Explain the different types of time response. Elaborate the stability and sensitivity of a system. [06]

(a) Define Control System. Differentiate between open loop system and close loop system [06]

5 **Attempt following questions**

(a) The table rotate in a horizontal plane about bearing A due to a torque $\tau(t)$. The mass of table is M and its radius of gyration about its centre is k. The slider, whose mass is m, moves within groove BC under the restraint of a pair of springs which are unstretched in the position. Derive the equation of motion for this system. [11]

OR

5 **Attempt following questions**

(a) A cable is tied to pin B on pinion gear A. A tensile force F is applied to the free end of the cable such that the cable remains horizontal. Determine the generalized force corresponding to the choice of the rotation of gear A as the generalized coordinate. [06]

(b) Two bars, pinned joint B, move in the horizontal plane subject only to the restriction that the velocity of end C must be directed toward end A. Determine the corresponding velocity constraint. Is this constraint holonomic? [05]

6 **Attempt following questions**

(a) Evaluate Holonomic Constraint and Nonholonomic Constraint [03]

(b) Define [03]

1. Scleronomic Constraint
2. Rhenomic Constraint

(c) Determine the equation of motion for the homogeneous sphere of radius r that rolls without slipping along the interior of the semi cylinder. The sphere is constraint to remain in the vertical plane. [06]

ALL THE BEST