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(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 2012-13

BASIC SYSTEM ANALYSIS

Time : 3 Hours *Total Marks : 100*

Note :– This paper contains **five** questions. Attempt **all** questions.

1. Answer any **four** parts : **(5×4=20)**

(a) Explain the concepts of Stability and time invariance taking suitable examples.

(b) Explain what are power and energy signals. Explain their relationship with periodicity.

(c) A x(t) signal is given by the figure 1. Draw and explain the signal $\phi(t) = x\left(\frac{t}{2} + 6\right)$.

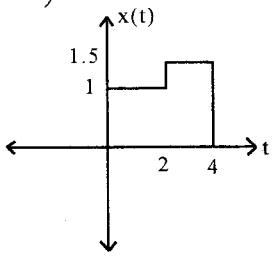

Figure 1

(d) Explain the Force-voltage and Force-current analogies.

(e) Draw the mechanical equivalent of the system shown in figure 2. Obtain the electrical analog system using the Force-

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Current analogy.

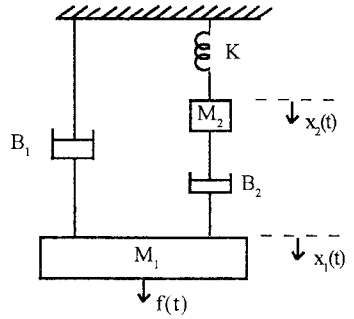

Figure 2

(f) An R-L-C series circuit is as shown in figure 3. The switch is moved from position 1 to 2 at t = 0 after it remained in position 1 for a long time. The initial current at ($t = 0^-$) in the inductor is 2 A and the voltage across the capacitor at that instant is = 4 volts.

Find the expression for the inductor current i(t) for t > 0

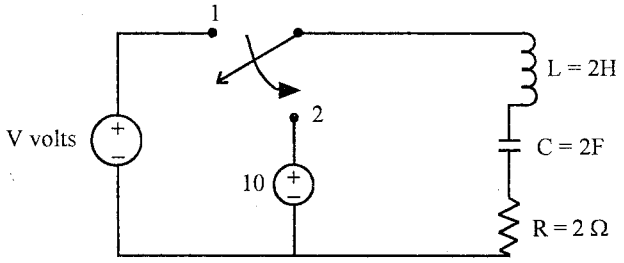

Figure 3

2. Answer any **two** parts : **(10×2=20)**

(a) Explain the three forms of Fourier series. Derive the exponential form of Fourier series. Find the exponential form of Fourier series for a triangular wave of maximum value 1 and time period 2 seconds.

(b) Derive the Fourier transforms of the following functions :

(i) Unit impulse function (ii) rect (t)

(iii) $e^{-2|t|}$ (iv) sin2t.

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(c) State and derive the following four properties of Fourier Transform :

(i) Duality (ii) Time shifting

(iii) Frequency shifting and (iv) Scaling.

3. Answer any **two** parts : **(10×2=20)**

(a) State and prove the Convolution theorem. Find the inverse Laplace transform of the following function using the Convolution theorem.

$$F(s) = \frac{1}{s(s^2 + 2s + 4)}$$

(b) Find the Laplace transform of the following waveforms shown in figure 4a and 4b.

(i)

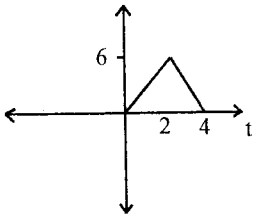

Fig 4 (a)

(ii)

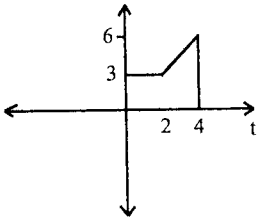

Figure 4(b)

(c) (i) State and prove the initial and final value theorems.

(ii) A pulse of width one second and magnitude one volt is applied across a series R-L circuit with R = 1 ohm and L = one Henry. Find the current i(t) flowing in the circuit as a function of time. Use Laplace transform method.

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4. Answer any **two** parts : **(10×2=20)**

(a) What is the state transition matrix ? What are its properties ? Find the state transition matrix for a system matrix

$$A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}.$$

(b) What are homogeneous and non-homogeneous systems ? Derive the solution of the two systems in terms of the state variables.

(c) Obtain the response of the system :

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

and $\mathbf{Y(t)} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}\mathbf{X}$

to the following input $U(t) = \begin{bmatrix} U_1(t) \\ U_2(t) \end{bmatrix} = \begin{bmatrix} U(t) \\ e^{-3t}U(t) \end{bmatrix}$

where U(t) is a unit step function.

5. Answer any **four** parts : **(5×4=20)**

(a) What is the difference between the Z-transform and the Laplace transform ? Explain.

(b) Define the properties of Z-transform.

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

(i) $Y_1[n] = \{2, 0, 3, \underset{\uparrow}{6}, 8\}$

(ii) u[n].

(d) Find the inverse Z-transform of the following function :

$$X[z] = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

for ROC (i) $|z| > 1$, (ii) $|z| < 0.5$ and (iii) $0.5 < |z| < 1$ draw the various ROCs.

(e) Enlist the properties of the ROC in Z-transform.

(f) Find the Z-transform of $x[n] = na^n u[n]$.