Name :

ID No:

VERSION A

BITS, PILANI – DUBAI CAMPUS

Knowledge Village, Dubai.

Semester I 2006-2007

QUIZ I (Closed Book)

BE (Hons) III year (EEE/EIE/CS)

Course No : AAOC UC321
Date : 17.10.06

Course Title: Control systems
Time: 30Minutes M.M = 20 (10%)

Note: Tick the appropriate one of the given options and fill up the blanks. Each question carries 1mark. All the symbols carry their usual meanings, unless otherwise stated.

1. A control system is said to be linear, if ...

2. By the use of negative feedback, the system gain is ..... .

(Increased / decreased)

3. If the transfer function of a system is given by

The order of a system will be.....

4. In a closed loop control system

(a) input signal controls the output

(b) error signal doesn't change

(c) feedback signal controls the output

(d) actuating signal controls the output

5. If the forward path transfer function of a system is G, then the transfer function of it with unity negative feedback will be

(a) G/ 1+G (b) 1/ 1+G

(c) 1/ 1-G (d) G/ 1-G

6. In case of mechanical rotational elements, the *Integrated through variable* is ..... Whereas the *across variable* is .....

7. Define linear time invariant system.

8. Consider the torsional spring in a mechanical rotational system. Its analogous element in Force- Voltage analog is .....

(a) resistance (b) inductance

(c) capacitance (d) 1/ Capacitance

9. For a given capacitance in Force-Current analog, the analogous element in mechanical translational system is .....

(a) Viscous friction (b) Force

(c) Displacement (d) Mass

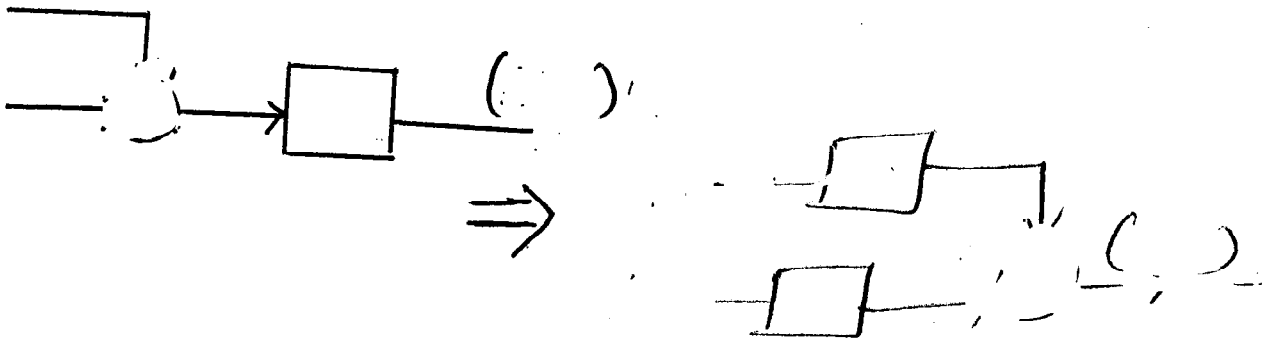
10. The force of sliding friction between dry surfaces is called as.. .....

11. In the gear train, the ratio of θ_1/θ_2 is equal to .....

(a) N_1/N_2 (b) N_2/N_1

(c) 1 (d) $[N_1/N_2]^2$

12. Draw the equivalent diagram for moving the summing point ahead of the block by block diagram reduction method.



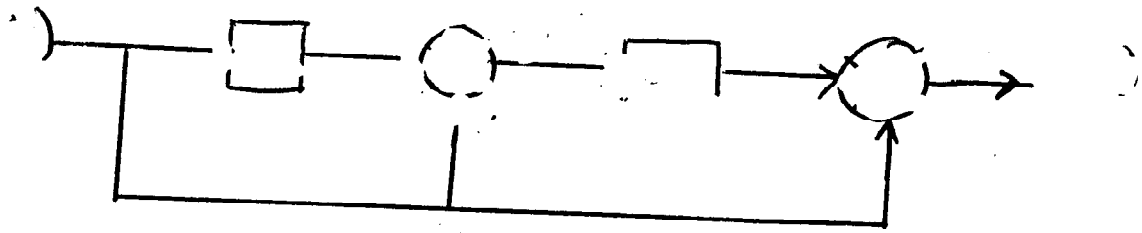
13. If torque T_1 is referred from a gear with N_1 teeth to a gear with N_2 teeth, the value of the torque received at the shaft of the second gear is

