G.PULLAIAH COLLEGE OF ENGINEERING & TECHNOLOGY (AT), KURNOOL

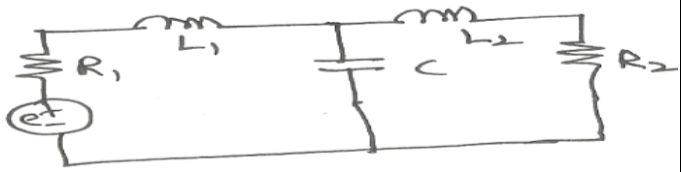
II.B.Tech - I Semester II MID Examinations

Branch: EEE

Subject: CONTROL SYSTES ENGINEERING (15A02303) **Date: 09-11-2017**

Time:1½ Hrs. **Max Marks: 30**

Question 1 is compulsory. Answer one from 2 or 3 and one from 4 or 5

Sl.No	Question	Marks	Unit	CO	Cognitive Level
1.i)	What is the relation between dominant roots and settling time?	**2**	**3**	C210.3	Understand
1.ii)	Give the pictorial representation of poles for unstable, limitedly stable and stable systems.	**2**	**3**	C210.3	Apply
1.iii)	What are the advantages of lead-lag compensator?	**2**	**4**	C210.5	Understand
1.iv)	Define Nyquist stability criterion.	**2**	**4**	C210.4	Understand
1.v)	Define state and state variables.	**2**	**5**	C210.6	Remember
2a)	The characteristic equation of a control system is given by $s^4+20Ks^3+5s^2+(10+K)s+15=0$. Determine the range of values of K for the system to be stable.	**5**	**3**	C210.3	Apply
2b)	A certain unity negative feedback system has the open loop transfer function G(s)= $\frac{K(s+1)}{s(s-1)(s+6)}$. Find the value of K which makes the closed loop system lose stability. What are the locations of unstable poles in the s-plane for this value of K?	**5**	**3**	C210.3	Apply
3a)	Explain the rules to construct Root Locus.	**10**	**3**	C210.3	Remember
3b)	Draw the bode plot and determine gain margin and phase margin for G(s)H(s)=$\frac{e^{-.03s}}{s(s+1)}$.	**10**	**4**	C210.4	Understand
4)	Explain in detail about Nyquist stability criterion.	**10**	**4**	C210.4	Remember
5a)	Obtain the canonical form and state model of a system described by a differential equation $\dddot{y} + 6\ddot{y} + 11\dot{y} + 6y = 8\ddot{u} + 17\dot{u} + 8u$; Where y is output and u is input.	**5**	**5**	C210.6	Apply
5b)	Obtain the state model of an electrical network shown below 	**5**	**5**	C210.6	Analyze

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1.i)	Define relative stability.	**2**	**3**	C210.3	Understand
1.ii)	Find the value of K and frequency of oscillations, if a system with CE $s^2+(2K-1)s+1=0$ will sustain oscillations.	**2**	**3**	C210.3	Apply
1.iii)	What is the relation between Phase margin and gain cross over frequency?	**2**	**4**	C210.4	Understand
1.iv)	Define corner frequency. For poles or zeros at origin, the corner frequency exists or not? Why?	**2**	**4**	C210.4	Understand
1.v)	State any two properties of STM.	**2**	**5**	C210.6	Understand
2a)	How many roots of a characteristic polynomial of a system s^4-s^2-2s+2 have positive real parts?	**5**	**3**	C210.3	Understand
2b)	Determine the value K for which the characteristic polynomial of a system $s^4+8s^3+24s^2+32s+K$ has roots with zero real part.	**5**	**3**	C210.3	Understand
3a)	Consider a feedback system with characteristic equation $1+\frac{k}{s(s+1)(s+2)}=0$. Sketch the root locus when open loop gain is varied from 0 to ∞.	**5**	**3**	C210.3	Apply
3b)	Draw the bode plot and determine gain margin and phase margin of a system whose open loop transfer function is given by $G(s)=\frac{100}{s(s+1)(s+2)}$.	**5**	**4**	C210.4	Understand
4	The open loop transfer function of a unity feedback system is given by $G(s)H(s)=\frac{(s+2)}{(s+1)(s-1)}$. Draw the Nyquist plot and determine stability of the closed loop system.	**10**	**4**	C210.4	Apply
5	Consider a control system with state model $\begin{bmatrix}\dot{x_1}\\ \dot{x_2}\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 2\end{bmatrix}[u]$; $\begin{bmatrix}x_1(0)\\ x_2(0)\end{bmatrix}=\begin{bmatrix}0\\ 1\end{bmatrix}$; Compute the STM and system response $x(t)$.	**10**	**5**	C210.6	Analyze

