

Name:
Enrolment No:



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

Course: Mechatronics system Design
Program: B.Tech Mechatronics
Course Code: MEPD4016

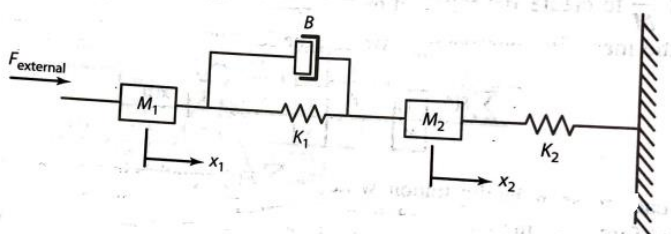
Semester: VIII
Time : 03 hrs.
Max. Marks: 100

Instructions:

SECTION A
(5Qx4M=20Marks)

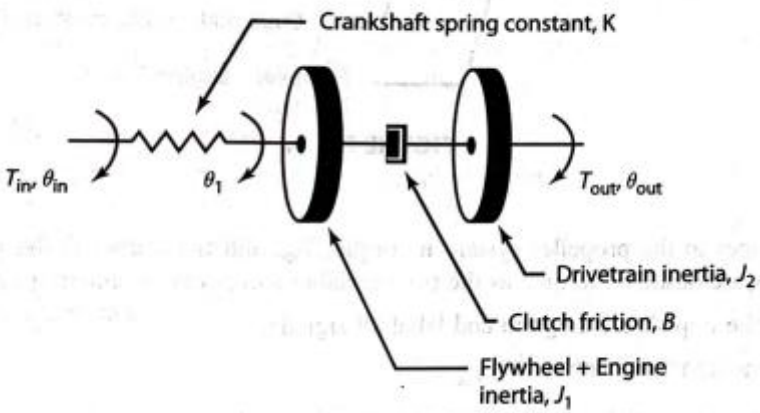
S. No.		Marks	CO
Q 1	Define optomechatronics and E-Manufacturing.	4	CO1
Q 2	State the significance of the modeling by analogy method.	4	CO1
Q 3	List the digital sensors for motion measurement.	4	CO2
Q 4	Discuss the temperature sensing using interferometric.	4	CO2
Q 5	Discuss the features of programmable controller.	4	CO2

SECTION B
(4Qx10M= 40 Marks)

Q 6	Apply the direct method of block diagram modeling and convert the transfer function given below to a block diagram model. $T(s) = \frac{s^2 - 3s + 4}{s^4 + 2s^3 - 5s^2 + 2s - 9}, y(0) = 1, \dot{y}(0) = -2, \ddot{y}(0) = 6, \dddot{y}(0) = 3$	10	CO3
Q 7	Apply the direct method of modeling convert the system shown in figure1 into block diagram form.  <p align="center">Figure 1</p>	10	CO3

Q 8	The automatic control system for the temperature of a bath of liquid consists of a reference voltage fed into a differential amplifier. This is connected to a relay, which then switches on or off the electrical power to a heater in the liquid. Negative feedback is provided by a measurement system, which feed a voltage into the differential amplifier. Sketch a block diagram of the system and explain the reason for error signal is produced.	10	CO3
Q 9	Prepare a table to compare and contrast the following actuators: (a) DC motors (b) Stepper motors (c) Fluid power actuators (d) Pneumatics OR Discuss the constructional features of brushless DC motors.	10	CO4

SECTION-C
(2Qx20M=40 Marks)

Q 10	<p>The dry plate clutch is often used in automobile drivetrain application to transmit power from the engine to the driving wheels. An illustration of the clutch is shown in figure 2.</p>  <p style="text-align: center;">Figure 2</p> <p>The input to the clutch is torque T_{in} and the output is speed, $\dot{\theta}_{out}$. The Impedances are based on torque as the flow variable and angle as potential variable. Speed is found by differentiating the potential variable</p> <p>(a) Construct the impedances diagram and label all signals</p> <p>(b) Compute the transfer function $\frac{\dot{\theta}_{out}}{\theta_{in}}$</p>	20	CO4
Q 11	A machine table driven by a closed loop positioning systems consists of a servo motor, lead screw, and optical encoder. The lead screw has a pitch of 0.500cm and is coupled to the motor shaft with a gear ratio of 4:1(4 turns of motor for 1 turn of lead screw). The optical encoder generates	20	CO4

	<p>150 pulses /rev of the lead screw. The table has been programmed to move a distance of 15 cm to a feed rate of 45cm/minute. Determine</p> <p>(a) Total number of pulses are received by the control system to verify that table has moved exactly 15 cm</p> <p>(b) Pulse rate</p> <p>(c) Motor speed that corresponds to the specified feed rate</p> <p style="text-align: center;">OR</p> <p>A CNC machine tool table is powered by a servo motor, lead screw and optical encoder. The lead screw has pitch of 5mm and is connected to the motor shaft with a gear ratio of 16:1(16 turns of the motor for one turn of the lead screw). 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 100mm at a feed rate of 500mm/minute. Determine</p> <p>(a) Pulse count received by the control system to verify that the table has moved exactly 100mm (b) pulse rate (c) motor speed that corresponds to the feed rate of 500mm/minute.</p> <p>If the range of the work table axis is 500 mm and there are 12 bits in the binary register used by the digital controller to store the position, determine the control resolution.</p>		
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