Code No. 441/CBCS

FACULTY OF ENGINEERING

B.E. (ECE) III Semester (CBCS) (Main) Examination, December 2017

Subject: Signal Analysis and Transform Techniques

Time: 3 Hours **Max. Marks: 70**

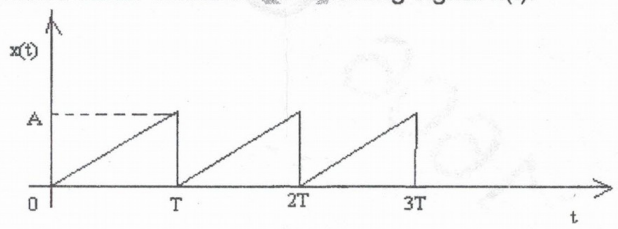
Note: Answer all questions from Part A and any five questions from Part B.

PART-A (20 Marks)

1. Plot the wave form for x(t)=u(t+2)+u(t+3)-u(t-4). 2
2. Define Energy signal and Power signal. 2
3. Write the relationship between Laplace transform and Fourier transform. 2
4. Define system transfer function. 2
5. Determine Z-transform and ROC of the discrete signal x(n)=u(n-5). 2
6. Explain linearity property of Z-transform. 2
7. Differentiate between convolution and correlation of two signals. 2
8. Perform the convolution between two signals x(n)={1,0,1,0} and h(n)={1,-2,1,0}. 2
9. Test the causality of the following system. $y(t)= x(t^2)$ 2
10. Define sampling. 2

PART-B (5X10=50 Marks)

11. Find the Exponential Fourier series of the following signal x(t). 10



12. a) Determine the Power of the signal $x(t)=e^{-3t}\,u(t)$. 5
    b) Explain the basic operations can be performed on a continuous time signal? 5
13. a) Write any five properties of Laplace transform. 5
    b) Determine the Inverse Fourier Transform of the following signal 5

$$X(j\Omega)= j\Omega + \frac{5}{(j\Omega+2)^2}$$

14. a) Find inverse Z-transform of $X(Z)= \frac{1}{[1-1.5Z^{-1}+0.5Z^{-2}]}$ 5
    if a) ROC |Z|> 1 b) ROC |Z|< 0.5 c) ROC 0.5<|Z|<1
    b) A causal system is represented by the following difference equation. Find its transfer function.

$$y(n)-\frac{1}{3}\,y(n-1)=x(n)+\frac{1}{4}x(n-1)$$ 5

15. a) Determine the response of the LTI system whose input x(n) and impulse response h(n) are given by, x(n)={1,2,3,-1} and h(n)={2,1,-1,2} 5
    b) Differentiate between auto and cross correlation? 5

16. Determine the Fourier series representation of the following discrete time signal and sketch spectrum. 10

$x(n)=\{\ldots\ldots,1,3,-2,\underset{\uparrow}{1},3,-2,1,3-2,\ldots\ldots\}$

17. Write short notes on **any two** of the following. 10

a) Stability and causality of the system.

b) Time shifting and scaling operations of discrete time sequences.

c) Cross correlation and its properties.

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FACULTY OF ENGINEERING

Code No.441/CBCS/S

B.E. III Semester (CBCS) (ECE) (Suppl.) Examination, May/June 2018

Subject: Signal Analysis and Transform Techniques

Time: 3 Hours **Max. Marks: 70**

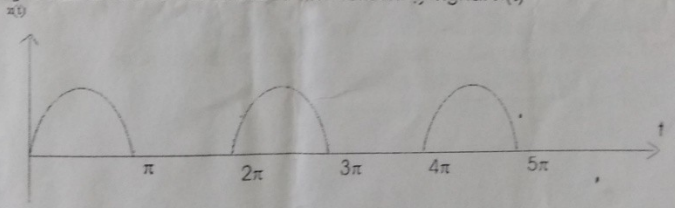
Note: Answer all questions from Part A & any five questions from Part B.