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Sl.No	Question	Marks	Unit	CO	Cognitive Level
1.i)	What is the effect of adding zeros to G(s)H(s) on root locus?	**2**	**3**	C210.3	Apply
1.ii)	The OLTF of a UFB system is given by G(s) =$\frac{Ks(s+2)}{(s-2)(s-3)}$. How many root locus branches are there?	**2**	**3**	C210.3	Understand
1.iii)	Define bandwidth and cut-off rate.	**2**	**4**	C210.4	Remember
1.iv)	What is the relation between Gain margin and phase cross over frequency?	**2**	**4**	C210.4	Understand
1.v)	Derive the relation between diagonal matrix, diagonalizing matrix for a state matrix A.	**2**	**5**	C210.6	Apply
2a)	The open loop transfer function of a unity feedback system is given by G(s)H(s)= $\frac{Ke^{-s}}{s(s^2+5s+9)}$. Determine the value of K for the system to be stable.	**5**	**3**	C210.3	Understand
2b)	Determine the value of K(K>0) such that the characteristic equation $s^3+3(K+1)s^2+(7K+5)s+(4K+7)=0$ has roots more negative than s=-1.	**5**	**3**	C210.3	Analyze
3)	Derive the expressions for resonant frequency, resonant peak and bandwidth of a second order system.	**10**	**4**	C210.4	Remember
4)	The open loop transfer function of a unity feedback system is given by G(s) =$\frac{(4s+1)}{s^2(s+1)(2s+1)}$. Draw the Nyquist plot and determine stability of the closed loop system.	**10**	**4**	C210.4	Apply
5a)	Consider a system with state model given by $\begin{bmatrix}\dot{x}1\\ \dot{x}2\\ \dot{x}3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 2\end{bmatrix}$u and y= $\begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}$; Check whether the system is completely state controllable or not.	**5**	**5**	C210.6	Understand
5b)	Examine the observability of a system represented by $\begin{bmatrix}\dot{x}1\\ \dot{x}2\\ \dot{x}3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}$ and y= $\begin{bmatrix}3 & 4 & 1\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}$	**5**	**5**	C210.6	Apply

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1.i)	The OLTF of a UFB system is given by G(s) =$\frac{K(s+2)}{(s+1)(s-1)}$. How many root loci will terminate on infinity?	**2**	**3**	C210.3	Apply
1.ii)	What is the effect of adding poles to G(s)H(s) on root locus?	**2**	**3**	C210.3	Remember
1.iii)	Define resonant peak and resonant frequency.	**2**	**4**	C210.4	Understand
1.iv)	What are the advantages of frequency response?	**2**	**4**	C210.4	Remember
1.v)	Define controllability and observability for state models.	**2**	**5**	C210.6	Understand
2a)	What are the difficulties with Routh criterion? How to overcome them?	**5**	**3**	C210.3	Remember
2b)	The open loop transfer function of a unity feedback system is given by G(s)H(s)=$\frac{K(s+1)}{(s^3+as^2+2s+1)}$ .Determine the values of K and a, if the system oscillates with a frequency 2 rad/sec.	**5**	**3**	C210.3	Understand
3a)	The open loop transfer function of a unity feedback system is given by G(s)H(s)=$\frac{K(s+2)}{(s^2+2s+2)}$. Sketch the root locus when open loop gain K is varied from 0 to ∞.	**5**	**3**	C210.3	Apply
3b)	Explain in detail about phase-lead, phase-lag and lead-lag compensators.	**5**	**4**	C210.5	Remember
4)	Consider a unity feedback system with open loop transfer function G(s) = $\frac{1}{s(1+.02s)(1+0.05s)}$. Sketch the polar plot and determine gain margin and phase margin.	**10**	**4**	C210.4	Analyze
5a)	For the state equation: $\begin{bmatrix}\dot{x}1\\ \dot{x}2\end{bmatrix}=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}$r(t)With a unit step input and the initial conditions are X(0) =$\begin{bmatrix}0\\ 1\end{bmatrix}$.Find the State transition matrix.	**5**	**5**	C210.6	Apply
5b)	Diagonalize the system matrix A=$\begin{bmatrix}0 & 6 & -5\\ 1 & 0 & 2\\ 3 & 2 & 4\end{bmatrix}$	**5**	**5**	C210.6	Understand