RATHI CLASSES

आजीवनम् ज्ञानवर्धनम्

New mantra for Success

CPT-2

Signals & Systems, Analog Communication 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 Q.30 (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 including 3 pages for Rough Work. Please check all pages and report, if there is any discrepancy.

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Q.1 If Fourier transform (FT) of x[n] is $X\left(e^{j\omega}\right)$, then the FT of $(-1)^n$ x[n] is

(a) $(-j)^{\omega} X\left(e^{j\omega}\right)$ (b) $(-1)^{\omega} X\left(e^{j\omega}\right)$

(c) $X\left(e^{j(\omega-\pi)}\right)$ (d) $\dfrac{d\left(X\left(e^{j\omega}\right)\right)}{d\omega}$

Q.2 Let x(t) be a continous-time (CT), real-valued signal band-limited to 'F' Hz. The Nyquist sampling rate in Hz, for y(t) = x(0.5t) + x(t) – x(2t) is

(a) F (b) 2F

(c) 4F (d) 8F

Q.3 Find the fundamental period of signal $x(n) = (-1)^n$, if it is periodic _____.

Q.4 Find energy or power of the following signal which is possible _____. Unit.

$x(t) = 5\cos(\pi t) + \sin(5\pi t)$ for all t

Q.5 The Laplace transform of $f(t) = 2\sqrt{t/\pi}$ is $s^{-3/2}$, The Laplace transform of $g(t) = \sqrt{1/\pi t}$ is _____.

Q.6 Let $X(z) = \dfrac{1}{1-z^{-3}}$ be the Z-transform of a causal signal x[n] then the value of x[1] is_____.

Q.7 The total capture range of a PLL demodulator is depend on

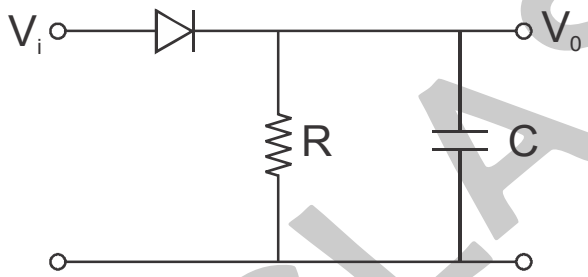
(a) f_m, Δf (b) f_m, Δf, A_m

(c) f_m, f_c, A_m (d) f_c, f_m, A_c

Q.8 A receiver is tuned to 700 K station corresponding image frequency is 1700 kHz; the IRR, if two such systems are in cascade having quality factor Q_1 = 65, Q_2 = 75 respectively_____.

Q.9 An AM signal is given by $\left[20+12\cos 2\pi\times10^{4}t+16\cos 4\pi\times10^{4}t\right]$ $\cos 2\pi\times10^{6}t$. The equivalent modulating index of the modulated signal _____.

Q.10 Find the appropriate value of capacitor 'C' used in envelop detector to avoid diagonal clipping for signal A(1 + 0.6 cos1000t) cos10^6t, $R=1300\Omega$ and diode is ideal_____.



Q.11 Let the transfer function of zero order hold is F(s) then the value of $\lim_{s\to0} sF(s)$ is _____.

Q.12 The signal $\cos\left(10\pi t+\frac{\pi}{4}\right)$ is ideally sampled at a sampling frequency of 15 Hz the sampled signal is passed through a filter with impulse response $\left(\frac{\sin\pi t}{\pi t}\right)\times\cos\left(40\pi t-\frac{\pi}{2}\right)$. The filter output is

(a) $\frac{15}{2}\cos\left(40\pi t+\frac{\pi}{4}\right)$ (b) $\frac{15}{2}\left(\frac{\sin(\pi t)}{\pi t}\right)\cos\left(10\pi t+\frac{\pi}{4}\right)$

(c) $\frac{15}{2}\cos\left(40\pi t-\frac{\pi}{4}\right)$ (d) $\frac{15}{2}\left(\frac{\sin(\pi t)}{\pi t}\right)\cos\left(10\pi t-\frac{\pi}{2}\right)$

