

B.Tech. 5th Semester Exam., 2014

SIGNAL AND SYSTEM

Time : 3 hours

Full Marks : 70

Instructions :

- (i) All questions carry equal marks.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct answer any seven of the following :

- (a) The period of the signal $x(t) = \cos 60\pi t + \sin 50\pi t$ is
- (i) $\frac{1}{5}$ sec
 - (ii) 5 sec
 - (iii) 10π sec
 - (iv) Not periodic

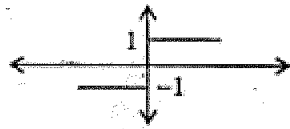
(b) The value of the following integral

$$x(t) = \int_{-\infty}^{\infty} e^{-\alpha t^2} \cdot \delta(t-10) dt$$

is

- (i) $e^{-10\alpha}$
 - (ii) $e^{-\alpha t^2}$
 - (iii) $e^{-100\alpha}$
 - (iv) None of the above
- (c) Which of the following is causal?
- (i) $y(n) = x(n+1)$
 - (ii) $y(n) = x(2n)$
 - (iii) $y(n) = e^{x(n^2)}$
 - (iv) None of the above
- (d) Which of the following is linear?
- (i) $y(n) = nx^2(n)$
 - (ii) $y(n) = x(n^2)$
 - (iii) $y(n) = e^{x(n)}$
 - (iv) $y(n) = Ax(n) + B$

- (e) The Fourier transform of the function shown below



is

- (i) purely real
 (ii) purely imaginary
 (iii) complex
 (iv) Does not exist
- (f) The inverse Laplace transform of
- $$X(s) = \frac{1}{s(s+2)}$$
- is
- (i) $e^{-t}u(t)$
 (ii) $e^{-2t}u(t)$
 (iii) $e^{2t}u(t)$
 (iv) None of the above
- (g) z-transform of convolution of two signals is equal to the — of their z-transform.
- (i) addition
 (ii) subtraction
 (iii) division
 (iv) multiplication

- (h) Which one of the following represents the impulse response of a system is defined by

$$H(z) = z^{-m}?$$

- (i) $u(n-m)$
 (ii) $\delta(n-m)$
 (iii) $\delta(m)$
 (iv) $\delta(m-n)$
- (i) A system with input $x(t)$ and output $y(t)$ is described by the relation $y(t) = tx(t)$. The system is
- (i) linear and time-variant
 (ii) linear and time-invariant
 (iii) non-linear and time-invariant
 (iv) non-linear and time-variant
- (j) The step response of the system whose impulse response $h(t) = tu(t)$ is given by
- (i) $t^2u(t)$
 (ii) $\frac{t^2}{2}u(t)$
 (iii) $\frac{t^3}{3}u(t)$
 (iv) $\frac{3t^2}{2}u(t)$

2. (a) Define z-transform. What is/are its application(s)? Find z-transform and ROC of the following signal :

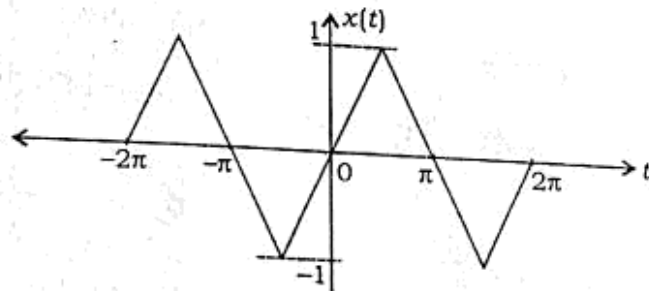
$$x(n) = [3(3)^n - 4(2)^n] u(n)$$

- (b) Determine all possible signals $x(n)$ associated with z-transform

$$X(z) = \frac{5z^{-1}}{(1-2z^{-1})(1-3z^{-1})}$$

3. (a) Explain the conditions under which any periodic waveform can be expressed using Fourier series.

- (b) Find trigonometric Fourier series representation of the triangular wave shown below :



4. (a) Define Fourier transform for a periodic signal. What are the conditions required for existence of Fourier transform?

- (b) Find Fourier transform of—

(i) $x(t) = e^{-at} u(t)$;

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

5. (a) Define Laplace transform. What is region of convergence? What is the necessary condition for existence of the Laplace transform? What is the difference between Laplace transform and Fourier transform?

- (b) Find Laplace transform and ROC of the signal

$$x(t) = e^{-at} u(t) + e^{-bt} u(-t)$$

6. (a) Define convolution sum.

- (b) Find the convolution of $x(t)$ and $h(t)$:

$$x(t) = 1 \quad 0 \leq t < 2$$

$$= 0 \quad \text{otherwise}$$

$$h(t) = 1 \quad 0 \leq t \leq 3$$

$$= 0 \quad \text{otherwise}$$

7. (a) (i) Define Discrete Time Fourier Transform (DTFT). What is the condition for the existence of DTFT? Does Fourier transform of sequence $x(n) = 3^n u(n)$ exist? If not, why?

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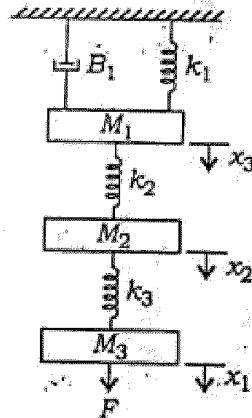
- (ii) Find Fourier transform of the following sequence :

$$x(n) = \delta(n+2) - \delta(n-2)$$

- (b) Find 4-point DFT of the following sequence :

$$x(n) = \sin \frac{n\pi}{2}$$

8. For the given mechanical system, draw the electrical analogous circuit using $f-v$ (force-voltage) and $f-i$ (force-current) analogies :



9. Write short notes on any two of the following :
- Energy signal and power signal
 - Classification of system
 - Analogous system
 - Fast Fourier Transform (FFT)
