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

PAPER ID : 2047 Roll No.

B.Tech.

THIRD SEMESTER EXAMINATION, 2006-07

BASIC SYSTEM ANALYSIS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt ALL questions.*
(ii) All questions carry equal marks.
(iii) In case of numerical problems assume data wherever not provided.
(iv) Be precise in your answer.

1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Define signal. What are various types of signals ?

(b) Define unit step, unit impulse, and unit ramp signals. Give their mathematical representation and characteristics.

(c) What are the properties of continuous time linear systems ? Consider a continuous time system, the input and output is related by $y(t) = t^2 \times (t-1)$. Determine whether the system is linear or nonlinear.

(d) What are the linear mechanical elements ? Discuss.

(e) Draw the electrical analogous circuit of the system shown in Fig.1. Write equilibrium equations.

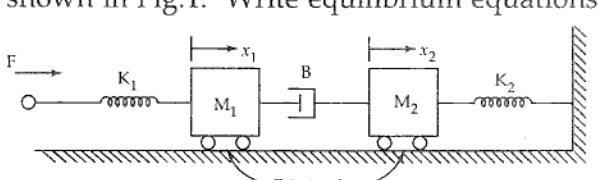

Fig. 1

(f) In Fig. 2 if 'K' is the stiffness of the spring, draw the analogous electrical circuit based on *f-v* analogy and determine $\frac{x_2(t)}{x_1(t)}$.

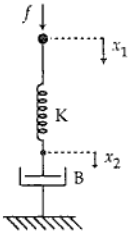

Fig. 2

2. Attempt *any four* parts of the following : **(5x4=20)**

(a) What is Fourier series ? Give its importance. What are the conditions required to be satisfied to expand a function $f(t)$ into Fourier series ?

(b) Differentiate even and odd functions with suitable examples.

(c) Determine the exponential form of Fourier series expansion for the periodic waveform shown in Fig. 3.

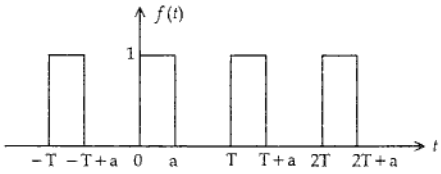

Fig. 3

(d) Determine the response of current in the network shown in Fig. 4(a) when a voltage having the waveform shown in Fig. 4(b) is applied to it by using the Fourier transform method.

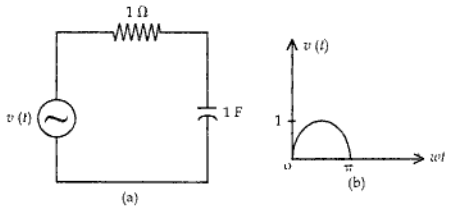

Fig. 4 (a) and (b)

(e) Find the inverse Laplace transform of the function

$$F(s)=\frac{s+5}{s(s^2+2s+5)}$$

(f) Define the terms-state, state space, state variables, and state vector.

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) For the circuit shown in Fig. 5 determine the total current delivered by the source when the switch is closed at $t=0$. Assume no initial charge on the capacitor.

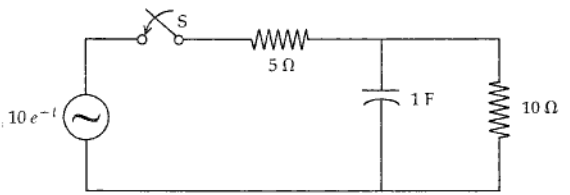

Fig. 5

(b) Find the $v_C(t)$ and $i_L(t)$ in the circuit of Fig. 6 assuming zero initial conditions.

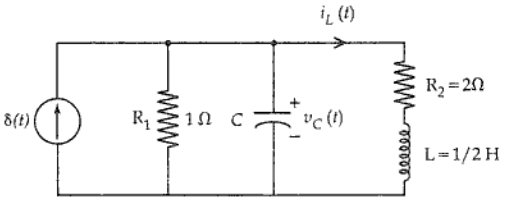

Fig. 6

(c) Determine the Laplace transform of the non-sinusoidal waveform in Fig. 7(a) and (b).

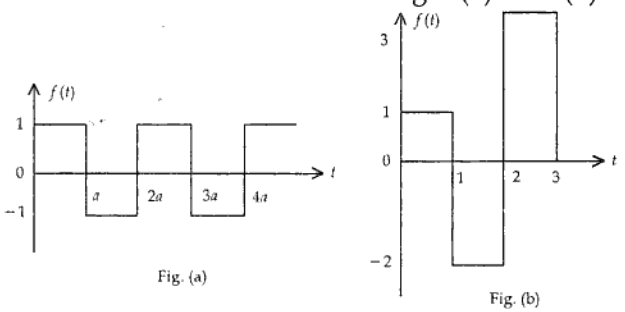

Fig. (a) Fig. (b)

Fig. 7 (a) and (b)

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) Obtain the state variable representation of the systems described by the following differential equations.

(i) $\dddot{y} + 4\ddot{y} + 5\dot{y} + 2y = v$

(ii) $\dfrac{d^3x}{dt^3} + 3\dfrac{d^2x}{dt^2} + 4\dfrac{dx}{dt} + 4x = u_1(t) + 3u_2(t) + 4u_3(t)$

and outputs, $y_1 = 4\dfrac{dx}{dt} + 3u_1$

$$y_2 = \frac{d^2x}{dt^2} + 4u_2 + u_3$$

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(b) Obtain the time response of the following system assuming zero initial conditions.

$$\dot{x} = \begin{bmatrix} 10 & 1 \\ -8 & 5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

and $y = [1\ 0]\ x$

(c) Obtain the state model for the electrical circuit given in Fig. 8.

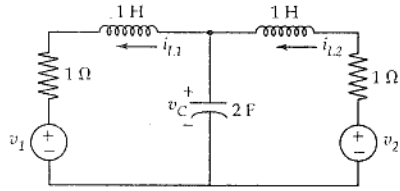

Fig. 8

5. Attempt *any two* parts of the following : **(10x2=20)**

(a) Determine the Z-transform of the following functions :

(i) $$F(s) = \frac{10}{s(s^2+s+2)}$$

(ii) $$F(s) = \frac{2(s+1)}{s(s+5)}$$

(b) Derive Z-transforms of the unit step and unit ramp functions.

(c) Discuss the significance of the difference equation Solve the following difference equation using the Z-transform method.

$C(k+2) - 0.1\ C(k+1) - 0.2\ C(k) = r(k+1) + r(k)$

Where, $r(k) = 1(k)$ for $k = 0, 1, 2, \text{---}$;

$C(0) = 0$, and $C(1) = 0$

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