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

PAPER ID : 0208 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2013-14

BASIC SYSTEM ANALYSIS

Time : 3 Hours *Total Marks : 100*

Note :– Attempt **all** questions which carry equal marks. Assume suitable data wherever necessary.

1. Attempt any **four** parts of the following : **(5×4=20)**

(a) Explain the concepts of linearity and time invariance.

(b) What is the significance of an impulse function ? What does the impulse response mean ? Explain.

(c) What are periodic signals ? Find the fundamental period of the discrete-time signal

$$X[n] = e^{j(2\pi/3)n} + e^{j(3\pi/4)n}.$$

(d) What are causal systems ? Check the causality of the following systems :

(i) $Y[n] = x[-n]$

(ii) $Y(t) = x(t) \cos(t + 1)$

where X is the input and Y the output.

(e) Explain the Force-current analogy taking a suitable example.

(f)

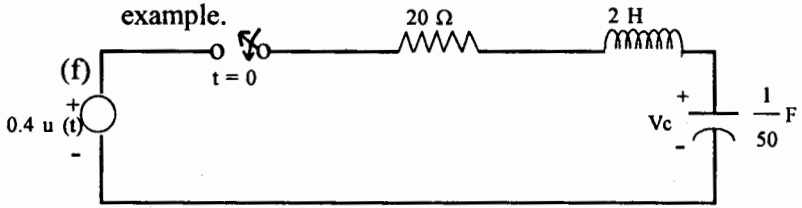

Fig. 1

In the circuit shown in fig. 1, the input is 0.4 u(t). Find $V_c(t)$ with the switch closed at t = 0 assuming zero initial conditions.

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

(a) Find the exponential Fourier series representation for the infinite square wave shown in figure 2.

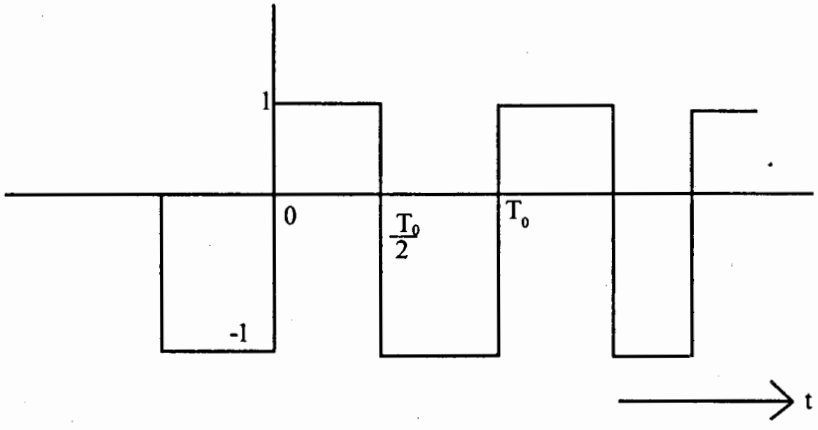

Fig. 2

(b) Find the Fourier transform of the following signals :

(i) Cos $w_c t$ u(t) and

(ii) Sin $w_c t$ u(t).

(c) A voltage $v = 100 \sin 314t + 25 \sin (942\,t + 60°)$ volts is applied to a circuit consisting of a resistance of 10 Ω, inductance of 10 MH and a capacitance of 50 μF connected in series.

Find the :

(i) rms values of the applied voltage and current that will flow

(ii) Power consumed in the circuit.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) Find the Laplace transforms of :

(i) sin wt

(ii) e^{-at} sin wt

(iii) te^{-at}.

(b) State and prove Initial Value and Final Value theorems. Find the final value of the function

$$f(t) = 2 + e^{-3t} \cos 2t.$$

(c) Find the expressions for the currents $i_1(t)$ and $i_2(t)$ in fig. 3 using Laplace transform method.

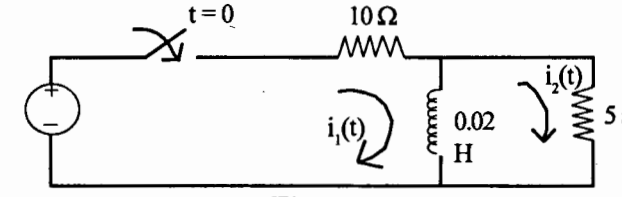

Fig. 3

The switch is closed at t = 0 and the circuit is initially a relaxed one.

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) Derive the expression for the transfer function of a State Model. Find the transfer function of the system given by :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 3 \\ -2 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

(b) What is the State Transition Matrix ? Derive its expression. Enlist its properties with proofs.

(c) Obtain the solution of the following non-homogeneous system.

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix} u(t),\ x(0) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$y(t) = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} x \quad \text{where } x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \text{ and } u = \begin{bmatrix} u(t) \\ e^{-3t}u(t) \end{bmatrix}$$

with u(t) being the unit step function.

5. Attempt any **two** parts of the following : **(10×2=20)**

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

(i) $x_1(n) = \{1, 2, 3, 4, 5, 0, 7\}$

(ii) $x_2(n) = \{1, 2, 3, \underset{\uparrow}{4}, 5, 0, 7\}$

(iii) $\delta(n)$.

(b) Find the Z-transform of the following :

(i) $n\left[\frac{1}{3}\right]^{n+3} u(n+3)$

(ii) $n^2\, u(n)$.

(c) Solve the following difference equation

$y(n) - 3y(n-1) - 4y(n-2) = 0,\ n \geq 0$

given $y(-1) = 5$ and $y(-2) = 0$.