Reg. No. | | | | | | | | | |

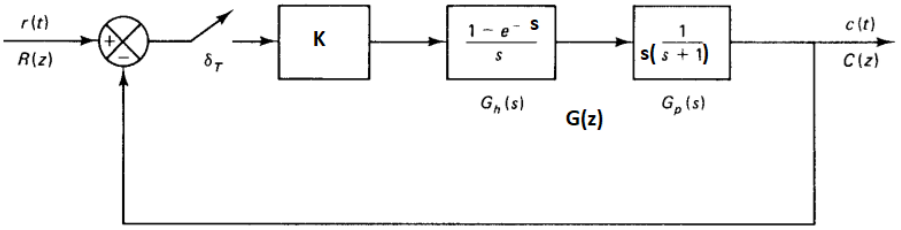
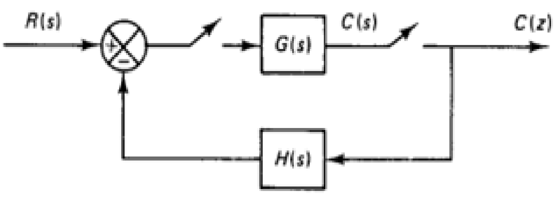
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

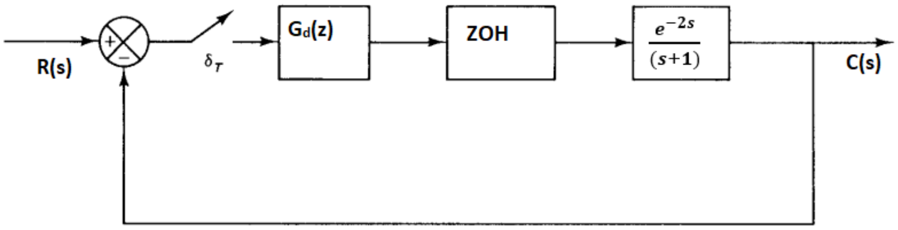
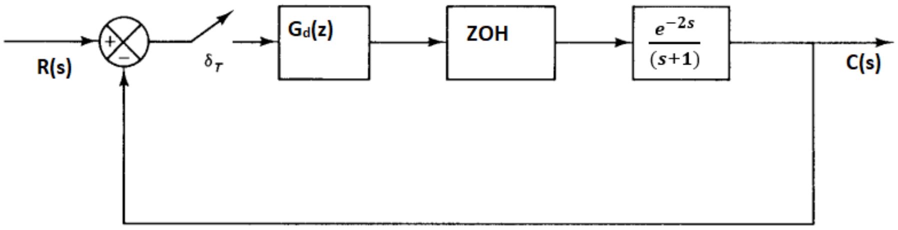
SECOND SEMESTER M.TECH. (AVIONICS)
MAKEUP EXAMINATIONS, JUNE 2024

DIGITAL CONTROL SYSTEMS [AAE 5433]
REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 24 JUNE 2024** **Max. Marks: 50**

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitably assumed.

Q.NO	Questions	Marks	CO	BTL
1A.	Find E(z) if the transfer function of the system is $E(s) = \frac{5}{s(s+1)(s+5)}$	***(03)***	***1***	***3***
1B.	Determine the inverse Z transform of the function $X(z) = \frac{z(z+2)}{(z-1)^2}$ using long division method. Consider k =0,1,2,3	***(02)***	***1***	***3***
1C.	Determine the stability of the given closed-loop control system when K=1 . The open loop pulse transfer function of the system is $G(z) = \frac{0.3679z+0.2642}{(z-0.3679)(z-1)}$  **Fig. Q1C**	***(05)***	***3***	***4***
2A.	Evaluate the pulse transfer function and step response of the following system.  **Fig.Q2A**	***(04)***	***2***	***3***
2B.	Analyze the stability of the system with characteristic equation $P(z) = z^4 - 1.2z^3 + 0.2z^2 + 0.05z - 0.001 = 0$, using Jury's stability test.	***(06)***	***3***	***4***

3A.	For a digital temperature control system with a digital PI controller have the given specifications, i. Develop the transient specifications ii. Determine the dominant closed loop poles Specifications: Sampling period = 1 sec, dominant closed loop poles with the damping ratio ,ζ = 0.5, number of samples per cycle of damped sinusoidal oscillation is 10. 	***(04)***	***4***	***3***
3B.	For a digital temperature control system with a digital PI controller have the given specifications, Specifications: Sampling period = 1 sec, dominant closed loop poles with the damping ratio ,ζ = 0.5, number of samples per cycle of damped sinusoidal oscillation is 10 The pulse transfer function of the plant is $G_{ho}G_p(z) = \frac{0.6321}{z^2(z-0.3679)}$. Design the controller by determining $G_d(z)$ and K. 	***(06)***	***4***	***6***
4A.	The motion of a satellite in equatorial is given by the state equation y(k+2) + 3y(k+1) +2y(k) = u(k) i) Develop the discrete state model ii) For the input u(k) = 1, k≥ 1, Solve output y(k). Where y(0)=0,y(1)=0, T= 1 sec	***(05)***	***5***	***4***
4B.	Analyse the controllability and observability of a computer control system with the given state space model. $x(k+1) = \begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k)$ y(k) = [1 1]x(k)	***(03)***	***5***	***4***
4C.	Determine the roots of the system if the system matrix is $A = = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$	***(02)***	***2***	***3***
5A.	Briefly explain the terminologies settling time, peak time, maximum overshoot and steady-state error	***(03)***	***5***	***2***

5B.	With the help of mathematical equations illustrate how controller is switching from a sampling period to a faster sampling period .	***(03)***	***5***	***3***
5C.	Find the transfer function corresponding to a digital positioning system with the state space matrices as given below A= $\begin{bmatrix} 0 & 1 \\ -0.4 & -1.3 \end{bmatrix}$; B = $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$; C= [1 1] ; D=0	***(04)***	***4***	***3***