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Question Paper Code : 27196

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fourth Semester

Electronics and Communication Engineering

EC 6405 — CONTROL SYSTEM ENGINEERING

(Common to Mechatronics Engineering and Medical Electronics Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Provide Semilog sheet, Polar graph and ordinary graph sheet)

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. List the advantages of Closed loop System?

2. What is Block diagram? What are its basic components?

3. State some standard test signals used in time domain analysis.

4. What is a steady state error?

5. Give the specifications used in frequency domain analysis.

6. What are Constant M and N circles?

7. What is dominant pole?

8. Define about Nyquist stability criterion.

9. What are state variables?

10. Draw the Sampler and hold circuits.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Write the differential equations governing the mechanical translational system as shown in Fig.1. Draw the Force – Voltage and Force – Current electrical analogous circuits and verify by mesh and node equations. (12)

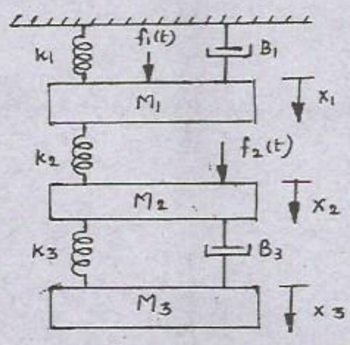

Fig. 1

(ii) What are the basic elements of mechanical rotational systems and write its torque balance equations. (4)

Or

(b) (i) Write the rule for eliminating negative and positive feedback in block diagram reduction. (4)

(ii) The signal flow graph for a feed back control system is shown in Fig. 2. Determine the closed loop transfer function $C(s)/R(s)$. (12)

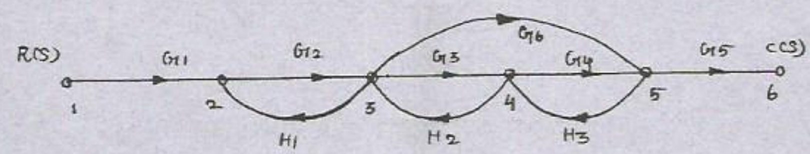

Fig. 2

12. (a) (i) Derive the time response analysis of a first order system for step and ramp input. (12)

(ii) What are the time domain specifications? Define any two. (4)

Or

(b) (i) Determine the type and order of the system with following transfer functions.

(1) $\dfrac{S+4}{(S-2)(S+3)}$

(2) $\dfrac{10}{S^3(S^2+2S+1)}$. (4)

(ii) With a neat diagram, explain the function of PID compensation in detail. (12)

13. (a) Sketch the Bode plot for the following transfer function and determine the Phase margin and gain margin.

$$G(S) = \frac{20}{S(1+3S)(1+4S)}.$$ (16)

Or

(b) The open loop transfer function of a unity feedback system is given by $G(S) = \dfrac{1}{S^2(1+S)(1+2S)}$. Sketch the polar plot and determine the gain and phase margin. (16)

14. (a) (i) Using Routh Hurwitz criterion, determine the stability of a system representing the characteristic equation :

$$S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0.$$

Comment on location of the roots of the characteristics equation. (8)

(ii) Write detailed notes on relative stability with its roots of s-plane. (8)

Or

(b) The open loop transfer function of a unity feedback system is given by

$$G(S) = \frac{K(S+9)}{S(S^2+4S+11)}$$

Sketch the root locus of the system. (16)

15. (a) (i) Consider the following system with differential equation given by

$$\dddot{y} + 6\ddot{y} + 11\dot{y} + 6y = 6u$$

Obtain the state model in diagonal canonical form. (12)

(ii) Draw the state model of a linear single-input-single-output system and obtain its corresponding equations. (4)

Or

(b) (i) State the properties of state transition matrix. (4)

(ii) Consider the system defined by

$X = Ax + BU$

$Y = Cx$

Where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; C = [10 \ \ 5 \ \ 1].$$

Check the controllability and observability of the system. (12)
