Reg. No. : | | | | | | | | | | | |

K 6030

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Second Semester

Applied Electronics

AN 1653 — DIGITAL CONTROL ENGINEERING

(Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

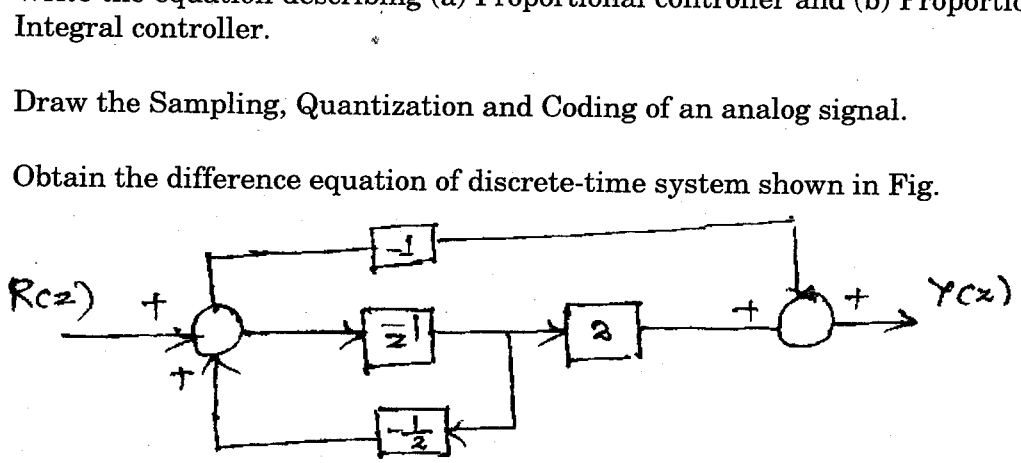
PART A — (10 × 2 = 20 marks)

1. Define (a) Settling time and (b) Overshoot in second order systems, for a unit step input.

2. Write the equation describing (a) Proportional controller and (b) Proportional–Integral controller.

3. Draw the Sampling, Quantization and Coding of an analog signal.

4. Obtain the difference equation of discrete-time system shown in Fig.



5. Convert the given transfer function in recursive form to non-recursive form for 3-samples.

$$D(z)=\frac{V(z)}{E(z)}=\frac{1-0.6z^{-1}}{1+0.5z^{-1}}.$$

6. Check the given system is stable (or) unstable using Jury stability criterion $\Delta(z)=z^3-1.3z^2-0.08z+0.24$.

7. Give the steady state errors for Type-0, Type-1 and Type-2 systems, when the unit-step signal as input.

8. Convert the given function in S-domain into z^{-1} – domain

$$G(s) = \frac{1}{(S+1)(10S+1)}.$$

9. What are the additional features of PID algorithm and give its disadvantage?

10. "Finite Word length effects" is the disadvantage of discrete-time system and brief about the reason for it.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Draw the typical unit-step response of a digital control system and explain. (8)

(ii) Explain the specifications of control system in terms of frequency response futures. (8)

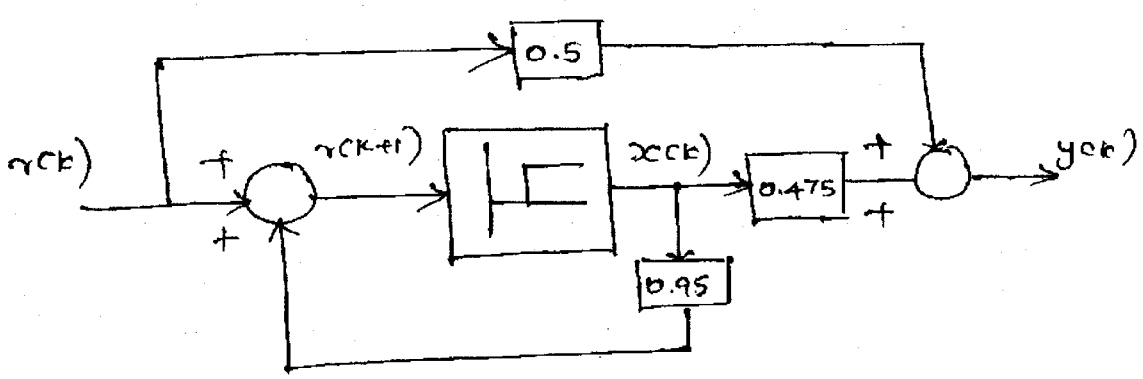
Or

(b) (i) Explain the Lead-Compensation with Bode-plot. (8)

