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Question Paper Code : 51437

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Fourth Semester

Electrical and Electronics Engineering

EE 2253/EE 44/EE 1253 A/080280033/10133 IC 401 — CONTROL SYSTEMS

(Common to Instrumentation and Control Engineering and Electronics and Instrumentation Engineering)

(Regulation 2008/2010)

(Common to PTEE 2253 – Control Systems for B.E. (Part-Time) Third Semester – Electronics and Instrumentation Engineering Regulation 2009)

Time : Three hours Maximum : 100 marks

Note : Polar plot to be issued.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. List the major advantages and disadvantages of open-loop control systems.

2. What are the applications of synchros?

3. What are the standard test signals used in control systems?

4. What is the effect of PD controller on the performance of a system?

5. Define the terms: ' resonant peak', and 'resonant frequency'.

6. What is a constant M circle?

7. How are the locations of roots of characteristic equation related to stability?

8. State the Nyquist stability criterion.

9. What is the necessity of compensation in feedback control system?

10. Write the transfer function of lag-lead compensator.

PART B — (5 × 16 = 80 marks)

11. (a) Write the differential equations for the mechanical system shown in Fig. 1. Obtain an analogous electric circuit based on force-current analogy.

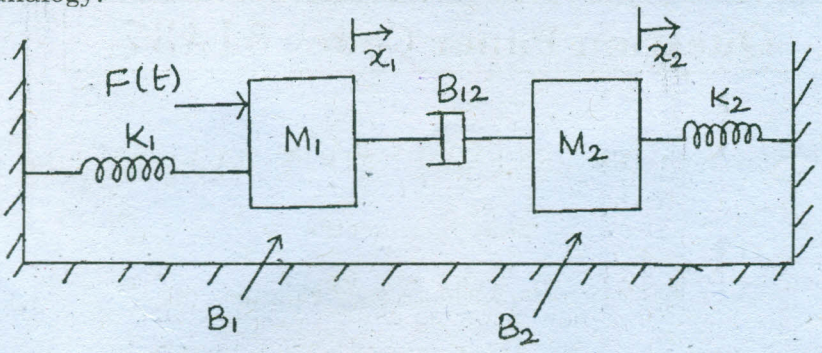

Fig. 1

Or

(b) Consider the signal flow graph shown in Fig. 2. Obtain the closed loop transfer function $\frac{C(s)}{R(s)}$ by the use of Mason's gain formula.

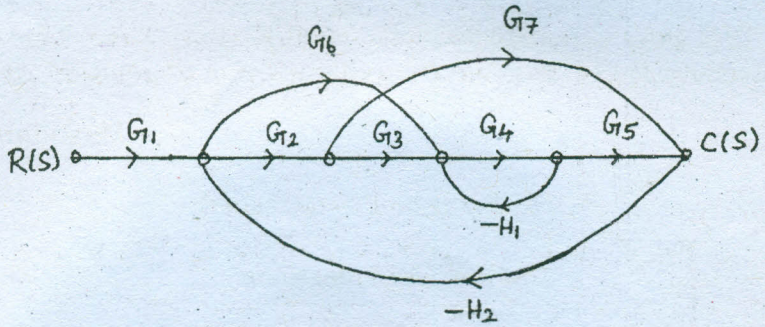

Fig. 2

12. (a) A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$.

Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K, determine settling time, peak overshoot and time to peak overshoot for a unit step input.

Or

(b) The open loop transfer function of a servo system with unity feedback is

$$G(s) = \frac{10}{s(0.1s+1)}.$$

Evaluate the static error constants (K_p, K_v, K_a) for the system. Obtain the steady state error of the system when subjected to an input given by the polynomial $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$.

13. (a) Sketch the Bode plot showing the magnitude in decibels and phase angle in degrees as a function of log frequency for the transfer function

$$G(s) = \frac{75(1 + 0.2s)}{s(s^2 + 16s + 100)}.$$

From the Bode plot, determine the gain cross-over frequency.

Or

(b) (i) Discuss the correlation between time and frequency response of second order system. (8)

(ii) How the closed loop frequency response is determined from the open loop frequency response using Nichols chart? Explain how the gain adjustment is carried out on the Nichols chart. (8)

14. (a) The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{K}{(s + 2)(s + 4)(s^2 + 6s + 25)}$.

By applying Routh criterion, discuss the stability of the closed loop system as a function of K. Determine the values of K which will cause sustained oscillations in the closed loop system. What are the corresponding oscillation frequencies?

Or

(b) Sketch the root locus plot of a unity feedback system with an open loop transfer function $G(s) = \frac{K}{s(s + 2)(s + 4)}$. Find the value of K so that the damping ratio of the closed loop system is 0.5.

15. (a) Explain the electric network realization of a lead compensator and also its frequency response characteristics.

Or

(b) Describe the procedure for the design of lag compensator using Bode plot.

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