RATHI CLASSES

आजीवनम् ज्ञानवर्धनम्

New mantra for Success

Concept Polariser Test-1

Signals & Systems

(Electronics & Electrical Engineering)

Duration ~ 1:00 Hour **Maximum Marks ~ 50**

Read the following instructions carefully

1. This question paper contains 30 objective types questions carrying 50 marks. Q.1 to Q.10 (10 Questions) carry **ONE MARK** and Q.11 to Q30 (20 Questions) and will carry **TWO MARKS** each.
2. Attempt all the questions.
3. Questions must be answered on **Objective Response Sheet (ORS)** by marking (A, B, C, D) using **Blue or Black ball pen** against the question number on the left hand side of **(ORS).** Each question has only one correct answer.
4. For **1 mark** multiple-choice questions, **1/3 marks** will be deducted for a wrong answer. Likewise, for **2 marks** multiple-choice questions, **2/3 marks** will be deducted for a wrong answer.

   There is NO negative marking for numerical answer type questions.
5. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **ORS**.
6. Calculator is allowed in the examinatinon hall.
7. Charts, graph sheets or tables are NOT allowed in the examination hall.
8. Rough work can be done on the question paper itself. Additionally blank pages are given at the end of the question paper for rough work.
9. This question paper contains 12 printed pages and 2 pages for Rough Work. Please check all pages and report, if there is any discrepancy.

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Q.1 The discrete LTI system is represented by impulse response $h[n] = a^n u[n], 0 < a < 1$. Then, the system is

(a) causal and stable (b) noncausal and stable

(c) causal and unstable (d) noncausal, unstable

Q.2 Eigen value of LTI continuous system if the response of the system is y(t), is equal to

(a) y(0) (b) depends on input

(c) equal to system type (d) (a) and (c)

Q.3 Which of the followings system is/are linear system

1. y_1 = u(t), u(t) is unit step signal
2. y_2 = r(t), is ramp signal
3. y_3 = sint

(a) Only one is correct (b) Only two is correct

(c) (a) and (b) both (d) All are correct

Q.4 Determine the fundamental period of $x[n] = \cos^2 \frac{\pi}{8} n$ _____.

Q.5 Which of the following cannot be the Fourier series expansion of a periodic signals?

(a) x(t) = 2cost + 3 cos3t (b) $x(t) = 2\cos \pi t + 7\cos t$

(c) x(t) = cost + 0.5 (d) $x(t) = 2\cos 1.5\pi t + \sin 3.5\pi t$

Common data for question number 6 and 7:

Given h[n] = [1$\underset{\uparrow}{2}$ 12] f_1 (n) is convolution of h[n] with itself, f_2(n) is Auto-correlation of h[n]

Q.6 Causals functions is/are:

(a) f_1(n) only (b) f_2(n) only

(c) f_1(n) and f_2(n) (d) None

Q.7 Maximum value of non-zero element f_2(n) is:

(a) 10 (b) 9

(c) 8 (d) 2

Q.8 The impulse response of an LTI system is given as

$$h(t)=\begin{cases} k & t=0,\ k>0,\ k \text{ is real} \\ \dfrac{C.\sin^2 \omega t}{\pi t} & t\neq 0,\ C \text{ is real number and } C\neq 0 \end{cases}$$