PART-A (20 Marks)

1. Show that whether the unit step signal is a power or energy signal. 2
2. Write the relation between exponential and trigonometric Fourier series coefficients. 2
3. Find the Fourier Transform of the signal $x(t)=e^{-4|t|}\,u(t)$. 2
4. Define ROC and determine ROC for a right sided signal. 2
5. Show clearly the S-plane and Z-plane correspondence. 2
6. Explain shifting property of Z-transform. 2
7. Write the properties of convolution. 2
8. Perform the convolution between two signals x(n)={1,2,1,2} and h(n)={2,0,2,0}. 2
9. State whether the following system is time invariant or not. $y(t)=2\,t\,x(t)$ 2
10. What is sampling? 2

PART-B (5X10=50 Marks)

11. Find the trigonometric Fourier series of the following signal x(t) 10



12. a) Determine the even and odd part of the following signal 5
$x(t)= \sin(3t)+\cos(2t)+\sin(t)\cos(2t)$.

b) Determine the energy of the signal $x(t)=e^{-5t}\,u(t)$. 5

13. a) Write any five properties of Fourier transform. 5

b) Using Laplace transform determine the complete response of the system represented by following equations. Assume initial conditions are zero. 5

$\frac{d^2y(t)}{dt^2}+11\frac{dy(t)}{dt}+24\,y(t)=3x(t)$; where $x(t)=4\,u(t)$

...2

14. a) Find inverse Z-transform of $X(Z)=\frac{1+z^{-1}}{1-(\frac{1}{3})z^{-1}}$ if ROC $|Z| > 1/3$.

b) Consider a causal discrete-time system whose output y(n) and input x(n) are related by

$$y(n) - \frac{5}{6}\, y(n-1) + \frac{1}{6} y(n-2) = x(n)$$

i)Find its transfer function H(z).

ii) Find its impulse response h(n).

15. a) Perform the convolution of the continuous signals using graphical method.

$x_1(t)=e^{-2t}\, u(t)$ and $x_2(t)=t\, u(t)$

b) Write short notes on scaling of discrete time signals.

16. a) Determine whether the following signal is energy or power signal

$x(n)= (1/4)^n\, u(n)$

b) Test the following systems is linear or not.

$$y(n)=3x(n)+\frac{1}{x(n-1)}$$

17. Write short notes on **any two** of the following.
   a) Addition and multiplication of discrete time sequences.
   b) Auto correlation and its properties.
   c) Fourier transform of periodic signals.

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Code No. : **6124**

FACULTY OF ENGINEERING
B.E. 2/4 (ECE) (II Semester) (Supple.) Examination, December 2009
SIGNAL ANALYSIS AND TRANSFORM TECHNIQUES

Time: 3 Hours] [Max. Marks: 75

Note : *Answer **all** questions of Part A.*
*Answer **five** questions from Part B.*

PART – A **(25 Marks)**

1. Determine whether a unit step function, U(n), is a power or energy sequence.

2. Prove that the Fourier series of a periodic signal with rotation symmetry contains only odd harmonics.

3. State and prove convolution property of Fourier transform.

4. If the z-transform of x(n) is X (z), then find the z-transform of n x(n).

5. Consider the analog signal

   $x_a(t) = 5 \cos 100\pi t + 10 \sin 200\ \pi t - 15 \cos 300\pi t$. What is the Nyquist rate for this signal ?

6. Define autocorrelation function and state any three of its properties.

7. State and prove the time-shifting property of z-transform.

8. Find the convolution integral when $f_1(t) = e^{-at}$ and $f_2(t) = t$.

9. Realize the system with 2 delays

   $y(n) = 5y(n-1) + 3x(n) + 2x(n-1)$

10. Find the Laplace transform of the function

    $f(t) = te^{-at}\, u(t)$.

