Roll No.:.....

National Institute of Technology Delhi

Name of the Examination: B.Tech.

Branch: ECE, EEE, and CSE
Course Title: Signals and Systems
Time: 3 Hours

Semester: 3^{rd}
Course Code: ECB 204
Maximum Marks: 50

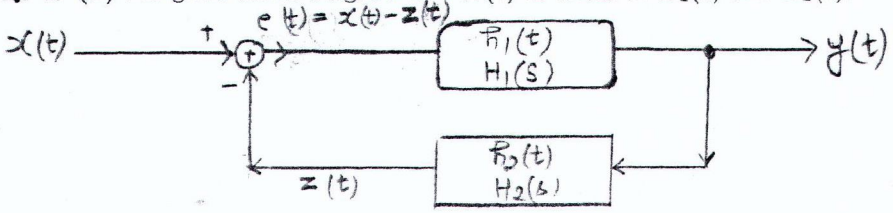
Section A

Note: All questions in this section are compulsory. Each carry 02 mark.

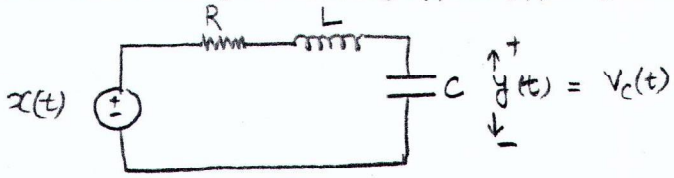
Q. 1. (a) Evaluate the following integral:

$$\int_{-5}^{5} sin(2\pi t)t^2\delta(t-0.25)dt$$

Q. 1. (b) For given block diagram find $H(s)$ in terms of $H_1(s)$ and $H_2(s)$.



Q. 1. (c) Determine the differential equation relating $x(t)$ and $y(t)$ for given RLC circuit.



Q. 1. (d) Impulse response of a discrete time system is given by

$$h[n] = (\frac{1}{2})^2 u[n] - 2^n u[-n-1]$$

Check whether the given system is causal and stable or not.

Q. 1. (e) Prove that Laplace transform of a finite duration signal $x(t)$ will have ROC entire s–plane.

Section B

Note: Solve any five questions in this section. Each carry 04 marks.

Q. 2. Let $x(t)$ be a signal with Nyquist rate ω_s. Determine the Nyquist rate for the following signal $y(t)$.

$$y(t) = x(5t - 2) + x(2t - 5)$$

Q. 3. For a given second order differential equation for causal and stable LTI system, determine whether the corresponding impulse response of the system is undapmed, underdapmed, overdamped, or critically damped:

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

Q. 4. Verify the Parseval Theorem for the following periodic signal (N=4).

Q. 5. An absolutly integrable signal $x(t)$ is known to have a pole at s=2. Answer the following question:

(a) Could $x(t)$ be of finite duration ?

(b) Could $x(t)$ be of left sided ?

(c) Could $x(t)$ be of right sided ?

(d) Could $x(t)$ be of two sided ?

Q. 6. Let $x(t)$ be a signal with Fourier Transform given by

$$\begin{aligned} X(j\omega) &= 1 \quad for \quad |\omega| < 1 \\ &= 0 \quad for \quad |\omega| > 1 \end{aligned}$$

Consider the signal

$$y(t) = \frac{d^2x(t)}{dt^2}$$

Find the value of

$$A = \sum_{-\infty}^{\infty} |y(t)|^2 dt$$

Q. 7. Find the Continuous Time Fourier Transform (CTFT) signal x(t)=u(t).

Section C

Note: Solve any two questions in this section. Each carry 10 marks.

Q. 8. Consider a real, odd and periodic signal $x(t)$ whose Fourier series representation is given by:

$$x(t) = \sum_{k=0}^{5} (\frac{1}{2})^k sin(k\pi t)$$

Let $x'(t)$ represent signal obtained by performing impulse-train sampling using a sampling period of T=0.2.

a) Dose overlapping occur when this impulse train sampling is performed on $x(t)$.

b) If $x'(t)$ is passed through a ideal low pass filter with cutoff frequency $\frac{\pi}{T}$ and passband gain T, Determine the Fourier series represtation of output signal g(t).

Q. 9. Consider the LTI system for which $x(t) = 0$ for $t > 0$ with Laplace transform

$$X(s) = \frac{s+2}{s-2}$$

and

outpt y(t) is given by:

$$y(t) = -\frac{2}{3}e^{(2t)}u(-t) + \frac{1}{3}e^{(-t)}u(t)$$

.

(a) Determine H(s) and its region of convergence.

(b) Determine h(t).

Q. 10. Let

$$x[n] = a^{|n|} \quad for \quad a > 0$$

Find the z-transform X(z) along with its ROC for given two cases.

a) $a < 1$

b) $a > 1$

End of Question Paper