(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2047 Roll No.

B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10

BASIC SYSTEM ANALYSIS

Time : 3 Hours] *[Total Marks : 100*

1 Attempt any **four** parts of the following : 5×4

(a) What is difference between continuous and discrete time signals ? Explain with examples.

(b) Define unit step and unit impulse functions.

(c) Determine whether or not each of the following signals is periodic.

(i) $x_1(t) = 2e^{j\left(t+\pi/4\right)}u(t)$

(ii) $x_2[n] = u[n] + u[-n]$

(d) Show that if $x_1[n]$ is an odd signal and $x_2[n]$ is an even signal, then $x_1[n]\ x_2[n]$ is an odd signal.

(e) Develop an analogous mechanical system for a series RLC circuit using Force-Voltage analogy.

2 Attempt any **two** parts of the following : 10×2=20

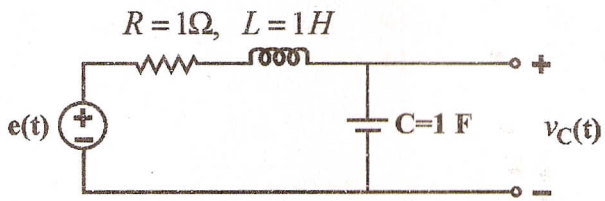
(a) Let $x(t) = \begin{cases} t, & 0 \le t \le 1 \\ 2-t; & 1 \le t \le 2 \end{cases}$ be a periodic signal with fundamental period $T = 2$ and Fourier coefficients a_k.

(i) Determine the value of a_0.

(ii) Determine the Fourier series representation of $\frac{dx(t)}{dt}$.

(iii) Use the result of part (ii) and the differentiation property of the continuous - time Fourier series to help determine the Fourier series coefficients of $x(t)$.

(b) Consider a causal LTI system implemented as the RLC circuit shown in the following figure. In this circuit, $e(t)$ is input voltage and $v_c(t)$ is considered as output.



(i) Find the differential equation relating $e(t)$ and $v_c(t)$.

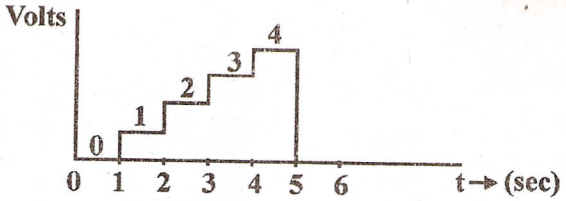
(ii) Determine the $v_c(t)$ if $e(t) = \sin(t)$.

(c) What do you mean by Fourier analysis ? What is Fourier transform ? Explain the development of continuous time fourier-transform.

3 Attempt any **two** parts of the following : **10×2**

(a) What do you understand by Laplace transform ? Distinguish between Laplace transform and continuous time Fourier transform. Discuss importannt properties of Laplace transform.

(b) The figure shows a staircase waveform :



(i) Write an equation for the waveform in terms of unit step functions.

(ii) If this voltage is applied to an RL series circuit with $R = 1\,\Omega$ and $L = 1H$, find the current $i(t)$ and sketch its waveform.

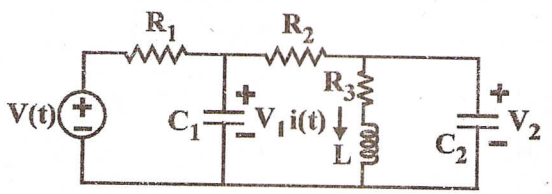
(c) Determine inverse Fourier transform of $F_1(s)F_2(s)$ by using convolution for the following functions :

(i) $F_1 = \frac{1}{(s-a)}, F_2 = \frac{1}{(s-a)}$

(ii) $F_1 = \frac{1}{s+1}, F_2 = \frac{2}{s+2}$

4 Attempt any **two** parts of the following : **10×2**

(a) Develop a state model for the circuit shown in the figure. The output is taken as the voltage across C_2.



(b) The differential equation of a certain electromechanical system is $\ddot{y}+3\dot{y}+2y=u(t)$, initial conditions $y(0^+)=0$, $\dot{y}(0^+)=0$. Use the state variable method to obtain the complete response of the system.

(c) Discuss the state variable analysis approach. Establish the relation between transfer function of a system and state variables.

5 Attempt any **two** parts of the following :

(a) Find the inverse Z-transform of the following :

(i) $$x(z)=\frac{1}{1024}\left[\frac{1024-z^{-10}}{1-\frac{1}{2}z^{-1}}\right], |z|>0$$

(ii) $$x(z)=\frac{1-\frac{1}{3}z^{-1}}{\left(1-z^{-1}\right)\left(1+2z^{-1}\right)}, |z|>2$$

(b) Define Z-transform. Give relationship between Z-transform and discrete-time Fourier transform. Dicsuss the important properties of ROCs for Z-transform.

(c) (i) Determine the system function for causal LTI system with difference equation

$$y[n]=\frac{1}{2}y[n-1]+\frac{1}{4}y[n-2]=x[n]$$

(ii) Using Z-transform, determine $y[n]$ if

$$x[n]=\left(\frac{1}{2}\right)^n u[n].$$