PART – B (50 Marks)

11. a) Find the complex Fourier series for the signal 5

$x(t) = 2 \cos 5t + 5 \sin 15t.$

b) Find the trigonometric Fourier series for the following periodic function shown in fig. 1. 5

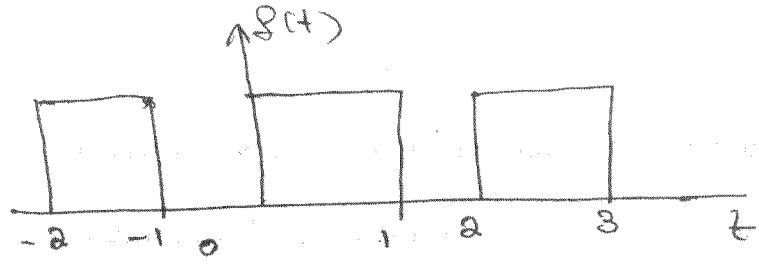

Fig. 1

12. a) A signal x(t) has the Fourier transform given by : 5

$$|X(\omega)| = 1 \quad -2 \le \omega \le 2$$
$$= 0 \quad \text{otherwise}$$

$$\text{and } X(\omega) = \pi/2, \quad -2 \le \omega \le 0$$
$$= -\pi/2, \quad 0 \le \omega \le 2$$

Find x(t).

b) State and prove the modulation theorem for Fourier transform. 5

13. a) Find the output of the system whose impulse response $h(t) = e^{-2t}U(t)$ when the excitation $x(t) = t\,u(t)$. 5

b) Find the inverse Laplace transform of

$$F(s) = \frac{e^{2s} - e^{3s}}{s^2 + 2s + 2}.$$ 5

14. a) Find the z-transform and sketch the ROC for the following sequences. **5**

i) $x(n) = \left(\frac{1}{2}\right)^n U(-n)$

ii) $x(n) = \left(\frac{1}{2}\right)^{n-1} U(n-1)$

b) A causal LTI system is described by the difference equation. **5**

$y(n) = y(n-1) + y(n-2) + x(n-1)$.

Find the unit sample response of the system.

15. a) How do you perform graphically convolution of two signals ? Explain with the example **5**

$x(t) = e^{-at} u(t)$, $h(t) = U(t) - u(t-T)$.

b) Obtain the convolution of a step function with respect to itself. **5**

16. a) State and prove the frequency shifting property of the Fourier transform. Explain its significance. **5**

b) Find the Fourier transform of the function shown in figure 2. **5**

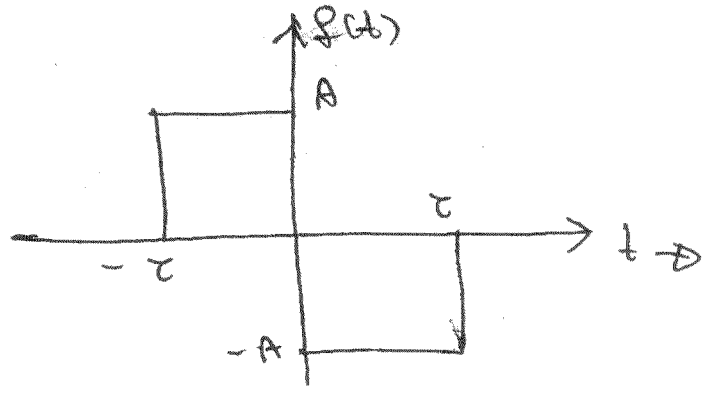

Fig. 2

17. a) Determine the inverse z-transform of

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}} \quad \text{ROC} : |z| < 0.5 . \qquad \textbf{5}$$

Using long division method.

b) Determine the inverse z-transform for the following function :

$$X(z) = \frac{(z+1)(z+5)}{(z+2)(z+3)(z+6)} \text{ for } |z| \leq 3 . \qquad \textbf{5}$$

Code No. 3280

FACULTY OF ENGINEERING

B.E. 2/4 (ECE) II-Semester (Supplementary) Examination, January 2011

SIGNAL ANALYSIS & TRANSFORM TECHNIQUES

Time : Three Hours] [Maximum Marks : 75

Answer **ALL** questions from Part A. Answer any **FIVE** questions from Part B.

