KATHMANDU UNIVERSITY
End Semester Examination
August/September, 2017

Mark Scored:	

Level : B. E.
Year : III

Course : COEG 301
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date : SEP 10 2017

SECTION "A"

[20 Q × 0.5 = 10 marks]

Encircle the most appropriate answer to the following questions.

1. A controller in a system is physically represented by a ______________
   (a) sensor (b) amplifier (c) clipper (d) comparator

2. Transient response of a feedback control system ____________
   (a) rises slowly (b) rises quickly (c) decays slowly (d) decays quickly

3. The transfer function for the system shown in Figure-1 is ______________
   (a) G(z)/[1+GH(z)] (b) G(z)/[1+G(z)H(z)]
   (c) G(z)H(z)/[1+GH(z)] (d) GH(z)/[1+G(z)H(z)]

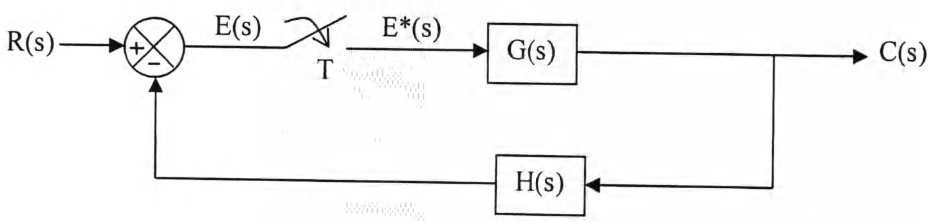

Figure-1

4. For a fuzzy logic control the fuzzified inputs are μ(x = A1) = 0.8, and μ (y = B1) = 0.2. The membership function μ (z =C1) for a fuzzy rule "*If x is A1 AND y is B1 then z is C1*", is ________
   (a) 0.16 (b) 1.0 (c) 0.8 (d) 0.2

5. For a force voltage analogous system, mass M of a mechanical system is analogous to ____________ of an electrical system.
   (a) resistance, R (b) inductance, L
   (c) capacitance, C (d) reciprocal of capacitance, 1/C

6. When the compensating network is connected in the feedback path the type of compensation is called ______________ compensation.
   (a) series (b) parallel (c) load (d) source

7. The polar plot of a system with the transfer function $G(s) = \frac{1}{s^2(sT+1)}$ will be as in Figure ____________________
   (a) 2.a (b) 2.b (c) 2.c (d) 2.d

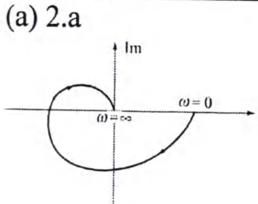

Figure 2.a

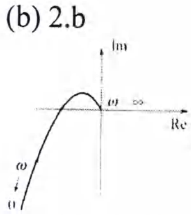

Figure 2.b

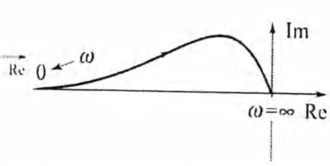

Figure 2.c

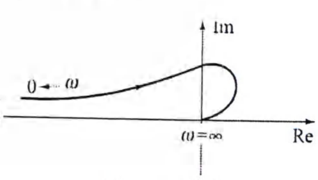

Figure 2.d

8. The steady state error in a system can be reduced by________________

(a) decreasing the type of the system (b) increasing the system gain

(c) decreasing the static error constant (d) increasing the input

9. Figure-3 shows a unity feedback closed loop control system. The steady state error of the above system to unit step input is________________

