Hall Ticket Number:

Code No. : 14406

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (ECE: CBCS) IV-Semester Main Examinations, May-2018

Signal Analysis and Transform Techniques

Time: 3 hours Max. Marks: 70

Note: Answer ALL questions in Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

1. Evaluate the integral $\int_{-\infty}^{\infty} e^{-t^2}\,\delta(-2t+4)\,dt$
2. What are the Dirichlet's conditions for the existence of Fourier series of a signal x (t)?
3. Determine the Fourier Transform of a signal $x(t) = \frac{1}{1+|t}$.
4. Draw the Magnitude and Phase spectrums of a Distortion less LTI system.
5. What is Aliasing? Mention one reason to overcome Aliasing?
6. State final value theorem with respect to Laplace transforms.
7. If x(n) is a Periodic signal with period 'N', then prove that its Fourier series Coefficient C_k is periodic with period 'N'.
8. Determine Inverse Z Transform of $X(Z) = Z^3 + 2Z^2 + 3Z^{-1}$
9. If a signal $x(-t)$ is convolved with $\delta(-t-t_0)$, what is the resultant signal?
10. State frequency convolution theorem.

Part-B (5 × 10 = 50 Marks)
(All sub-questions carry equal marks)

11. a) Consider Continuous time signal $x(t) = \delta(t+2) - 2\delta(t-2) + 2\delta(t-3) - \delta(t-4)$ and another signal $y(t) = \int_{\tau=-\infty}^{t} x(\tau)\,d\tau$ then,
    i) Sketch the signal y(t)
    ii) Find the energy of the signal y(t)

    b) Show that over an interval $-\pi < t < \pi$, the best approximation of the signal x(t) = t in terms of the function sin(t) is 2sin(t). Also verify that whether the error signal e(t) = 2-2sin(t) is orthogonal to the signal sin(t) over the interval $-\pi < t < \pi$ or not.

12. a) The impulse response of an LTI system is given by $h(t) = e^{-3t}u(t) + e^{-2t}u(-t)$, Check whether the system is
    i) Static or Dynamic
    ii) Causal or Non causal
    iii) Stable or Unstable.

    b) Find the Fourier transform of the signal $x(t) = e^{-|t|}$ for $-4 \leq t \leq 4$ and it is zero otherwise.

13. a) State and prove the Sampling theorem for Band limited signals.

    b) Using properties of Laplace transforms, find the Laplace transform of the following signal $x(t) = t^2e^{-t}u(t)$.

Contd... 2

14. a) The DTFT of a signal x(n) is given by $\mathbf{X(\Omega)} = \frac{1}{(1-ae^{-j\Omega})^2}$, then determine x(n).

    b) Using Residue method, find the inverse z transform for $\mathbf{X(Z)} = \frac{Z}{(Z-1)^2}$ if ROC is

    i) $|Z| > 1$ ii) $|Z| < 1$

15. a) Define Autocorrelation of Energy signal. Write its properties.

    b) Using Graphical convolution determine the convolution of $\mathbf{x(t) = u(t) - u(t-2)}$ and $\mathbf{h(t) = 2u(t) - 2u(t-1)}$.

16. a) Determine the Exponential Fourier series coefficients of a periodic signal with fundamental time period '2π' is defined over one period as x(t) = 1 for $0 \leq t \leq \pi$ and -1 for $\pi \leq t \leq 2\pi$.

    b) Let $\mathbf{x(t) = rect(t - \frac{1}{2})}$, where rect(t) = 1 for $-\frac{1}{2} \leq t \leq \frac{1}{2}$ and 0 otherwise. Then determine the Fourier Transform of x(t) + x(-t).

17. Answer any *two* of the following:

    a) An LTI system is described by a Differential equation $\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 12y(t) = x(t)$, and the initial conditions are $\frac{dy(0)}{dt} = 2$ and y(0) = 1. Determine the Natural response and Forced response of the system for input x(t) = u(t) using Laplace Transform.

    b) State and prove the differentiation in Z domain property of Z Transform.

    c) Write the properties of Continuous time convolution.