PART—A (Marks : 25)

1. Determine whether the signal $x(t) = t\ u(t)$ is an energy signal, power signal or neither.
2. Check the orthogonality of signals e^{-j2wt} and e^{j2wt} over the time interval [O, T].
3. Determine the complex exponential Fourier series representation for the signal :

   $x(t) = \cos 4t + \sin 6t$.
4. Find the Fourier transform of the signal $x(t) = e^{-jw_0t}$.
5. State and prove the time differentiation property of Fourier transform.
6. Find the Laplace transform and the associated ROC for the signal $x(t) = \delta(at + b)$, a, b are real constants.
7. Find the inverse Laplace transform for :

   $$X(s) = \frac{2s+1}{s+2}, \text{Re}(s) > -2.$$
8. Obtain the z-transform and the associated ROC for the sequence $x(n) = a^{-n}\ u(-n)$.
9. Find the inverse z-transform of :

   $$X(z) = \frac{z}{2z^2 - 3z + 1}, |z| < \frac{1}{2}$$

   using partial-fraction expansion.
10. Obtain the convolution of the functions $f_1(t) = e^{-5t}$ and $f_2(t) = t$.

PART—B (Marks : 50)

11. Consider the triangular wave x(t) shown in Fig. 1. Find :

    (a) the complex exponential Fourier series of x(t), and

    (b) the trigonometric Fourier series of x(t).

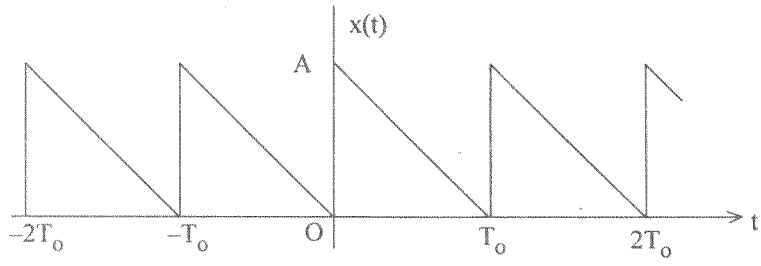

Fig. 1

12. State and prove the time differentiation property of Fourier transform. Using this property, find the Fourier transform of the triangular pulse signal shown in Fig. 2.

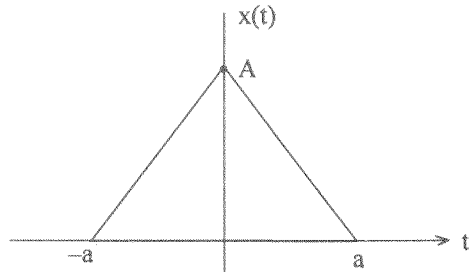

Fig. 2

13. (a) State and prove the time-scaling property of Laplace transform.

    (b) Obtain the Laplace transform of the signal :

    $f(t) = e^{-at} \cos w_o t \; u(t)$.

14. (a) Using the power series expansion technique, find the inverse z-transform of

$$X(z) = \frac{z}{2z^2 - 3z + 1}, \; |z| < \frac{1}{2}.$$

    (b) Solve the following difference equation with the given initial conditions :

    $y(n) - 3y(n-1) = x(n)$, with $x(n) = 4U(n)$, $y(-1) = 1$.

15. (a) Define autocorrelation and state its properties.

    (b) How do you perform graphically convolution of two signals ? Explain with the example $x(t) = e^{-2t}\, u(t)$ and $y(t) = u(t)$.

16. (a) State and prove sampling theorem.

