Tanta University		Department: Computers and Automatic Control	Faculty of Engineering
		Total Marks: 100 Marks	

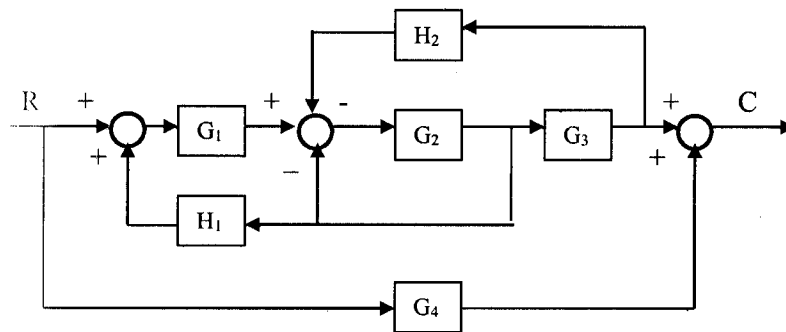| Course Title: Automatic control Engineering	Course Code:	Year: 2nd
Date: May 2105	Allowed time: 3 hrs	No. of Pages: (2)

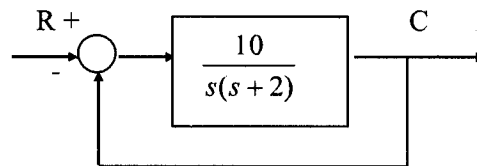**Remarks:** (answer the following questions

Q1) a) Find transfer function of the following system. (10 Marks)
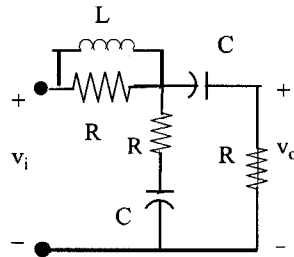
b) Determine the transfer function using signal flow graph (10 Marks)
and block diagram reduction. (10 Marks)

Q2) [a] For the following system: (10 Marks)

1) Find the type of the system and its order?
2) Determine the natural frequency and damping factor?
3) Compute the rise time and the percentage overshoot for the step input?

[b] For each of the following characteristic equations, find the root distribution and determine whether the system is stable, marginally stable, or unstable: (15Marks)

i) $S^6 + S^5 + 2S^4 + 2S^3 + 3S^2 + 2S + 4 = 0$

ii) $S^7 + 3S^6 + 3S^5 + S^4 + S^3 + 3S^2 + 3S + 1 = 0$

iii) $S^5 + 2S^4 + 2S^2 + 4S + 5 = 0$

Q(3): For positive values of K, <u>plot</u> the root locus for a unity negative feedback control system having the following open-loop transfer function:

$$G(s) = \frac{K(s+2)}{(s-1)(s+3)(s+5)}$$

For <u>what values</u> of gain K does the system become unstable? <u>Find</u> also the value of K at which the damping ratio is 0.5.   (15 Marks)

Q(4):

[a] Find a state space model for a control system having the transfer function:

$$G(s) = \frac{(s+2)}{(s+3)} \frac{(s+5)}{(s^2+s+4)}$$

in the pole-zero form (10 Marks) and other representation. (5 Marks)

[b] For the following system

$$\dot{\underline{X}} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \underline{X} + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 2 & 3 \end{bmatrix} \underline{X}$$

Find: 1) Determine whether the system in (b) is completely state controllable, observable and stable . (5Marks)

2) The transition matrix $\Phi(s)$.   (4 Marks)

[c] Given a system described by the dynamic equations (6 Marks)

$$\frac{dx(t)}{dt} = Ax(t) + bu(t) \qquad y(t) = cx(t)$$

where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & -2 \end{bmatrix} \qquad b = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \text{ and } C = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix}$$

1) The characterstic equation.

