OLABISI ONABANJO UNIVERSITY
COLLEGE OF ENGINEERING AND ENVIRONMENTAL STUDIES,
IBOGUN CAMPUS
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
2024/2025 HARMATTAN SEMESTER EXAMINATION

COURSE CODE: EEG 411
COURSE TITLE: CONTROL THEORY I
TIME ALLOWED: 2:30 hrs.
COURSE UNIT: 3
INSTRUCTION: Answer Any Four (4) Questions

QUESTION ONE.

(a) What is a control system? **(2 marks)**

(b) List four differences between a close-loop and open-loop systems. **(4 marks)**

(c) Using the block diagram reduction technique, obtain the transfer function $\frac{C(s)}{R(s)}$ of the block diagram shown below in Figure Q1.

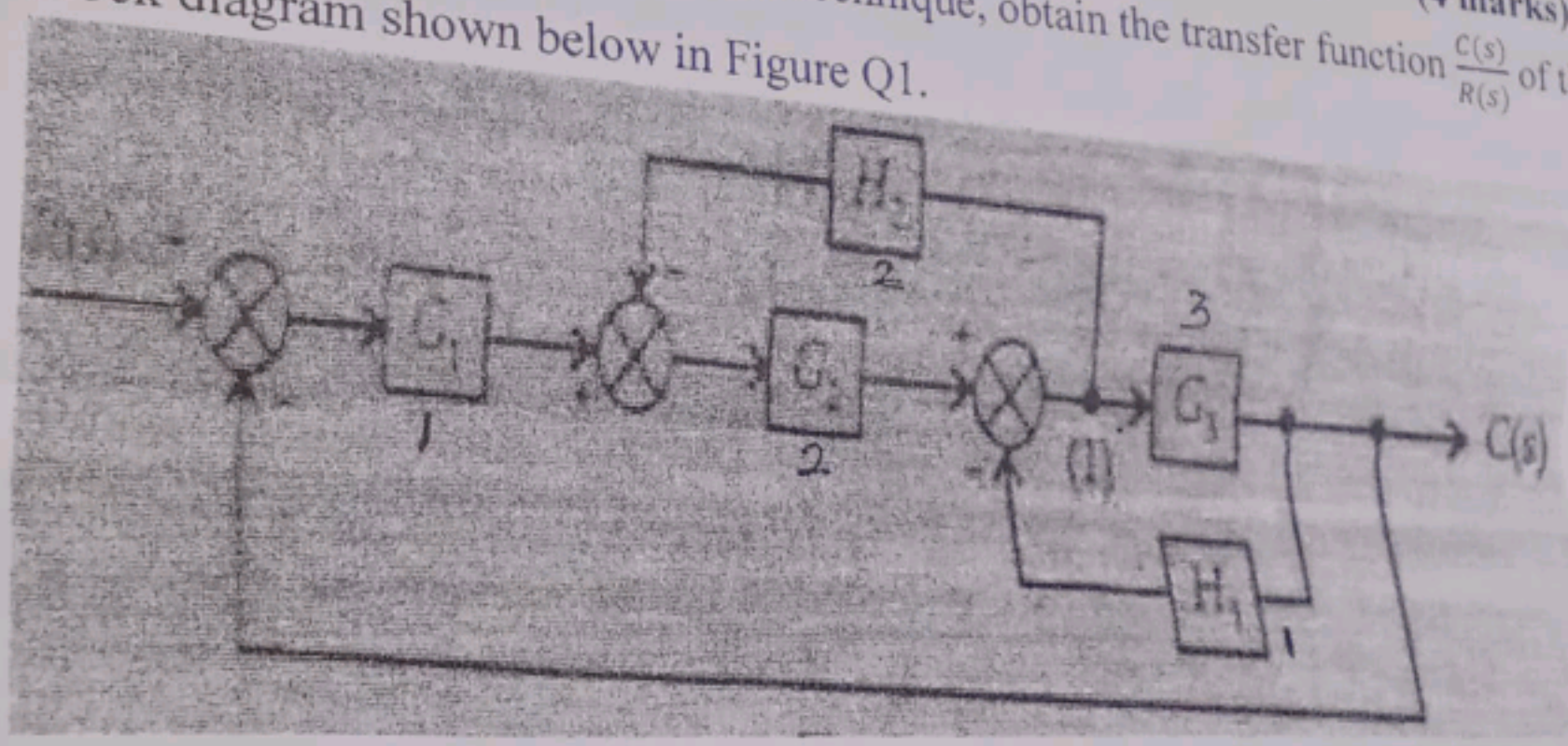

Figure Q1 **($11\frac{1}{2}$ marks)**