(a) $[N_1/ N_2]. T_1$ (b) $[N_2/ N_1]. T_1$

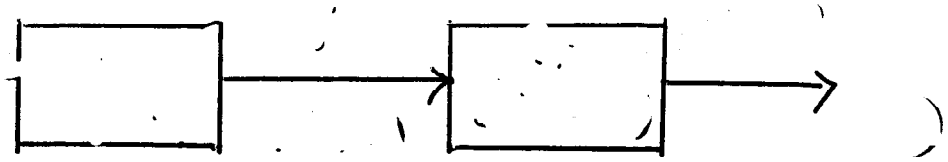
(c) N_1T_1 (d) $[N_2/ N_1]^2. T_1$

14. Inertia and friction parameters are referred from one shaft of the gear train to the other in the direct ratio of ....

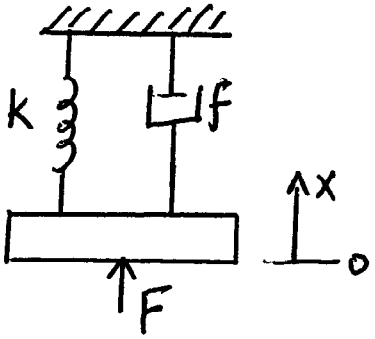
15. The overall transfer function **C(s)/R(s)** of the following block diagram will be.....



16. In the following block diagram of the field controlled Dc motor, identify the missing quantities.



17. What is the force equation for the given figure?



18. A spring is called as non linear spring then force (F) and displacement (Y) are related as .....

(a) $F = KY$ (b) $F = K/Y$

(c) $F = KY^2$ (d) None of the above.

19. After linearization technique applied to a Mass – spring (Non Linear) – Dashpot system, the order of the resulting differential equation becomes

(a) 3 (b) 2

(c) 1 (d) 4

20. In a negative feedback closed loop control system, the feedback path transfer function tends to infinite value. The over all gain of the system will tend to

(a) Infinite Value (b) Zero value

(c) 1 (d) Any value between zero and infinity.

BITS, PILANI – DUBAI CAMPUS

Knowledge Village, Dubai.
Semester I 2006-2007

COMPREHENSIVE EXAMINATION

BE (Hons) III year (EEE/EIE/CSE/MECH)

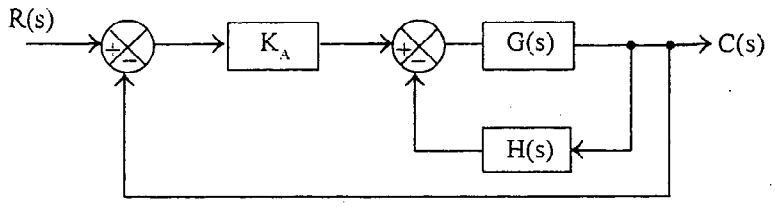
Course No : AAOC UC321 Course Title: Control systems
Date : 28.12.06 Time:3hrs M.M = 80 (40%)

Note:

1. Answer all the questions.
2. Write **SECTION A** in the main sheet and **SECTION B** in supplementary sheet.
3. If you are using graph or semi log graph sheets, first get it signed by the invigilator then only use it. **Graph sheets** used without **invigilator signature** will not be accepted.
4. All the symbols carry their usual meanings unless otherwise stated.
5. Any missing data can be assumed, but need to be mentioned.

