Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course:Advanced Robotics **Semester:VI**
Program:Mechatronics **Time : 03 hrs.**
Course Code:MECH3016 **Max. Marks: 100**

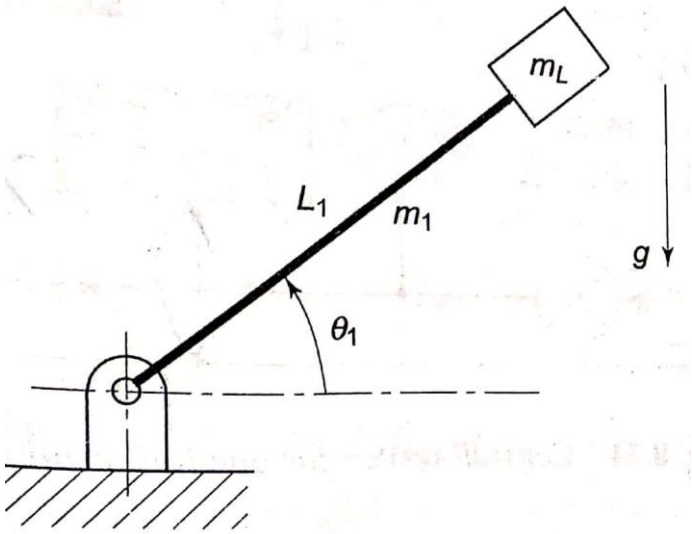
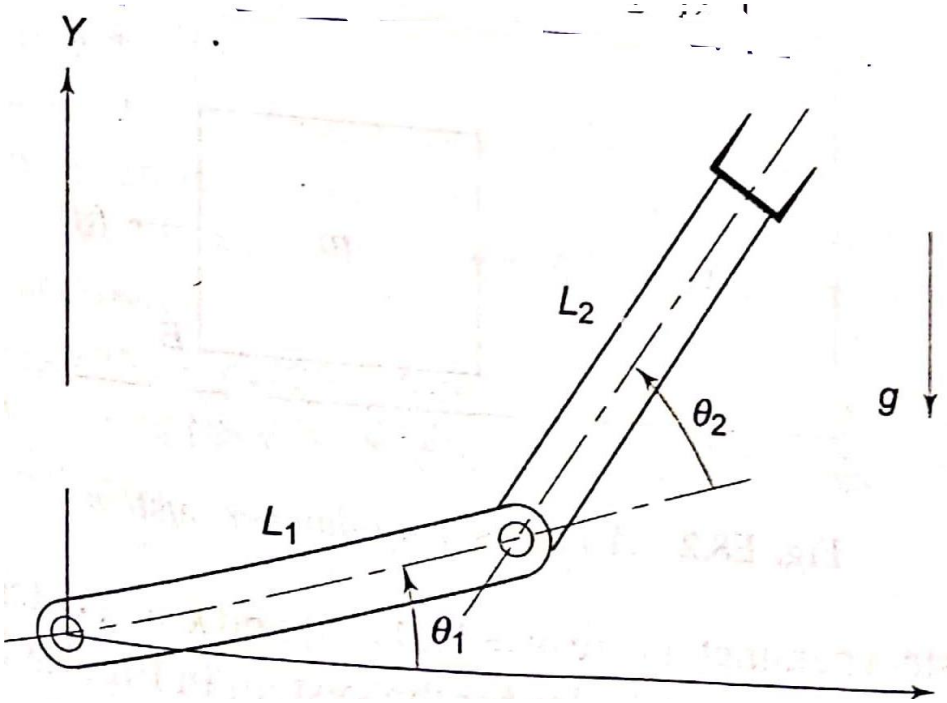
Instructions:

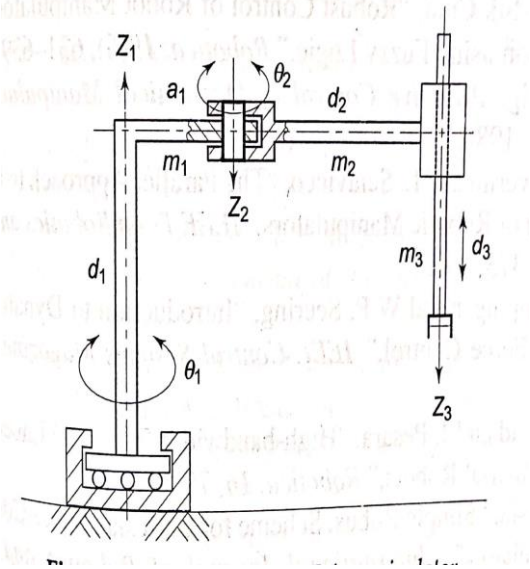
SECTION A

S. No.		Marks	CO
Q 1	Describe the four characteristic industrial applications of robot.	**5**	**CO1**
Q 2	List the steps involved in robotics assembly application	**5**	**CO2**
Q 3	Illustrate the methods of providing compliance to the peg.	**5**	**CO2**
Q 4	Consider the following case and answer the question below it. A local chemical factory has 550 employees. because of strong competition and economical reasons, the owner decides to fire 90 workers and install 10 robots. (a) Comment your view on this proposal of the owner (b) Is it fair to fire the workers. (c) Is owner obliged to retain the workers and use them for other tasks. (d) If the chemicals in the factory are injurious to the workers and workers often have health problems, what will be your suggestion.	**5**	**CO3**

