USN 01JST18EC055 **Code: EC540**

JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY

SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING

JSS Technical Institutions Campus, Mysuru – 570 006, Karnataka

JANUARY/FEBRUARY 2021 SEMESTER END EXAMINATIONS

PROGRAMME: B.E.	DATE: 27.01.2021
BRANCH: E&C	DAY: Wednesday
SEMESTER: V	TIME: 9.30 A.M. to 12.30 P.M.
SECTION: 'A' & 'B'	DURATION: 3 hrs.
PAPER SETTER: Dr. S. Patil Kulkarni	MAX. MARKS: 100

CONTROL SYSTEMS

NOTE:

1. PART-A is compulsory.
2. PART-B follow Internal Choices
3. Sketch diagrams wherever necessary.

PART – A

Q. No.	CO	CD	QUESTION	MARKS
1.	CO1	L3	For the interconnected system shown in Figure Q1, sketch the signal flow graph and apply Mason's gain formula to find $G(S)=\dfrac{Y(s)}{U(s)}$	10
2.	CO2	L3	a) For the series RLC circuit shown in Figure Q2, with L=0.2H, design R and C to satisfy $\Sigma=0.5$ and Wn=5 rad/sec. b) Write the step response. c) Compute the four time domain parameters.	(4+2+4 =10)
3.	CO3	L3	Given the transfer function of a system $G(S)=\dfrac{3S^2+4S+5}{S^3+10S^2+12S+20}$ a) Write the controller canonical model and draw the circuit diagram, using integrator blocks. b) Write the observer canonical model and draw the circuit, using integrator blocks.	(5+5=10)

4.	CO4	L3	Implement the phase-lead controller $D(S)=20\frac{S+2}{S+10}$ as an op-amp based circuit. Sketch the circuit diagram	10
5.	CO4	L2	Explain closed-loop observer with circuit diagram and equations. Derive expression for observer gain L.	10

PART – B

Q. No.	CO	CD	QUESTION	MARKS
6.a)	CO1	L3	Write the differential equations for D.C. Motor, (describe parameters)	02
b)	CO1	L3	Obtain state space model with angular position of motor as output variable y(t).	04
c)	CO1	L3	Obtain minimal state-space model with angular velocity as output variable.	04
			OR	
7.	CO1	L3	For the circuit shown in Figure Q7, write the differential equations and obtain a state-space model.	10

8.	CO2	L3	In a unity feedback system, plant model is $G(S)=\frac{S+1}{S(S-1)(S+6)}$. Determine the values of proportional controller K for which closed-loop system is stable. Also find the poles on imaginary axis when closed-loop system is marginally stable.	10
			OR	
9.	CO2	L3	For the system shown Figure Q9, a) find the expressions for transfer function of closed-loop system. $G_{cl}(S)$. b) find equivalent unity feedback system and L(S), E(S), type of system. c) find steady state error values for standard reference inputs.	(3+5+2 =10)

10.	CO3	L3	Given the state-space model of a system. $A=\begin{bmatrix}-10 & 1\\ 0 & -4\end{bmatrix}$ $B=\begin{bmatrix}1\\ 0\end{bmatrix}$ $C=[1 \quad 1]$ D=0 a) Find state solution in S-domain, when $X(0)=\begin{bmatrix}0\\ 0.5\end{bmatrix}$ and input signal is unit step. b) Find state solution in time domain. c) Verify X(o) from solution.	(4+4+2 =10)

USN: Code: EC540

OR				
11.	CO3	L3	Define Observability property for state-space model. Given the state-space model. $A=\begin{bmatrix}-10 & 1 & 1\\ 0 & -4 & 0\\ 0 & 0 & -3\end{bmatrix}$ $B=\begin{bmatrix}1\\0\\0\end{bmatrix}$ C=[1 1 1] D=0 (a) Test for observability property. (b) Find inverse of similarity transformation operator to that converts given model to observer canonical model.	10

12.	CO4	L3	Given the plant model $G(S)=\dfrac{1}{S(S+3)}$ design phase-lead controller such that dominant poles of closed-loop system satisfy Σ=0.6 and natural frequency Wn=10 rad/sec. Sketch the approximate root-locus for L(S)=D(S)G(S)	10
OR				
13.	CO4	L3	Given $L(S)=\dfrac{1}{S(S+1)(S+5)}$, Sketch the root-locus as accurately as possible by applying all the rules. Find K i) When root-locus crosses imaginary axis. ii) When root-locus crosses Σ=0.5.	10

14.	CO4	L3	Given the state-space model of plant. $A=\begin{bmatrix}4 & 1\\ 1 & -2\end{bmatrix}$ $B=\begin{bmatrix}1\\ -1\end{bmatrix}$ C=[1 1] D=0 a) Test for controllability. b) Compute T_c that converts given model to controller canonical model. c) Compute SVFB gain K to place poles of closed-loop system at $-2\pm j4$	10
OR				
15.	CO4	L3	For the model in Q14, a) Test for observability. b) Compute T_0^{-1} that converts given model to observer canonical model. c) Compute closed loop observer gain L to place its poles at $-20\pm j40$	10

Diagram

Semester End Examination Jan 2021

EC540 Control Systems.

