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

(a) A second order system is shown in figure 3. Determine its :

(i) Critical resistance R_{cr} and Damping ratio

(ii) Undamped natural frequency w_n

(iii) Impulse Response h(t)

(iv) Transfer function.

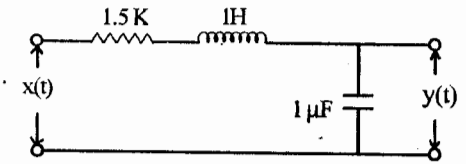

Figure 3

(b) In the circuit of Figure 4 the switch k is suddenly closed at t = 0. The capacitor was initially uncharged and there was no current flowing through the inductance at t = 0. Determine the current $i_1(t)$ for t > 0.

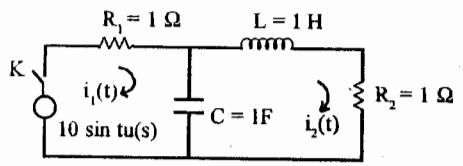

Figure 4

(c) Using block diagram reduction techniques, simplify the block diagram of a system given in figure 5 and find the overall transfer function :

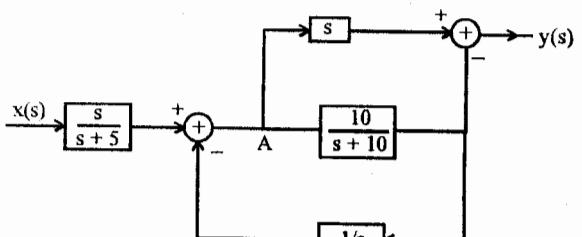

Figure 5

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

PAPER ID : 0324 **Roll No.**

B.Tech.

(SEM. IV) THEORY EXAMINATION 2011-12

SIGNALS AND SYSTEMS

Time : 3 Hours *Total Marks : 100*

Note :—Attempt **all** questions. All questions carry equal marks.

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

(a) Determine whether the following signal is periodic. If periodic determine the fundamental period :

$$x(t) = 2\sin\left(\frac{2}{3}\right)t + 3\cos\left(\frac{2\pi}{5}\right)t$$

(b) For the signal x(t) shown in Figure 1, draw the signals :

(i) x (t + 2)

(ii) x (t – 2)

(iii) x (2t + 3)

(iv) $x\left(\frac{3}{2}t\right)$

(v) x (– t + 1)

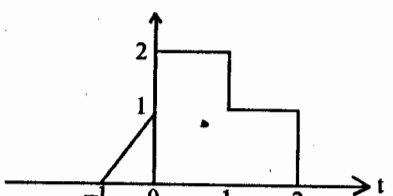

Figure 1

(c) Determine and sketch the even and odd components of the continuous time signal $x(t) = 10\, e^{-2t}\, u(t)$.

(d) Determine whether the discrete time signal $x(n) = u(n) - u(n-4)$ is an energy signal or a power signal.

(e) Define deterministic, random, odd, even and periodic signals with the help of examples.

(f) Write down the expression for and plot the sinusoidal discrete-time sequence whose peak amplitude is 10 and frequency is 100 Hz. The sampling frequency is 1000 samples per second.

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

(a) Find the Laplace Transform of the signal
$x(t) = e^{-3t}\,u(t) + e^{-2t}\,u(t)$ and find ROC.

(b) Find the inverse Laplace Transform of

$$x(s) = \frac{3s^2 + 8s + 6}{(s+2)(s^2+2s+1)}.$$

(c) Using Laplace Transform method, solve the following differential equation for the given initial conditions :

$$\frac{d^2x(t)}{dt^2} + 5\frac{dx(t)}{dt} + 6x(t) = 8(t) + 6u(t) \quad \text{with} \quad x(\bar{0}) = 1,$$

and $x'(\bar{0}) = 2$.

(d) Find the unilateral z-Transform of $x(n) = [a^n \cos \omega_0 n]\,u(n)$.

(e) Using long division method, determine the inverse z-Transform of $x(z) = \dfrac{1+2z^{-1}}{1-2z^{-1}+z^{-2}}$

If x(n) is causal.

(f) Solve the differential equation using z-Transform method $x(n-2) - 9x(n-1) + 18\,x(n) = 0$. Initial conditions are $x(-1) = 1$, $x(-2) = 9$.

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

(a) (i) Find and plot the magnitude and phase spectra of the signal $x(t) = A\,e^{-\sqrt{T}}\,u(t)$.

(ii) Find the Fourier transform of signal $x(t) = \cos(\omega_0 t)$.

(b) If the signal $x(t) = A\,e^{-\sqrt{T}}\,u(t)$ considered is given as input to an ideal low pass filter whose cut-off frequency is $fe = \dfrac{1}{2\pi T}$. What percentage of the energy of x(t) will be available at the output of the filter ?

(c) If $x(n) = a^{|n|}$; $0 < a < 1$, find the DTFT of x(n) and plot its magnitude spectrum.

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

(a) (i) A discrete-time system is described by the following input-output relation $y(n) = n^{x(n)}$.

Is this system (A) static or dynamic ? (B) linear or non-linear ? (C) time-varying or time-invariant ? Give justification for your answer.

(ii) Check whether the following systems are causal or not :

(A) $y(t) = x^2(t) + x(t-2)$

(B) $y(t) = x(t-2) + x(2-t)$

(b) If x(t) and y(t) are shown in Figure 2(a) and (b) determine graphically, the signal $z(t) = x(t) + y(t)$

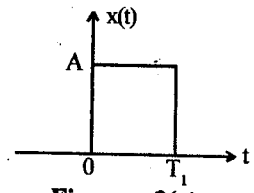

Figure : 2(a)

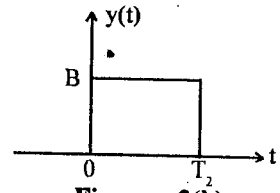

Figure : 2(b)

(c) Find the auto-correlation function and the energy spectral density of the signal $x(t) = e^{-t}\,u(t)$.