(3 Hours) **[Total Marks : 100**

N.B. (1) Question No.1 is compulsory.

(2) Attempt any four questions out of remaining six questions.

(3) Assume any data if necessary and clearly state it.

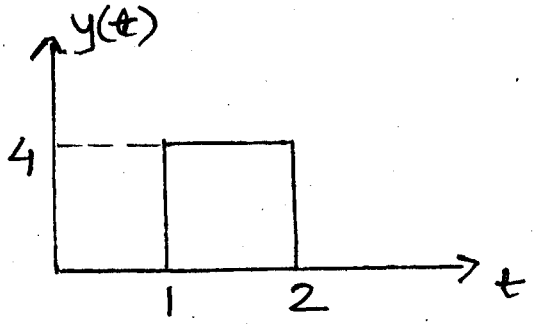
1. Solve the following **20**

(a) Find Z- transform of $x(n) = \left(\frac{1}{2}\right)^n u(n)$ & specify the ROC

(b) Compute the signal energy and signal power for $f(t) = e^{-3t}$

(c) Explain relationship between Fourier transform and Laplace transform.

(d) Find odd & even parts of a signal y(t)



2. (a) Sketch the Root Locus for the unity feedback system **10**

$$G(s)H(s) = \frac{K}{s(s^2 + 2s + 2)}$$

and Comment on the stability of system.

(b) i) Examine the stability for the system with characteristic equation **05**

$$F(s) = s^5 + 6s^4 + 3s^3 + 2s^2 + s + 1 = 0$$

ii) Find range of values of "K" so that the system with following characteristic **05**

equation will be stable. $F(s) = s(s^2 + s + 1)(s + 4) + k = 0$

3 (a) A certain discrete time system is stable and has the transfer function as given **10**

below. Find the impulse response of the system

$$H(z) = \frac{z^3}{(z - 0.2)(z - 0.5)(z - 2)}$$

(b) Given h(n)={ 1, 2, 3, 4 } and y(n)={5 , 16, 27 , 38 , 24} **10**

Find input x (n) using convolution property of Z- Transform

4. (a) Give classification of systems with Examples for each. **10**

(b) Let $x(t) = 1.5t$, $0 \le t \le 2$ and zero elsewhere. Sketch the following **10**

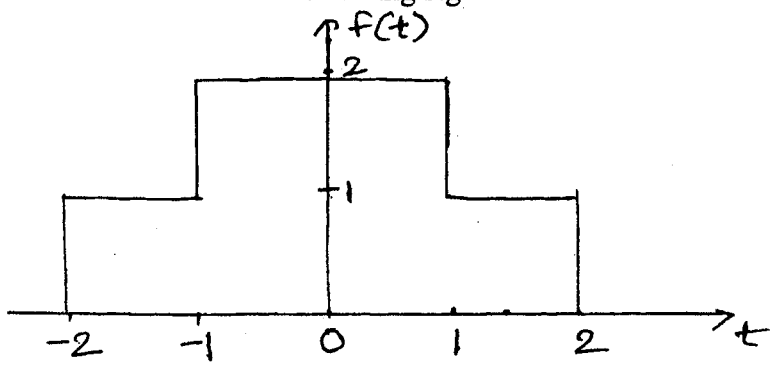
i) $x(t)$ *ii)* $f(t) = 1 + x(t - 1)$ *iii)* $g(t) = x(1 - t)$

