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(Pages : 4)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2014

Sixth Semester

Branch : Automobile Engineering / Mechanical Engineering

AU 010 605 AND ME 010 605—MECHATRONICS AND CONTROL SYSTEMS (AU, ME)

(New Scheme—2010 Admission onwards)

[Regular/Improvement/Supplementary]

Time : Three Hours

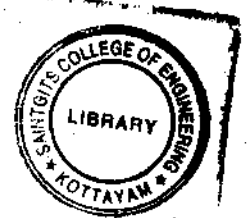
Maximum : 100 Marks

Part A

Answer all questions.

Each question carries 3 marks.

1. Define the term modulation.
2. What are the commonly used protocols in communication ?
3. What are the basic elements used for modelling mechanical rotational system ?
4. What is steady-state error of control system ? Explain.
5. What are the advantages of Bode plot.



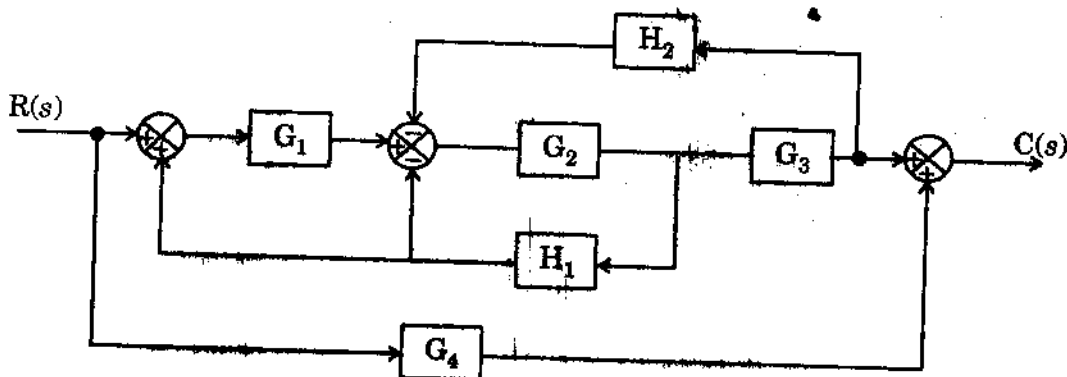
(5 × 3 = 15 marks)

Part B

Answer all questions.

Each question carries 5 marks.

6. Explain any one mechanical transducer.
7. Draw the ladder program for an XOR gate and explain each step.
8. Obtain the closed loop transfer function $C(s)/R(s)$ of the system whose block diagram is given by :



Turn over

9. A unity feedback system has the forward transfer function $G(s) = \frac{k_1(2s+1)}{s(5s+1)(1+s)^2}$. The input $r(t) = 1 + 6t$ is applied to the systems. Determine the minimum value of k_1 , if the steady error is to be less than 0.1.
10. What are gain margin and phase margin? How do they enable to analyse the stability of a control system?



(5 × 5 = 25 marks)

Part C*Answer all questions.**Each question carries 12 marks.*

11. A parallel plate capacitive transducer uses plates of area 250 mm^2 , which are separated by a distance of 0.2 mm . The dielectric used is air which is having a permittivity of $8.85 \times 10^{-12} \text{ F/m}$. Calculate the change in capacitance, if a linear displacement reduces the distance between the plates to 0.18 mm . Also calculate the ratio of per unit change of capacitance to per unit change of displacement.

(12 marks)

Or

12. Discuss the major features, scope and application of Mechatronics. (12 marks)
13. With neat diagram, explain programmable logic controller. With an example, explain ladder logic used in PLC. (12 marks)

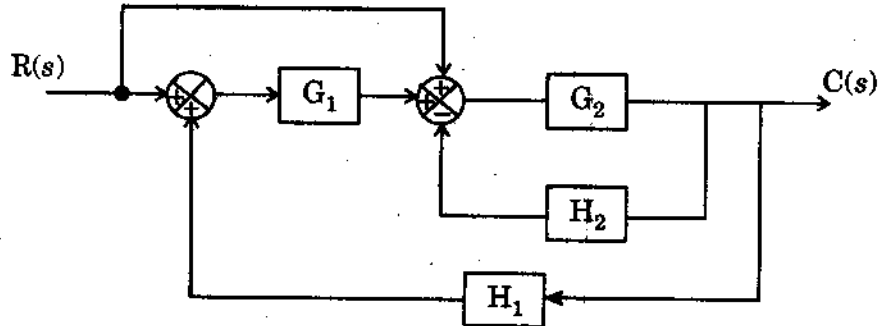
(12 marks)

Or

14. Discuss the Mechanical and PLC design solution for timed switch. (12 marks)

(12 marks)

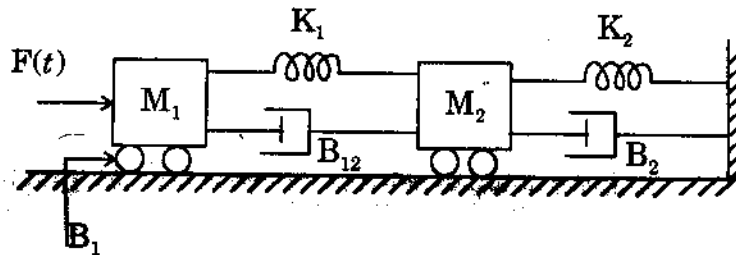
15. Using the block diagram reduction technique, find the transfer function for the system :



(12 marks)

Or

16. Explain the governing equation of the following Mechanical system :



(12 marks)

17. Derive the response of second order system for unit step input for the damping ratio ζ , under :

- $0 < \zeta < 1$.
- $\zeta = 1$.
- $\zeta > 1$.

(12 marks)

Or

18. Using the Routh stability criteria, determine the stability of the system whose characteristic equation is given by :

$$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0.$$

(12 marks)

Turn over

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

(12 marks)

Or

20. For the function $G(s) = \frac{5(1+2s)}{(1+4s)(1+0.25s)}$, draw the bode plot.

(12 marks)

(5 × 12 = 60 marks)

