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

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

B.Tech.

(SEM. III) THEORY EXAMINATION 2011-12

BASIC SYSTEM ANALYSIS

Time : 3 Hours *Total Marks : 100*

Note :— (1) Attempt **all** questions.

(2) All the questions carry equal marks.

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

(a) What do you understand by "Continuous time signals and systems" ? Explain unit ramp. Unit impulse and periodic signals with their mathematical representation and characteristics.

(b) What do you mean by "*f* - *i* analogy" and "*f* - *v* analogy" in analogous systems ? Also mention their significances.

(c) What do you understand by "First Order Systems" and "Second Order Systems" in linear control theory ? Explain with a suitable example.

(d) What do you mean by "Electro-mechanical systems" ? Explain with a suitable example.

(e) Check whether the following properties hold good for the system :

$$y(t) = \sin(6t) \cdot x(t)$$

(i) Linearity

(ii) Causality and

(iii) Stability.

(f) Obtain the transfer function of the mechanical system shown in Fig. 1.

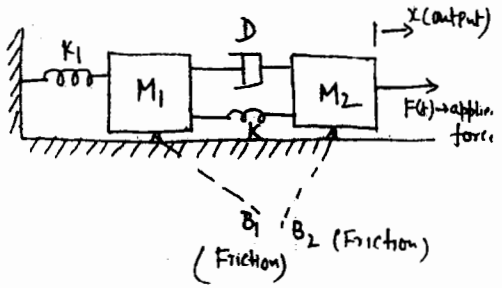


Fig. 1.

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

(a) Explain the "trigonometric form" and "exponential form" of Fourier series with help of a suitable example.

(b) What do you understand by "FOURIER TRANSFORM" AND "FOURIER INTEGRAL" ? Also mention its importances in basic systems analysis.

(c) What do you mean by "EVEN FUNCTIONS" and "ODD FUNCTIONS" ? Explain with a suitable example. Also explain the properties of Half wave symmetry.

(d) Determine the response of the network shown in Fig. 2(a) when a voltage having the waveform shown in Fig. 2(b) is applied to it, by using the Fourier transform method.

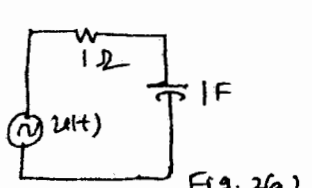


Fig. 2(a)

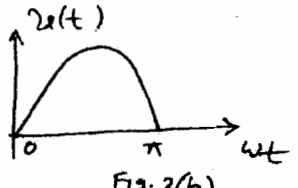


Fig. 2(b)

(e) Find the Fourier Transform of the following signals :–

(i) The unit impulse function $\delta(t)$

(ii) The exponential function $e^{-a|t|}$

(iii) The signum function $\delta gn(t)$.

(f) Show that the exponential Fourier series for the symmetric square wave shown in Fig. 3 can be written as :

$$f(t) = \frac{2}{\pi} \sum_{n=-\infty}^{\infty} \frac{(-1)^n}{2n+1} e^{j(2n+1)\pi/2}$$

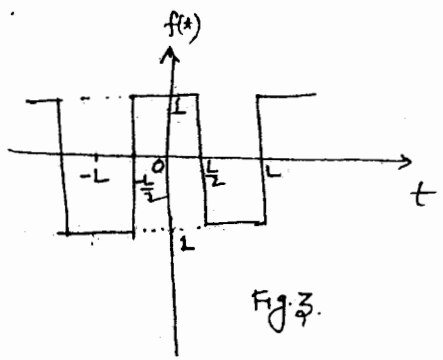


Fig. 3.

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

(a) What do you mean by "INITIAL VALUE" and "FINAL VALUE THEOREM" in Laplace Transform ?

Consider the transfer function of a network given as :

$$Z(s) = \frac{s^3 + s^2 + 5s + 25}{s^4 + 5s^3 + 4s^2 + 9s + 5}.$$

Find the initial and final value of above transfer function.

(b) In the circuit in Fig. 4, switch K is closed and steady-state conditions reached. Now, at time t = 0, switch k is opened. obtain the expression for the current through the inductor.

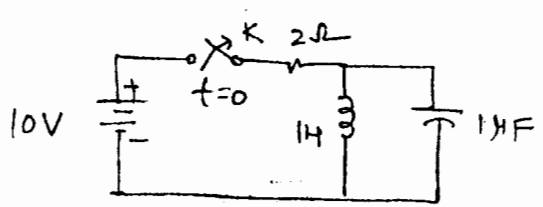


Fig.4.

(c) What do you mean by "LAPLACE TRANSFORM" and "INVERSE LAPLACE TRANSFORM" ? What are the advantages and disadvantages of Laplace transform ? Also mention its importance in circuit theory.

The impulse response of a network is given as $(e^{-t} - e^{-2t})$. Find the transfer function. Determine the input excitation required to produce an output response as te^{-2t}.

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

(a) Explain the following :

(i) State

(ii) State variables

(iii) State vectors

(iv) State Transition Matrix, $\phi(t)$.

Also mention the advantages and disadvantages of state-space techniques.

(b) The natural response of a certain system is described by the homogeneous state equations :

$$\frac{dy_1}{dt} + 7y_1 - y_2 = 0$$

$$\frac{dy_2}{dt} + 12y_1 = 0.$$

Show that the state transition matrix can be written as :

$$\phi(t) = \begin{bmatrix} 4e^{-4t} - 3e^{-3t} & e^{-3t} - e^{-4t} \\ 12e^{-4t} - 12e^{-3t} & 4e^{-3t} - 3e^{-4t} \end{bmatrix}.$$

(c) Find the time response of the following system :

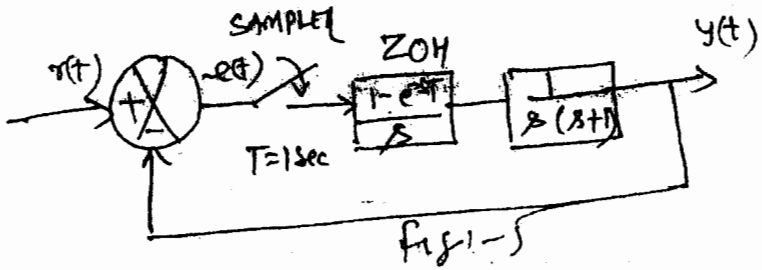
$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$$

where u(t) is the unit step function and initial conditions are all zero.

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

(a) What do you mean by "PULSE TRANSFER FUNCTION" ? Also mention its significances.

Consider the block diagram representation of sampled data control system shown in Fig. 5.



Find the pulse transfer function of above system.

(b) A discrete-time system is described by the difference equation :

$$y(k+2) + 5y(k+1) + 6y(k) = v(k)$$

$$y(0) = y(1) = 0;\ T = 1\text{sec}.$$

(i) Determine a state model in canonical form.

(ii) For input $v(k) = 1$, for $k \geq 0$, find the output $y(k)$.

(c) $$T(s) = \frac{s^2 + 3s + 3}{s^3 + 2s^2 + 3s + 1}.$$

For the above transfer function, find its z-transform and then the initial and final values.