SECTION A

1. A unity feedback control system has an amplifier with gain $K_A = 10$ and gain ratio $G(s) = 1/s(s+2)$ in the feed forward path shown in figure 1. A derivative feedback $H(s) = sK_0$ is introduced as a minor loop around G(s). Determine the derivative feedback constant K_0, so that the system damping factor is 0.6. [10 M]



Fig(1)

2. The signal flow graph of figure 2 describes a speed control system using an armature controlled DC motor. The output of the system is speed $\omega(s)$ while the input is voltage $V_1(s)$. The disturbance $T_d(s)$ is present in the forward path of the system. Determine the sensitivity of the system $S_K^{M_d}$ and $S_{K_b}^{M_d}$.
(Here $M_d(s) = \omega(s)/ T_d(s)$ in the absence of $V_1(s)$). [10 M]

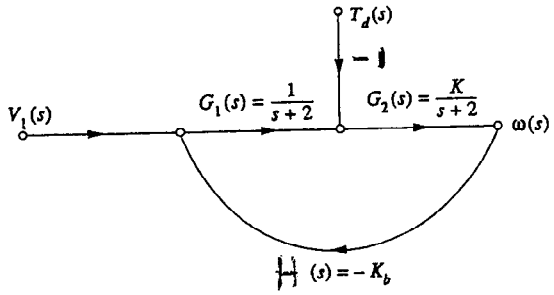


Fig (2)

3. Plot the Root locus for the unity feedback system whose open loop transfer function is $G(s) = K / s(s^2+6s+10)$. [10 M]

4. Sketch the Bode plot for the following transfer function and obtain the gain cross over Frequency. $G(s) = 20 / s(1+3s)(1+4s)$. (Assume the low frequency as 0.15rad/sec and high frequency as 1 rad/sec). [10 M]

SECTION B

5. Write the velocity differential equations governing the mechanical system shown in figure 3. [10 M]

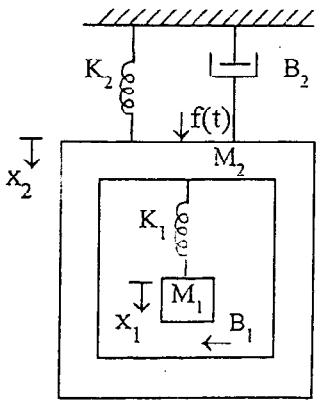


Fig (3)

6. Draw the signal flow graph and evaluate the closed loop transfer function of a system whose block diagram is shown in figure 4. [10 M]

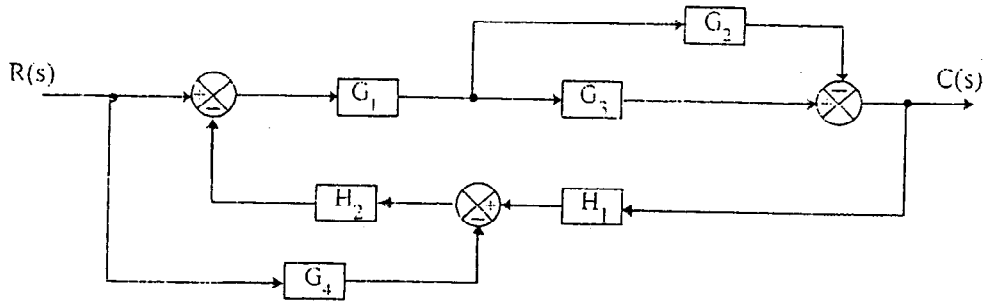


Fig (4)

7. The characteristics polynomial of a system is $s^7+9\,s^6+24\,s^5+24\,s^4+24\,s^3+24\,s^2+23s+15=0$. Determine the location of roots on s – plane and hence the stability of the system by Routh method. [10 M]

8. a. Sketch the polar plot for the transfer function $1/\,s^2(1+sT_1)\,(1+sT_2)\,(1+sT_3)$.

b. The damping ratio of the system is 0.6 and the natural frequency of oscillation is 8 rad/sec. Determine the rise time.

c. What is synchros? What are the trade names of synchros? What is the basic unit of synchros?

d. State Nyquist stability criterion.

e. Derive the response of second order system for critically damped case and when the input is unit step. [5*2=10 M]

