Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: M. Tech Automation and Robotics **Semester: II**
Program: Robotics Control System **Time: 03 hrs.**
Course Code: ECEG 7006 **Max. Marks: 100**

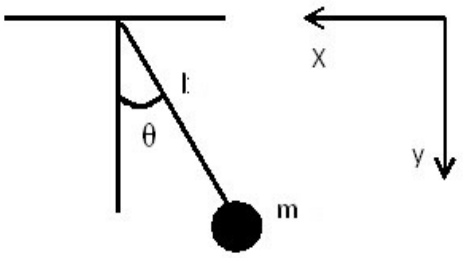
Instructions:

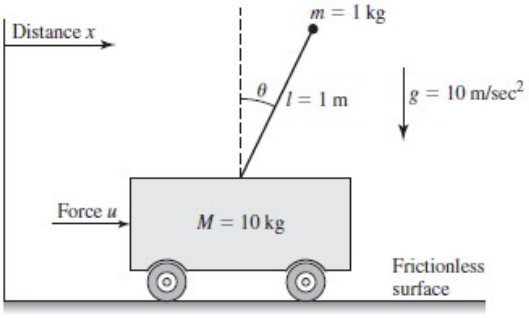
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What do you understand by feedback control system.	**4**	**CO1**
Q2	What are the actuator nonlinearities.	**4**	**CO1**
Q3	What do you understand by set point control.	**4**	**CO2**
Q4	What are the objectives in the design of control system.? Differentiate between regulation and tracking of a system?	**4**	**CO2**
Q 5	Differentiate between autonomous and non autonomous system with some example	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Q 6	The characteristics equation of a system in differential form is $\ddot{x}-(K+2)\dot{x}+(2K+10)x=0$ Find the values of K for which the system is (i) stable (ii) limited stable and (iii) unstable	**10**	**CO3**

Q 7	For single link manipulator as shown in fig, obtain the modeling in sate space format.  	**10**	**CO4**
Q 8	How fuzzy logic controller is differentiated form PID Controller. Explain with the closed loop controller diagram.	**10**	**CO4**
Q 9	Given the unity feedback control system with $G(s) = \frac{K}{s(s+a)}$ Find the value of K and a to yield K_v (velocity constant) and 20 % peak overshoot. **OR** For the following scalar nonlinear function $\dot{x} = -x^3 + u$ using Lyapunov approach comment on the stability?	**10**	**CO2**
SECTION C **(2Qx20M= 40 Marks)**			
Q 10	Consider a dynamical system that consists of a cart with an inverted pendulum attached to it as depicted in figure 3. (i)Write the Lagrange equation of motion for the system. (ii)Represent the obtained model in the state space format using the state variables $X_1=X$, $X_2=\dot{x}$, $X_3=\theta$, $X_4=\dot{\theta}$	**20**	**CO1**

	 Fig.		
Q 11	What do you understand by fuzzy logic control? Explain the working of fuzzy PI controller.Explain the generalized robot manipulator equation and their properties. Obtain the derivation for position control of robot manipulator? **OR** Given a dynamical system described by $\dot{x} = ax + b\cos(x) + u$ *where* $a, b \in R$ are known constants (assume a= 2, b =5).Design a robust controller to achieve tracking control $x \rightarrow x_d$	**20** **20**	**CO4**