iv) $h(t) = x(0.5t + 0.5)$, *v)* $w(t) = x(-2t + 2)$

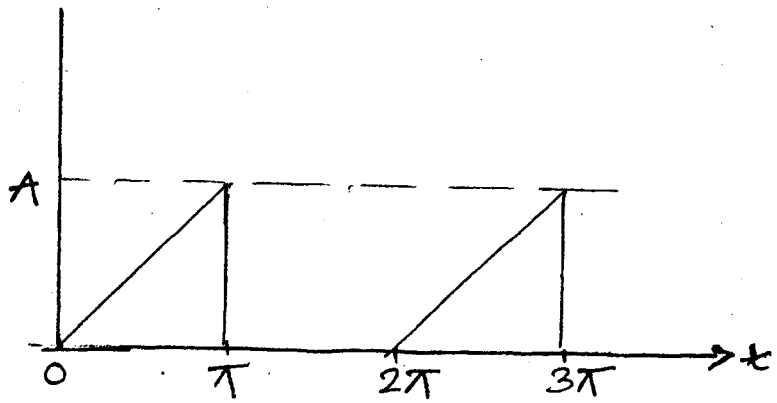
5. (a) For the system represented by given difference equation. Assuming initial conditions are zero. Compute Transfer function , impulse response and find y(t) if $x(t) = 4.e^{-2t}\,u(t)$ **10**

$$\frac{d^2}{dt^2}y(t) + 3\frac{d}{dt}y(t) + 2y(t) = \frac{d}{dt}x(t) + 2x(t)$$

(b) Find Fourier transform of the following signal **10**



6. (a) Find the trigonometric Fourier series for the given periodic signal. **10**



(b) State and prove time scaling and time shift properties of the Fourier series **10**

7. (a) Find laplace transform of the following signals **10**

i) $x(t) = e^{3t}\,u(t)$

ii) $x(t) = t.\sin^2 t$

(b) A unity feedback control system has **10**

$$G(s) = \frac{80}{s(s+2)(s+20)}$$

Draw the Bode-plot and determine Gain Margin and Phase Margin

Date :- 15-12-10 Sem :- Vth (Rev) Bio-Med

124 . 2nd Half-Exam-10-DD (A) Sub :- Signals And Systems

Con. 6208-10. **(REVISED COURSE)** **GT-6742**

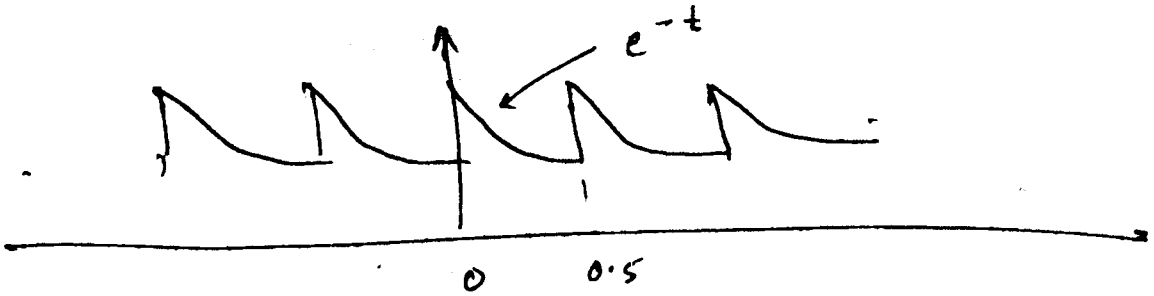
(3 Hours) **[Total Marks : 100**

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** out of remaining **six**.
(3) Assume **suitable** data wherever **necessary**.
(4) **Each** question is of **20** marks.

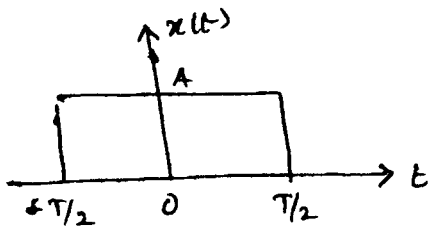
1. Attempt any **five** :— **20**
   (a) Explain Energy and Power Signals with examples.
   (b) Explain Linear and Non-linear System with examples.
   (c) Explain the relationship between Laplace Transform and Fourier Transform.
   (d) Plot the line spectrum (single sided as well as double sided) of the signal.
   $x(t) = 7 - 10 \cos (40 \pi t - 60°) + 14 \sin (120 \pi t)$
   (e) Derive the Transfer function of a closed loop system.
   (f) Determine z-transform of the following signals :—
   (i) $x_1(n) = \{ 1, 2, 3, 4, 5, 0, 6 \}$
   (ii) $x_2(n) = \{ -1, -2, -3, 004, 5 \}$