Q.13 Two sequences [a, b, c] and [A, B, C] are related as

$$\begin{bmatrix} A \\ B \\ C \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & W_3^{-1} & W_3^{-2} \\ 1 & W_3^{-2} & W_3^{-4} \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix}$$ where $W_3 = e^{j\frac{2\pi}{3}}$ if another sequence

[p, q, r] is derived as $\begin{bmatrix} p \\ q \\ r \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & W_3^1 & W_3^2 \\ 1 & W_3^2 & W_3^4 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & W_3^2 & 0 \\ 0 & 0 & W_3^4 \end{bmatrix} \begin{bmatrix} A/3 \\ B/3 \\ C/3 \end{bmatrix}$

then the relationship between the sequences [p, q, r] and [a, b, c] is

(a) [p, q, r] = [b, a, c] (b) [p, q, r] = [b, c, a]

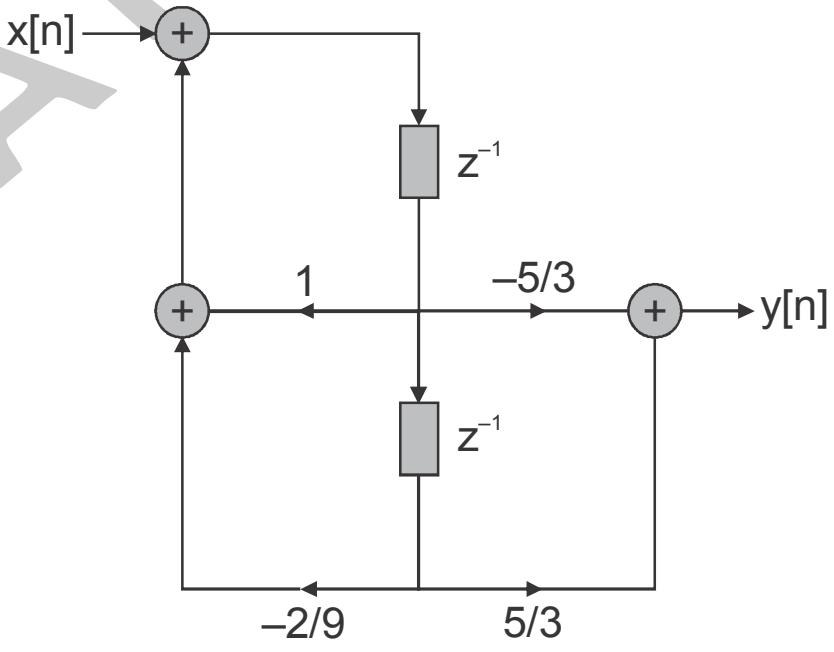
(c) [p, q, r] = [c, a, b] (d) [p, q, r] = [c, b, a]

Q.14 A 5-point sequence x[n] is given as x[–3] = 1, x[–2] = 1, x[–1] = 0, x[0] = 5 and x[1] = 1. Let $X\left(e^{j\omega}\right)$ denotes the discrete-time Fourier transform of x[n]. The value of $\int_{-\pi}^{\pi} X\left(e^{j\omega}\right) d\omega$ is

(a) 5 (b) 10π

(c) 16π (d) $5 + j10\pi$

Q.15 Find the energy of the output y[n] _____.



Q.16 Suppose x[n] is an absolutely summable discrete-time signal. If Z-transform is a rational function with two poles and two zeroes. The poles are at $z = \pm 12j$. Which one of the following statement is TRUE for the signal x[n]?

(a) It is a finite duration signal.
(b) It is a causal signal.
(c) It is a non-causal signal.
(d) It is a periodic signal.

Q.17 A system with transfer function H[z] has impulse response h[n] defined as h[2] = 1, h[3] = –1 and h[k] = 0 otherwise. Consider the following statements.

