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RN-6783

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

May / June – 2010

Control System Engineering

Time : **3** Hours] [Total Marks :

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,.....) : 1&2

Seat No. :

Student's Signature

(2) Attempt all questions.

(3) Figures to the right indicate full marks.

1 (a) Select correct answer from given options. **5**

(i) Transfer function of a system is defined as the ratio of output to input in
- (a) Simple algebric form
- (b) Fourier transform
- (c) Laplace transform
- (d) Z-transform

(ii) Synchros are widely used for transmission of _____ data
- (a) angular
- (b) digital
- (c) mathematical
- (d) computed

(iii) Feedback control systems are
- (a) Band - pass filters
- (b) Low - pass filters
- (c) High pass filters
- (d) None of the above

(iv) The system generally preferred is _____ system
- (a) overdamped
- (b) crtitically damped
- (c) slightly under damped
- (d) highly damped

(v) In a control system, the use of netgative feedback
(a) eliminates the chances of instability
(b) increases the reliability
(c) reduces the effects of disturbance and noise signals in the forward path.

(b) Differentiate open loop and close lop control system. **5**

(c) Derive transfer function of following system. **10**

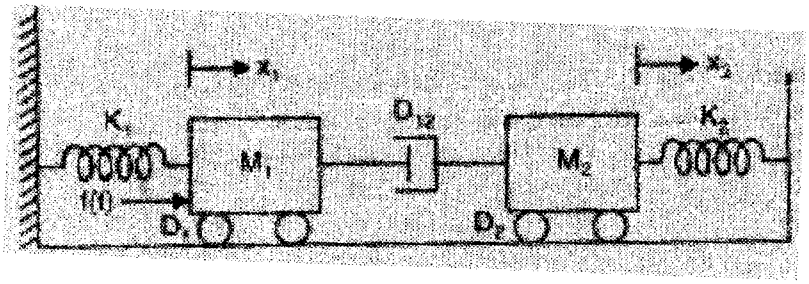


Fig. 1

2 (a) State and explain Mason's gain formula. **4**

(b) State and explain how type and order of control system are determined. **4**

(c) Derive transfer function of following system. **7**

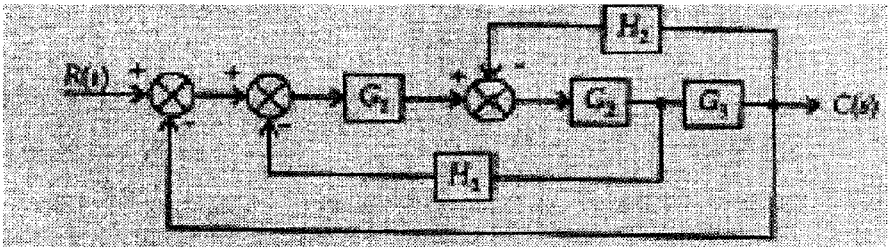


Fig. 2

OR

2 (a) Explain different input test signals. Derve laplace transform of each. **7**

(b) Using mason's gain formula determine the transformation ratio of signal flow graph. **8**

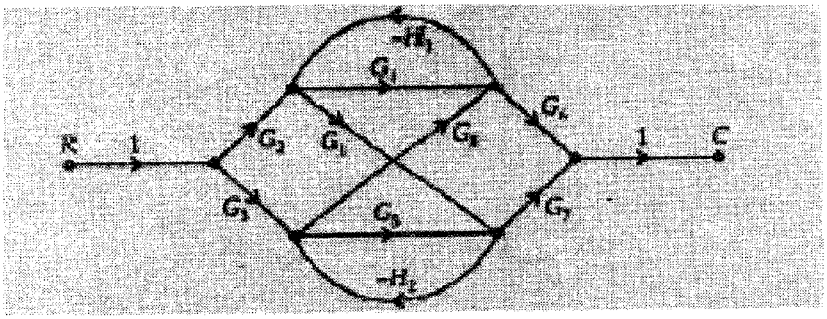


Fig.