    (b) Realize the system with 2 delays $y(n) = y(n - 1) + 2x(n) + 8x(n - 1)$.

17. Write short notes on the following :

    (a) Singularity functions

    (b) Parseval's relation

    (c) Relationship between s-plane and z-plane.

Code No. : **5139**

FACULTY OF ENGINEERING
B.E. 2/4 (ECE) II Semester (Suppl.) Examination, January 2012
SIGNAL ANALYSIS AND TRANSFORM TECHNIQUES

Time : 3 Hours] [Max. Marks : 75

Note : *Answer **all** questions from Part **A**, answer **any five** questions from Part **B**.*

PART – A **(10×2$^1/_2$=25 Marks)**

1. Check whether the signal $x(t) = 2\cos\left(\frac{1}{2}t\right) + 3\cos\left(\frac{1}{3}t - \frac{1}{5}\pi\right)$ is periodic or not. If periodic, what is the period ?
2. Distinguish between Energy Signal and Power Signal.
3. Test whether the signal $\sin\left(\frac{1}{t}\right)$ has Fourier transform or not.
4. Match the following :

Time Signal	**Its spectrum**
a) Continuous and periodic	i) Continuous and Aperiodic
b) Continuous and Aperiodic	ii) Continuous and periodic
	iii) Discrete and periodic
	iv) Discrete and Aperiodic

5. What is the Laplace transform of $f(t) = e^{-3t}[u(t) - u(t-4)]$?
6. What is the significance of ROC ?
7. What is the z-transform of x(–n) ?
8. If $X(z) = 3z^2 + 5z - 7z^{-1} + 6z^{-2} - 4z^{-3}$, find the sequence x(n).
9. State the properties of Autocorrelation.
10. What is the autocorrelation of u(t) ?

PART – B (5×10=50 Marks)

11. a) Explain the symmetry properties of Fourier Series.

    b) Find the trigonometric Fourier Series expansion of the signal shown in Fig. (1).

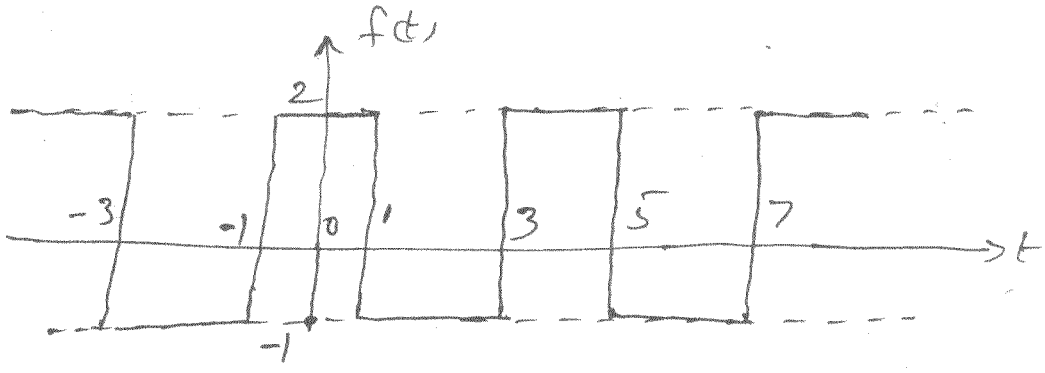

Fig. (1)

12. a) State and prove the modulation property of Fourier transform.

    b) A signal f(t) = cos 50 t + cos 70 t modulates the carrier $f_c(t)$ = cos 500t. Find the spectrum of the modulated signal using Fourier transforms.

13. Find the Laplace transform of the functions :

    a) $f(t) = 5u(t) \cdot u(3 - t)$

    b) $f(t) = e^{-3t}[u(t + 2) - u(t - 3)]$.

14. a) State and prove time differentiation property of FT.

    b) Find the FT of the waveform shown in Fig. (2).