S_1 : H[z] is a low-pass filter
S_2 : H[z] is an FIR filter
Which of the following is true

(a) Only S_1 is true
(b) Only S_2 is true
(c) Both S_1 and S_2 are true
(d) Both S_1 and S_2 are true but S_2 is not correct reason

Q.18 A system is described by the differential equatiion $\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 6y(t) = x(t)$. Let x(t) be a rectangular pulse given by

$$x(t) = \begin{cases} 1 & 0 < t < 2 \\ 0 & \text{otherwise} \end{cases}$$

Assuming that y(0) = 0 and $\frac{dy}{dt} = 0$ at t = 0, the Laplace transform of y(t) is

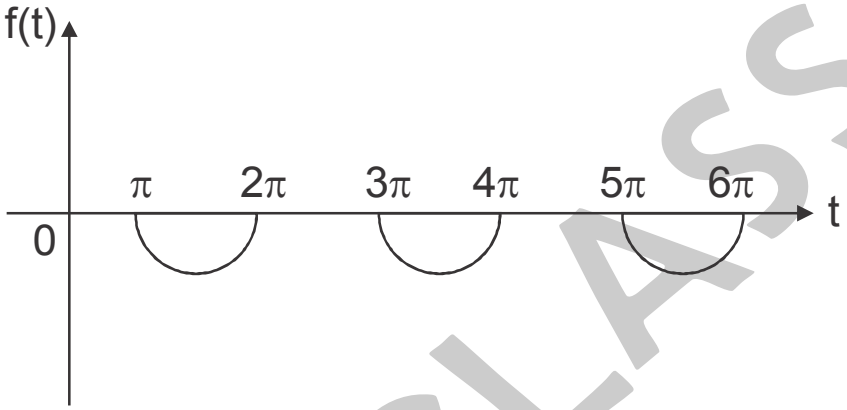
(a) $\frac{e^{-2s}}{s(s+2)(s+3)}$ (b) $\frac{1-e^{-2s}}{s(s+2)(s+3)}$

(c) $\frac{e^{-2s}}{(s+2)(s+3)}$ (d) $\frac{1-e^{-2s}}{(s+2)(s+3)}$

Q.19 The Laplace transform of the periodic function f(t) described by the curve below, i.e.

$$f(t)=\begin{cases}\sin t & \text{if } (2n-1)\pi \le t \le 2n\pi \quad (n=1, 2, 3\ldots)\\ 0 & \text{otherwise}\end{cases}$$

is F(s), then the value of $\lim_{s\to\frac{1}{\pi}}$ F(s) is _____.



Q.20 Let $t_g(f)$ be the group delay function of the given RC-LPF and f_1 = 100 Hz, then $t_g(f_1)$ in ms is _____. (Where $R=1.0\,k\Omega$, $C=1.0\mu F$)

Q.21 The function f(t) has the Foruier transform (FT), $g(\omega)$. The Fourier transform of

$$g(t)=\left(\int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt\right) \text{ is}$$

(a) $\frac{1}{2\pi}f(\omega)$ (b) $\frac{1}{2\pi}(-\omega)$

(c) $2\pi f(-\omega)$ (d) none

Q.22 The signal $x[n] = \sin\left(\frac{\pi n}{6}\right)/(\pi n)$ is processed through a linear filter with the impulse response $h(n) = \sin(\omega_c n)/(\pi n)$, where $\omega_c > \frac{\pi}{6}$. The output of the filter is

(a) $\sin(2\omega_c n)/(\pi n)$ (b) $\sin(\pi n/3)/(\pi n)$

(c) $\left[\sin(\pi n/6)/(\pi n)\right]^2$ (d) $\sin(\pi n/6)/(\pi n)$

Q.23 Let 3 + 4j be a zero of a fourth order linear phase FIR filter. The complex number which is NOT a zero of this filter is

(a) 3 – 4j (b) $\frac{3}{25} + \frac{4}{25}j$

(c) $\frac{3}{25} - \frac{4}{25}j$ (d) $\frac{1}{3} - \frac{1}{4}j$

Q.24 In a FM system, a carrier of 100 MHz is modulated by a sinusoidal signal of 5 kHz the bandwidth by Carson's approximation is 1 MHz. If y(t) = (modulated waveform)^3 then by using Carson's approximation. The bandwidth of y(t) around 300 MHz and the spacing of spectral components are respectively

