Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

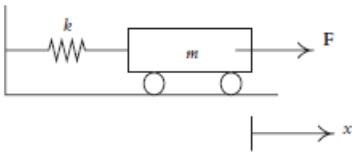
End Semester Examination, December 2020

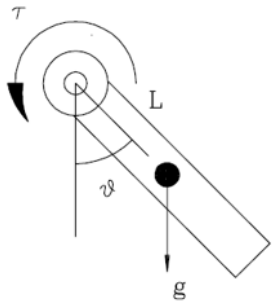
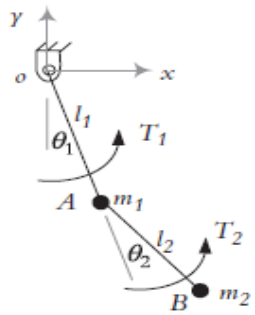
Programme Name: M. Tech. A&RE **Semester : I**
Course Name : Introduction to Robotics **Time : 03 Hrs**
Course Code : ECEG7002 **Max. Marks: 100**
Nos. of page(s) : 02
Instructions: Attempt all the questions

SECTION A **(5 X 6 = 30 Marks)**

S. No.		Marks	CO
Q 1	Elucidate the working of encoder with the help of neat and clean diagram and differentiate incremental and absolute encoder.	**5 M**	**CO1**
Q 2	With respect to the characteristics of sensor elucidate the following terms: (i) Resolution (ii) Sensitivity (iii) Linearity (iv) Range	**5 M**	**CO2**
Q 3	Explain the difference between path planning and trajectory planning with proper example.	**5 M**	**CO3**
Q 4	What is Lagrangian mechanics and how it is different from Newtonian mechanics?	**5 M**	**CO3**
Q 5	What is joint space trajectory planning.	**5 M**	**CO4**
Q 6	Explain third-order polynomial trajectory planning.	**5 M**	**CO4**

SECTION B **(10 X 5 = 50 Marks)**

Q 7	Derive the force-acceleration relationship for the 1-DOF system shown in figure, using both the Lagrangian mechanics as well as the Newtonian mechanics. Assume the wheels have negligible inertia. 	**10 M**	**CO2**
Q 8	Design the schematic representation of a 3-DOF mobile robot by using appropriate symbols.	**10 M**	**CO3**

Q 9	Derive the matrix that represents a pure rotation about the x-axis of the reference frame.	**10 M**	**CO4**
Q 10	It is desired to have the first joint of a 6-axis robot go from initial angle of 30° to a final angle of 75° in 5 seconds. Using a third-order polynomial, calculate the joint angle at 1, 2, 3, and 4 seconds.	**10 M**	**CO2**
Q 11	Derive the dynamic modeling of pendulum (1 DOF) manipulator.  	**10 M**	**CO1**
	SECTION C	**(20X1 = 20 Marks)**	
Q 12	Derive the mathematical relation of linear segments with parabolic blends with suitable diagram. **OR** With respect to Lagrangian equation of motion derive the equations of motion for the 2-DOF link manipulator system as shown in following figure.  	**20 M**	**CO3**