Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2720820

Subject Name: MULTIBODY DYNAMICS

Date: 31/05/2016

Total Marks: 70

Time:10:30 am to 01:00 pm

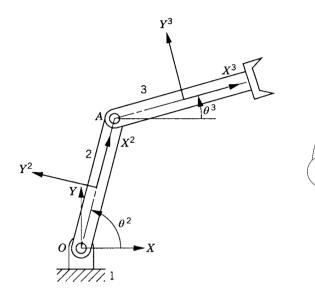
Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.

Q.1	(a)	Explain following terms with suitable illustration:: (1) Holonomic Constraints (2) Non-Holonomic Constraints	06
	(b)	Derive the algebraic kinematic constraint equations of the three-body system shown in Fig. 1, and determine the number of the system degrees of freedom.	08
Q.2	(a)	A point mass attached to a massless rod and hanging from a revolute joint, called a simple pendulum is illustrated in Fig. 2. A local coordinate frame B is attached to the pendulum that rotates in a global frame G. Derive the position vector, velocity vector and acceleration vector of the mass in global frame.	08
	(b)	Explain formulation of joint constraints for the following joint configurations: (1) Ground (2) Prismatic (3) Revolute	06
		OR	
	(b)	With a suitable example differentiate between quasi-static and kineto-static systems.	06
Q.3	(a)	For the system shown in Fig 1, determine the Jacobian matrix.	09
	(b)	Explain the significance coordinate partitioning.	05
	(U)		05
~ 1		OR	00
Q.3	(a)	From the Rodriguez formula, derive matrices for the rotation in XY plane, YZ plane and XZ plane.	08
	(b)	Write Newton-Euler equations for a four bar mechanism when coupler is subjected to external force.	06
Q.4	(a)	Derive the Rodriguez formula in terms of Euler parameters.	08
	(b)	Fig. 3 shows a particle of mass m that slides freely in the X_1X_2 plane on a	06
	(0)	slender massless rod that rotates about the X_3 axis. Derive the differential equations of motion of the system using Lagrange's equation. OR	00
Q.4	(a)	Explain the principle of virtual work and illustrate its application in defining connectivity conditions.	07
	(b)	Illustrate Lagrange's multiplier method for deriving equation of motion.	07
05	(a)	Derive the equation of element stiffness matrix of a beam element neglecting	08
Q.5		shear deformation.	
	(b)	Discuss the factors affecting stability and accuracy of the solution	06
		OR	
Q.5	(a)	Find the generalized reaction forces associated with the Cartesian coordinates of two bodies connected by a revolute joint in terms of Lagrange multipliers.	07

(b) Prove that the absolute acceleration of an arbitrary point on the rigid body can 07 be given as:

 $\ddot{r}^{i} = \ddot{R}^{i} + \omega^{i} \times (\omega^{i} \times u^{i}) + \alpha^{i} \times u^{i}$



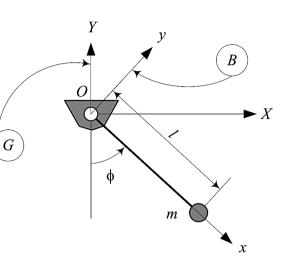


Fig. 2

Fig. 1

