Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

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

END SEMESTER EXAMINATIONS, NOV - 2017

SUBJECT: DIGITAL CONTROL SYSTEMS [ICE 4022]

Duration: 3 Hour | Max. Marks:50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A For the following pulse transfer function provide the difference equation for computer simulation $\frac{U(z)}{E(z)} = \frac{z^2+3z}{z^3-1.5z^2+0.66z-0.08}$. 2

1B For the system shown in Fig. Q1B, what is the type of the system? Estimate the forward path gain with unity negative feedback which sets the steady state gain with unit step function to be 10. Assume sampling time as 1s. Hence determine the steady state error. 3

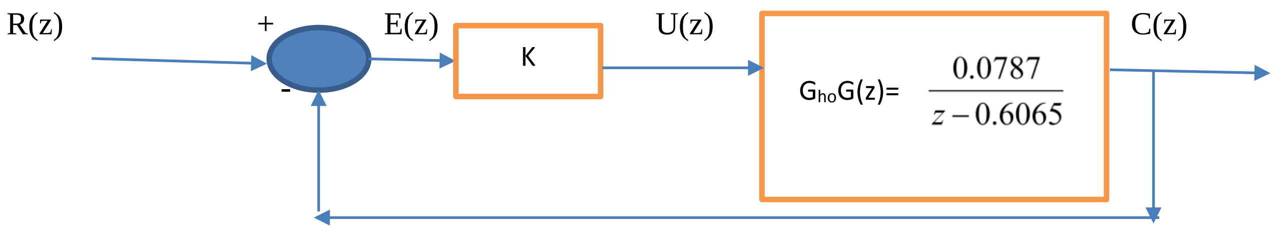

Fig Q1B

1C For the following second order system, with ZOH and sampling time of 0.2 s, compute G(z) and obtain the output for a unit Knronecker delta(discrete time impulse) function. 5

$$G_p(s)= \frac{3}{s^2+4s+3}$$

2A Derive the mathematical model for a discrete time PD controller. 2

2B Using RH criteria for the discrete time system, determine stability of the following DTS characteristic equation $F(z)= z^3-1.198z^2+0.441z-0.0498=0$ 3

2C Consider the following antenna tracking problem with an open loop transfer function of 5

$G_p(s)= \frac{3}{s^2+4s+3}$. Assuming a sampling time of 0.2s and ZOH, design a cascade discrete time PD controller to achieve a damping ratio of 0.707 and to achieve 8 samples in one period of the damped sinusoidal oscillation.

3A For the system shown in Fig. Q3A, obtain discrete time output C(z), in terms of input and transfer function of block diagram. 2

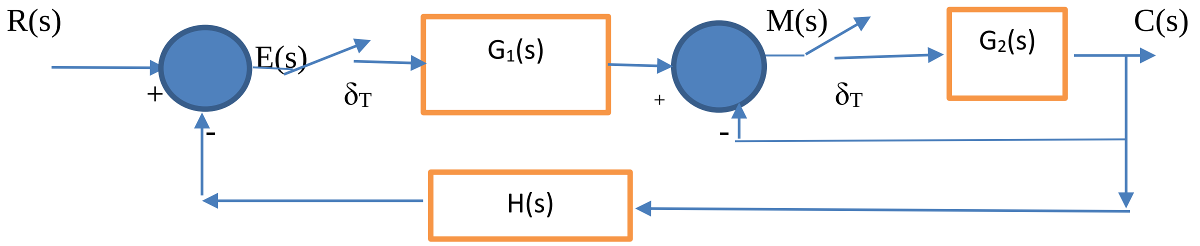

Fig Q3A

3B Consider the digital controller 3

$G_c(z)=\dfrac{2z^2+2.2z+0.2}{z^2+0.4z-0.12}$. Realize the transfer function in ladder form.

3C The open loop frequency response of the antenna control problem given in Q2C, is given in Fig. Q3C in the W-plane as a function of fictitious frequency υ with compensation for steady state gain requirement. A lead compensator needs to be designed to have a phase margin of +35 deg. Find the discrete time lead compensator in W plane, corresponding controller function in z domain and in difference equation form. 5

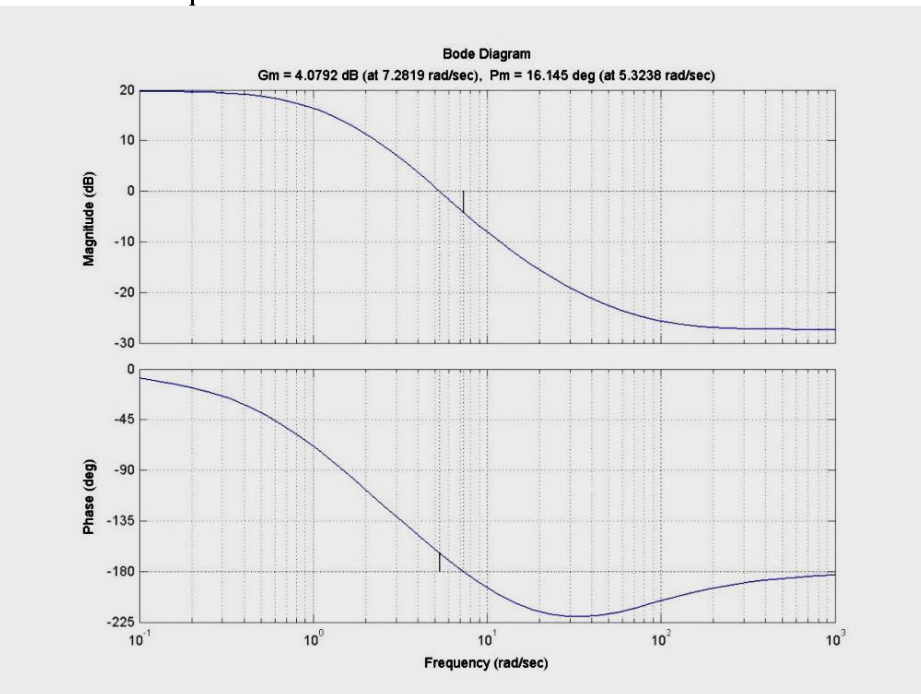

Fig. Q3C

4A Compare the bilinear transformation 2

$z=\dfrac{1+r}{1-r}$ and $z=\dfrac{1+0.5W}{1-0.5W}$

4B Show the mapping of constant σ, ω and ξ lines from s-plane to z- plane mathematically. 3

4C How Jury's stability test is carried out. Clearly highlight the necessary conditions, formation of table and sufficient conditions. 5

5A Compare the given open loop continuous time plant transfer function and its equivalent W-transformed transfer function highlighting the similarities and distinctions. 2

5B With a general block schematic, explain a digital control system. Enumerate the advantages of discrete time control system. 3

5C Derive the mathematical model for sampler and zero order hold. Hence obtain the transfer function for a zero order hold and also bring out the concept of sampling operation as impulse modulation. 5