2) Find the transfer function $Y(s)/U(s)$.

| Course Title: Mathematics(3B)   Course Code: PME2211 | Year: 2nd(Computer &Control Dep.) |
| Date: 2015 (Second term)   Allowed time: 3 Hrs | تخلفات |

Q (1)

(a) Show that the set $A = \int \left(\frac{1}{\sqrt{1+5x}}\right)/x$ is convex

(b) Consider the fuzzy sets F and G defined in interval [0,10] by the memberships
$\mu_F(x) = 2^{-x}$ and $\mu_G(x) = \frac{1}{1+10(x-2)^2}$ .Determine the mathematical formulas and graphs

of memberships functions of   (i) $\mu_{\bar{F}}$ and $\mu_{\bar{G}}$ (ii) $\mu_{F\cup G}$ and $\mu_{F\cap G}$

(c) A product with memberships represents, degree of high expensive $\mu_A(x)$, degree of medium expensive $\mu_B(x)$ and degree of cheap expensive $\mu_c(x)$ .Us defuzzification methods to find suitable price if its cheap degree is 0.2 , its medium degree is 0.5 and high degree 0.7 where
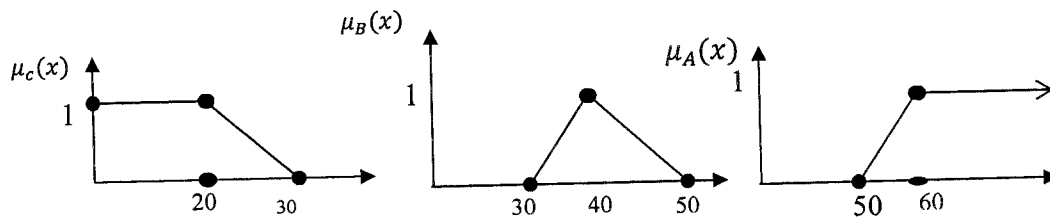
Q (2)

(a) Solve by series solutions $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + (x^2 + 1)y = 0$ at the point x = 0

(b)Find all values of z such that $\cosh z = 1 + i$

(c) Find an analytic function whose real part is $U(x,y) = x^3y - y^3x$.

Q (3)

a) Let f(z) be an analytic in a simple connected domain and let C be a simple closed contour lying entirely within the domain, if z_o is any point interior in C then prove that
$2\pi i\, f^{(n)}(z_o) = n! \oint_C \frac{f(z)}{(z-z_o)^{n+1}}dz, \quad n = 0,1,2,3, \dots .$

b) Evaluate $\oint_C \frac{\cos(z)}{(z-3)^3(z+4)^2}dz, \quad C:|z| = 5.$

c) Find and sketch the image of the circular curve $|z - 1| = 1$ under the mapping $= \frac{1}{z}$.

Q (4)

(a) Let f(z) be an analytic function within and on a closed contour C except at a finite number of singular points $z_1, z_2, \dots, z_n$ interior to C. Then prove $\oint f(z)dz = 2\pi i \sum_{i=1}^n \operatorname*{Res}_{z=z_i}\{(f(z)\}$ where the integral is taken counter clockwise direction around C

(b) Using the residue theorem to evaluate $\int_0^{2\pi} \frac{\cos 3\theta}{5-4\cos\theta}d\theta.$

(c) Using the residue theorem to evaluate $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+1)^2(x^2+2x+2)}dx.$

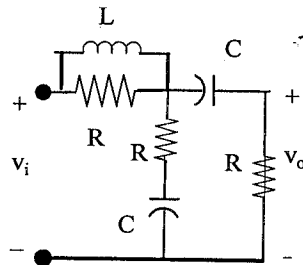With Best Wishes   Dr. Mohamed Shokry and the committee

Tanta University Engineering

Department: Computers and Automatic Control
Total Marks: 120 Marks

Faculty of

Course Title: Signals and Systems Date: May 2015	Course Code: Allowed time: 3 hrs	Year: 2nd No. of Pages: (2)