ALL THE BEST

BITS,Pilani-DUBAI CAMPUS
Knowledge Village , Dubai
Semester-I 2006-2007
Test II(MAKE UP) (OPEN BOOK)
BE(Hons.) III year (EEE/CS/EIE/MECH.)
Subject-Control Systems
Course No. AAOC UC 321 M.M=20 (Weightage 20%)
Date 19-12-2006 Time: 50 Minutes

Note:

1. Answer all the questions
2. All the symbols carry their usual meanings unless otherwise stated
3. Only text book is allowed
4. If you are using graph/semilog graph paper, these papers have to be brought by you and get these papers signed by the invigilators before use
5. All questions carry equal marks

(1)A control system shows the system response to be $c(t)=1.0+0.2e^{-60t} -1.2e^{-10t}$, when subjected to a unit step- input. Obtain the expression for the transfer function and also determine the values of the undamped natural frequency and damping ratio of the system.

(2) A unity feedback control system has $G(s)=K(s+1)/((s+0.1)(s-1))$. Apply Routh Stability Criteria to determine the range of values of K for the system to be stable. Also find the range of values of K such that the system will have poles in the right half s-plane and alsofind the numbers of such poles.

(3)Sketch the root locus of the control system having $G(s)H(s)=K/(s^2+4s+20)$. Calculate the angles of asymptotes and the coordinate of centroid and also find out the "Breakaway Points".

(4) For $G(j\omega)= 1.0/ ((1+j\omega T_1) (1+j\omega T_2))$, Sketch the Polar Plot, after deriving necessary detail steps of calculations and hence determine the value of frequency corresponding to which the Polar Plot intersects the imaginary axis.

BITS-Pilani,DUBAI CAMPUS
Knowledge Village,Dubai,
Semester-I 2006-2007
QUIZ-II(MAKE-UP)
BE(Hons) III year(EEE/EIE/CS/MECH.)

Course No :AAOC UC321 Course Title: Control Systems
Date :12.12.2006 Time : 30 Minutes Max. Marks =20(10%)

ALL THE SYMBOLS CARRY THEIR USUAL MEANINGS,UNLESS OTHERWISE STATED

Name : ID No. :

PART-A (6*1=6 marks)

(1) In a regenerative feedback system,for G(s)H(s)=1,"C(s)/R(s)"tends to the value:
(a)1 (b)0 (c)infinity (d)none of them

(2)For Type-2 system , e_{ss}(velocity) has a value :
(a) 0 (b)1 (c) infinity (d)0.5

(3)For unit parabolic signal input, e_{ss} will have the expression(unity feedback system)
(a)$1/(1+K_p)$ (b)$1/K_a$ (c)$1/K_v$ (d)$1/(1+K_a)$

(4) As per Routh Stability criteria, the system is stable,if the 1^{st} column terms of the Routh Array have:
(a)only one sign change
(b)Any number of sign changes
(c)No sign change
(d)None of them

(5)For the characteristic equation $s^2+6s+8=0$,the roots:
(a)lie in left half s-pane
(b)lie in right half s-plane
(c) lie on imaginary axis
(d)Both (a) and(c)

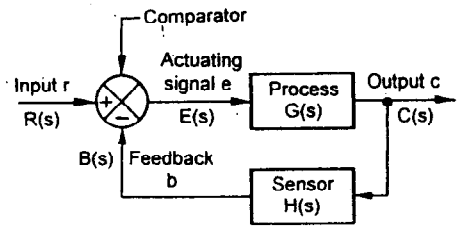
(6) In connection with the unit step response of a typical second order closed loop (negative feedback) control system for damping ratio less than unity (not equal to zero),the error (=1-c(t)) can be termed as:
(a)sine wave
(b)constant
(c)Exponentially decaying sine function
(d)Decaying exponential function

Part-B (7*2=14 marks)

(7)A unity feedback system has a transfer function G(s)=1/(1+Ts).Due to unit ramp input,determine the steady state error.

