

Name:			
Enrolment No:			
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES End Semester Examination, May 2023			
Course: Mechatronics System Design		Semester: VII	
Program: B.Tech Mechatronic		Time : 03 hrs.	
Course Code: MEPD4019		Max. Marks: 100	
SECTION A (5Qx4M=20Marks)			
S. No.		Marks	CO
Q 1	List the characteristics of mechatronics design supports for the concepts of concurrent engineering .	4	CO1
Q 2	List the different configuration for hardware -in-the-loop simulation.	4	CO1
Q 3	Label the condition monitoring system for typical precaution systems.	4	CO2
Q 4	Discuss the framework for integrating heterogeneous systems.	4	CO2
Q 5	Discuss the interactive modelling in the mechatronics system design.	4	CO2
SECTION B (4Qx10M= 40 Marks)			
Q 6	Discuss the principle of magnetostrictive transducer principle.	10	CO3
Q 7	A hospital is interested in developing an instrument to measure the force exerted by the human finger. This instrument will be useful in the rehabilitation department. Illustrate the Principle behind the design of such an instrument.	10	CO3

Q 8	<p>A 1.8 ° stepper motor is directly connected to a machine table driven by a lead screw with three threads per cm.</p> <p>(a) Determine the axial distance traveled by the lead screw when an external input of 4355 pulses are sent to the motor.</p> <p>(b) A separate encoder is connected to the other end of the lead screw . The encoder generates 180 pulse/rev. Calculate the number of pulse.</p>	10	CO3
Q9	<p>A CNC machine tool table is powered by a servo motor, lead screw , and optical encoder . The lead screw has a pitch of 5 mm and is connected to the motor shaft with a gear ratio of 16:1. The optical encoder is connected directly to the lead screw and generates 200 pulses per revolution of the lead screw. The table must move a distance of 100 mm at a feed rate of =500 mm/min. Determine</p> <p>(a) Pulse count received by the control system</p> <p>(b) Pulse rate</p> <p>(c) Motor speed</p> <p style="text-align: center;">OR</p> <p>A computer -numerically -controlled PCB drilling machine uses a stepper motor for positioning purposes. The lead screw which drive the table of the machine tool has pitch of 10 mm. The work table traverse a distance of 40 mm at a linear speed of 400 mm per minute. If the stepper motor has 180 step angles, calculate the speed of the stepper and the number of pulses needed to move the machine table to desired a location.</p>	10	CO4
<p>SECTION-C (2Qx20M=40 Marks)</p>			

Q 10	<p>An industrial robot performs a machine loading and unloading operations. A controller is used as the robot cell controller. The cell operates as follows: (1) a human worker places a work part into a nest, (2) the robot reaches over and picks up the part and places it into an induction heating coil, (3) a time of 10 seconds is allowed for the heating operation, and (4) the robot reaches in and retrieves the part and places it on an outgoing conveyor . A limit switch X_1 will be used in the nest to indicate part presence in step (1). Output contact Y_1 will be used to signal the robot to execute step (2) of the work cycle. This is an output for the processor, but an input interrupt for the robot controller used to signal the robot to execute step(4). Design the process flow for the processor to control the system.</p>	20	CO4
Q 11	<p>In a machining operation using a horizontal boring machine, assume that the sensors have been installed to measure cutter vibration(v), product surface roughness (s) , product dimensional accuracy (a) , and cutter temperature (t). Assume that the sensors send the following digital signals:</p> <p>$v = 1$ for excessive vibration $t = 1$ for high temperature $s = 1$ for poor product surface $a = 1$ for poor quality Otherwise these signals are zeros. Design the machine control unit for this task</p> <p style="text-align: center;">OR</p> <p>Discuss the rapid prototyping of a mechatronics product.</p>	20	CO4