(ii) Compare the performance of all continuous time PI, PD and PID controllers. (8)

12. (a) (i) Obtain the State equations for the first order, second order discrete time system and also generate the same for MIMO systems. (8)

(ii) Find the response of discrete time system shown in fig. to the (1) unit step sequence (2) unit alternating sequence. (4 + 4 = 8)



Or

(b) (i) Derive the expressions for Zero-order and first order hold operations. (8)

(ii) A discrete-time system is described by the transfer function $G(z)=\frac{Y(z)}{R(z)}=\frac{0.05}{z-0.95}$. Find the response $y(k)$ to the inputs $r(K)=\delta(K)$ and $r(K)=\mu(K)$. (4 + 4 = 8)

(a) (i) Check the stability of the following system using Jury Stability test. (8)

$$G(z)=\frac{3z^4+2z^3-z^2+4z+5}{z^4+0.5z^3-0.2z^2+0.4+z}$$

(ii) Obtain the State variable model of LTI system and find its state and output equations. (8)

Or

(b) Consider the digital controller defined by

$$D(z)=\frac{U(z)}{E(z)}=\frac{4(z-1)\left[z^2+1.22+1\right]}{[z+1]\left[z^2-0.3z+0.8\right]}$$

Realize this digital controller in

(i) the cascade form and

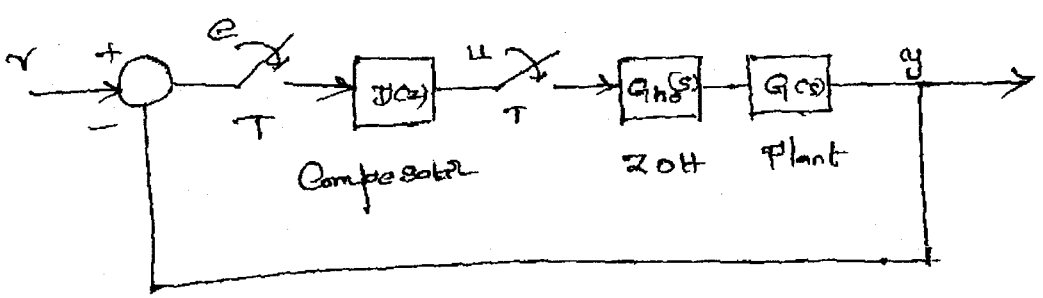
(ii) parallel form. Use one first order section and one second order section. (8 + 8 = 16)

14. (a) Design a digital control scheme for the system to meet the following specifications. (16)

(i) Velocity error constant $K_v \geq 10$

(ii) Peak overshoot M_p to step input $\leq 25\%$

(iii) Settling time t_s (2% tolerance band) $\leq$ 2.5 sec.



The plant $G(S)$ is described by the transfer function $\frac{K}{S(S+5)}$.

Or

(b) Design a lead compensator $D(z)$ in the W-plane such that the phase margin is 50, the gain margin is at least 10 dB and the velocity error constant K_V is 2 and assume that the sampling period is 0.2 sec. With the transfer function of the plant is $G(S) = \frac{1}{S[S+1]}$. (16)

15. (a) (i) Brief about the choice of data acquisition systems. (4)

(ii) Explain in detail about the microcontroller based temperature control systems. (12)

Or

(b) (i) Compare the implementation of digital control algorithms in microprocessors and microcontrollers. (4)

(ii) Explain the microcontroller based motor speed control systems. (12)
