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, MARCH - 2021

Digital Control System [ICE 4022]

TIME: 3 HOURS 22-03-2021 MAX. MARKS: 50

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

1A. With a neat diagram explain mapping of s plane to z plane.

1B. Derive the Pulse Transfer function of the system given in Fig. Q1B

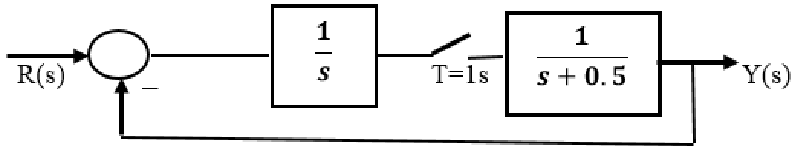

Fig. Q1B

1C. Analyse the closed loop stability of the system given in Fig. Q1B.

(3+4+3)

2A. The response of a system is given by

$$Y(z) = \frac{K[z^3 - 2az^2 + (a^3 - a^2 + a)z]}{(z-1)(z-a)(z-a)^2}$$

Determine K to obtain Y(∞)=1.

2B. For what value of K the closed loop system poles of the system described by

$$G(z) = \frac{0.2385K(z+0.876)}{(z-1)(z-0.2644)}$$

will be on unit circle.

2C. Find the solution of difference equation, y(k+2)+3y(k+1)+2y(k)=r(k); where r(k) is unit step function.

(3+4+3)

3A. Starting from fundamentals derive the Z transform of the following signals and determine the ROC

$$f(k) = a^k \quad ; \quad k \geq 0$$
$$= b^k \quad ; \quad k < 0$$

3B. By applying Routh's stability criteria, determine whether the discrete time system having

$G(s) = \frac{10}{s+1}$ is stable or not. Assume Sampling period T=1s.

(5+5)

4A. Plot Bode diagram for the system shown in Fig Q4A. Determine gain margin, phase margin, gain cross over frequency and phase cross over frequency. Comment on Closed loop stability.

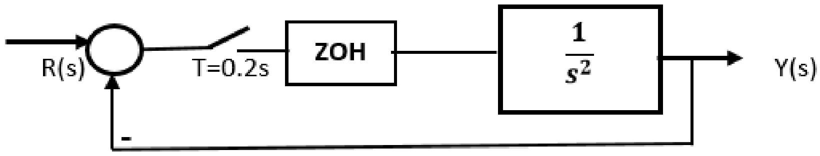

Fig Q4A

4B. Derive open loop pulse transfer function of Fig Q4B and find step, ramp and parabolic error constants and their respective errors.

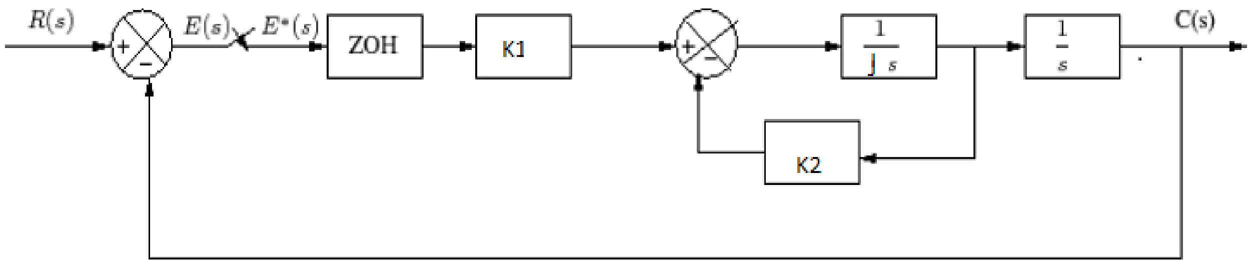

Fig. Q.4B

(6+4)

5A. For the system $G(z)=\dfrac{K}{z(z-0.5)(z+0.5)}$ plot root locus. Calculate the system gain at break away point. Also measure the System gain at z=-1. Analyse the closed loop stability of the system.

5B. Design a lag compensator using root locus method for the digital system whose pulse transfer function(T=0.5s) is given by $G(z)=\dfrac{0.092K(z+0.71)}{(z-0.1)(z-0.368)}$, such that compensated system satisfies the following specifications, Steady state error $\leq 2/15$, peak overshoot$\leq 15\%$.

(5+5)

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