It represents an

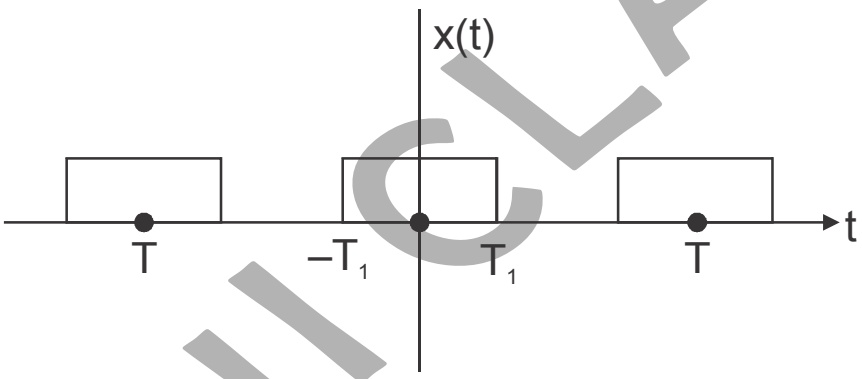
(a) non-causal, low-pass filter

(b) causal, low-pass filter

(c) non-causal, high-pass filter

(d) causal, high-pass filter

Q.9 Consider a periodic pulse train signal x(t) shown below



The magnitude spectrum of Fourier Series coefficient is

(a) Continuous in time Gaussian curve

(b) Discrete in time Gaussian curve

(c) Continuous in time and Practical Low Pass Filter

(d) None of the above

Q.10 The impulse response of a system is h(t) = tu(t). For an input u(t –1), the output is

(a) $\dfrac{t^2}{2}u(t)$ (b) $\dfrac{t(t-1)}{2}u(t-1)$

(c) $\dfrac{(t-1)^2}{2}u(t-1)$ (d) $\dfrac{t^2-1}{2}u(t-1)$

Q.11 If a discrete time signal x(n) became $x\left(\frac{n}{10}+10\right)$ after passing through a digital signal processor, then number of default interpolation terms are needed in it _____.

Q.12 Two signals to be orthogonal in the interval $\left(-\frac{T}{2}, \frac{T}{2}\right)$ if

1. both are independent in nature
2. both are exchaustive in nature
3. both are exclusive is nature

(a) Only one is correct (b) Only two is correct

(c) (a) and (b) both (d) All are correct

Q.13 A periodic signal x(t) of period T_0 is given by

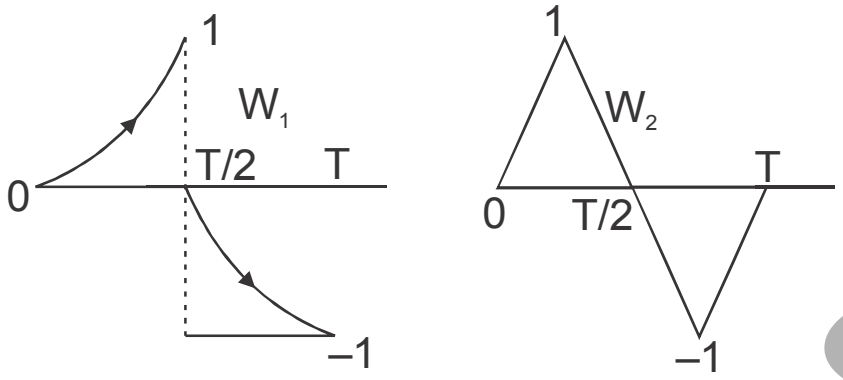
$$x(t)=\begin{cases}\frac{1}{2} & |t|<T_1\\ 0, & T_1<|t|<\frac{T_0}{2}\end{cases}$$

the dc component of x(t) is

(a) $\frac{T_1}{T_0}$ (b) $\frac{T_1}{(2T_0)}$

(c) $\frac{2T_1}{T_0}$ (d) $\frac{T_0}{T_1}$

Q.14 One period (0, T) each of two periodic waveforms W_1 and W_2 are shown in the figure. The magnitudes of the nth fourier series coefficients of W_1 and W_2, $n \geq 1$, n odd, are respectively proportional to

