10/9/9AM2

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- 2026

B.Tech-V Semester (ECE/ECS)

COURSE CODE (CREDITS): 25B11EC519/ ~~25B1WEC545~~ (04) MAX. MARKS: 15

COURSE NAME: Theory and Applications of Control System/Control Systems

COURSE INSTRUCTOR: Dr. Rajiv Kumar MAX. TIME: 01 Hour

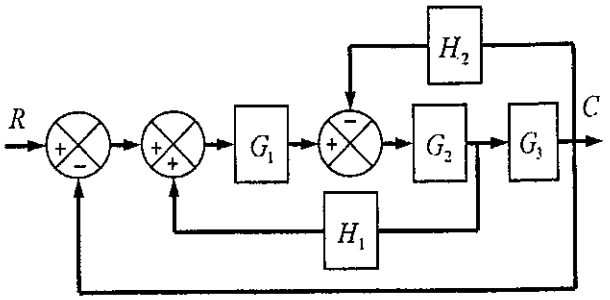
Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c) Use of scientific calculator is allowed

Q.No	Question	CO	Marks
Q1	Explain the difference between open-loop and closed-loop control systems with the help of a liquid-level control system in a water tank.	CO-1	02
Q2	Derive the expression for the closed-loop transfer function, $\frac{G(s)}{1+G(s)H(s)}$, of a feedback control system. Explain the significance of the error between the command signal and the desired output, and discuss what happens when the error is zero or minimized.	CO-1	02
Q3	For a standard second-order system, derive the expression for the percentage peak overshoot. Explain how the damping ratio affects the peak value of the system response.	CO-1	03
Q4	For a linear control system, the relationships between the input $R(s)$, output $C(s)$, and intermediate variables are described by the following simultaneous equations: $X_1(s) = G_1(s)R(s) - H_1(s)X_4(s) - H_2(s)C(s)$ $X_2(s) = G_2(s)X_1(s) + G_3(s)X_5(s)$ $X_3(s) = G_4(s)X_2(s) - H_3(s)C(s)$ $X_4(s) = G_5(s)X_3(s)$ $X_5(s) = G_6(s)X_3(s)$ $C(s) = G_7(s)X_4(s) + G_8(s)X_5(s)$ where $R(s)$is the input signal, $C(s)$is the output signal, $G_1(s), G_2(s), \dots, G_8(s)$are forward-path transfer functions, and $H_1(s), H_2(s), H_3(s)$are feedback transfer functions. (i) Construct the complete Signal Flow Graph (SFG) corresponding to the above simultaneous equations. Clearly indicate all nodes, directions of branches, and branch gains. (ii) Identify and list all forward paths from $R(s)$to $C(s)$, and determine the gain of each forward path. (iii) Identify and list all individual loops in the Signal Flow Graph, and determine the gain of each loop.	CO-2	04

225

	(iv) Using Mason's Gain Formula, determine the overall transfer function		
Q5	(A) Find the overall transfer function $\frac{C(s)}{R(s)}$ of the control system represented by the following block diagram.  (B) For the characteristic equation $s^3 + 3s^2 + 3s + 1 + K = 0$, determine the range of values of the system parameter K for which the system remains stable.	CO-2	2+2=4

MID TEST-1 EXAMINATION - AUG 2023