B. Power Engineering 4th Year Second Semester Examination 2025
Digital Control Systems

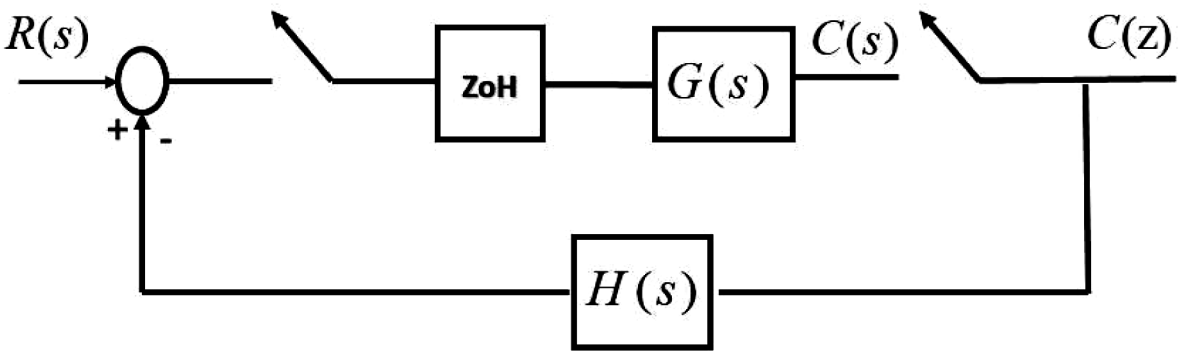
Full Marks :100 **Time: 3 hrs**

Group A
(Answer Q1 and any one of Q2 or 3)

1. Derive the Z transform of a pulse of height H and width T starting at time t=0. Hence derive the Z-transform of a Pulse Train with a time-period of **2T** seconds. **C0(1) 20**
2. Derive the sampling time to discretize a CT system with poles $s_1, s_2 = -0.8 \pm j0.6$ in the Z plane and obtain the corresponding Discrete TF using Tustin Substitution **C0(2) 20**
3. Is it possible to map a pole at $z = -0.1$ to the s plane? If so what is /are the s plane equivalent(s)? Derive the result. **CO(2) 20**

Group B
(Answer all Questions)

4. Deduce the Pulse Transfer Function of the following Sampled-Data System



OR

Write the MATLAB code to perform the following operations:

(i) Define a continuous time system $G(s) = {}^{5}/_{(0.2s+1)}$
(ii) Define a suitable sample time T for this system
(iii) Discretize the system with this sample time to obtain a discrete time transfer function
(iv) Obtain the discrete [A,B,C,D] matrices corresponding to the transfer function in (iii)

CO(3) 20

5. Derive the discrete equivalent $[F, G]$corresponding to state matrices $[A, B]$for a CT system discretized with sampling time T
Obtain a discrete state space representation for a system defined by$G(z) = \frac{b_0 + b_1 z^{-1}}{a_0 + a_1 z^{-1} + a_2 z^{-2} + a_3 z^{-3}}$ **CO(4) 10+10**

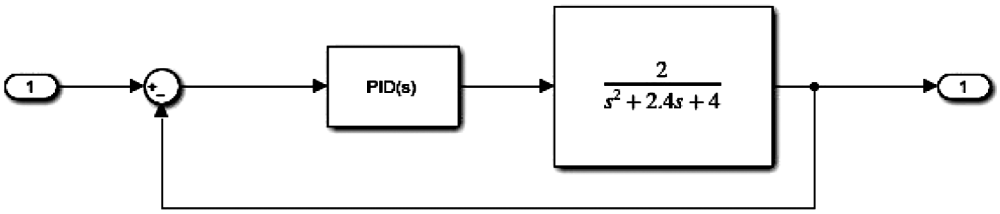
OR

Analyse the stability of a discrete system with characteristic equation
$P(z) = z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.08 = 0$ using Jury Test.
Formulate the constant damping and constant frequency locii for a second order discrete system with **complex poles**. Is there any sample-time dependence? **CO(4) 10+10**

6. Derive the transfer function of a discrete PID controller $\frac{u(z)}{e(z)}$ starting from first principles

OR

Derive the Discrete PID Controller Co-efficients for the system shown in the figure below using **indirect** Method of discretization with the PID constants $k_p = 1, k_i = 4, k_d = 0.4$



CO(4) 20