Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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A Constituent Institution of Manipal University

SIXTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER EXAMINATIONS, APRIL/MAY 2017

SUBJECT: DIGITAL CONTROL SYSTEMS [ICE 304]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.

1A. Derive the transfer function of zero order hold **2**

1B. Find the Z transform of (i) Step function (ii) ramp function **3**

1C. Determine the Initial value and final value of the function **5**

$F(z)=\dfrac{6z^3-5z^2+8z}{(z-1)(z-0.5)^2}$. Also find the inverse Z transform by long division

2A. Derive the pulse transfer function of the system shown in Fig. Q2A **2**

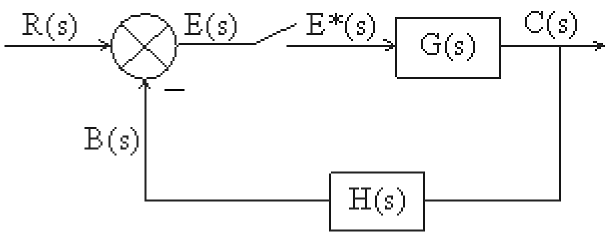

Fig. Q2A

2B. With usual notations derive the expressions for K_p, K_v, K_a in discrete domain. **3**

2C. Determine the stability of the system by Jury's test $F(z)=z^3+1.9z^2+1.1z+0.2=0$. Verify the result by Bilinear transformation **5**

3A. Define state variables (ii) state space **2**

3B. State space model is represented by F, G,C,D matrices and hence derive transfer function from state space model **3**

3C. Determine the critical value of K for a sampling period 1see for the system shown in Fig. Q3C. Also sketch the root locus plot. **5**

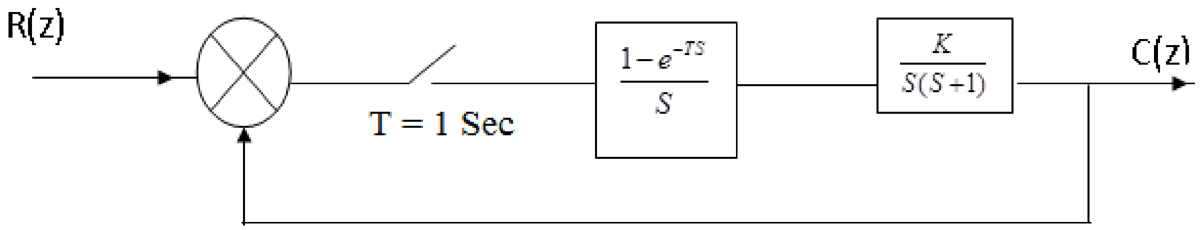

Fig. Q3C

4A. List the properties of state transition matrix **2**

4B. Obtain the state models in (i) controllable canonical form (ii) observable canonical form **3**

$$F(z) = \frac{3z}{2z^3 + 5z^2 + 4z + 1}$$

4C. Find the step response of the system given **5**

$$F = \begin{bmatrix} 0 & 1 \\ -0.16 & 1 \end{bmatrix}; \quad G = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \; ; \; C = \begin{bmatrix} 1 & 0 \end{bmatrix}; \; x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

5A. State controllability and observability matrix of a control system. **2**

5B. Derive an expression for discretization of continuous time system **3**

5C. Determine the stability of the system described by the following equation **5**

$$x(k+1) = \begin{bmatrix} -1 & -2 \\ 1 & -4 \end{bmatrix} x(k)$$

6A State Stability and instability in the sense of Lyapunov **2**

6B Check the Sign definiteness of the following **3**

(i) $V(x) = x_1^2 + 4x_2^2 + 2x_3^2 - 3x_1x_2 - 4x_2x_3 + 4x_1x_3$

(ii) $V(x) = -x_1^2 - 2x_2^2 - 4x_3^2 - 2x_1x_2 + 4x_2x_3 + 4x_1x_3$

(iii) $V(x) = x_1^2 + 2x_2^2 + x_3^2 + 2x_1x_2 + 6x_2x_3 + 4x_1x_3$

6C In Digital control system shown in Fig. Q6C, design a lead compensator with following specifications. Maximum overshoot to step input < 18%; settling time < 2 sec. **5**

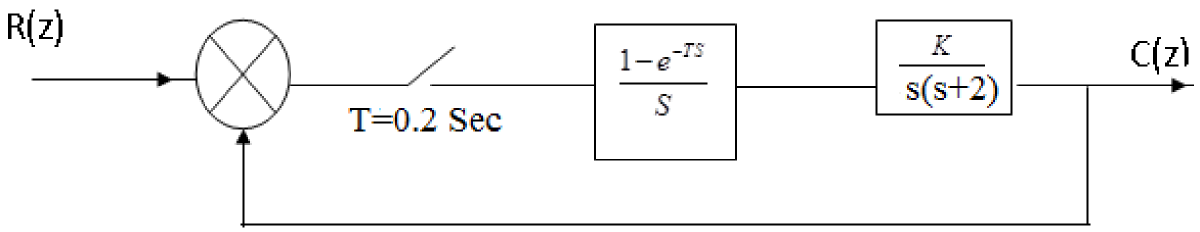

Fig. Q6C

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