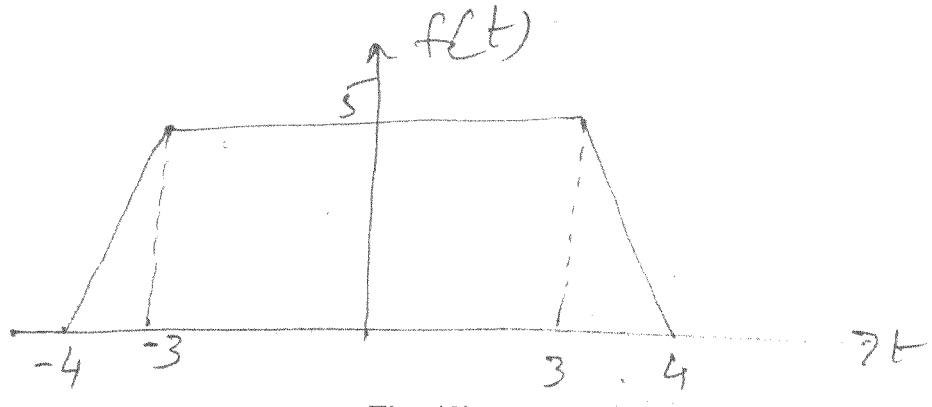

Fig. (2)

15. Find the inverse Laplace transform of

a) $F(s) = \dfrac{e^{-2s}}{(s+1)(s+2)^2}$

b) $F(s) = \dfrac{1-e^{-3s}}{3s^3+2s^2}$.

16. a) Find the inverse z-transform of $\left(1-z^{-1}\right)^{-2}$.

b) A linear discrete time system is given by $y(n) + 0.95y(n-1) = 0.05x(n)$

i) Find the impulse response of the system

ii) Find the response of the system if $x(n) = 0.5^n\, u(n)$.

17. a) Show that convolution operation is commutative.

b) Determine the convolution of the sequence x(n) and h(n)

where $x(n) = \begin{cases} -n/2, & 2 \le n \le 5 \\ 0, & \text{elsewhere} \end{cases}$

and $h(n) = \begin{cases} n, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$.

Code No. : 6124

FACULTY OF ENGINEERING
B.E. 2/4 (ECE) II Sem. (Main) Examination, June 2010
SIGNAL ANALYSIS AND TRANSFORM TECHNIQUES

Time : 3 Hours] [Max. Marks : 75

*Note : Answer **all** questions from Part – A. Answer **any five** questions from Part – B.*

PART – A **(25 Marks)**

1. Determine whether the signal $x(t) = A \cos(\omega_0 t + \theta)$ is a energy signal, power signal or neither.

2. Find the orthogonality of the signals $\sin \omega t$ and $\sin 2\omega t$ over the time interval (O, T).

3. Obtain the complex exponential Fourier series representation for the signal $x(t) = \sin^2 t$.

4. Find the Fourier transform of the signal $x(t) = 1$.

5. State and prove Parseval's theorem for the Fourier transform.

6. Find the Laplace transform and the associated ROC for the signal $x(t) = e^{-2t}[u(t) - u(t-5)]$.

7. Find the inverse Laplace transform for $x(s) = \dfrac{2s+4}{s^2+4s+3}, -3 < \text{Re}(s) < -1$

8. Obtain the z-transform and the associated ROC for the sequence $x(n) = n\,a^n\,U(n)$.

9. Determine the initial and find values of x(n), given $x(z) = \dfrac{z}{2t^2 - 3z + 1}, |z| > 1$.

10. Obtain the convolution of the functions $f_1(t) = e^{-2t}$ and $f_2(t) = u(t)$.

PART – B (50 Marks)

11. Consider the triangular wave x (t) shown in Fig. 1. Find

a) the complex exponential Fourier series of x (t), and

b) the trigonometric Fourier series of x (t).