(8)For a typical closed loop second order control system , the value of damping ratio is zero. Write the expression for c(t) due to unit step input.

(9)What is the sensitivity of T with respect to G(the process) for the figure shown:



(10)Derive the expression for the term $(S_G^T+S_H^T)$,where the expression for each individual sensitivity is known(refer same figure of question 9)

(11)A typical second order control system has damped frequency of oscillation of 6.0 rad./sec. and damping ratio is 0.65. Determine the natural frequency of oscillation.

(12)A unity feedback system has an open loop transfer function, G(s)=10/s(s+1)(s+2). Determine the steady state error due to unit ramp signal input.

(13)Write the special cases (Difficulties 1 and 2) of Routh Stability Criteria.

BITS, PILANI – DUBAI CAMPUS

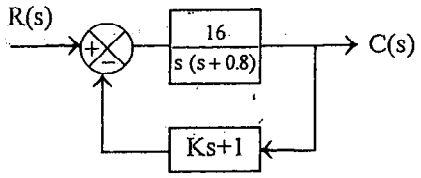
Knowledge Village, Dubai.
Semester I 2006-2007
TEST II (Open Book)
BE (Hons) III year (EEE/EIE/CSE/MECH)

Course No : AAOC UC321 **Course Title: Control systems**
Date : 17.12.06 **Time: 50Minutes M.M = 20 (20%)**

Note:
1. Answer all the questions.
2. If you are using graph or semi log graph sheets, first get it signed by the invigilator then only use it. **Graph sheets** used without **invigilators signature** will not be accepted.
3. All the symbols carry their usual meanings unless otherwise stated.
4. Any missing data can be assumed, but need to be mentioned.
5. Only text book is allowed

(4*5=20Marks)

1. A position control system with velocity feedback is shown in figure1. For a damping ratio (ξ) = 0.5 , Find the value of K and hence obtain the expression for the response C(t) to the unit step input.



Fig(1)

2. The open loop transfer function of a unity feedback control system is given by

$$G(s) = K / (s+2)(s+4)(s^2+6s+25).$$

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?

PTO

3. Sketch the Bode plot for the following transfer function.

$$G(s) = K\, e^{-0.2s} / s(s+2)(s+8).$$

(Assume low frequency as 0.5rad/sec and high frequency as 50rad/sec)

4. The open loop transfer function of a unity feedback system is given by

$$G(s) = K\,(s+9) / s(s^2+4s+11).$$

Sketch the Root locus of the system.

.....

A

Name : **ID No:**

BITS, PILANI – DUBAI CAMPUS

Knowledge Village, Dubai.
Semester I 2006-2007
QUIZ II (Closed Book)
BE (Hons) III year (EEE/EIE/CS)

Course No : AAOC UC321 **Course Title: Control systems**
Date : 07.12.06 **Time: 30Minutes M.M = 20 (10%)**

All the symbols carry their usual meanings, unless otherwise stated.

PART A **(4*1=4 Marks).**

The unity feedback system is characterized by an open loop transfer function $G(s) = K / s(s+10)$. The damping ratio is 0.5. Calculate the below mentioned parameters.

1. The value of gain K= .....

2. The value of settling times are .....

3. The Value of percentage peak overshoot is.....

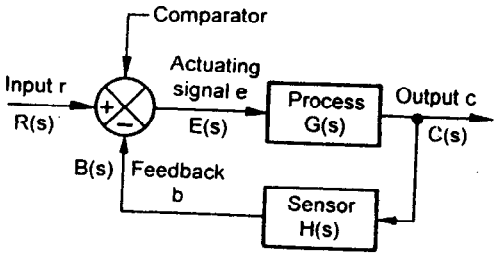
4. The value of peak time is.....

PART B **(8*2=16Marks).**

5. A unity feedback system has a open loop transfer function of $G(s) = 10/ (s+1)(s+2)$. Determine the steady state error for unit step input.

6. The closed loop transfer function of a second order system is given by $200/(s^2+20s+200)$. Determine the damping ratio and natural frequency of oscillation.

