B.Tech. 5th Semester Exam., 2013

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*) :

(a) What is the fundamental period T of the signal $x(t) = 4\cos 5\pi t$?

(i) $\frac{5}{4}$ sec

(ii) $\frac{4}{5}$ sec

(iii) $\frac{2}{5}$ sec

(iv) 5π sec

(b) Which of the following systems is time-invariant?

(i) $y(t) = x(2t)$

(ii) $y(t) = x(t) + x(t-1)$

(iii) $y(t) = x\left(\frac{t}{2}\right)$

(iv) $y(t) = x(-t)$

(c) The system $y(t) = e^{x(t)}$ is

(i) stable, causal

(ii) noncausal, stable

(iii) unstable, causal

(iv) unstable, noncausal

(d) The system $y(t) = tx(t)$ is

(i) linear and time-invariant

(ii) linear and time-variant

(iii) nonlinear and time-invariant

(iv) nonlinear and time-variant

(e) A good measure of similarity between two signals $x_1(t)$ and $x_2(t)$ is

(i) convolution

(ii) correlation

(iii) power density spectrum

(iv) Laplace transform

(f) If $x(t)$ is odd, then its Fourier series coefficients must be

(i) real and odd

(ii) imaginary and odd

(iii) real and even

(iv) imaginary and even

(g) The Fourier transform of odd signal is

(i) real and even

(ii) imaginary and even

(iii) imaginary and odd

(iv) real and odd

(h) The inverse Laplace transform of the function

$$y(s) = \frac{s+5}{(s+1)(s+3)}$$

is

(i) $2e^{-t} - e^{-3t}$

(ii) $2e^{-t} + e^{-3t}$

(iii) $e^{-t} - 2e^{-3t}$

(iv) $e^{-t} + e^{-3t}$

(i) The number of complex multiplications required to calculate N-point DFT using radix-2 DTT-FFT algorithm is

(i) $N\log_2 N$

(ii) $\frac{N}{2}\log_{10} N$

(iii) $N\log_{10} N$

(iv) $\frac{N}{2}\log_2 N$

(j) The region of convergence of the z-transform of a unit step function is

(i) $|z|>1$

(ii) $|z|<1$

(iii) (Real part of z) > 0

(iv) (Real part of z) < 0

2. (a) Define z-transform. Which type of system is studied using z-transform? Find the z-transform and region of convergence (ROC) for the signal

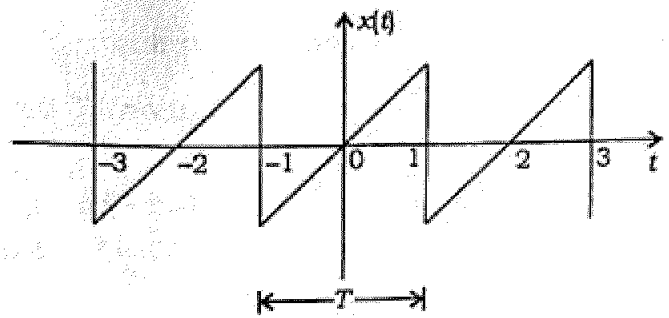
$$x(n) = -b^n u(-n-1)$$

(b) Find the inverse of z-transform of the following :

$$X(z) = \frac{\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}, \text{ ROC} : |z| > \frac{1}{2}$$

3. *(a)* What are Dirichlet conditions?

(b) Find the trigonometric Fourier series for the periodic signal $x(t)$ as shown in the figure below :



4. *(a)* Define Fourier transform for a periodic signal. Explain briefly how Fourier transform is different from Fourier series. Can we find the Fourier transform of $x(t) = e^{2t}u(t)$? If not, why?

(b) Find the Fourier transform of—

(i) sgn (t)

(ii) $u(t)$

5. *(a)* Define Laplace transform. Find out the relation between Fourier transform and Laplace transform. What is the difference between Laplace transform and Fourier transform?

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

$$x(t) = e^{-3t}u(t) + e^{-2t}u(t)$$

6. *(a)* *(i)* Define convolution sum.

(ii) Determine convolution of the following sequence :

$$x(n) = 2\delta(n+1) - \delta(n) + \delta(n-1) + 3\delta(n-2)$$
$$h(n) = 3\delta(n-1) + 4\delta(n-2) + 2\delta(n-3)$$

(b) If $x(n) = x_1(n) * x_2(n)$, where

$$x_1(n) = \left(\frac{1}{3}\right)^n u(n)$$

$$x_2(n) = \left(\frac{1}{5}\right)^n u(n)$$

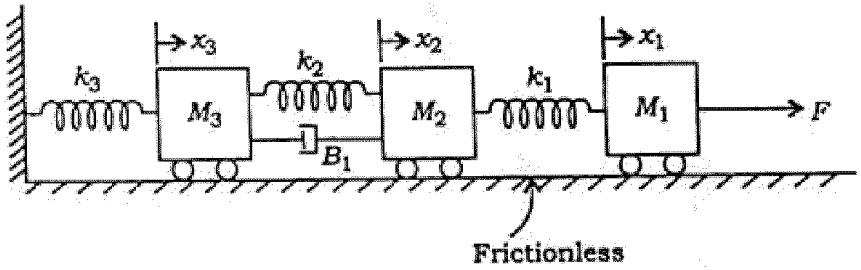
find $X(z)$ using convolution property for z-transform.

7. *(a)* Define discrete Fourier series. What is the condition for the existence of Discrete Time Fourier Transform? Does DTFT of the sequence $x(n) = 2^n u(n)$ exist?

(b) Find the Fourier transform of $x(n) = u(n-k)$.

8. *(a)* What do you mean by analogous system?

(b) Draw force-voltage (*f*-*v*) and force-current (*f*-*i*) analogous circuits of the mechanical system shown in the figure below :



9. Write short notes on any *two* of the following :

(a) Causal and noncausal signals

(b) Bounded input bounded output (BIBO) stability criterion

(c) Cross correlation

(d) Relationship between *s*-plane and *z*-plane

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