

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November-December 2017

B. Tech/ M. Tech (*as applicable*) in ...Electrical & Electronics.....Engineering, Semester ...V...

Roll No.....

COURSE CODE: EE501

Time: 3 hours

Max. Marks: 100

COURSE TITLE: Linear Control System

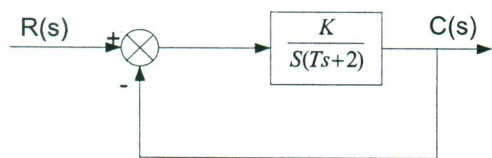
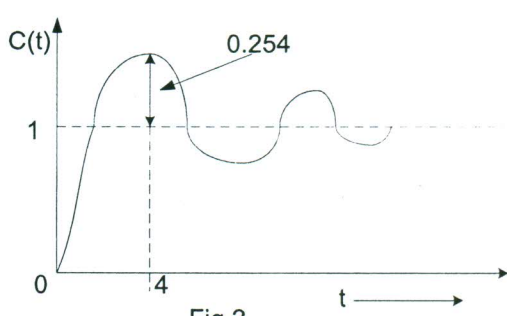
Instructions to students:

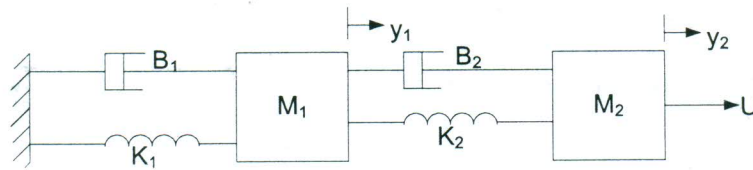
1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	The Nyquist plot of $G(j\omega)H(j\omega)$ for a closed loop control system, passes through $(-1, j0)$ point in the GH plane. The gain margin of the system in dB is equal to: (a) Infinite (b) Greater than Zero (c) Less than Zero (d) Zero	
ii.	The loop transfer function has a pole in the right half of the s-plane. The Nyquist plot makes one clock wise encirclement of $(-1, 0)$ point. The closed loop system is. (a) Unstable (b) Stable (c) Marginally stable (d) Asymptotically stable	
iii.	First order system with a proportional controller in the negative feedback loop has an offset to a step input. This offset can be eliminated by. (a) Adding a derivative mode to the controller (b) Adding an integral mode to the controller (c) Decreasing the magnitude of the gain of the proportional controller (d) Adding a delay in the controller loop	
iv.	None of the poles of linear control system lie in the right half of s-plane. For a bounded input, the output of this system (a) Is always bounded (b) Could be bounded (c) Always tends to zero (d) None of the above	
v.	If $s^3+3s^2+4s+A=0$, then all roots of this equation are in the left half plane provided that (a) $A>12$ (b) $-3<A<4$ (c) $0<A<12$	

	(d) $5 < A < 12$	
vi.	The loop gain GH of a closed loop system is given by the following expression $\frac{K}{s(s+2)(s+4)}$. The value of K for which the system just becomes unstable is (a) K=6 (b) K=8 (c) K=48 (d) K=96	
vii.	The closed loop transfer function of a control system is given by $\frac{C(s)}{R(s)} = \frac{1}{1+s}$. For the input $r(t) = \sin t$, the steady state value of $c(t)$ is equal to (a) $\frac{1}{\sqrt{2}} \cos t$ (b) 1 (c) $\frac{1}{\sqrt{2}} \sin t$ (d) $\frac{1}{\sqrt{2}} \sin(t - \frac{\pi}{4})$	
viii.	The transfer function of a system is given as $\frac{100}{s^2 + 20s + 100}$ This system is (a) An overdamped system (b) An underdamped system (c) A critically damped system (d) An unstable system	
ix.	A unity feedback system has open-loop transfer function G(s). The steady-state error is zero for. (a) Step input and type 1 G(s) (b) Ramp input and type 1 G(s) (c) Step input and type 2 G(s) (d) Ramp input and type 0 G(s)	
x.	For a first order system a 5% settling time is equal to (a) Three times the time constant (b) Two times the time constant (c) The time constant (d) Time required for the output signal to reach 5% of the final value.	

Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	The damping ratio of a system is 0.75 and the natural frequency of oscillation is 12 rad/sec. Determine the peak overshoot and the peak time.	
ii.	A unity feedback system has a open loop transfer function of $G(s) = \frac{10}{(s+1)(s+2)}$. Determine the steady state error for unit step input.	
iii.	What is the relation between stability and coefficient of characteristic polynomial?	
iv.	What is a Nyquist stability criterion?	
Q.3A	Consider a unity feedback system with a closed loop transfer function $\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2+as+b}$. Determine the open loop transfer function G(s). Show that the	05

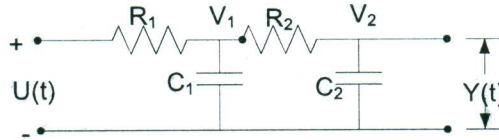
	steady state error with unit ramp input is given by $\frac{(a-K)}{b}$.	
Q.3B	The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$. By applying the routh criterion, discuss the stability of the closed-loop system as a function of K. Determine the value of K which will cause sustained oscillations in the closed-loop system. What are the corresponding oscillating frequencies?	05
Q.4A	The unity feedback system is characterized by an open loop transfer $G(s) = \frac{K}{s(s+10)}$. Determine the gain K, so that the system will have a damping ratio of 0.5 for this value of K. Determine settling time, peak overshoot and time to peak overshoot for a unit step input.	05 10
~~Q.4B~~		~~05~~
Q.5A	When the system shown in the fig.1 is subjected to a unity step input, the system output responds as shown in fig.2. Determine the value of K and T from the response curve.	05
	 Fig.1  Fig.2	
Q.5B	State how to check stability by the following methods	05
	(i) Routh stability criterion (ii) Root locus method (iii) Bode plot (iv) Nyquist plot (v) Polar plot	
Q.6A	Write a short note on principle of argument Draw a table showing examples of arbitrary s-plane contours and their corresponding F(s)-plane contours, where the F(s) plane contour encloses	05
	(i) Equal numbers of poles and Zeros in the right half of S-plane (ii) Only Zeros (iii) Only Poles (iv) Number of poles greater than Number of Zeros (v) Number of Zeros greater than Number of Poles	
Q.6B	Determine the transfer function $\frac{Y_2(s)}{U(s)}$ for the mechanical system given below.	05



OR

Q.6B Determine the closed loop transfer function $\frac{Y(s)}{U(s)}$ for the electrical system given below.

05



Q.7 For a spring mass damper system shown in the fig.1, an experiment was conducted by applying a force of 2 N to the mass. The response $x(t)$ was recorded using an xy plotter and the experimental result is shown in fig.2. Find the value of M , K , B .

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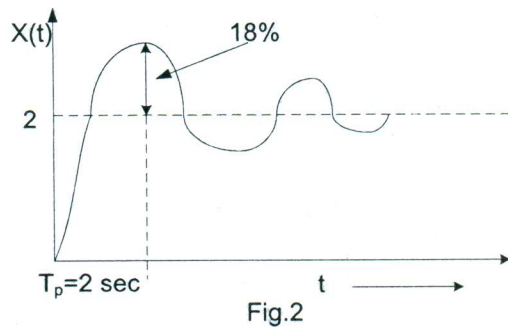
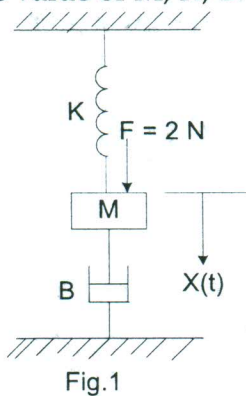


Fig.2

OR

Q.7 The open loop transfer function of a unity feedback control system is

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$$G(s) = \frac{K}{s(s^2 + 4s + 8)}$$

Sketch the root loci of the system, touching the following points.

- Number of root loci
- Number of asymptotes
- Angle of asymptotes and their real axis intercept
- Angle of departure
- Imaginary axis intercepts
- Real-axis part of the root locus

Q.8 The open loop transfer function of a unity feedback system is given by $G(s) = \frac{1}{s(1+s)(1+2s)}$. Sketch the polar plot and determine the gain margin and phase margin of the system.

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Q.9A By Nyquist stability criterion determine the stability of closed loop system,

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	whose open loop transfer function is given by, $G(s)H(s) = \frac{(s+2)}{(s+1)(s-1)}$. Comment on the stability of open-loop and closed loop system.	
Q.9B	The open loop transfer function of a system is $G(s) = \frac{K}{s(1+0.1s)(1+s)}$. (i) Determine the value of K so that gain margin is 6db (ii) Determine the value of K so that phase margin is 40°.	10
OR		
Q.9B	Sketch the Bode plot for a unity feedback system characterized by the open-loop transfer function. $G(s) = \frac{1000}{(1+0.1s)(1+0.001s)}$ find (a) Gain Margin (b) Phase Margin (c) Stability of the system	10

Best of luck!!!