Exam.Code:0927
Sub. Code: 6898

1079

B.E. (Electronics and Communication Engineering)
Third Semester
EC-302: Signal and Systems

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.*

x-x-x

1. (a) Describe representation of Mechanical and Hydraulic systems as differential equations.
(b) For the following impulse response, determine, whether the system is causal, and stable: $h(t) = \{e^{-2t}u(t-1)\}$
(c) Determine the Laplace transform of the signal:
$$x(t) = (1 + 0.5\sin(t))\sin(1000t)\,u(t)$$
(d) Find the final value of the signal corresponding to the following Z-transform
$$X(z) = \frac{1 + z^{-1}}{1 - 0.25z^{-2}}$$
(e) Specify the Nyquist rate and Nyquist interval for the signal:
$$x(t) = sinc(250t) + sinc^2(200t)$$
(5 × 2 = 10)

Section-A

2. (a) Find whether the following systems are Memoryless, Time-Invariant, Linear, Causal, and Stable. Justify your answer. (5)
   i. $y(t) = x(t-2) + x(2-t)$
   ii. $y[n] = \cos(2\pi x[n+1]) + x[n]$

(b) The unit impulse response of an LTI system is $h(t) = e^{-t}u(t)$. Find the system's zero state response y(t) if the input signal is $x(t) = e^{-2t}u(t-3)$. (5)

(5)

3. (a) Consider the electric circuit shown in Fig 1:
   i. Determine the differential equation that relates the input current x(t) to output current y(t).
   ii. Determine the zero-input response given initial conductor currents of 1A each. That is, find $y_0(t)$, given $i_{L1}(0) = i_{L2}(0) = 1A$.

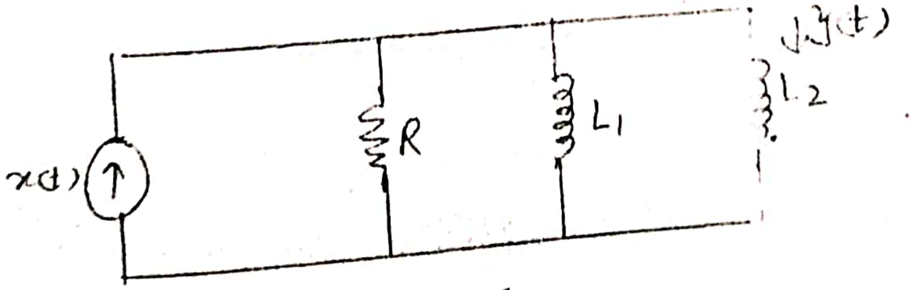

Fig 1.

P.T.O.

(b) Find the Fourier transform of the signal: (5)

$$x(t) = t.e^{-a|t|}u(t)$$

4. (a) Determine the periodic signal x(n) with period N=8, whose DTFS coefficients are as follows: (5)

$$X_k = \cos\frac{k\pi}{4} + \sin\frac{3k\pi}{4}$$

(b) Determine the unit impulse response h[n] of the system: (5)

$$y[n] - 6y[n-1] + 25y[n-2] = 2x[n] - 4x[n-1]$$

Section-B

5. (a) Find the DTFT of the sequence (5)

$$x(n) = \frac{1}{4}Sinc(\frac{1}{4}(n-2))$$

(b) Solve, by using Laplace Transform, the following set of simultaneous differential equations: (5)

$$2\frac{dx(t)}{dt} + 4x(t) + \frac{dy(t)}{dt} + 7y(t) = 5u(t)$$

$$\frac{dx(t)}{dt} + x(t) + \frac{dy(t)}{dt} + 3y(t) = 5\delta(t)$$

The initial conditions are $x(0^-) = y(0^-) = 0$.

6. (a) Determine the signal x(n) whose z-transform is given by (5)

$$X(z) = \log(1 + az^{-1}), \qquad |z| > |a|$$

(b) Determine the Z-transform of the signal and sketch the ROC: (5)

$$x[n] = n\left(\frac{1}{2}\right)^{|n|}$$

7. (a) Describe the reconstruction of signals using Interpolation. What is Aliasing and how can it be avoided in the sampled signals? (5)

(b) Determine the state-space representation of the system (5)

$$H(s) = \frac{3s+7}{(s+1)(s+2)(s+5)}$$

x-x-x