Reg. No.

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

SEVENTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)
END SEMESTER DEGREE EXAMINATIONS, DECEMBER - 2019

SUBJECT: DIGITAL CONTROL SYSTEM [ICE 4022]

TIME: 3 HOURS MAX. MARKS: 50

Instructions to candidates :*Answer ALL questions and missing data may be suitably assumed.*

1A. Plot the gain and phase characteristic of ZOH system.

1B. Find the step response of the system shown in Fig. Q1B. (T=1s), where G(s) = 1/(s+1).

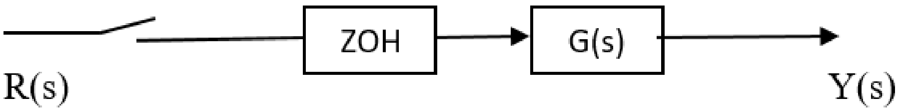

Fig. Q1B.

1C. Derive the closed loop pulse transfer function of the system shown in Fig. Q1C.

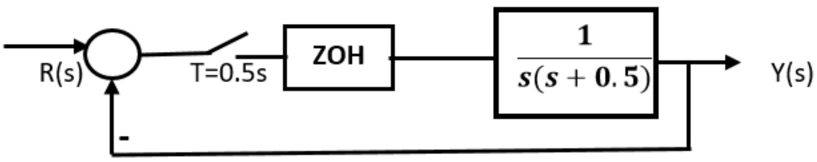

Fig. Q1C.

(3+3+4)

2A. Obtain initial value and final value of $\frac{(z-2)z}{(z+2)(z-3)(z+4)}$

2B. Determine the closed loop stability of system by z domain fundamentals if characteristic equation is given by

$$\mathbf{P(Z) = Z^3 - 1.7Z^2 - Z + 0.8 = 0}$$

2C. Obtain step, ramp and parabolic error constants and corresponding errors of the system shown in Fig. Q2C.

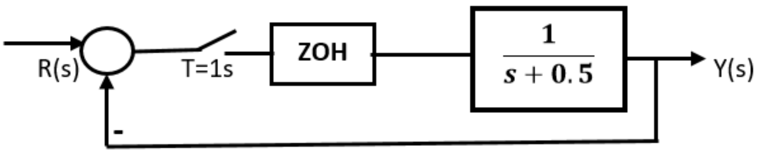

Fig. Q2C.

(2+4+4)

3A. Find the range of K for which the closed loop system is stable using Jury's test if

$$G(z) = \frac{K}{z(z-0.5)(z+0.5)} \; ; T = 1\ s$$

3B. Plot root locus if open loop system is given as $G(z) = \frac{Kz}{(z-1)(z-0.2)}$; $T = 0.5\ s$. Find the range of K and corresponding 'Z' for which the closed loop system is stable. Also find K at break away and break in points.

3C. The function f(t) after passing through the sampler is represented in discrete domain as ______.

(4+5+1)

4A. Plot Bode magnitude and phase plots of $G(z) = \frac{0.368z + 0.264}{(z-1)(z-0.368)}$ and analyze its closed loop stability. (T=1s)

4B. Design a lag compensator for system given in (Q. 4A) using Bode plot approach so that overshoot of the desired output is $\leq 15\%$

(5+5)

5A. Determine whether the given difference equation is stable, unstable or marginally stable with u(k) as step input.(Assume all initial conditions to be zero)

$$y(k+2) + 0.5(k+1) + 0.06y(k) = -0.5u(k)$$

5B. Draw the Nyquist plot of $G(z) = \frac{z}{(z-0.6)(z-0.2)}$; $T = 1\ s$. Determine its closed loop stability.

(5+5)

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