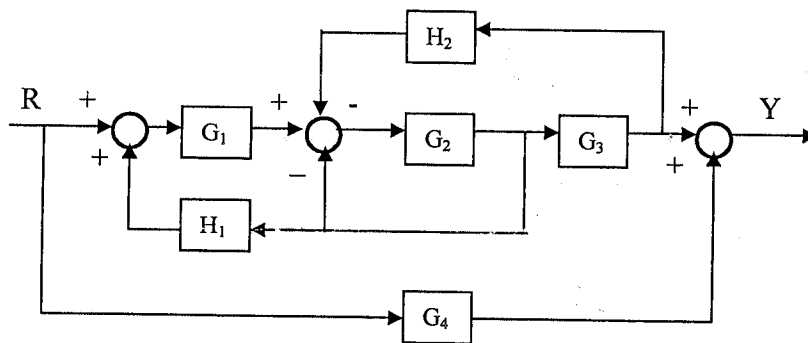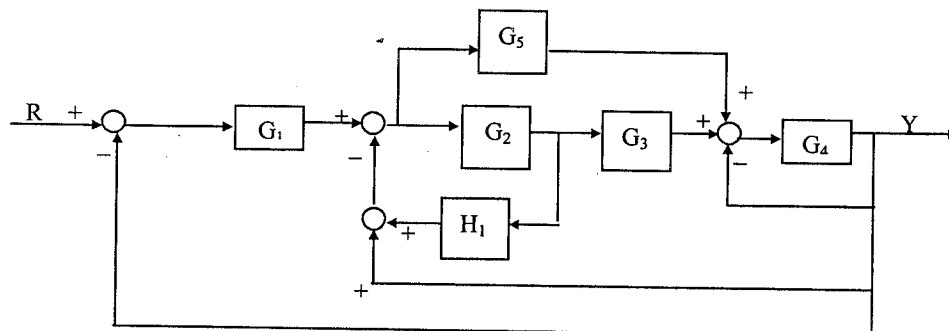**Q1) a)** Find the transfer function of the following system. **(10 Marks)**
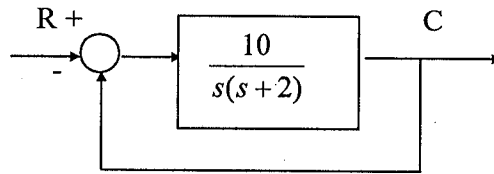

b) Determine the transfer function using signal flow graph. **(10 Marks)**

c) Determine the transfer function using block diagram reduction. **(14 Marks)**

Q2) [a] For the following system: (16 Marks)

1) Find the type of the system and its order?
2) Determine the natural frequency and damping factor?
3) Determine the steady state error for step input?
4) Compute the rise time and the percentage overshoot for the step input?

[b] For each of the following characteristic equations, find the root distribution and <u>determine whether the system is stable</u>, marginally stable, or unstable: (20 Marks)

    i) $S^6 + S^5 + 2S^4 + 2S^3 + 3S^2 + 2S + 4 = 0$

    ii) $S^7 + 3S^6 + 3S^5 + S^4 + S^3 + 3S^2 + 3S + 1 = 0$

    iii) $S^5 + 2S^4 + S^2 + 3S + 8 = 0$

    iv) $S^4 + S^3 + 2S^2 + 4S + 1 = 0$

    v) $S^3 + 2S^2 + 4S + 6 = 0$

Q(3): 1- Explain three properties of the system and give an example for each. (9 Marks)

    2- Define the state of the system and how choose it. (4 Marks)

    3- Define controllability and observability. (5 Marks)

Q(4): [a] Find a state space model for a control system having the transfer function:

$$G(s) = \frac{(s+2)}{(s+7)} \frac{(s+5)}{(s^2+s+3)}$$

in the <u>pole-zero form</u> (11 Marks) and <u>other representation.</u> (6 Marks)

[b] For the following system

$$\dot{\underline{X}} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \underline{X} + \begin{bmatrix} r \\ 2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 5 & 1 \end{bmatrix} \underline{X}$$

Find : 1) Determine whether the system in (b) is completely state <u>controllable, observable</u> and <u>stable</u> .   (9 Marks)

    2) The transition matrix $\Phi(s)$.   (6 Marks)

Course Examination Committee

Dr: Mohamed Ahmed Shoaib