

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)  $10\pi$  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?

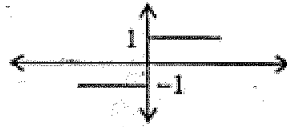
(i)  $y(n) = nx^2(n)$

(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 :

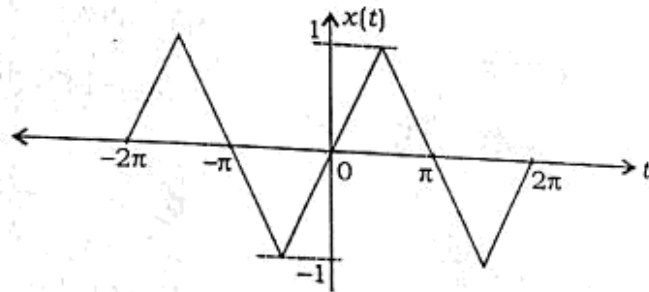
$$x(n) = [3(3)^n - 4(2)^n] u(n)$$

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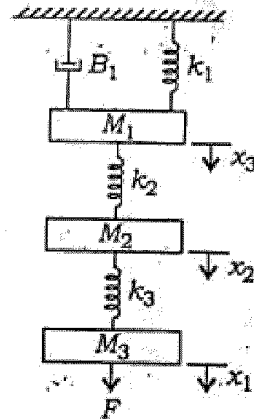
(ii) Find Fourier transform of the following sequence :

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

(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)

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