23MTOE311

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
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Model Question Paper

Fifth Semester BE Degree Examination

Mechatronics System Design

Time: 3 Hours (180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

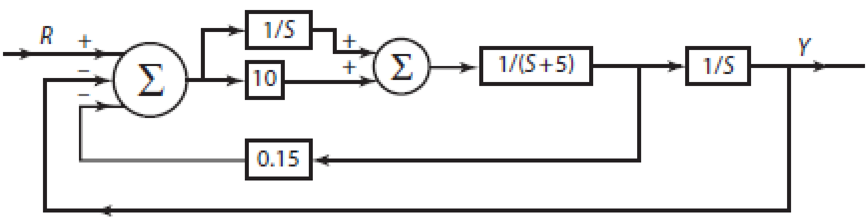
<table>
<tr><th colspan="3">Module -1</th><th>M</th><th>L</th><th>C</th></tr>
<tr><td rowspan="2">Q1</td><td>a.</td><td>Explain the main challenges faced in the integrated design of a Mechatronic system.</td><td>10</td><td>L2</td><td>CO1</td></tr>
<tr><td>b.</td><td>Explain the steps involved in the Mechatronics design process of a electric fan.</td><td>10</td><td>L2</td><td>CO1</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td rowspan="2">Q2</td><td>a.</td><td>Illustrate the key elements of a Mechatronic system.</td><td>10</td><td>L2</td><td>CO1</td></tr>
<tr><td>b.</td><td>Explain the implementation of supervisory control structures in Mechatronic applications.</td><td>10</td><td>L2</td><td>CO1</td></tr>
<tr><td colspan="6">Module - 2</td></tr>
<tr><td rowspan="2">Q3</td><td>a.</td><td>Deduce Y/ R Utilizing Block diagram reduction technique of fig.3a


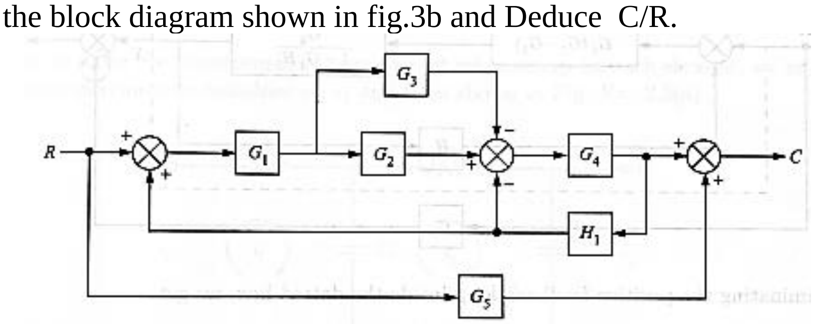
Fig.3 a</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td>b.</td><td>Reduce the block diagram shown in fig.3b and Deduce C/R.


Fig.3 b</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td colspan="6">OR</td></tr>
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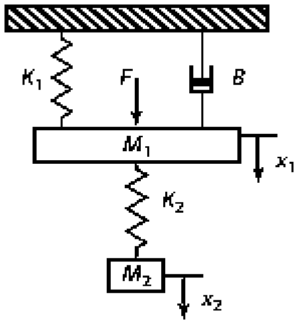
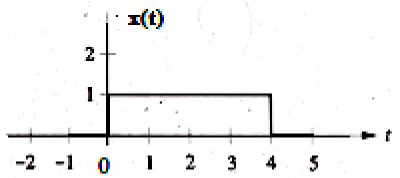
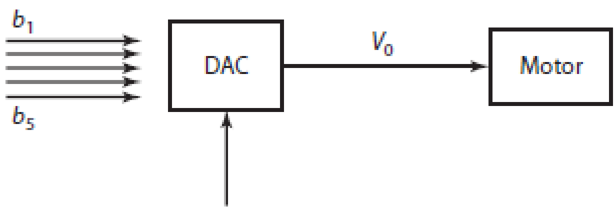
Q4	a.	Construct the block diagram model and deduce the transfer function $\frac{x2}{F}$ for the given mechanical system shown in fig.4a utilized to measure acceleration  Fig.4 a	10	L3	CO2
	b.	Deduce the following differential equations in *D*-operator form: a. $\dot{x}(t) + r(t) = 2x(t)$ b. $\ddot{x}(t) + x(t) = 0$ c. $\dot{x}(t) + \int x(\tau)d\tau = x(t)$ d. $\dddot{x}(t) + 2\ddot{x}(t) + x(t) = \dot{r}(t) + 3r(t)$	10	L3	CO2
Module - 3					
Q5	a.	Explain with diagram the working principle of permanent magnet stepper motor.	10	L2	CO3
	b.	Explain the difference between continuous and discrete signals with suitable examples.	10	L2	CO3
OR					
Q6	a.	Explain steps to identify a periodic signal and give an example for a non-periodic signal.	10	L2	CO3
	b.	A continuous time signal x(t) is shown in fig.6b. Sketch each of the following signals with respect to given signal x(t) 1. x(t-2) 2. x(2t) 3. x(-t)  Fig.6 b	10	L2	CO3
Module - 4					
Q7	a.	A motor to be driven by a digital signal has a speed variation of 200 rev/min per volt with minimum rpm at 5 V and maximum at 10 V. Determine the minimum speed word, maximum speed word, and speed change for change of 1 bit. Use a 5-bit, 15 V reference, D/A converter, as shown in fig.7a  Fig.7 a	10	L3	CO4
	b.	Determine the binary equivalent word that results from a 6.424 V input to a 5-bit A/D converter with a 10 V reference.	10	L3	CO4
OR					

Q8	a.	An inverting amplifier uses Rin = 12kΩ and Rf = 120kΩ .The opamp is powered from ±15V supply rails and can swing to within 1.5V of each rail.Assume an ideal opamp. Determine the closed loop voltage gain Av.If the input is Vin =0.25V, calculate the output voltage.	10	L3	CO4
	b.	Determine how many bits a converter must have to provide output increments of 0.02 volts or less. The reference is 10 V.	10	L3	CO4
Module – 5					
Q9	a.	Considering a car park barrier system explain the detection of vehicle and controls the opening and closing of the barrier.	10	L2	CO5
	b.	Explain the function of an ECU in an automotive system and how it manages engine parameters.	10	L2	CO5
OR					
Q10	a.	Explain the ABS system which enhances vehicle safety by preventing wheel lock-up during braking.	10	L2	CO5
	b.	Explain how mechatronic components work together to read and write data in a hard disk drive.	10	L2	CO5