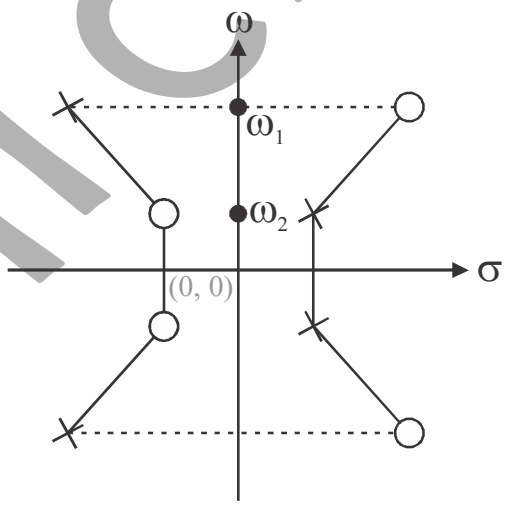


(a) $|n|^{-3}$ and $|n|^{-2}$ (b) $|n|^{-2}$ and $|n|^{-3}$

(c) $|n|^{-1}$ and $|n|^{-2}$ (d) $|n|^{-4}$ and $|n|^{-2}$

Q.15 Let y[n] denote the convolution of h[n] and g[n], where h[n] = $(1/2)^n$ u[n] and g[n] is a causal sequence. If y[0] = 1 and y[1] = 1/2, then g[1] equals _____.

Q.16 A continuous time LTI system with system function $H(\omega)$ has the following pole-zero plot, for this system, which of the following alternatives is TRUE?



(a) $|H(\omega_1)| > |H(\omega_2)|$

(b) $|H(\omega)|$ has multiple maxima, at ω_1 and ω_2

(c) $|H(\omega_1)| < |H(\omega_2)|$

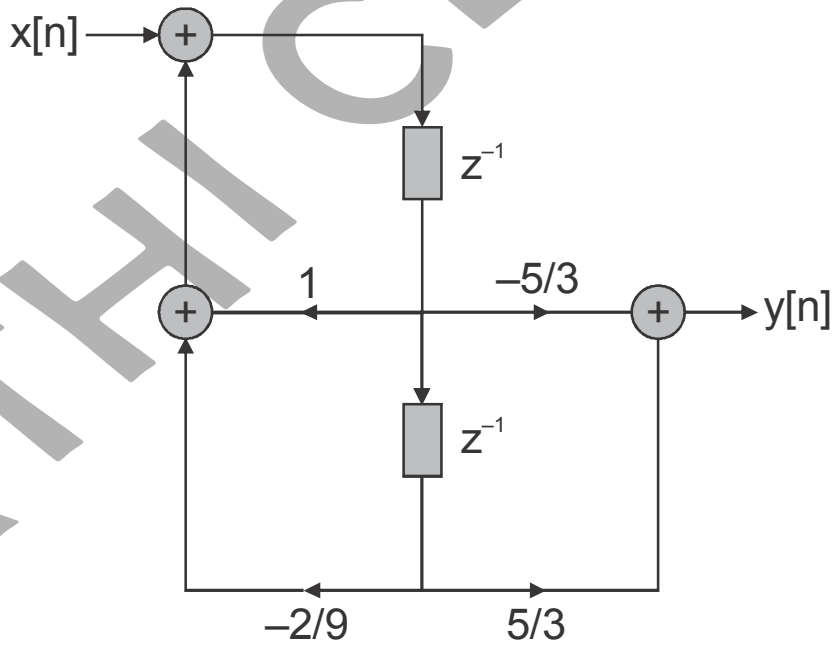
(d) $|H(\omega_1)| = |H(\omega_2)|$ = constant, $\forall\ \omega$

Q.17 Find the value of $\int_{\pi/2}^{\pi} f(t)dt$ where f(t) = x(t). $\sin\left(3t-\frac{\pi}{2}\right)$,

x(t) = h(t) * g(t), $h(t)=\delta(t-\pi)$ and $g(t)=\delta(t+\pi)$._____.

Q.18 For a function g(t), it is given that $\int_{-\infty}^{+\infty} g(t)e^{-j\omega t}dt = \omega e^{-2\omega^2}$ for any real value ω. If y(t) = $\int_{-\infty}^{t} g(\tau)d\tau$, then $\int_{-\infty}^{+\infty} y(t)dt$ is _____.