QUESTION TWO

(a) Define the followings with respect to SFG

i. Path **(1 mark)**
ii. Forward path **(1 mark)**
iii. Source node **(1 mark)**
iv. Sink node **(1 mark)**
v. Feedback path **(1 mark)**
vi. Self-loop **(1 mark)**

(b) Draw the signal flow graph of the block diagram shown in Figure Q2 below and determine $\frac{C}{R}$.

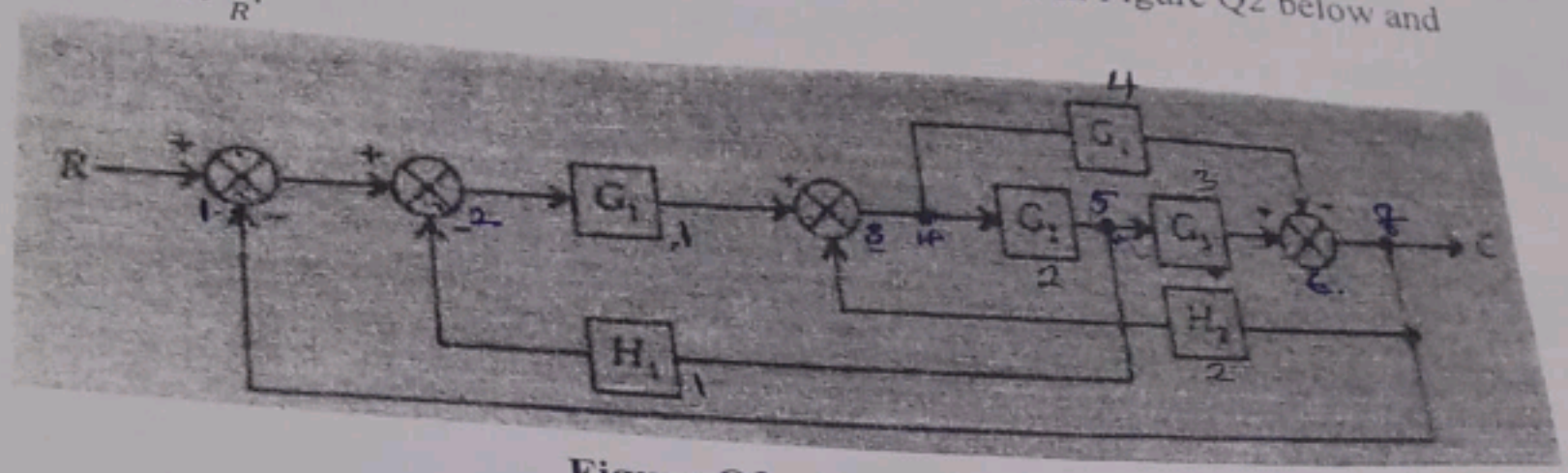

Figure Q2

QUESTION THREE **($11\frac{1}{2}$ marks)**

(a) What is signal flow graph (SFG)? **(2 marks)**

(b) State the Mason's gain formula. **(4 marks)**

(c) Using the Mason's gain formula, determine the transfer function $\left(\frac{C}{R}\right)$ for the SFG shown in Figure Q3 below. **($11\frac{1}{2}$ marks)**

