Final Assessment Test

VIT
Vellore Institute of Technology

Course: ECE1004 - Signals and Systems
Class NBR(s): 1527 / 3085
Time: Three Hours

Slot: B2
Max. Marks: 100

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. Find and Sketch the Even and Odd Components of the following Signals [5]

a) $x(t) = 4e^{-at}.u(t); 0 < a < 1$ [5]

b) $x(n) = 4^n.u(n-3); 0 < a < 1$

2. Determine, if the following Signals are Periodic and If Yes, what is its Fundamental Period? [2.5]

a) $x(t) = e^{j8t}$ [2.5]

b) $x(t) = e^{(-1+j)t}$ [2.5]

c) $x(n) = 4\,Cos(3\pi n)$ [2.5]

d) $x(n) = Cos(2n)$

3. Determine, whether the following Signals represented are Energy or Power Signals or Neither? [2.5]

a) $x(t) = e^{-at}.u(t); a > 0$ [2.5]

b) $x(t) = \frac{1}{2}[Cos(\omega t) + 1]; -\frac{\pi}{\omega} \le t \le \frac{\pi}{\omega}$;

$x(t) = 0; otherwise$ [2.5]

c) $x(n) = A.\delta(n)$ [2.5]

d) $x(n) = Cos(\pi n); -4 \le n \le 4$

4. Determine, whether the following Systems, modelled by their respective and corresponding Input - Output Equations (given) are: (i) Static / Dynamic; (ii). Causal / Anti-Causal; (iii) Linear / Non-Linear; (iv) Time-Invariant / Time- Varying; (v) Stable / Unstable

a) $x(t) = t^2.x(t-1)$ [5]

b) $x(n) = r^n; r > 1$ [5]

5. Find the Fourier Transform of the following signals and draw its corresponding Magnitude and Phase Spectra.

a) $x(t) = e^{-at}.u(t)\,; a > 0$ [5]

b) $x(n) = \delta(6-3n)$ [5]

a) Find the Frequency Response and the Impulse Response of the System described by the differential equation, using Fourier Transform: $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$

b) Obtain the Frequency Response and Impulse Response of the system described by the difference equation: $y(n) + \frac{1}{2}y(n-1) = x(n) + 2x(n-1)$ using Fourier Transform.

7. Find the Convolution of $x_1(t)$& $x_2(t)$ for the following signals:

a) $x_1(t) = u(t)$ & $x_2(t) = u(t)$ [2]

b) $x_1(t) = tu(t)$ & $x_2(t) = u(t)$ [2]

c) $x_1(t) = Sin(t).u(t)$ & $x_2(t) = u(t)$ [3]

d) $x_1(t) = e^{-at}.u(t)$ [3]

& $x_2(t) = e^{-bt}.u(t)$

8. Find both the Cross-Correlations $S_{xy}(t)$ & $S_{yx}(t)$ of the functions $x(t) = e^{-t}.u(t)$ and $y(t) = e^{t}.u(-t)$. [10]

9. a) Find the Auto-Correlation of the signal $x(t) = e^{-at}.u(t)$, with itself. [6]

b) Find the Energy Spectral Density (ESD) of the signal in the region [4]

$x(t) = t;\ -1 < t < 1;$

$x(t) = 0;\ other\ wise$

10. If the input to an LTI system is $x(t) = e^{-3t}u(t)$ and output is $y(t) = [e^{-t} - e^{-2t}]u(t)$. Find the impulse response and the differential equation of the system using Laplace transform. [10]

11. By using the properties, find the z-transform of the following, remembering to include the ROC for each one. Comment, if ROC does not exist.

a) $x(n) = n\alpha^n u(-n)$ [5]

b) $x(n) = 3^{n+1}u(n) - 2\left(\frac{1}{2}\right)^n u(-n-1)$ [5]

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