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 – 2018
SUBJECT: DIGITAL CONTROL SYSTEM [ICE 4022]

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

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A Find the solution of $y(k+2)+3y(k+1)+2y(k)=r(k)$ given $y(-1)=-5, y(-2)=0.75$ and *r(k)* is unit step function. 5

1B Determine final value of the function 3

$$f(z)=\frac{z^2+2z+1}{z^3+3z^2+3z+1}$$

1C State and prove final value theorem. 2

2A Derive the closed loop pulse transfer function of Fig. Q 2A 4

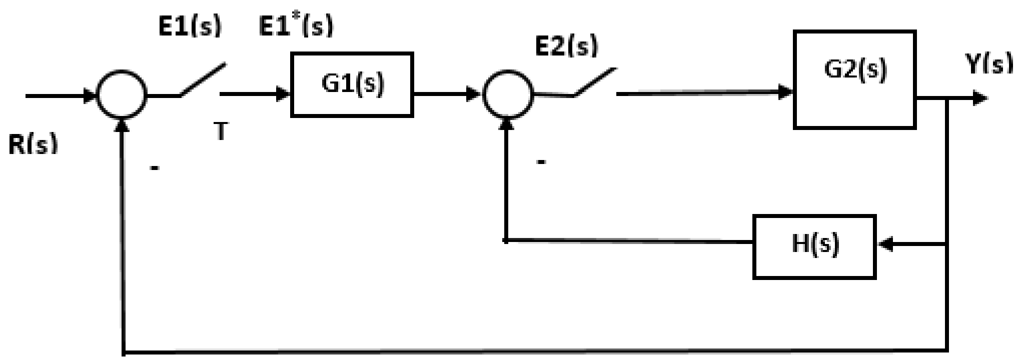

Fig. Q. 2A

2B Find step, ramp and parabolic steady state error constants and corresponding errors for a unity feedback system with open loop pulse transfer function $G(z)=\frac{(z+0.5)(z+0.2)}{(z-1)^2(z+0.8)(z+1)(z+0.9)}$ with T=1 s. 4

2C After bilinear transformation a discrete system characteristic equation is given as $P(r)=0.9r^3+8.1r^2-0.1r-0.9=0$. Comment on the closed loop stability of the system. 2

3A Obtain unit step response of the closed loop system if the open loop transfer function is given by $G(s)=\frac{(1-e^{-sT})}{s(s+1)}$. Consider sampling period as 0.1 s 5

3B For the following pulse transfer function, obtain a state model of the system using parallel decomposition. $\frac{Y(z)}{U(z)}=\frac{6(z-0.5)}{(z-2)(z-0.8)(z-0.4)}$ 3

Also draw state diagram.

3C Obtain the dominant pole locations of a second order discrete system if overshoot is 16%, settling time is 1 s and sampling period is 1 s. 2

4A Using Jury's test find the range of K for which the discrete time system $G(z)$ is stable. Given $G(s)=\frac{K}{s(s+4)}$; T=0.25s 4

4B Sketch root locus of open loop pulse transfer function $G(z)$ and determine value of K at break away, break in and range of K for which the system is stable. $G(z)=\frac{0.368K(z+0.7183)}{(z-1)(z-0.368)}$; T=1s 6

5A Design lag compensator for $G(z)=\frac{0.095z}{(z-1)(z-0.9)}$ such that $K_v \geq 10$ and PM > 60 degree. 6

5B Plot Nyquist diagram of $G(z)=\frac{0.095z}{(z-1)(z-0.9)}$ with Sampling period T=0.1 s. Obtain Gain margin and Phase Margin. 4

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