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, NOVEMBER - 2018

SUBJECT: DIGITAL CONTROL SYSTEMS [ICE 4022]

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.
- Semi-log graph paper may be supplied.

1A A discrete time system is described by $y(k+2)+0.25y(k+1)-0.125y(k)=3r(k+1)-r(k)$ with $r(k)=(-1)^k$ and initial conditions $y(-1)=5, y(-2)=-6$. Find $y(k)$ for $k \geq 0$. 5

1B Determine K for $Y(\infty)=1$; 3

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

1C Write the transfer function of Zero Order Hold and prove that it behaves like low pass filter. 2

2A Derive the open loop pulse transfer function of Fig. Q 2A and obtain the step, ramp and parabolic steady state error gains and corresponding errors for the given block. 5

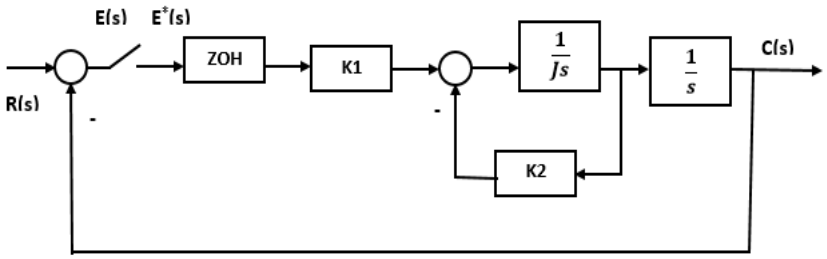

Fig. Q. 2A

2B Starting from the fundamentals derive closed loop pulse transfer function of the system given in Fig. Q. 2B. 3

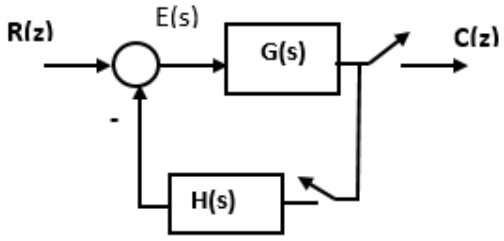

Fig. Q. 2B

2C Using fundamentals of Z transform determine the ROC of the signal 2

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

$f(k)=b^k; k<0$

3A Obtain unit impulse response of the closed loop system given in Fig. Q 3A. 5

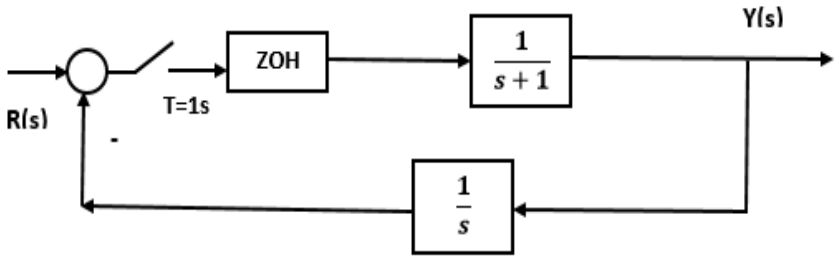

Fig. Q. 3A

3B Discretize the continuous time system and determine the stability of the system by using bilinear transformation $G(s)=\frac{10}{s(s+1)}$; Sampling period T=1s. 3

3C Given the pulse transfer function. Using direct decomposition obtain state model of the system. 2

$$\frac{Y(z)}{U(z)}=\frac{6(z-0.5)}{(z-2)(z-0.8)(z-0.4)}$$

4A Using Jury's test find the range of K for which the discrete time system $G(z)$ is stable. 4

$$G(z)=\frac{K(0.368z+0.264)}{(z-0.368)(z-1)}$$

4B Sketch root locus of $G(z)$ and comment on stability. 4

$$G(z)=\frac{K}{z(z+0.5)(z-0.5)}$$

4C The open loop pulse transfer function is given by 2

$G(z)=\frac{K(z+0.718)}{(z-1)(z-0.368)}$. While plotting root locus determine the break away and break in points.

5A Plot bode diagram for the system 6

$G(z)=\frac{0.01(z+0.984)}{(z-1)(z-0.951)}$. Obtain gain margin, phase margin, gain cross over frequency and phase cross over frequency of closed loop system. Design a lead compensator to improve the phase margin to 50 degree (sampling period 0.1 s).

5B Sketch Nyquist diagram and measure Gain margin and phase margin for the given system 3

$G(z)=\frac{0.7(z+1)}{(z-1)(z-0.4)}$; Sampling period=1s.

5C What basic physical components are present in Lag - Lead compensator circuit? 1

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