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الفرقة الثالثة

٢٠١٩/٥/٢٧

Nonlinear Control Systems, Third year, Industrial Electronics & Control Eng., 27/5/2019

University	:	*Menoufia*		*Date*	: *27/05/2019*
Faculty	:	*Electronic Engineering*		*Time*	: *3 Hours*
Department	:	*Industrial Electronics & Control Eng.*	جامعة المنوفية	*No. of pages*	: *2*
				No of Quest	: *4*
Academic level	:	*3rd Year*		*Full Mark*	: *70 Marks*
Course Name	:	*Nonlinear Control Sys.*		*Exam*	: *Final Exam*
Course Code	:	*ACE 321*		*Examiner*	: *Dr: Hosny Shohla*

Answer all the following questions :

Question No 1 : (20 Marks)

For the system having a nonlinear element as Thershold with dead zone and linear transfer function as shown in Fig. (1),

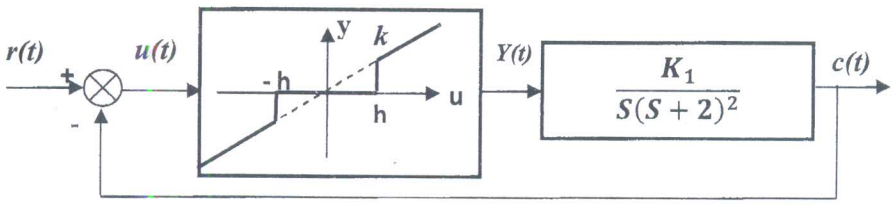

Fig. (1)

a) Determine the ***describing function N*** of the nonlinear element. (10Marks)

b) Determine the value of the ***gain K_1*** of the linear element required for oscillation with magnitude $U = 8$, and corresponding frequency where *the slop* $k = 0.5$, $h = 4$, , and u is the amplitude of the input signal. (10 Marks)

Question No 2: (20 Marks)

Fig. (2) shows the block diagram of a servomechanism, with assumptions $b = 1$, $K = 1$, $K_n = 1$, $K_e = 10$, $K_m = 0.7\ sec^{-1}$, *and* $T_m = 1\ sec$.

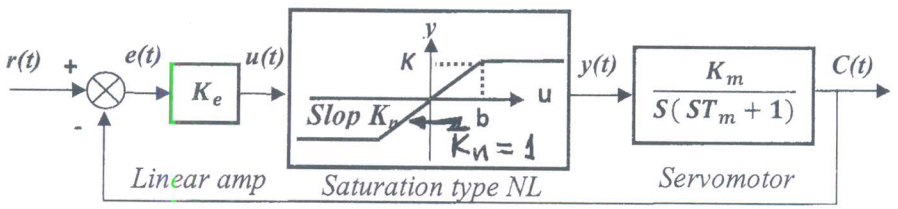

Fig. (2) Block diagram of a servomechanism

a) Determine the singular points. (5 Marks)

b) Determine roots of the auxiliary equation and the shape of the trajectory. (5 Marks)

c) Draw the ***phase portrait*** (e ***Vs.*** $\dot{e}$) using the ***Isocline method*** with initial condition ***(0.8,0)*** for step input $r(t) = 0.8$ (10 Marks)

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Question No 3 : (10 Marks)

Draw the trajectory of the system,

$\dot{x_1} = x_2$

$\dot{x_2} = -5x_1 - 2\,x_2$

Which passes through the point $x_1 = 1$ *and* $x_2 = 0$

Question No 4 : (20 Marks)

Consider the following second order system described by:

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -1 & 4 \\ 0 & -3 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

a) Find a ***Liapunov function*** for the system, and examine the stability of the system. (10 Marks)

b) Obtain an upper bound on ***response time*** that it takes the system to go from a point on the boundary of the closed curve $V(X) = 120$ to a point within the closed curve $V(X) = 0.2$ (10 Marks)

Achieved ILOS :

Question No		Q1		Q2			Q3	Q4	
		a	b	a	b	c		A	b
Achieved ILOs	A- Knowledge & Understanding	a1	a8	a1	a8	a15	a1,a8,a15	a15	a15
	B- Intellectual skills	b1	b2	b1	b2,b3	b12	b1.b2,b12		
	C- Professional and practical skills	c1	c18	c1	c1	c23	c1,c23	c12	c12
	D- General and transferable skills								