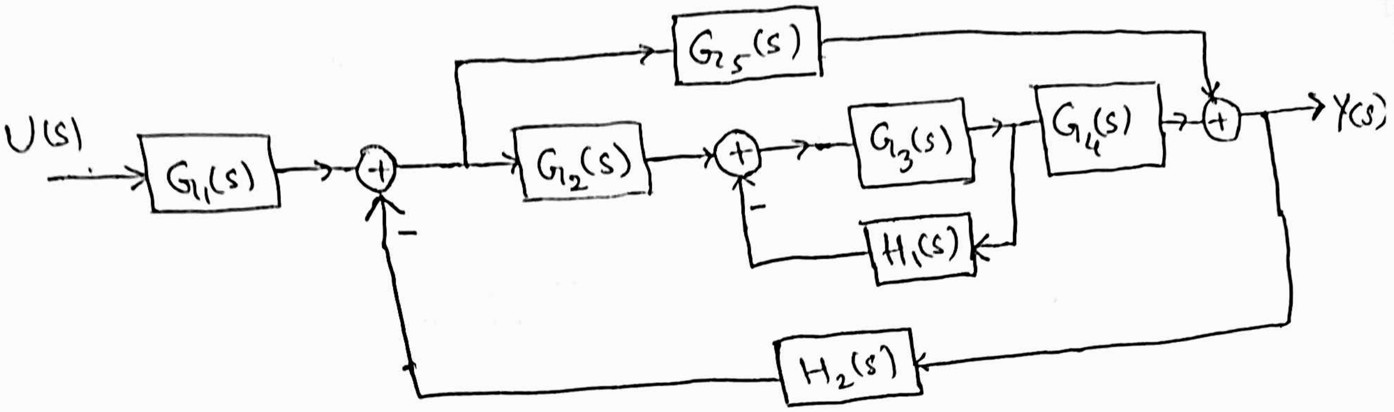

Figure Q1

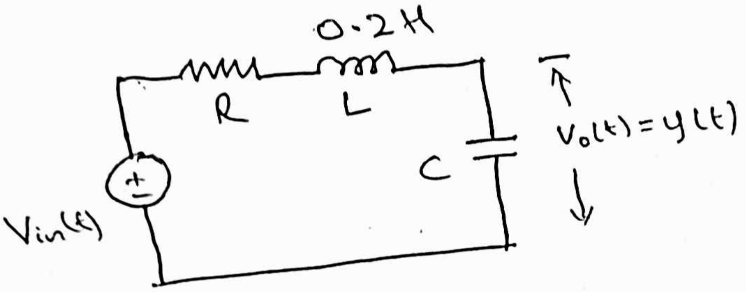

Figure Q2

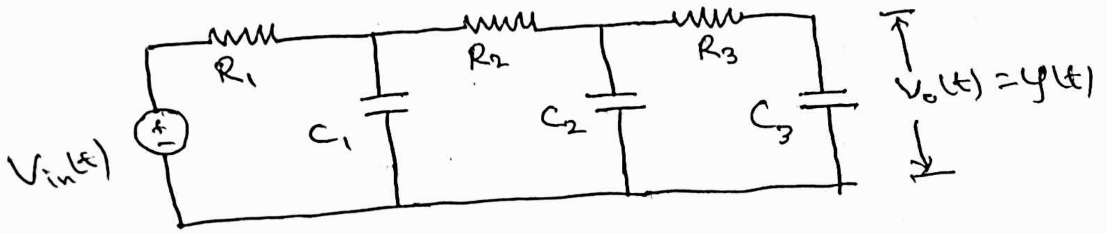

Figure Q7:

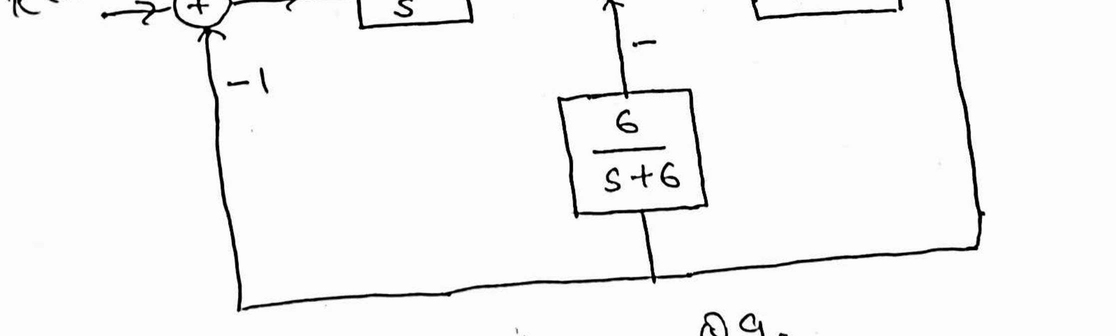

Figure Q9.

USN: Code: EC540

Bloom's Taxonomy

Definition	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions and stating main ideas.	Solve problems to new situations by applying acquired knowledge, fact, techniques and rule in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalization s.	Present and defend opinions by making judgements about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.

Course Outcome

At the end of the course, the student must be able to	
CO–1	Represent physical systems as mathematical model (transfer function and state-space model).
CO–2	Analyze various properties of the control systems in time domain and frequency domain using appropriate tools.
CO–3	Evaluate and realize the state-space models of systems using appropriate tools.
CO–4	Design and test the controllers for transfer function and state-space models.
CO–5	Use modern tools to design, implement, test the controllers and document the results in professional manner.

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