(a) 6% (b) 75% (c) 25% (d) 33%

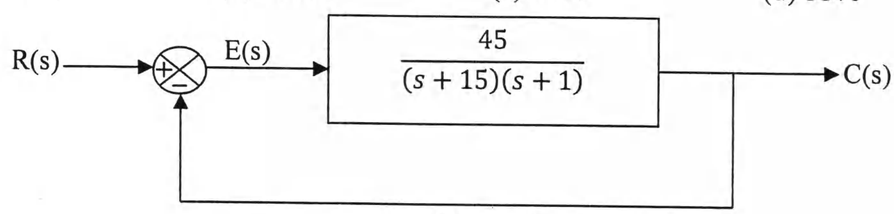

Figure-3

10. For the system of Figure-4, the damping ratio of closed loop poles is________________

(a) 1 (b) 1.5 (c) 0.5 (d) 0.25

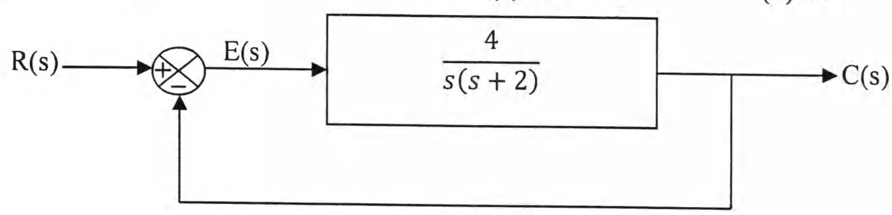

Figure-4

11. A system is represented by the equations

$$\dot{x}(t) = \begin{bmatrix} 4 & -1.5 \\ -4 & 0 \end{bmatrix} + \begin{bmatrix} 2 \\ 0 \end{bmatrix} u(t) \text{ and } y(t) = [1.5 \quad 0.625]x(t).$$

The transfer function G(s) of the system is________________

(a) $\frac{3s+5}{s^2+4s+6}$ (b) $\frac{3s}{s^2+4s+8}$ (c) $\frac{3s-5}{s^2-4s-10}$ (d) $\frac{5s}{s^2+6s+10}$

12. For the system with $G(s) = \frac{K(s+5)}{s(s+2)(s+4)(s^2+2s+2)}$ and $H(s) = 1$, the meeting point of asymptotes of the root locus at the real axis is at________________

(a) -1.2 (b) -0.85 (c) -105 (d) -0.75

13. The transfer function C(s)/R(s) for the signal flow graph shown in Figure-5 is__________

(a) G_1+G_2 (b) $G_1+G_1/1-G_1H+G_2H$

(c) $G_1+G_2/1+G_1H+G_2H$ (d) G_1-G_2

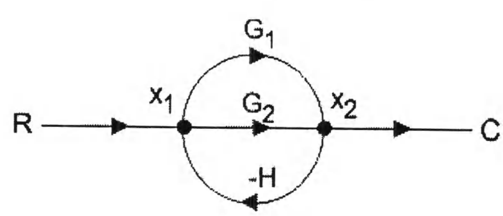

Figure-5

14. The transfer function W(s)/Y(s) for the block diagram shown in Figure-6 is ____________

(a) $\frac{D(s)G(s)N(s)}{1+D(s)G(s)N(s)}$ (b) $\frac{N(s)}{1+D(s)G(s)N(s)}$ (c) $\frac{G(s)}{1+D(s)G(s)N(s)}$ (d) $\frac{D(s)}{1+D(s)G(s)N(s)}$

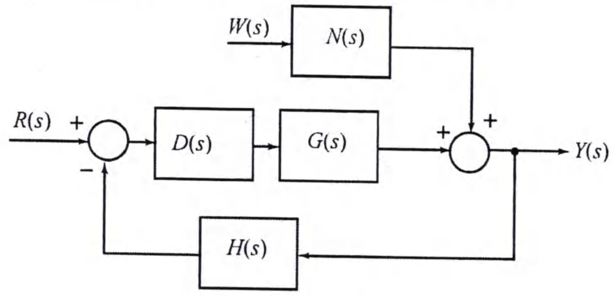

Figure-6

15. The Bode magnitude plot of a system has -20dB gain at low frequencies. The system is a ____________ system.

(a) type 0 (b) type 1 (c) type 2 (d) type 3

16. A unity feedback system has its polar plot as shown in Figure-7. The gain margin(GM) and phase margin(PM) of the feedback system are ____________

(a) GM = -0.3; PM = 112.33° (b) GM = 0.3; PM = 112.33°
(c) GM = 3.33; PM = 67.67° (d) GM = 0.3; PM = 67.67°

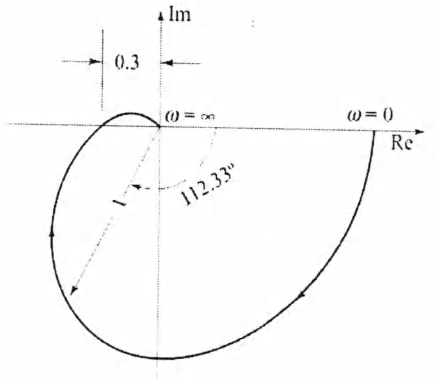

Figure-7

17. A unity feedback system with open loop poles are at s = -1±j1, and zeros at s = -2, the root locus of the system system will as in Figure ____________

