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SE-6783

B. E. III (Sem. V) (EC) Examination

April / May – 2011

Control System Engineering

Time : Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :
☛ **B. E. 3 (Sem. 5) (EC)**

Name of the Subject :
☛ **Control System Engineering**

☛Subject Code No. : **6 7 8 3** ☛Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) Attempt all questions.

(3) Figures to the **right** indicates **full** marks.

(4) Assume necessary data wherever required.

(5) Scientific calculator upto casio-100D, 100MS series is permitted.

1 (a) State 'True' or 'False' : **5**

(1) It is easy to analysis a system in transfer function form compared to differential equations.

(2) Speed control of a car is an example of open loop system.

(3) Critically damped system have no oscillations.

(4) 'Mass' is analogous to inductance in force voltage analogy.

(5) System with negative feedback is always stable.

(b) Differentiate between open loop and closed loop systems. **5**

(c) For the system shown below, find overall transfer function using block diagram reduction method. **10**

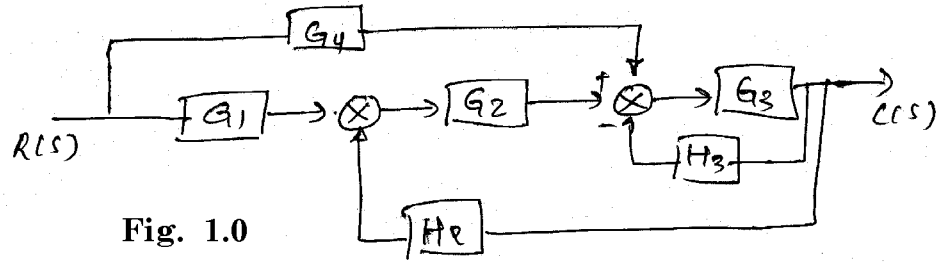
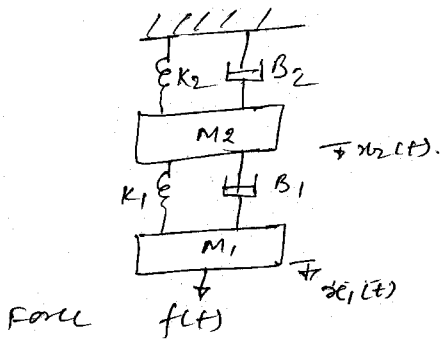


Fig. 1.0

2 (a) For the system shown in Fig. 1.0 draw signal flow graph and find its overall transfer function using Mason's gain formula. 8

(b) For the following mechanical system find overall transfer function $\frac{X_1(s)}{F(s)}$. 7



OR

2 (a) Define steady state error. Derive expression for position error constant K_p velocity error constant Kv and accelaration error constant Ka for type O and type -1 system. 8

(b) A system has $G(S)=\frac{(S+1)}{S^2(S+4)}$ and $H(S)=\frac{2}{S+2}$. 7

Determine static error constants and steady state error for unit step and unit ramp input.

3 Attempt 'any **three**' 15

(1) Derive expression for unit step response of standard first order system.

(2) Write a short note on "synchroc"

(3) For system having $G(s)=\frac{16}{s(s+4)}$ and H (s) = 1, find undamped natural, frequency, damped natural frequency, damping ratio and settling time if unit step input is applied to it.

(4) For second order time response, explain following terms with neat sketch.

(i) rise time

(ii) settling time

(iii) peak time

(iv) steady state error.

4 (a) Do as directed : **10**

Fill in the blanks **5**

(i) A Routh Hurwitz criterion is a _____ domain approach. (Time/Frequency)

(ii) Root locus terminates at zero. The value of K is _____ at every zero. (zero/infinity)

(iii) In terms of bode plot, the system is stable if gain margin and phase margin both are _____ .

(iv) If the poles of control system lie on the imaginary axis of S plane, the system _____ .

(v) Poles of closed loop transfer function are equal to _____ of 1+GH.

State whether following statements are true/false : **5**

(1) Relative stability can be obtained from RH criteria.

(2) Nichol's chart is time domain tool.

(3) If there are three zeros and two poles of G(s) H(S), then there will be three root loci.

(4) In frequency domain analysis both amplitude and phase vary with frequency.

(5) For the stable system all the roots must lie on left hand side of s-plane.

(b) Define stability of system and explain what do mean of absolute and relative stability. **4**

(c) For characteristics equation $S^3+3KS^2+(K+2)S+1 = 0$ find range of K for stability and frequency of oscillation. **6**

5 For $\frac{k}{s(s+2)(s+20)}$ sketch bode plot and find GM and PM **15**

(i) k = 40, (ii) k = 400 and (iii) k = 4000, comment on stability of system.

OR

5 (a) State and explain principle of argument in complex variable theory. Also describe how it is used in the nyquist criterion for stability analysis. **8**

(b) Draw Nyquist contour and Nyquist plot for the system with $G(s)H(S)=\frac{K}{(s+1)(s+2)(s+3)}$ and hence find the range of values of K for this system to be stable. **7**

6 Attempt any **three** : **15**

(1) Discuss special cases of R-H criterion when it fails and also suggest the methods for overcoming it.

(2) Describe procedure to construct the Nichol's chart from M and N circle.

(3) Prove mathematically that every Root Locus branch originates at an open loop pole and terminates either at open loop zero or at infinity.

(4) Write steps for solving bode plots and state advantages of bode plot.