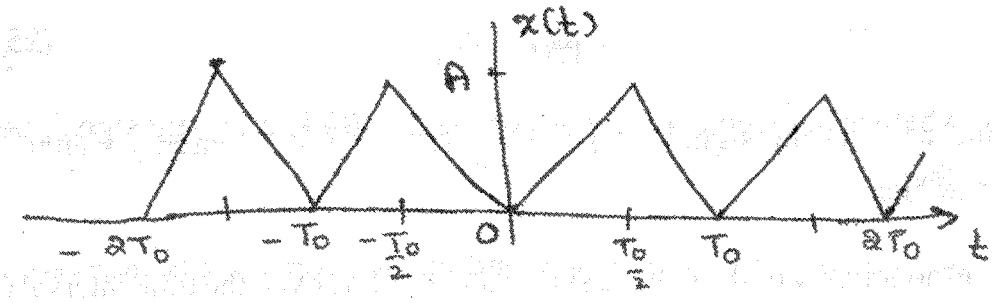

Fig. 1

12. a) Find the Fourier transform of the signum function, sgn (t) which is defined as

$$\text{Sgn}(t) = \begin{cases} 1 & t > 0 \\ -1 & t < 0 \end{cases}.$$

b) Using the time convolution theorem, find the inverse Fourier transform of

$$X(\omega) = 1/(a + j\omega)^2.$$

13. a) Find the Laplace transform of

$$x(t) = \left(e^{-t}\cos 2t - 5e^{-2t}\right)u(t) + \frac{1}{2}e^{-2t}u(-t).$$

b) Find the inverse Laplace transform of

$$X(s) = \frac{s^2 + 2s + 5}{(s+3)(s+5)^2} \qquad \text{Re}(s) > -3.$$

14. Consider a causal discrete-time system whose output y(n) and input x(n) are related by $y(n)-\frac{5}{6}y(n-1)+\frac{1}{6}y(n-2)=x(n)$.

    a) Find its system function H (t)

    b) Find its impulse response h (n).

15. a) State the properties of convolution.

    b) Obtain the output signal of a system whose input signal, $x(t)=e^{-t}u(t-1)$ and the impulse response, h (t) = 2u (t – 1).

16. a) Determine the z-transform of $x(n)=(\cos^2 \omega n)u(n)$.

    b) Using partial fraction expansion method obtain the inverse z-transform of

$$x(z)=\frac{6z^3+2z^2-z}{z^3-z^2-z+1}.$$

17. Write short notes on the following :

    a) Sampling theorem

    b) Fourier transform of periodic signals

    c) Autocorrelation and its properties.

Code No. : 3280

FACULTY OF ENGINEERING

B.E. 2/4 (ECE) II Semester (Main) Examination, May/June 2011

SIGNAL ANALYSIS AND TRANSFORM TECHNIQUES

Time : 3 Hours] **[Max. Marks : 75**

Note : Answer **all** questions from Part – A. Answer any **five** questions from Part – B.

PART – A (Marks : 25)

1. Test whether the ramp function is energy signal or power signal.
2. The signal f(t) = 3t for $0 \leq t \leq 4$ and is periodic with period 4. What are the harmonics present ?
3. If the Fourier transform of f(t) is F(w), what is the Fourier transform of f(at) ?
4. Define the Bandwidth of a signal.
5. State the condition in terms of impulse response for a system to be causal.
6. What is the FT of a unit step function ?
7. For a left sided sequence $x(n)$, draw the ROC in the z-plane.
8. If the z-transform of a sequence is $x(z)$, what is the z-transform of $nx(n)$?
9. What is the relation between convolution and correlation ?
10. State the properties of cross correlation.

PART – B (Marks : 50)

11. (a) Derive the expressions for the Fourier series coefficients.
    (b) For the periodic waveform shown in Fig.(1) determine the Fourier series coefficients.