2. (a) Perform convolution of the given two signals. Draw output waveform. **10**
   $x(t) = e^{-3t} \{ u(t) - u(t-2) \}$
   $h(t) = e^{-t} u(t)$
   (b) Perform Discret convolution using graphical technique to get the output response. **10**
   $x(n) = \{ 1, 2, 3, 4 \}$
   $h(n) = \{ -1, -2, 0, 1, -2 \}$

3. (a) Derive the formula for Trignometric Fourier Series. **10**
   (b) Find the Trignometric Fourier Series for the given periodic signal. **10**



4. (a) Find the Laplace transform of the following signals :— **10**
   (i) $x(t) = (t-3)^2$
   (ii) $x(t) = \cos\left(t - \frac{2\pi}{9}\right)$
   Prove the property used in the above examples.
   (b) Obtain the Fourier transform of the following signals :— **10**
   (i) Delta function
   (ii)



[TURN OVER

5. (a) Prove the differentiation property of the z-transform and hence find out the z-transform of : **10**

$$x(n) = n\, a^n\, u(n)$$

(b) (i) Compute the z-transform of : **10**

$$x(n) = a^n \cos(won)\, u(n)$$

(ii) For a causal system, find the impulse response. The system function of :

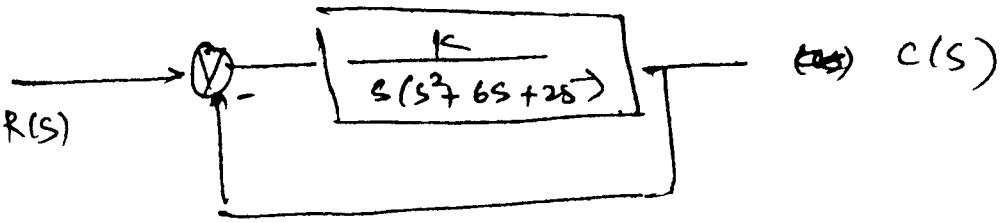
$$H(z) = \frac{z^2}{z^2 + \frac{5}{4}z + \frac{3}{8}}$$

6. (a) For a system with characteristic eqution : **10**

$$F(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$$

Examine the stability.

(b) Draw the Root Locus of the given system and comment on the stability. **10**



7. (a) Draw the Bode Plot of the given system and comment on the stability. **10**

$$G(s)\,H(s) = \frac{80}{s(s+2)(s+20)}$$

Also determine, W_{gc} and W_{pc}.

(b) Explain the concept of stability based on the position of poles and zeros. What is the significance of the characteristic equation ? **10**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Q. **No. 1 is compulsory.**
(2) **Attempt** any **four** out of remaining **six** questions.
(3) Assume **suitable** data wherever **necessary.**

1. Attempt any **four** :– **20**

(a) Determine whether the following signals are periodic or not.

(i) $x_1(n) = \sin(3n)$; (ii) $x_2(n) = \cos\left(\frac{n}{4}\right) \cos\left(\frac{\pi n}{6}\right)$

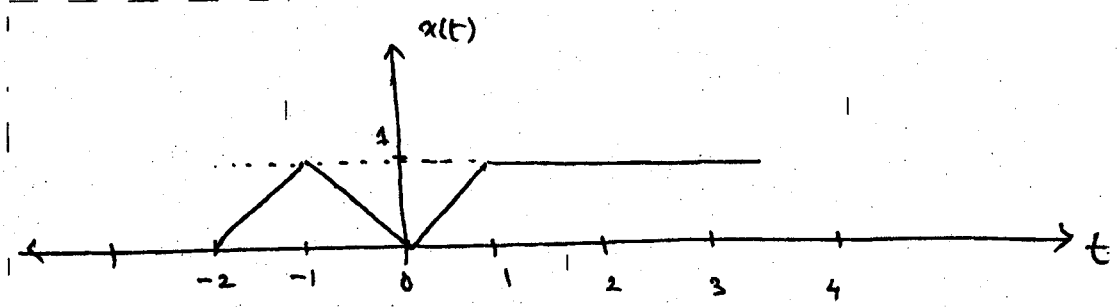
(b) Determine whether the following signals are energy signals or power signals and why

(i) $x(t) = e^{-at}$ (ii) $x(t) = \sin w_1 t + \cos w_2 t$

(c) Plot the following signal with respect to time.