SECTION B

Q 5	Consider a manipulator with a linear, second -order dynamic model as; $\tau = I\ddot{\theta}_o + B\dot{\theta}_o$ where I is total inertia and B is effective friction. The actuator gain is K_m in Nms/rad. The manipulator is required to follow the desired trajectory defined by $[\ddot{\theta}_d\ \dot{\theta}_d\ \theta_d]$. Develop a model-based control system is deployed for the dynamic control of the manipulator	**10**	**CO4**
Q 6	Develop the controller design for a single -link manipulator shown in figure1. The load carried by the link is modeled as a point mass m_L at the distal end of the link.	**10**	**CO3**

	 Figure 1		
Q 7	Consider the 2_DOF , RR manipulator , as shown in figure2. Derive the impedance control law for the manipulator assuming no gravity loading.  Figure 2	**10**	**CO4**
Q 8	A shaft of stiffens 2000Nm/rad has inertia of 2kgm^2. determine the resonance frequency of the link assuming the drive system to be rigid.	**10**	**CO2**

	OR For the mass-spring -damper system, design a PPID control system. Describe the schematic block diagram of the controller and its mathematical model.		
SECTION-C			
Q 9	For the three axes SCARA manipulator shown in figure 3 with the gravity loading terms as $G(q) = [0 \ \ 0 \ \ -mL_3 g]'$, determine the controller law for impedance control. Comment on the selection of the controller gains.  Figure 3	**20**	**CO3**
Q 10	The manipulator task for a manipulator is to use its end-effector to wind a mechanical clock. The winding task is equivalent to turning a crank as shown in the figure 4. Choose the appropriate constraint frame and identify all the natural and artificial constraints.	**20**	**CO4**

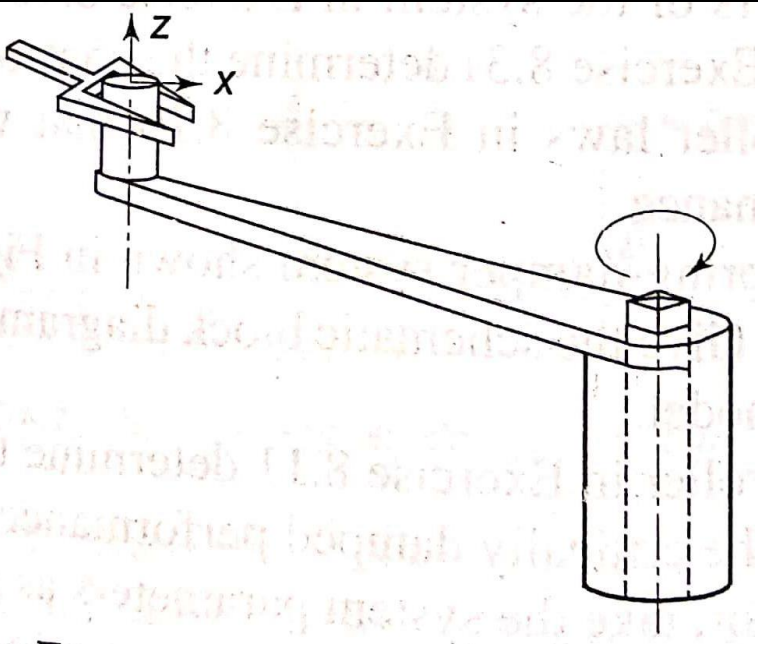


Figure 4

OR

For the task of driving a screw of pitch p at a desired angular velocity w_d using a screwdriver, determine the natural and artificial constraints. The schematic of the task is shown in figure 5.

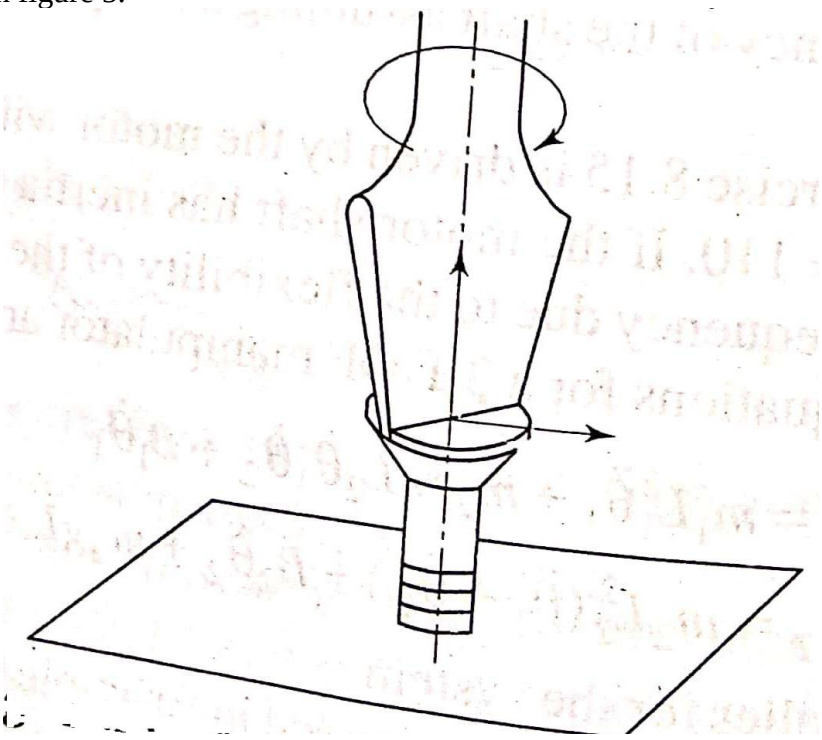


Figure 5