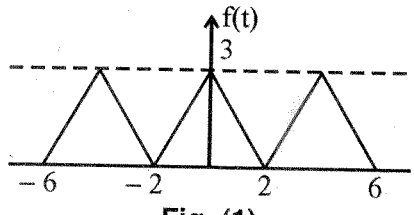

Fig. (1)

12. (a) Find the FT of the signal $f(t) = te^{-at} u(t)$.
    (b) State and prove Parseval's theorem of FT.

13. (a) State and prove scaling property of L-transform.

(b) If the L-transform of $x(t)$ is $X(s) = \frac{4}{(s+2)^2}$, find the L-transform of $g(t) = x(2t - 2)$.

14. (a) Find the inverse L-transform of $X(s) = \frac{4(s+1)}{s^2 + 2s + 2}$

(b) The transfer function of a system is $1 + (s) = \frac{s+2}{(s+3)(s+4)^2}$

Sketch the pole-zero plot and test the stability of the system.

15. (a) Find the z-transform and the ROC for the sequence, $x(n) = 0.8^n\, u(n)$.

(b) State and prove convolution property of z-transform.

16. (a) Find the inverse z-transform of $x(t) = \frac{z+1}{(z+0.2)(z-0.6)}$

(b) For the system given by the difference equation, draw the canonical form realization diagram.

$y(n) + 0.5y(n-1) + 2y(n-2) + 3y(n-3) + 0.8y(n-4) = 3x(n) + 5x(n-2)$.

17. (a) State and prove the properties of auto correlation.

(b) Compute the convolution of $h(t)$ and $x(t)$ where $h(t) = e^{-\alpha t}\, u(t)$, $x(t) = e^{\alpha t} u(-t)$ and $\alpha > 0$.

Code No. 2060

FACULTY OF ENGINEERING

B.E. 2/4 (ECE) II-Semester (Main) Examination, April / May 2013

Subject : Signal Analysis and Transform Techniques

Time : 3 Hours **Max. Marks: 75**

Note: Answer all questions of Part - A and answer any five questions from Part-B.

PART – A (25 Marks)

1. If x(t)=δ'(t+3)-3δ(t=3)+4δ(t+2) then sketch G(t) = $\int_{-\infty}^{+\infty} x(t)dt$. (3)
2. If x(t) $x(t)=\cos\left(\frac{\pi}{3}t\right)+\sin\left(\frac{\pi}{4}t\right)$ is x(t) periodic, if periodic, if periodic find the period of x(t). (3)
3. Show clearly the S-plane and Z-plane corresponding. (3)
4. Write the properties of convolution. (3)
5. If x[n] = $-a^n u[-n-1]$ find the Fourier transform of x[n] (3)
6. Write the relation between exponential and trigonometric Fourier series coefficients. (2)
7. What is the Fourier transform of unit step signal? (2)
8. Find the Laplace transform of x(t) = $e^{-at}u(-t)$. (2)
9. Express the ramp sequence in terms of step sequence. (2)
10. Clearly show that the unit step sequence is a power or energy signal. (2)

PART – B (5x10=50 Marks)

11. (a) State and prove the Parseval's power theorem applicable to periodic signals. (5)
    (b) Prove that the half wave symmetric signal contains only odd harmonics in the Fourier series. (5)

12. (a) If x(t) = 1 |t| < a
    = 0 otherwise obtain the Fourier transform of x(t) (5)
    (b) If $X(\omega)=j\frac{d}{d\omega}\left\{\frac{e^{j2\omega}}{1+\frac{j\omega}{3}}\right\}$ is the Fourier transform of a signal x(t), then find the signal x(t). (5)

13. Consider a continuous time linear time invariant system for which the input x(t) and output y(t) are related by $\frac{d^2y(t)}{dt^2}+\frac{dy(t)}{dt}-2y(t)=x(t)$
    (a) Find the system function (4)
    (b) Determine the impulse response for each of the following cases:
    (i) the system is stable (3)
    (ii) the system is causal and stable (3)

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