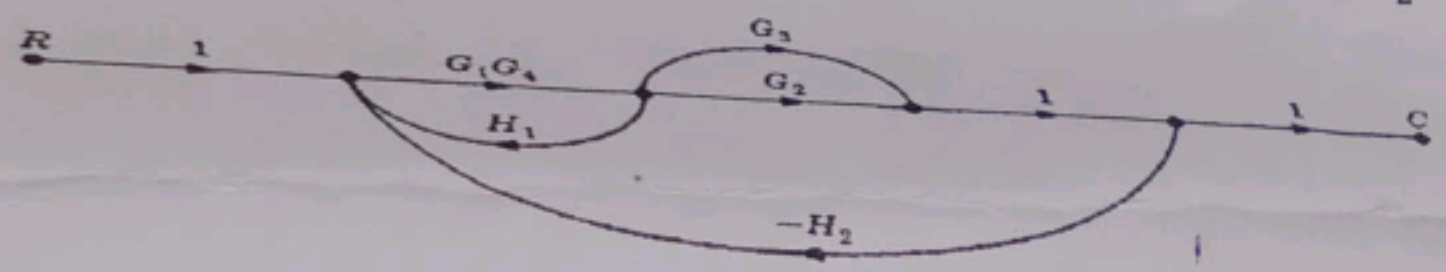

Figure Q3

QUESTION FOUR

(a) Explain the term "system stability". **(2 marks)**

(b) Using the Routh-Hurwitz criterion, determine the stability of the closed-loop system that has the characteristic equation

$s^6 + 2s^5 + 8s^4 + 15s^3 + 20s^2 + 16s + 16 = 0.$ **(6 marks)**

(c) Consider the closed-loop system shown in Figure Q4 below. Determine the range of K for stability. Assume that $K > 0$. **($9\frac{1}{2}$ marks)**

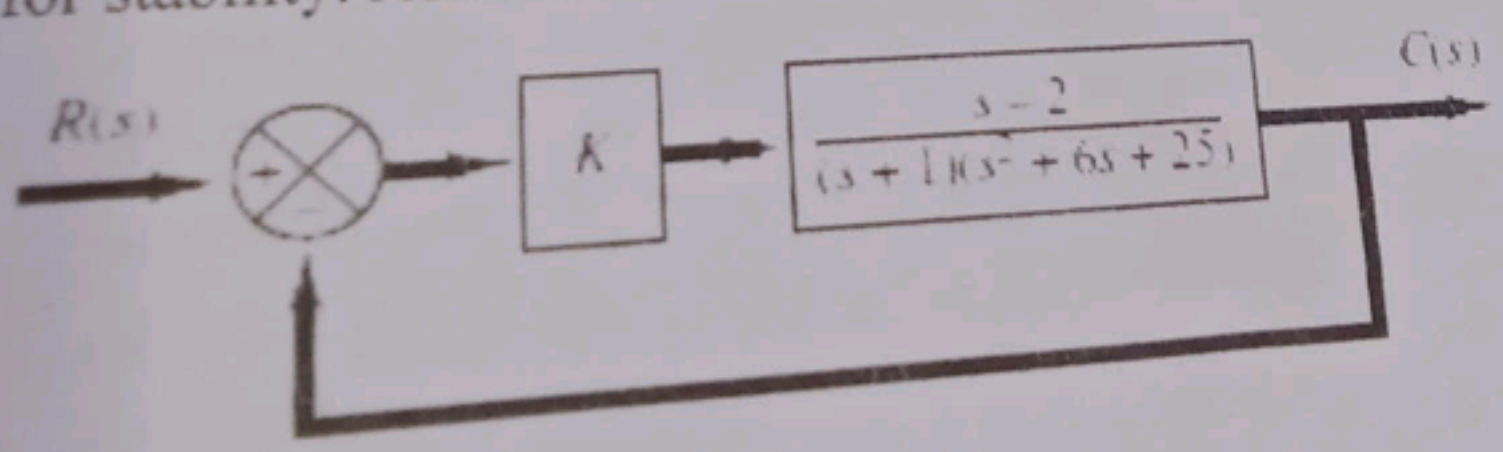

Figure Q4

QUESTION FIVE

Consider the system block diagram shown in Figure Q5 below. Determine:

i. Obtain the transfer function of the system $\frac{C(s)}{R(s)}$ (10 Marks)

ii. What is the characteristics equation? ($1\frac{1}{2}$ Marks)

iii. Determine the value of K such that damping ratio is equal to 0.5. (2 Marks)

iv. Calculate the maximum overshoot (2 Marks)

v. Determine the settling time (2 Marks)