3 Attempt any **three** : **15**

(a) Write short note on sinchros.

(b) Derive transfer function of field controlled DC servo motor.

(c) Consider the unit-step response of a unity feedback control system whose open loop transfer function is

$$G(S) = \frac{1}{S(S+1)}$$

Obtain the rise time, peak time maximum overshoot and settling time.

(d) Derive transient response of second order control system for step input.

SECTION - II

4 (a) Answer the following :

(i) The phase crossover frequency is the one at which the phase of G(jw) H(jw) is _____.

(ii) A system has open loop poles at S = –1 and –5 and open loop zeros at S = 1 and –2. Is this system stable or unstable? Justify the answer.

(iii) In position control sytem, the device used for providing the feedback voltage is _____.

(iv) Nyquist stability criteria is applied on an open loop transfer function of the sytem to determine its closed loop stability. Is the statement true or false? Justify.

(v) Explain in short "relative stability of a dynamic system.

(b) Using Routh-Hurwitz criteria determine the stability of the followng system. **7**

(i) $S^6 + S^5 + 5S^4 + 3S^3 + 2S^2 - 4S - 8 = 0$

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

(c) Using Nyquist stability criteria, determine the stability of the following system **8**

$$G(S)H(S) = \frac{K}{S(S+1)(S+4)}$$

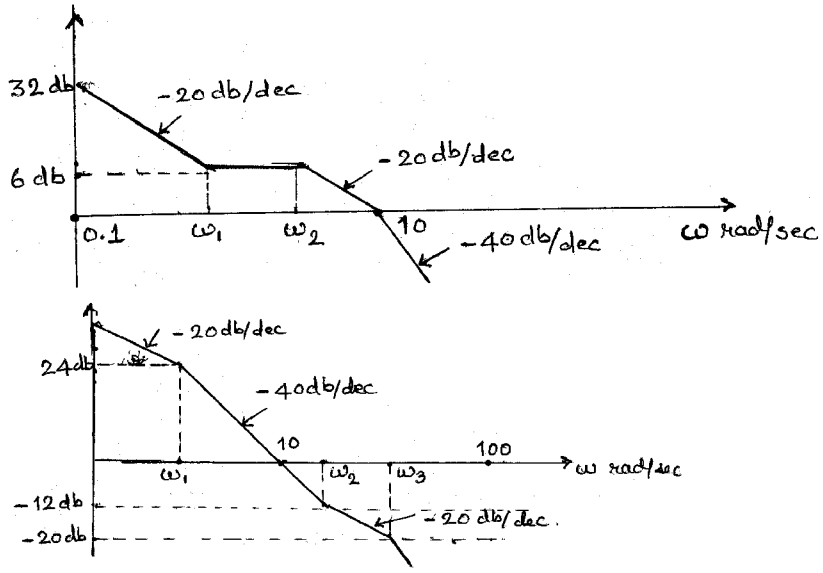
5 (a) Construct a Bode plot for the given open loop transfer function. Hence, find GM and PM **10**

$$G(S)=\frac{64(S+2)}{S(S+0.5)\left(S^2+3.2S+64\right)}$$

(b) Define M circles as applicable to transfer functions. Hence, derive the expression for M circlesl and draw the circles for various values of M. **5**

OR

5 (a) Assuming that the Bode plots shown in fig. below are for physical systems;' obtain the transfer function of each. **8**



(b) State and explain the principle of argument in complex variable theory. Describe how it is used in Nyquist criteria for judging the closed loop stability of a given system. **7**

6 Answer any **three** : **15**

(i) Explain the correlation of frequency domain specifications with the time domain specifications.

(ii) Derive the expression for resonant frequency and resonant peak for a second order system excited by a unit step input.

(iii) Define N circles as aplicable to transfer function. Hence derive the expression of N circles and draw these circles for various values of N.

(iv) Define Gain Margin GM and phase margin PM of a dynamic control system. Hence, show how it can be calculated from Nyquist plots.