Q.19 A realization of a stable discrete time system is shown in figure. If the system is excited by a unit step sequence input x[n], the response y[n] is



(a) $4\left(-\frac{1}{3}\right)^n u[n]-5\left(-\frac{2}{3}\right)^n u[n]$

(b) $5\left(-\frac{2}{3}\right)^n u[n]-3\left(-\frac{1}{3}\right)^n u[n]$

(c) $5\left(\frac{1}{3}\right)^n u[n]-5\left(\frac{2}{3}\right)^n u[n]$

(d) $5\left(\frac{2}{3}\right)^n u[n]-5\left(\frac{1}{3}\right)^n u[n]$

Q.20 A continuous-time system is described by $y(t)=e^{-|\tan x(t)|}$, where y(t) is the output and x(t) is the input, y(t) is bounded

(a) only when x(t) is bounded

(b) only when x(t) is non-negative

(c) only for $t \le 0$ if x(t) is bounded for $t \ge 0$

(d) for all x(t)

Q.21 Consider a discrete-time system for which the input x[n] and the output y[n] are related as $y[n]=x[n]-\frac{1}{3}y[n-1]$. If y[n] = 0 for n < 0 and $x[n]=\delta[n]$. then y[n] can be expressed in terms of the unit step u[n] as

(a) $\left(-\frac{1}{3}\right)^n u[n]$ (b) $\left(\frac{1}{3}\right)^n u[n]$

(c) $(3)^n u[n]$ (d) $(-3)^n n[n]$

Q.22 Find the HCF of number 'm' and 'n' where given that $\int_0^{\frac{2\pi}{\ell}} e^{jmt}.\left(e^{jnt}\right)^* dt=0$, where $\left(e^{jnt}\right)^*$ is complex conjugate of $\left(e^{jnt}\right)$

_____.

Q.23 $x(n) \rightarrow \boxed{s_1} \xrightarrow{w(n)} \boxed{s_2} \rightarrow y(n)$

$s_1,\ w(n) = 2w(n-1) + x(n)$

$s_2,\ y(n) = k_1 y(n-1) + k_2 w(n)$

the y(n) and x(n) are related as

$y(n) = 6y(n-2) - 5y(n-1) + 2x(n)$

then find the values of k_1 and k_2 _____/_____.

Q.24 An input/output relation of a system is described as follows:

$$\frac{d^2y(t)}{dt^2} + \frac{dy(t)}{dt} + y(t) + 15 = 13\frac{dx^2(t)}{dt} + 7x(t)$$

(a) Linear, Time Variant

(b) Linear, Time Invariant

(c) Non-Linear, Time Variant

(d) Non-Linear, Time Invariant

Q.25 A periodic signal x(t) is having Fourier Series x(n) and another signal y(t) having Fourier Series y(n)

$y(t) = x(t + 2t_0) - x(t - 2t_0)$. It is also given that y(n) = 0, for all even values of n then value of t_0 is

(a) $\frac{T}{8}$ (b) $\frac{T}{4}$

(c) $\frac{T}{6}$ (d) $\frac{T}{3}$

Q.26 If a real valued continous time signal x(t) has a fundamental period T = 8 and the non zero Fourier Series coefficients of x(t) are $x(1) = x(-1) = 4$, $x(3) = x^*(-3) = 4j$ then the signal x(t) is

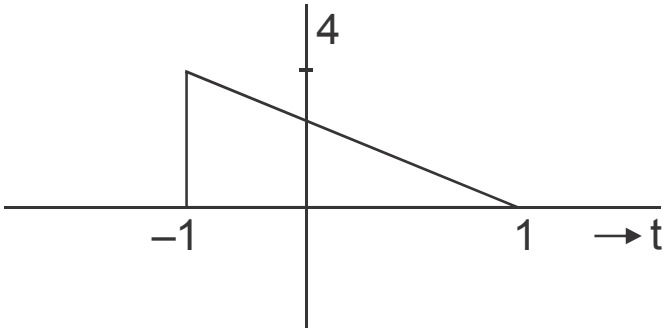
(a) $8\cos\left(\frac{\pi t}{4}\right) + 4j\sin\left(\frac{3\pi}{4}t\right)$

