USN | | | | | | | | | | 18EE61

Sixth Semester B.E. Degree Examination, June/July 2024
Control Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Distinguish between open-loop and closed-loop control system with an example. **(08 Marks)**

b. For the mechanical system shown in Fig.Q1(b), write the differential equation relating to the force F(t). Also obtain the analogous electrical networks based on :

i) Force-voltage analogy

ii) Force-current analogy.

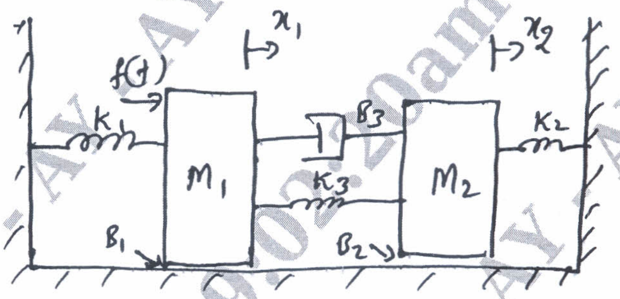

Fig.Q1(b) **(12 Marks)**

OR

2 a. List the features of transfer function. **(04 Marks)**

b. Derive the transfer function of armature controlled DC motor. **(08 Marks)**

c. For the rotational mechanical system shown in Fig.Q2(c), draw an electrical network based on Torque-voltage analogy.

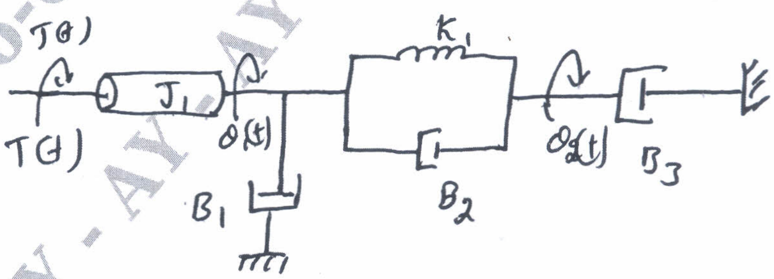

Fig.Q2(c) **(08 Marks)**

Module-2

3 a. Explain the following block diagram reduction techniques :

i) Combining blocks in parallel

ii) Moving a summing point behind a block

iii) Eliminating a feedback loop. **(06 Marks)**

b. Obtain the transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig.Q3(b). Using block diagram reduction technique.

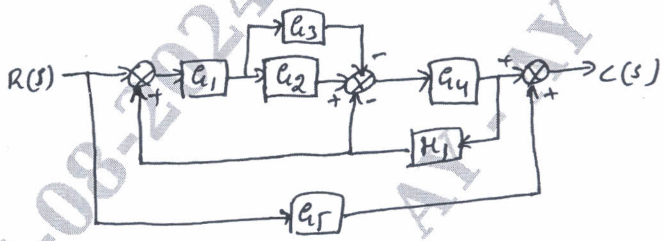

Fig.Q3(b) **(08 Marks)**

c. Find the overall transfer function for the signal flow graph shown in Fig.Q3(c), using Masons Gain formula.

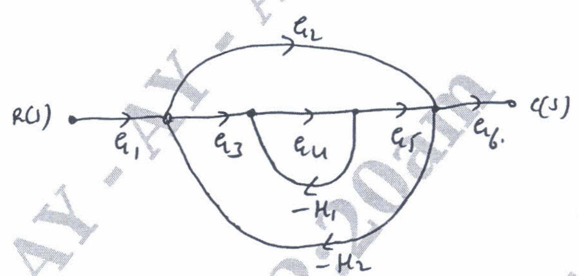

Fig.Q3(c) **(06 Marks)**

OR

4 a. For the electrical network shown in Fig.Q4(a), find $\frac{V_0(s)}{V_i(s)}$ using Masons Gain formula.

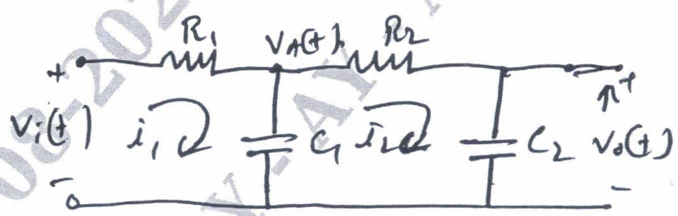

Fig.Q4(a) **(10 Marks)**

b. Using block diagram reduction technique, obtain the transfer function C(s)/R(s) for the block diagram shown in Fig.Q4(b).

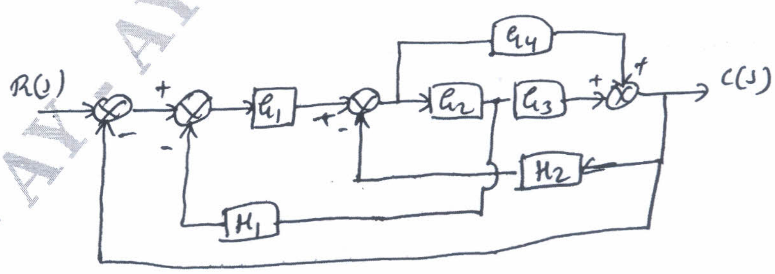

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Derive an expression for the following time domain specification second order system :
i) Rise time
ii) Peak time
iii) Maximum overshoot. **(12 Marks)**

b. Determine the stability of the system using Routh's stability criterion for the characteristic equation : $s^6 + 2s^2 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. **(08 Marks)**

OR

6 a. For a negative units feedback control system with $G(s) = \frac{50}{s(s+5)}$, find the following :
i) Percentage overshoot for a unit step input
ii) Settling time for a unit step input
iii) Steady state error for an input $r(t) = r(t) = 2 + 4t + 6t^2$ for $t \geq 0$. **(12 Marks)**

b. Find the range of 'K' for which the system, whose characteristic equation is given by $S^3 + (K + 0.5)s^2 + 4KS + 50 = 0$ is stable. **(08 Marks)**

Module-4

7 a. A negative feedback control system is characterized by

$$G(s) \cdot H(s) = \frac{k}{s(s^2 + 2s + 2)}$$

Sketch the root locus plot for values of 'K' ranging from 0 to ∞ and comment on stability. **(12 Marks)**

b. Derive an expression for resonant peak and resonant frequency for a second order system. **(08 Marks)**

OR

8 a. A negative feedback control system in characterized by an open loop transfer function :

$$G(s) \cdot H(s) = \frac{k}{s(s+1)(0.1s+1)}$$

Draw the bode plot and determine :
i) The value of k to give a GM of 10dB
ii) The value of K to give a PM of 24°. **(14 Marks)**

b. What are breaks way points and break in points. Explain how to find them. **(06 Marks)**

Module-5

9 a. A feedback control system has open loop transfer function :

$$G(s) \cdot H(s) = \frac{1}{s(s+1)}$$

Sketch the Nyquist plot and comment on the stability of the system. **(10 Marks)**

b. Explain lag and lag-lead compensator. **(10 Marks)**

OR

10 a. Explain PIP controllers. **(10 Marks)**
b. State explain Nyquist stability criterion. **(05 Marks)**
c. List the effects of lead compensator. **(05 Marks)**

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