(a) 3 MHz, 5 KHz (b) 1 MHz, 15 KHz

(c) 3 MHz, 15 KHz (d) 1 MHz, 5 KHz

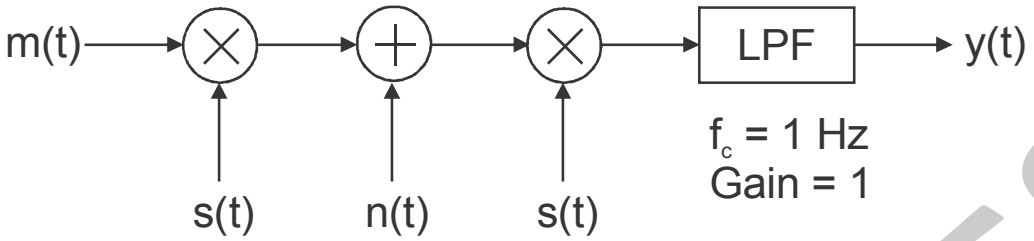
Q.25 An angle modulated signal is given by $s(t) = \cos 2\pi\left(2\times10^6 t + 30\sin 150t + 40\cos 150t\right)$ the maximum frequency and phase deviation of s(t) are.

(a) 10.5 KHz, 140π rad (b) 6 KHz, 80π rad

(c) 10.5 KHz, 100π rad (d) 7.5 KHz, 100π rad

Q.26 In the figure $m(t)=\frac{2\sin 2\pi t}{t}, s(t)=\cos 200\pi t$ and $n(t)=\frac{\sin 199\pi t}{t}$.

The output y(t) will be



(a) $\frac{\sin 2\pi t}{t}$

(b) $\frac{\sin 2\pi t}{t}+\frac{\sin \pi t}{t}\cos 0.75\pi t$

(c) $\frac{\sin 2\pi t}{2t}+\frac{\sin \pi t}{t}\cos 1.5\pi t$

(d) none

Q.27 Consider the frequency modulated signal

$$x(t)=10\cos\left[2\pi\times 10^5 t+5\sin(2\pi\times 1500t)+7.5\sin(2\pi\times 1000t)\right]$$

with carrier frequency of 10^5 Hz. The modulation index is ____.

Common Data Question (Q.28 and Q.29)

A communication channel of bandwidth 100 kHz is to be used for transmission of an analog source m(t), where $|m(t)|<1$. The bandwidth of message signal is W = 4 kHz and power content of the message signal is 0.1 W.

Q.28 The ratio of the output SNR of an FM system that utilizes the whole bandwidth to the output SNR of a conventional AM system with a modulation index of 0.85 is

(a) 38.9 dB

(b) 56.2 dB

(c) 27.4 dB

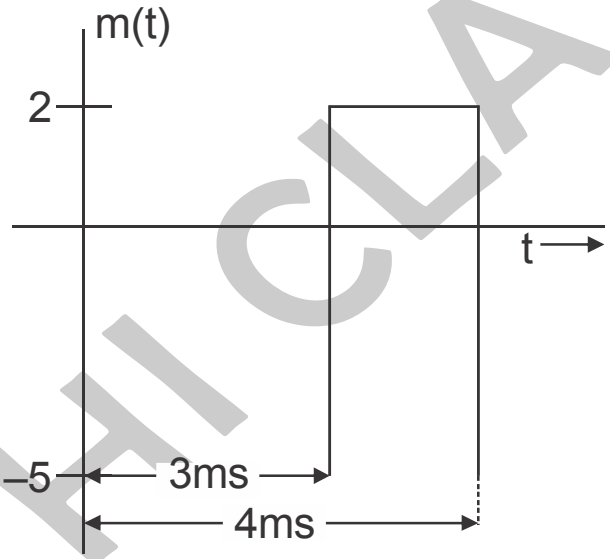
(d) 98.3 dB

Q.29 If FM system and PM system are employed and these systems have the same SNR, then $\frac{BW_{PM}}{BW_{FM}}$ would be

(a) $\frac{\sqrt{2}\beta_f + 1}{\beta_f + 1}$ (b) $\frac{\sqrt{3}\beta_f + 1}{\beta_f + 1}$

(c) $\frac{\beta_f + 1}{\sqrt{2}\beta_f + 1}$ (d) $\frac{\beta_f + 1}{\sqrt{3}\beta_f + 1}$

Q.30 Find the transmission efficiency of an AM if it is given that $s(t) = [A + m(t)]\cos\omega_c t$, $\mu = 0.65$ _____.



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