$x(t) = u(t) - r(t-1) + 2r(t-2) + u(t-4)$

(d) Find even and odd parts of the signal x(t)



(e) Discuss the relationship between the Laplace transform and the Fourier transform.

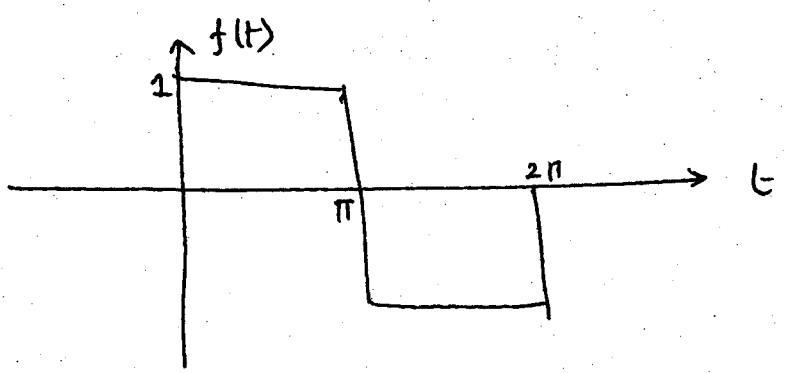
2. (a) Determine whether the following systems are Static / Dynamic, Linear/Non Linear, Causal / Anti-Causal, Time Variant / Time Invariant. **10**

(i) $\frac{d}{dt}y(t) + ty(t) = x(t)$

(ii) $y(t) = x(t^2)$

(b) The impulse response of an L.T.I. system is h(t) = u(t). Determine the output of the system if input $x(t) = e^{-at}\,u(t)$, $a > 0$. **10**

3. (a) The **figure** below is a square wave. Represent this signal by sin t. Plot the error in this representation. **10**



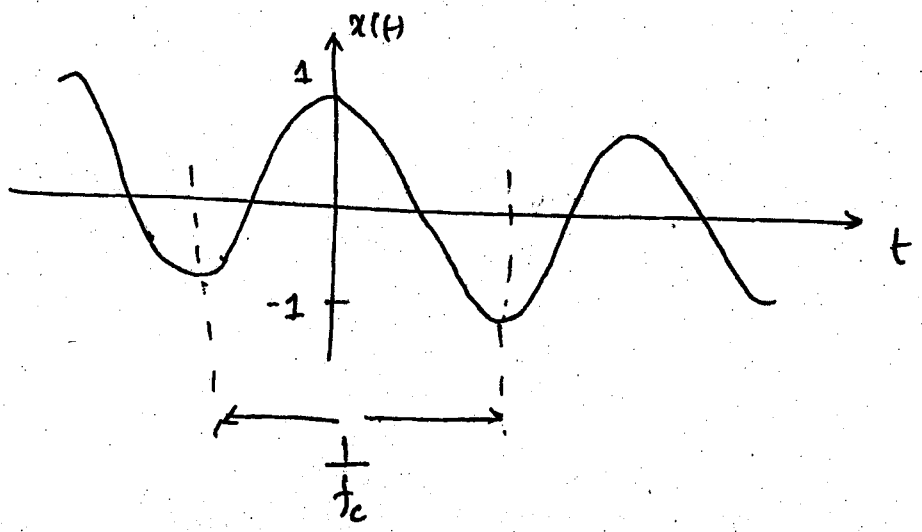
(b) Show that the set of exponentials is orthogonal over any interval T_0 **10**

