Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

FIRST SEMESTER M.TECH. (AEROSPACE ENGINEERING)

END SEMESTER EXAMINATIONS, DEC - 2017

SUBJECT:ADVANCED CONTROL SYSTEMS [ICE 5102]

Duration: 3 Hour Max. Marks:50

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A Compare the properties of Lag compensator with that of Lead compensator 3

1B Given the open loop transfer function of a continuous time system 7

G(s)= $\frac{K}{s(s+3)(s+6)}$. Design a phase lead compensator using Root locus approach to achieve the desired damping ratio of 0.4 and undamped natural frequency of 4r/s. Also the system should exhibit static velocity error constant of 5 /sec.

2A The frequency response of open loop transfer function with gain adjustment for steady state error requirement is shown in Fig. (Q2A). Design a phase lag compensator to meet the desired phase margin of 45^0. 4

2B Explain with neat block diagram a typical digitally controlled system. Also mention the advantages of discrete system analysis. 3

2C Derive the expression for steady state error due to step, ramp and parabolic input for a unity feedback discrete time system having forward path with a plant $G_p(s)$ preceded by a sampler and ZOH. 3

3A Find the response y[k] for a system described by the difference equation 4

y[k+2]+y[k+1]+0.16y[k]=x[n+1]+0.32x[n], for the input x(z)= $\frac{z}{z+0.5}$, assuming all initial conditions as zero.

3B A sampled data control system has its characteristic equation given by 3
$F(z)=z^4-1.4z^3+0.4z^{2+}0.1z+0.002=0$. Determine stability of the system using Jury's stability test.

3C 3

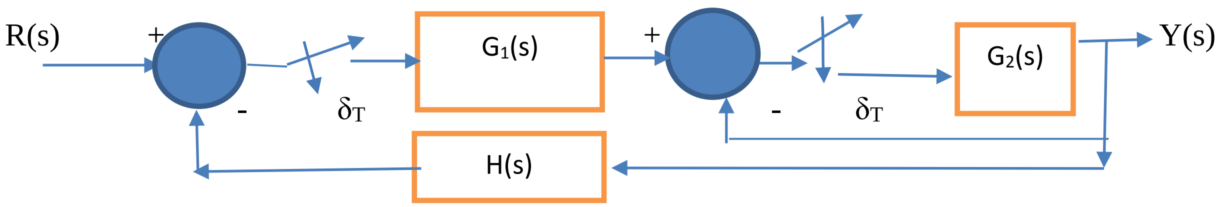

Fig. Q3C

Derive the pulse transfer function $\dfrac{Y(Z)}{R(z)}$ for the discrete time system shown in Fig. Q3C.

4A Consider the system $G(s)=\dfrac{s^2-4}{(s-2)(2s^2+3s+1)}$. Comment on its controllability and observability. Give reason. Obtain the minimal realization of the system in controllable canonical form. 3

4B Given the system description $\dot{x}(t)=\begin{bmatrix}0 & 1\\ -1 & 0\end{bmatrix}x(t)$. Determine the unforced system response for an arbitrary initial condition of x(0). 4

4C Derive the transfer function for 3

$$\dot{x}(t)=\begin{bmatrix}-6 & -1\\ 5 & 0\end{bmatrix}x+\begin{bmatrix}0\\ 1\end{bmatrix}u;\quad y=x_1$$

5A Consider the continuous time system described by 5

$\dot{x}(t)=\begin{bmatrix}-2 & 2\\ 1 & -3\end{bmatrix}x+\begin{bmatrix}-1\\ 5\end{bmatrix}u;\quad y=\begin{bmatrix}2 & -4\end{bmatrix}x+6u(t)$. Obtain equivalent discrete time model, when the sampling time is T=0.2s

5B Consider the system $x(t)=\begin{bmatrix}0 & 1\\ 20.6 & 0\end{bmatrix}x+\begin{bmatrix}0\\ 1\end{bmatrix}u$. Design a state feedback control law to place the closed loop poles at -1.8±j2.4. Verify the result by using Ackerman's formula. 5

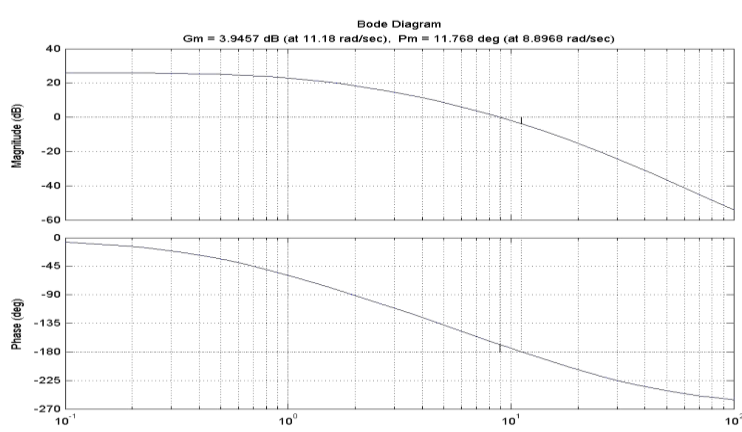

Fig. Q2A