(a) 8.a (b) 8.b (c) 8.c (d) 8.d

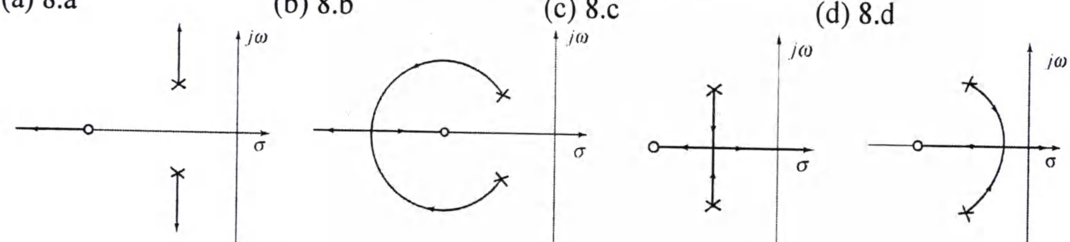

Figure 8.a Figure 8.b Figure 8.c Figure 8.d

18. For an RLC series circuit described by the equation $5\ddot{E} + 5\dot{E} + 4E = V$. Considering E and $\dot{E}$ as the state variables and V as input variable the input matrix is ____________

(a) $\begin{bmatrix} 0 \\ 0.1 \end{bmatrix}$ (b) $\begin{bmatrix} 0 \\ 0.2 \end{bmatrix}$ (c) $\begin{bmatrix} 0 \\ 0.5 \end{bmatrix}$ (d) $\begin{bmatrix} 0 \\ 0.4 \end{bmatrix}$

19. For a force voltage analogous system the mass M is analogous to ______________
(a) Resistance R (b) inductance L (c) Capacitance C (d) charge q

20. The step response of the system of Figure 9.a is as presented in 9.b. The damping ratio of the system is ______________
(a) 0.39 (b) 0.49 (c) 0.59 (d) 0.69

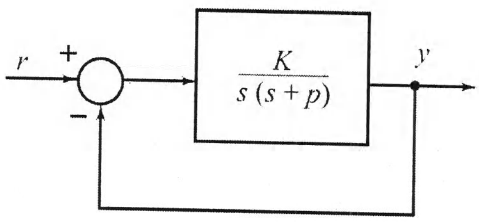

Figure 9.a

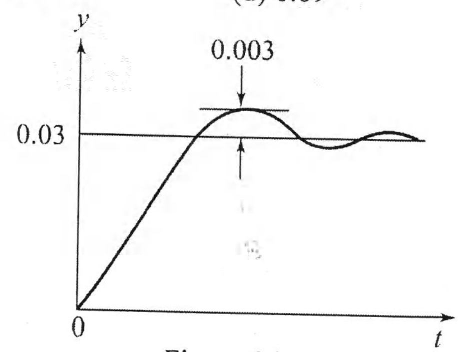

Figure 9.b

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SECTION "B"

Attempt *ANY FIVE* questions. Assume necessary data if required.

1. The system of Fig.1 shows the layout of a hydroelectric power plant with two surge tanks. The installation upstream of the turbine consists of a reservoir, a penstock having a cross section area A_1 and length l_1, and a surge tank with a cross section area S_1. The conduits between the turbine and the two surge tanks are assumed to be of negligible length. Downstream from the turbine there is a surge tank with cross section S_2 and a tail-water tunnel of length l_2 and cross section A_2. The water level at the two surge tanks for steady flow conditions is h_1 and h_2 respectively.

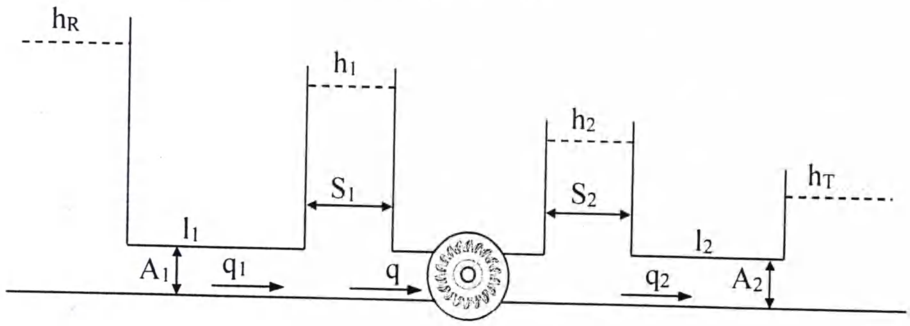

Fig.1

a. Determine the transfer function $Q_2(s)/Q_1(s)$ for the system in Fig.1. Assume necessary parameters required for modeling the system. Ignore the leakage losses. [5]

b. Determine the state space model for the system in Fig.1. Consider q_1 and q_2 as input variables and h_1 and h_2 as the output variables. [3]

2. The block diagram in Fig. 2 represents the speed control of a hydro generating unit feeding an isolated load. The speed governor representation includes a permanent droop $R = 0.05$ and governor time constant $T_G = 0.5$ seconds. The turbine is represented by water starting time $T_W = 2.0$ seconds. The generator and the load is represented by a mechanical starting time $T_M = 10.0$ seconds and a system damping coefficient $K_D = 1$.