$\{1, e^{\pm jw_0 t}, e^{\pm j2w_0 t}, e^{\pm j3w_0 t} \ldots\ldots\}$

[TURN OVER

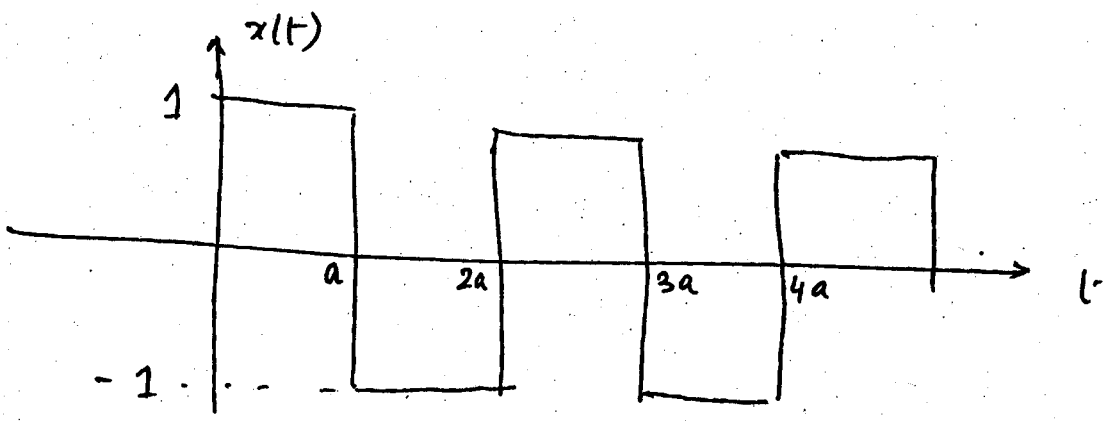
4. (a) Prove the following properties of the Fourier series – 10
   (i) Linearity Property
   (ii) Scaling Property.

   (b) Obtain the Fourier transform of the Cosine wave shown below – 10



5. (a) Give that the Laplace transform of the first cycle of the periodic function is f(s), then prove the Laplace transform of a periodic function with period T. 10

   (b) Use the property is (a) and find the Laplace transform of the square wave shown below – 10



6. (a) Draw the Root Locus for the following system and comment on stability 10

$$G(s) = \frac{k(s+5)}{s(s+2)}$$

   (b) Draw the Bode-plot for the given system $G(s)H(s) = \frac{100(s+4)}{s(s+0{\cdot}5)(s+10)}$ 10

   Compute Gain Margin and Phase Margin.

7. (a) Find z-transform of the given signal and draw the ROC. 8

$$x(n) = 14^n u(n) + 26^n u(-n-1)$$

   (b) Give the relationship between the z-transform and the Fourier transform. 6

   (c) Prove the convolution property of the z-transform. 6

Bio-Medical - V th (Rev) - Dec 2009
Signals & Systems

21-12-09

P4–Exam.–Oct-09–258

Con. 5491–09. (REVISED COURSE) SP–8582

(3 Hours) [Total Marks : 100

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** of the remaining **six**.
(3) Assume **suitable** data wherever **necessary**.

1. Attempt any **four** :– **20**

(a) Determine whether the following signals are periodic or aperiodic
$x_1(t) = \cos(0{\cdot}01\pi t)$, $x_2(t) = \sin(6t)$.

(b) Check whether the following signals are energy or power signals.
(i) $x(t) = \text{sect}\ (t/T_0)$
(ii) $x(t) = \cos^2 w_0 t$

(c) Give an expression to computer the even and odd components in a signal. Plot the even and odd components for the given signal
$x(n) = \{ 1, 5, 6, \underset{\uparrow}{2}, 1, 3, 2, 1 \}$

(d) Discuss the relationship between the Laplace transform and the Fourier transfer.