(b) $8\cos\left(\frac{\pi t}{4}\right) + 8\cos\left(\frac{3\pi}{4}t + \frac{\pi}{2}\right)$

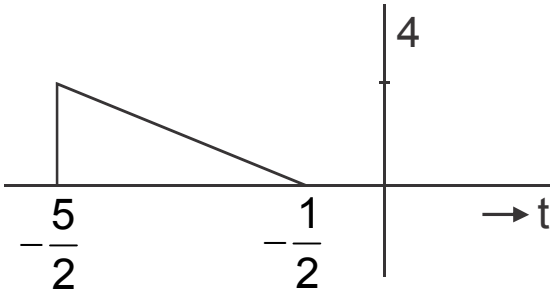
(c) $4\cos\left(\frac{\pi t}{4}\right) - 4j\cos\left(\frac{3\pi}{4}t\right)$

(d) None of these

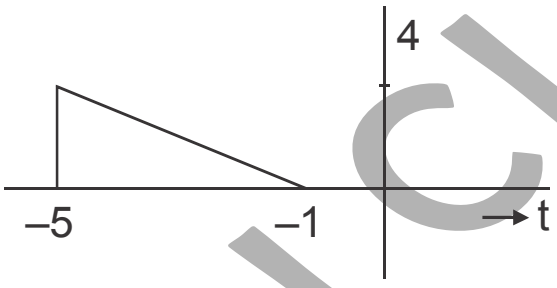
Q.27 The signal y(t) = x(–2t + 3) is shown below then the signal x(t) will be



(a)



(b)



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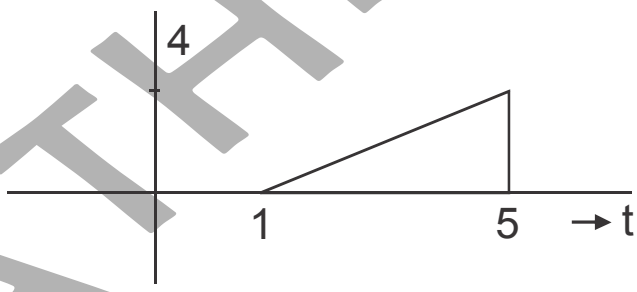
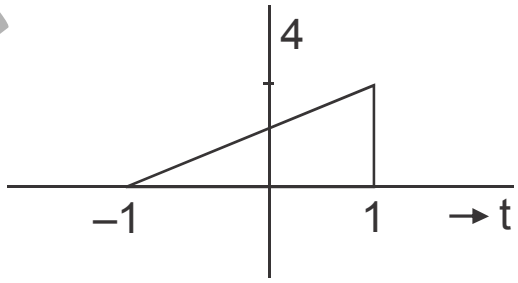


(d)



Q.28 If $x(t)=\delta(t+2)-\delta(t-2)$ calculate the energy of the signal $y(t)=\int_{-\infty}^{t} x(\tau)d\tau$ _____.

Q.29 Which of the following is/are Fourier Series coefficient of Real and Odd Signal in time domain

(a) $a_k=\frac{6j\cos\pi k}{\pi\left(9-4k^2\right)}$ (b) $a_k=\frac{6jk\cos\pi k}{\pi\left(9-4k^2\right)}$

(c) $a_k=\frac{6\cos\pi k}{\pi\left(9-4k^2\right)}$ (d) All of the above

Q.30 A signal x(t) has a period 1 unit and the Fourier Series coefficients are

$a_k=\left(-\frac{1}{3}\right)^k, k\geq 0$

$=0 \qquad k<0$

What is the power of signal x(t) _____.

(END OF THE QUESTION PAPER)

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(SPACE FOR ROUGH WORK)

(SPACE FOR ROUGH WORK)