



COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY  
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING  
B.E. (HONORS) (ELECTRICAL & ELECTRONICS ENGINEERING) (BENG 3)

## EEB 722/EEE 743 CONTROL SYSTEM

### **FINAL EXAMINATION** **(SEMESTER 2, 2018)**

DATE/TIME/ROOM – Refer to Timetable

Total Marks – 100

Time Duration – 3 hours & 10 Minutes

#### **INSTRUCTIONS TO CANDIDATES**

1. This paper should take for unit MEB805 from school of mechanical engineering.
2. You are allowed 10 minutes extra time during which you are not to write.
3. Begin each answer on a fresh new page and use both sides of the sheets.
4. Write your identification number on the top of each attached sheet.
5. Insert all written foolscaps, graph paper, drawing paper etc. in their correct sequence and secure with string provided.
6. For all sheets of paper in which rough work has been done, cross it through and you must attach to your answer script.
7. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
8. This paper has two sections. Section A has 10 multiple choice questions and section B has 11 questions. Students have to answer all the questions.
9. Total number of pages – 5

**SECTION A (MULTIPLE CHOICE QUESTION)**

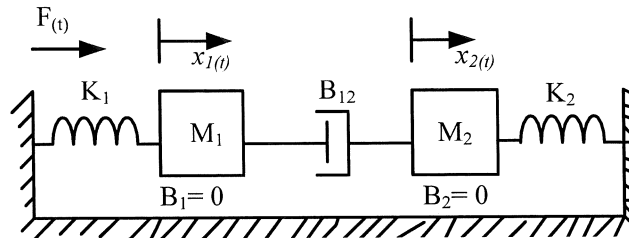
**[10 MARKS]**

1. The output signal is fed back at the input side from the \_\_\_\_\_ point
  - (a) Summing
  - (b) Differential
  - (c) Take-off
  - (d) All of them
2. While shifting a take-off point after the summing point, which among the following should be added?
  - (a) Summing point in series with take-off point
  - (b) Summing point in parallel with take-off point
  - (c) Block of reciprocal transfer function
  - (d) Block of inverse transfer function
3. Consider the assertions related to block diagram. Which among them represents the precise condition?
  - A. Block diagram is used for analysis & design of control system.
  - B. Block diagram also provides the information regarding the physical construction of the system.
  - (a) A is true, B is false
  - (b) A is false, B is true
  - (c) Both A & B are true
  - (d) Both A & B are false
4. According to signal flow graph, which among the following represents the relationship between nodes by drawing a line between them?
  - (a) Branch
  - (b) Self-loop
  - (c) Semi-node
  - (d) Mesh
5. If a system is subjected to step input, which type of static error coefficient performs the function of controlling steady state error?
  - (a) Position
  - (b) Velocity
  - (c) Acceleration
  - (d) All of them
6. If an error signal  $e(t)$  of an ON-OFF controller is found to be greater than zero, what would be its output?
  - (a) 10%
  - (b) 50%
  - (c) 80%
  - (d) 100%
7. What is the value of steady state error in closed loop control systems?
  - (a) Zero
  - (b) Unity
  - (c) Infinity
  - (d) Unpredictable
8. If a signal is passed through an integrator, it \_\_\_\_\_ the amplitude of noise signal.
  - (a) Enhances
  - (b) Reduces
  - (c) Stabilizes
  - (d) Factorizes
9. Two loops are said to be non-touching only if no common \_\_\_\_\_ exists between them.
  - (a) Loop
  - (b) Feedback path
  - (c) Branch
  - (d) Node
10. Which point on root locus specifies the meeting or collision of two poles?
  - (a) Centroid
  - (b) Break away point
  - (c) Stability point
  - (d) Anti break point