7. What is the sensitivity of T with respect to H (the feedback sensor) for the figure shown.



8. A second order system has a damping ratio of 0.6 and natural frequency of oscillation is 10rad/sec. Determine the damped frequency of oscillation.

9. Define delay time.

10. What do you mean by regenerative feedback?

11. What is asymptotic stability?

12. Define absolute stability for the system.

BITS, PILANI – DUBAI CAMPUS

Knowledge Village, Dubai.
Semester I 2006-2007
TEST I (Closed Book)
BE (Hons) III year (EEE/EIE/CS)

Course No	: AAOC UC321	Course Title: Control systems	
Date	: 05.11.06	Time: 50Minutes	M.M = 20 (20%)

ANSWER ALL THE QUESTIONS

(4*5=20)

1. **Derive the transfer function of an armature controlled DC motor shown in figure (1) and draw the corresponding block diagram.**

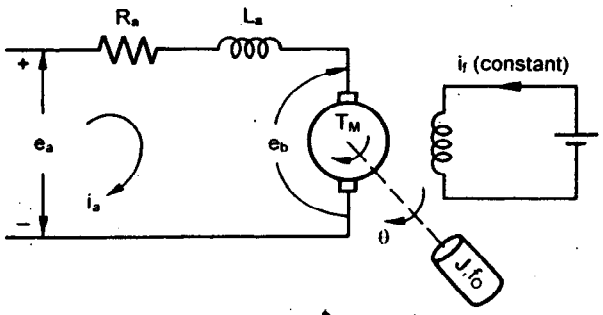


Fig (1)

2. **Write the differential equation of the mechanical system shown in figure (2) and obtain its transfer function.**

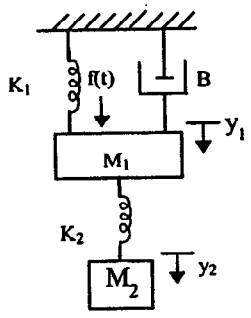


Fig (2)

3. **Simplify the block diagram shown in figure (3) using block diagram reduction technique and obtain the closed loop transfer function C(s)/R(s).**

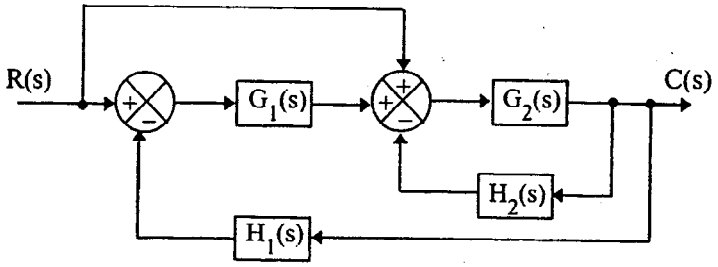


Fig (3)

4. **Draw the signal flow graph of the system shown in figure (4) and find the overall transfer function of the system C(s)/R(s) by applying Masons gain formula.**

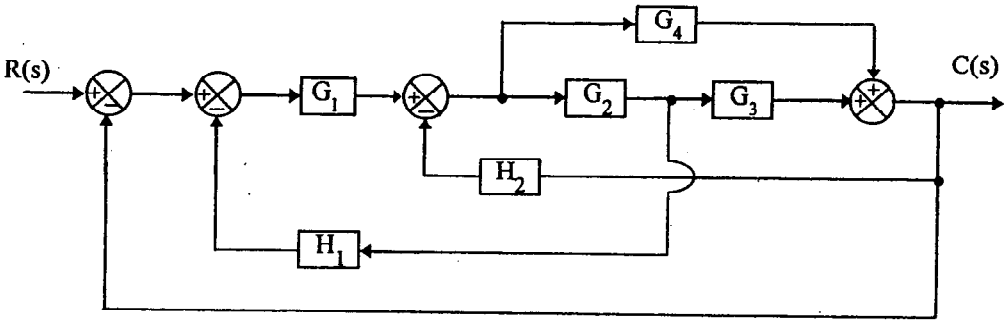


Fig (4)