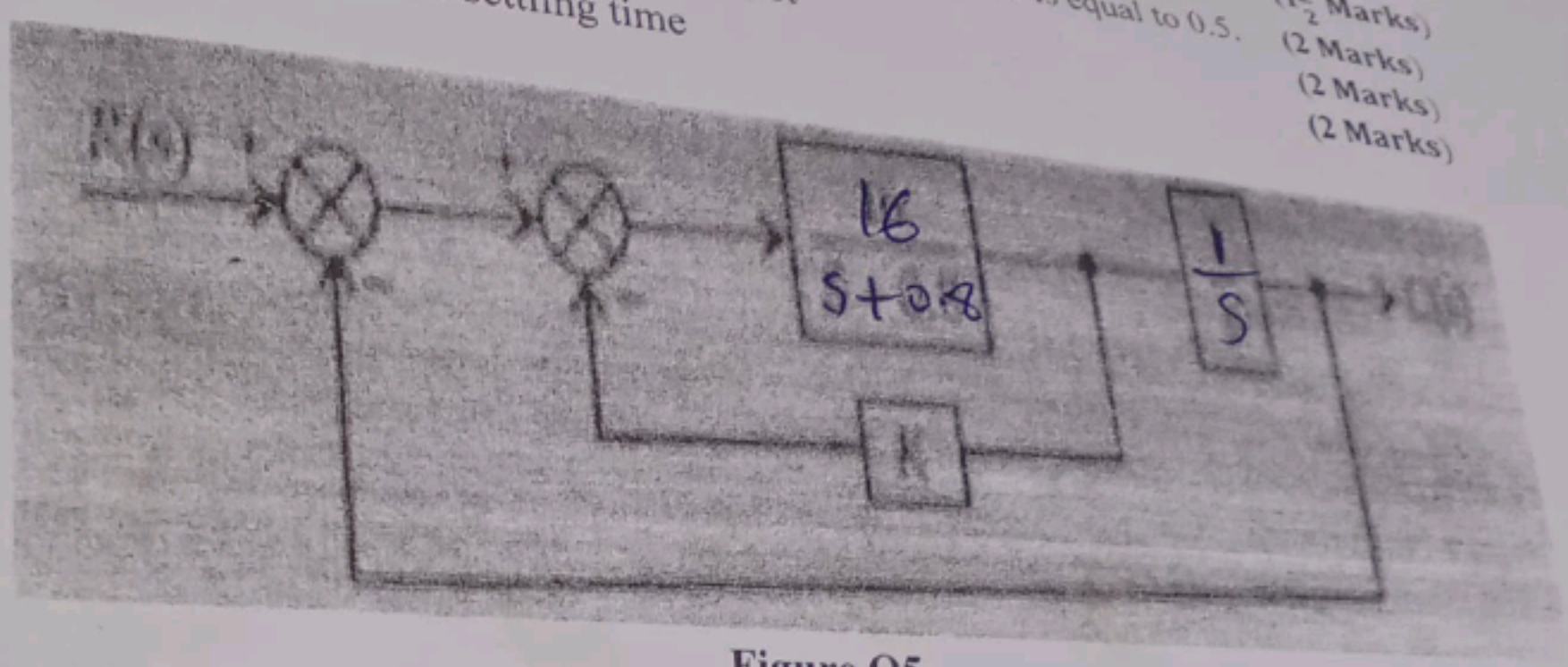

Figure Q5

QUESTION SIX

Given that the transfer function of a RC passive filter is $H(s) = \frac{2}{1+0.5s}$.

(a) Copy and complete the table below: (8 marks)

ω(rad/sec)	0.1	0.3	0.8	1.0	3.0	8.0	30.0	100.0
$\lvert H(j\omega)\rvert$(dB)								
$\angle H(j\omega)^{\circ}$								

(b) On a logarithm graph paper, draw the bode plot of the transfer function. ($9\frac{1}{2}$ marks)