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## GUJARAT TECHNOLOGICAL UNIVERSITY M. E. - SEMESTER - I • EXAMINATION - WINTER • 2014

M. E. - SEMESTER - I • EXAMINATION - WINTER • 2014 Subject code: 2710907 Date: 12-01-2015 **Subject Name: Advanced Engineering Dynamics** Time: 02:30 pm - 05:00 pm **Total Marks: 70 Instructions:** 1. Attempt all questions. 2. Make suitable assumptions wherever necessary. 3. Figures to the right indicate full marks. **Q.1** (a) Derive the velocity and acceleration relations for a particle moving on a curved **07** path using  $(r, \theta)$  coordinate system. (b) The airplane climbs at a constant speed  $\nu$  and at a constant climb angle  $\beta$ . The 07 airplane is being tracked by a radar station at point A on the ground. Determine the radial velocity and angular velocity as a function of the tracking angle  $\theta$ . Explain the concept of joint kinematical analysis. **Q.2** 07 **(b)** Discuss: Eulerian angles 07 OR (b) Collar B is pinned to arm AB as it slides over a circular guide bar. The guide 07 bar translates to the left at a constant speed v, such that the distance from pivot A to the center C is vt. Derive the expression for the angular velocity of collar B. (see Fig. 1) Fig. 1 **07** 0.3(a) Derive the momentum and energy principles for rigid bodies. A homogeneous disk of mass m and radius R spins at rate  $\omega_I$  about its skewed 07 axis, which rotates about the horizontal at rate  $\omega_2$ . Derive an expression for the kinetic energy of the disk. (see Fig. 2) Fig. 2 OR 0.3(a) Derive Newton-Euler equation of motion for rigid bodies. **07 (b)** Determine the rate of change of diskøs centroidal angular momentum of Fig.2. 07 Both  $\omega_1$  and  $\omega_2$  are constant.

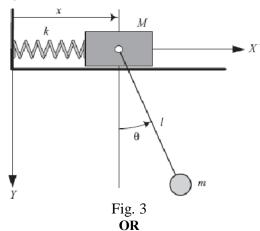
(a) Derive the Lagrange form of Newton equation of motion.

(b) Derive the equation of motion for the following system using Lagrange

**Q.4** 

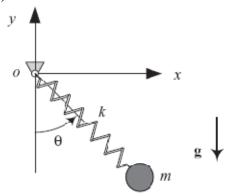
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## approach. (see Fig. 3)



Q.4 (a) Discuss the Lagrange equation including potential force.

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- **(b)** Derive the equation of motion for the following system using Lagrange approach. (see Fig. 4)



- Q.5 (a) Discuss the Hamilton principle
  - (b) Prove that the virtual work done by the inertia forces is equal to the time rate of change of the work done by the momentum minus the virtual change in kinetic energy.

## OR

Q.5 (a) Discuss Lagrange equation with constraints.

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- **(b)** Discuss the nonholonomic Hamilton principle with suitable example.

on principle with suitable example. 07

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