(e) Compute the transfer function for the system represented by the given differential equation $\frac{d^2y(t)}{dt} + \frac{6\,dy(t)}{dt} + 2y(t) = \frac{3d}{dt}x(t) + x(t)$

2. (a) Determine whether the following signals are Static/Dynamic, Linear/Nonlinear, Time Invariant/ Time variant, Causal/Anticausal. **10**
(i) $y(t) = x(t) \cos 100\ \pi(t)$
(ii) $y(t) = 20\ x(t) + 5$

(b) Derive the convolution Integral and explain the significance of convolution. **10**

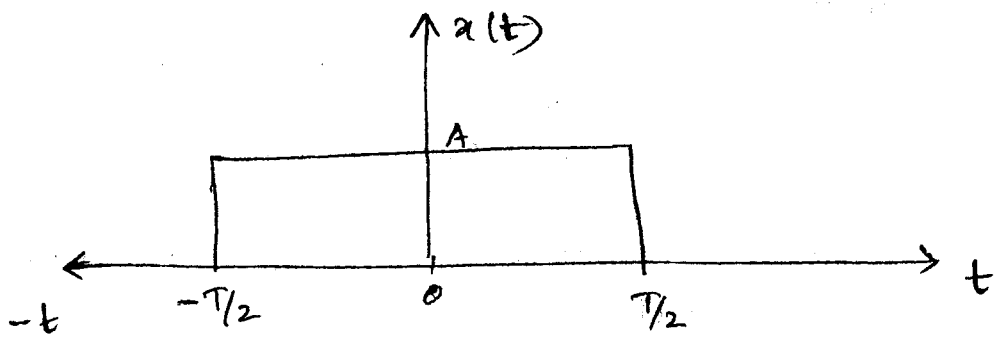
3. (a) The impulse response and the input to the system is given as **10**
$x(t) = u(t + 1)$
$h(t) = u(t - 2)$
Perform convolution and determine the output of the system.

(b) Show that the signal set **10**
$\{ \cos w_0 t, \cos 2w_0 t, \cos n w_0 t, \sin w_0 t, \sin 2 w_0 t, \sin n w_0 t \ldots . \}$
are orthogonal over an interval $T_0 = \frac{2\pi}{w_0}$

[TURN OVER

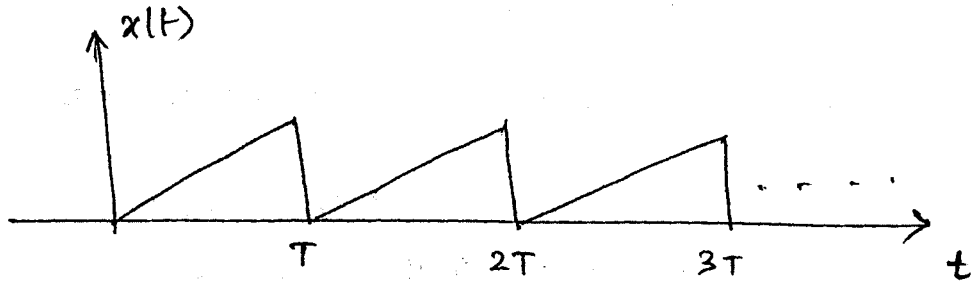
4. (a) State and prove the time shift and frequency shift property of the Fourier series. **10**

(b) Obtain the Fourier Transform of the rectangular pulse of duration T and amplitude a shown below – **10**



Draw the Magnitude and Phase plot.

5. (a) Find out the Laplace transform of the signal shown below – **10**



(b) Check whether the following system represented by their characteristic equation are stable or not – **10**

(i) $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$

(ii) $S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$

6. (a) Draw the Root Lous for the following system and comment on its stability **10**

$$G(s) = \frac{K}{s(s+6)(s+3)} \; ; \; H(s) = 1$$

(b) Draw the Bode Plot for the given unity feedback system and compute Gain margin and Phase margin **10**

$$G(s) = \frac{100(s+4)}{s(s+0\cdot5)(s+10)}$$

7. (a) Give the relationship between the Laplace transform and the z-transform **6**

(b) Find the z-transform of the given signal $x(n) = 4^n u(n) + 6^n u(-n-1)$ **8**

(c) Draw the Pole-zero plot for the given system **6**

$$y(n) - \frac{3}{4}\, y(n-1) + \frac{1}{8} y(n-2) = x(n) - x(n-1).$$