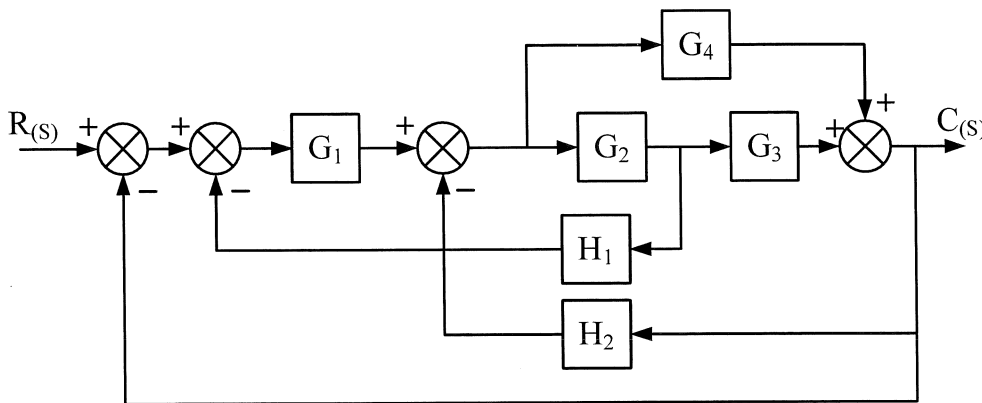
**SECTION B**

**[90 MARKS]**

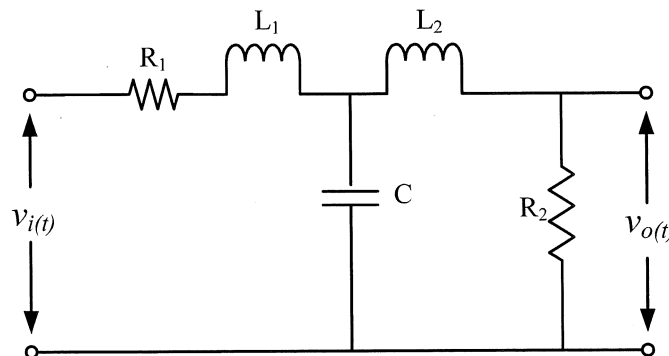
1. Define the force-voltage and force-current analogy for translational mechanical system. [6 Marks]
2. Derive the system equations and find the value of  $X_{2(s)}/F_{(s)}$  for the system shown in figure [8 Marks]



3. Using block diagram reduction technique, find the closed loop transfer function  $C_{(s)}/R_{(s)}$  of the system whose block diagram is shown below. [7 marks]



4. Draw the signal flow graph of the network shown and obtain its transfer function using Mason's Gain formula. [9 Marks]



5. A unity feedback control system has a forward transfer function  $G(s) = \frac{36}{s(s+6)}$ . Calculate the rise time, peak time, settling time and maximum peak overshoot for the closed loop frequency response. [6 Marks]

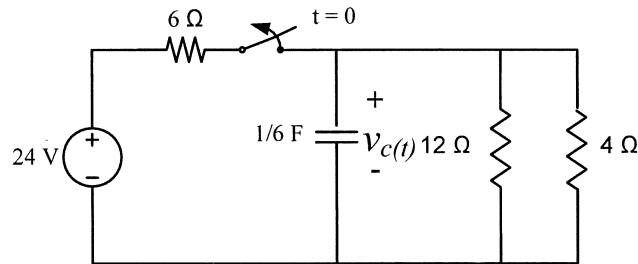
6. The closed loop transfer function of a unity feedback control system is [6 Marks]

$$\frac{C(s)}{R(s)} = \frac{20s^3}{(s+1)(s+3)(s+5)}$$

Determine the response of the system when the excitation applied to the input terminal is

$$r(t) = 1 + 2t + \frac{3t^2}{2}$$

7. The switch in the circuit shown in the figure has been closed for long time and open at  $t = 0$ . Find  $v_{C(t)}$  for  $t \geq 0$ . Calculate the initial energy stored in the capacitor. [8 Marks]



8. Determine the stability of control system with below characteristic equation using Routh Hurwitz criterion  $s^6 + 5s^5 + 10s^4 + 24s^3 + 20s^2 + 15s + 10 = 0$ . [5 Marks]

9. Sketch the polar plot and determine the stability for a system given by  $G(s).H(s) = \frac{100}{s(s+2)(s+4)(s+8)}$ . Also calculate the phase margin, gain margin, phase cross over frequency and gain cross over frequency. [12 Marks]

10. Sketch the Bode plot for a system having  $G(s) = \frac{1000}{s(1+0.1s)(1+0.01s)}$  and determine the gain margin, phase margin, phase cross over frequency and gain cross over frequency. Also comment on the stability of the system. [12 Marks]

11. (a) A system is described by the following equations [5 Marks]

$$x(\dot{t}) = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 2 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} x(t)$$

Find the transfer function of the system.

- (b) A system is characterised by the equation  $\frac{y(s)}{u(s)} = \frac{20(4s+2)}{s^3+5s^2+8s+2}$  Find its state and output equation and express in matrix form. [6 Marks]

[THE END]