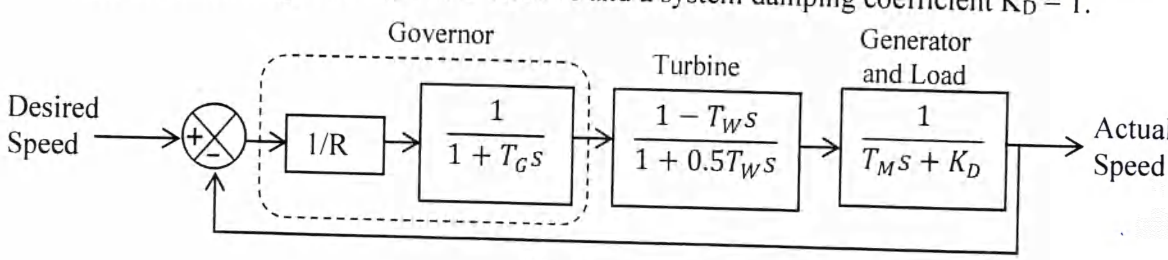

Fig.2

a. Determine the open loop transfer function of the system in Fig.2 and use Bode plot to find the gain margin, phase margin and stability of the system. [4]

b. Design a phase lead compensator which is to be included in cascade with the speed governor of Fig.2 to fulfill the specification phase margin $\geq 40°$. Also comment on the stability of the compensated system. [4]

3. The system structure for a Variable Speed Wind Turbine is shown in Fig.3. T_a is the torque developed by the wind on the rotor and T_g is the torque developed at the generator shaft. T_{ls} is the low speed torque and T_{hs} is the high speed torque.

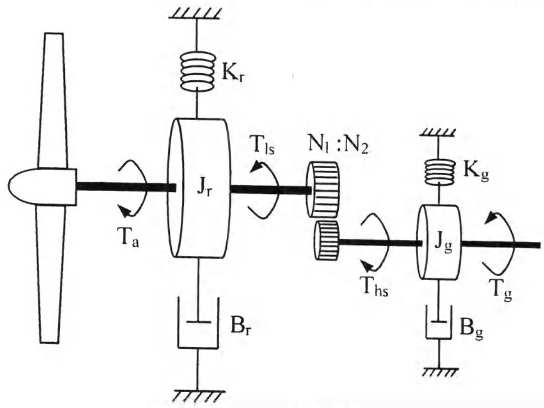

Fig.3

a. For the system in Fig.3 determine the transfer function $T_g(s)/T_a(s)$. Assume necessary parameters required for modeling the system. [4]

b. If $J_r = 150 kgm^2$, $J_g = 50 kgm^2$, $K_r = 2.5 kNm/rad$, $K_g = 5 kNm/rad$, $N_1:N_2 = 1:50$, $B_r = 10 kNms/rad$ and $B_g = 5 kNms/rad$, check whether the unity feedback with the transfer function of the system in (a) is stable or not. Use Routh-Hurwitz criterion. [4]

4. Fig.4 shows a position control system. Deviations from the desired position are sensed, and the amplifier input is changed to compensate for the position error.

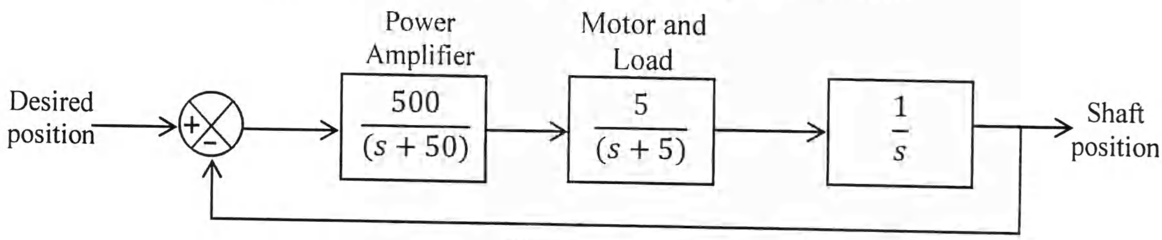

Fig.4

a. Find the steady state error of the system when subjected to unit step and ramp input. [2]

b. Sketch the Nyquist plot for the system in Fig.4 and determine the gain margin, phase margin and stability of the system. [6]

