BINDURA UNIVERSITY OF SCIENCE EDICATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ENGINEERING AND PHYSICS

Bachelor of Science Honours Degree in Electronic Engineering

EEE2209/3205 - Control Engineering

Time Allowed: 3 Hours **Total Marks:100**

Special Requirements: Scientific Calculator, rule, pen, pencil

INSTRUCTIONS

1. Answer any **FIVE (5) questions**

2. The question paper **contains SEVEN (7)** questions

3. Each question carries **20 marks**

1(a) Discuss briefly the following requirements of an ideal control system

(i) Stability [2]

(ii)Sensitivity [2]

(iii)Noise [2]

(b) Draw the block diagram representation of a traffic robot control system as an Open and closed loop control system [3,5]

(c) Describe briefly how negative feedback affect the following parameters on a closed loop control system

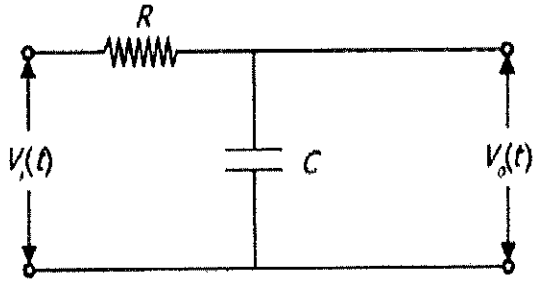
(i)Gain [2]

(ii)Stability [2]

(iii)External disturbance or noise [2]

2(a) With aid a single block diagram define transfer function of control systems. [3]

(b) Determine the transfer function of Figure below where $V_i(t)$ is the input to the system and $V_o(t)$ is the output of the system. [6]



(c)State two advantages of using transfer function in control systems [2]

(d)Find the Laplace transform of the signal below [4]

$$r(t) = \begin{cases} A\ for\ t \geq 0 \\ 0\ for\ t < 0 \end{cases}$$ where A is a real constant

(e) What is the significance of standard test signals in control systems? [2]

(f) State three properties of transfer function [3]

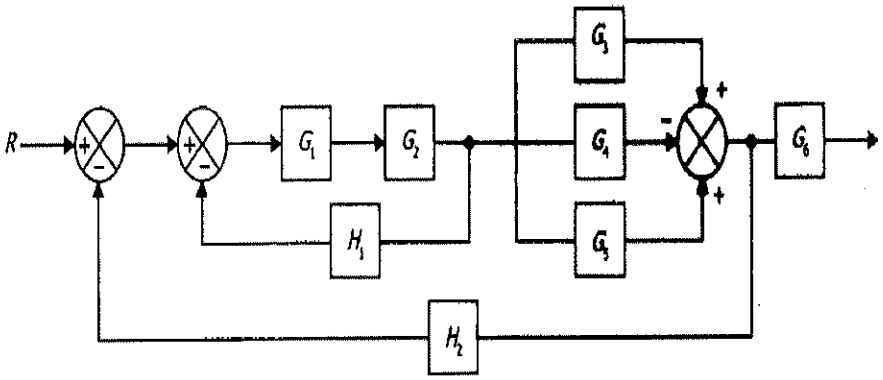
3(a) With the aid of well labelled diagram discuss the following elements of a block diagram

(i) summing point [3]

(ii) take-off point [3]

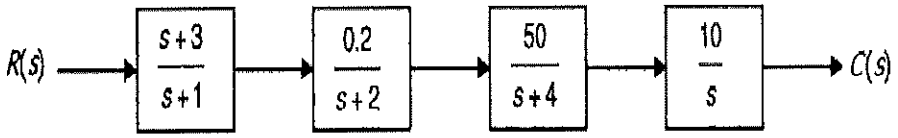
(b) A negative-feedback closed-loop system is subjected to an input of 5 V. Determine the output voltage. The system has a forward gain of 1 and a feedback gain of 1.[3]

(c) Reduce the figure below to a single block equivalent system [10]



(d) Using your knowledge of circuit analysis, write down the voltage across a capacitor (C) [1]

4(a) Determine the ratio $\frac{C(s)}{R(s)}$ of the block diagram shown below. [3]

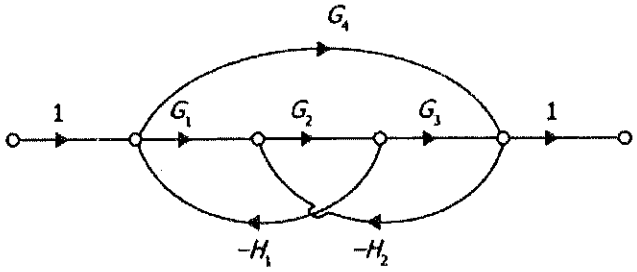


(b) Sketch the polar diagram for the control system having the transfer function. [12]

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

(c) Find the root locus of the unity feedback system having $G(s) = \frac{K}{s+1}$ shown below [5]

5(a) Find the transfer function of the system shown in Fig. below using Mason's gain formula. [8]



(b) Examine the stability of $s^5 + 6s^4 + 3s^3 + 2s^2 + s + 1 = 0$ using Routh Stability Criterion. [8]

(c)With the aid of diagrams define the following Signal Flow Rules

(i)Addition Rule [2]

(ii)Transmission rule [2]

6(a) Discuss the following basic elements of Signal Flow graph (SFG) with the aid of diagrams

(i) Self-loop [2]

(ii)Path gain [2]

(iv)Non Touching loops [2]

(b) Determine the poles and zeros of the closed-loop system. [5]

$$G_1(s) = \frac{0.1s+1}{s}, \quad G_2(s) = \frac{s+1}{s^2 + 2s + 4}$$

(c) Determine the characteristic equation of the following system: [3]

$G(s) = \frac{12}{s(s^2+4s+2)}$ and $H(s) = 0.5$

(d) Find the error coefficients of a system having $G(s)H(s) = \frac{(s+3)}{s(1+0.60s)(1+0.35s)}$ [3]

(e) State three advantages of a digital control system over an analogue control system [3]

7(a) Calculate the frequency response of the following system over a frequency range of 0.01 to 10 rad/s. [12]

(b) Draw a well labelled diagram of a general digital control system [4]

(c) Draw a well labelled diagram closed loop control system for drug delivery system into the body of a patient e.g. a diabetic. [4]

The End of Examination