5.

a. A feedback control system has $G(s) = 16/[s(s+0.6)]$ and $H(s) = (1+Ks)$. Determine the value of K if damping ratio is 0.5 and obtain t_r, t_p, M_p, and t_s. [3]

b. A closed loop negative feedback system used to control the yaw of an intruder jet is shown in Fig.5. Sketch the root loci for the system. [5]

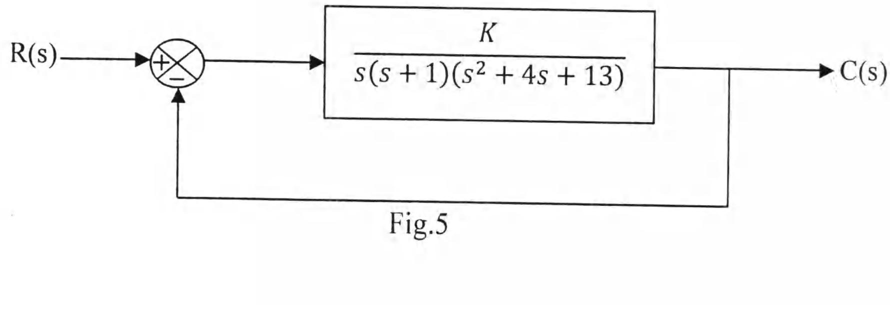

Fig.5

6.

a. Obtain the overall transfer function of the system shown in the Fig.6 using signal flow graph. [5]

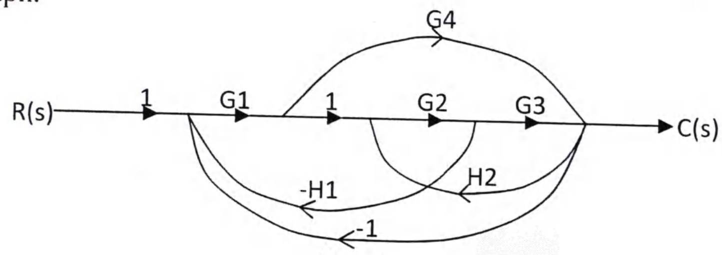

Fig.6

b. The Nichol's plot for a feedback system is shown in figure-7. Determine the resonant peak, resonant frequency, system bandwidth, phase margin and gain margin of the system. [3]

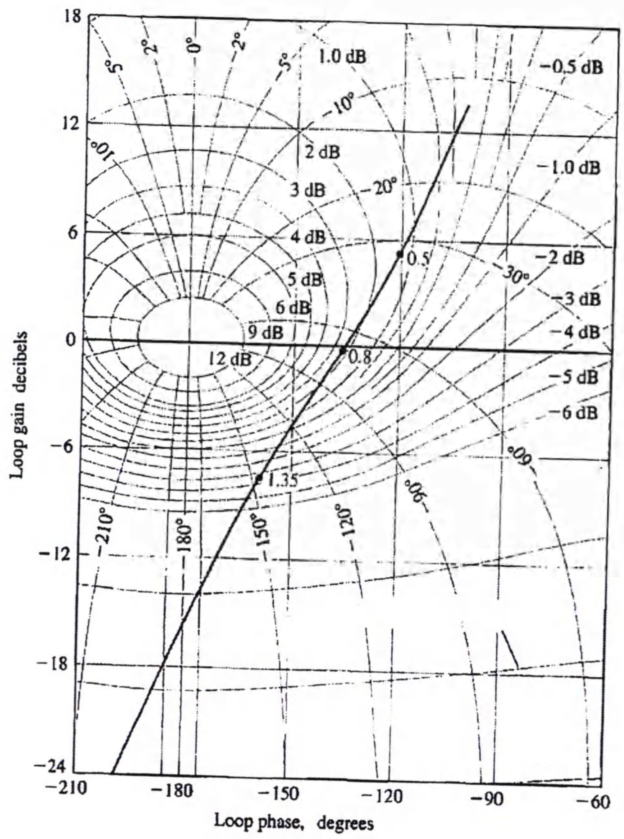

Figure – 7