GATE SOLVED PAPER - IN

COMMUNICATION SYSTEM

YEAR 2012 ONE MARK

Q. 1 Two independent random variables X and Y are uniformly distributed in the interval $[-1, 1]$. The probability that max $[X, Y]$ is less than 1/2 is

(A) 3/4 (B) 9/16

(C) 1/4 (D) 2/3

YEAR 2011 ONE MARK

Q. 2 Consider the signal

$$x(t) = \begin{cases} e^{-t}, & t \geq 0 \\ 0, & t < 0 \end{cases}$$

Let $X(\omega)$ denotes the Fourier transform of this signal. The integral $\frac{1}{2\pi}\int_{-\infty}^{\infty} X(\omega) d\omega$ is

(A) 0 (B) 1/2

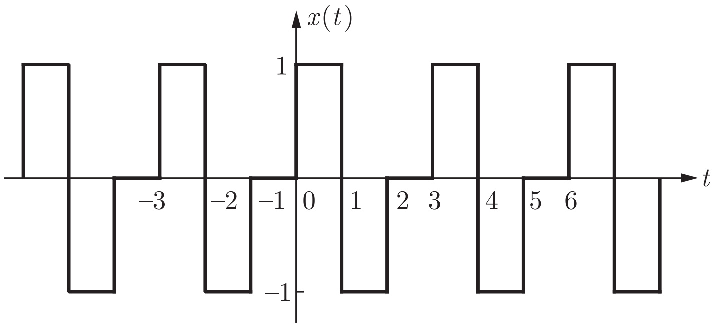
(C) 1 (D) ∞

Q. 3 The continuous time signal $x(t) = \sin \omega_0 t$ is a periodic signal. However, for its discrete time counterpart $x[n] = \sin \omega_0 n$ to be periodic, the necessary condition is

(A) $0 \leq \omega_0 < 2\pi$ (B) $\frac{2\pi}{\omega_0}$ to be an integer

(C) $\frac{2\pi}{\omega_0}$ to be a ratio of integers (D) None of the above

Q. 4 Consider a periodic signal $x(t)$ as shown below.



It has Fourier series representation

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{j(2\pi/T)kt}$$

Which one of the following statements is true?

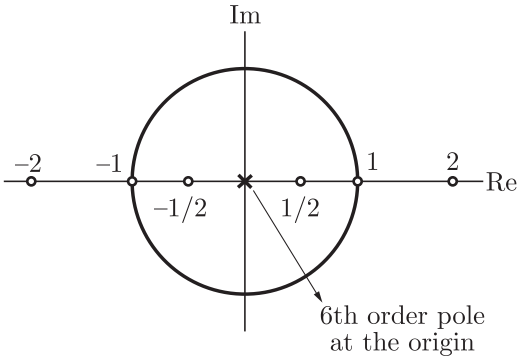
(A) $a_k = 0$, for k odd integer and $T = 3$

(B) $a_k = 0$, for k even integer and $T = 3$

(C) $a_k = 0$, for k even integer and $T = 6$

(D) $a_k = 0$, for k odd integer and $T = 6$

Q. 5 Shown below is the pole-zero plot of a digital filter.



Which one of the following statements is true?

(A) The is a low-pass filter (B) This is a high-pass filter

(C) This is an IIR filter (D) This is an FIR filter

Q. 6 The continuous time signal

$$x(t) = \cos(100\pi t) + \sin(300\pi t)$$

is sampled at the rate $100\,\text{Hz}$ to get the signal

$$x_S(t) = \sum_{n=-\infty}^{\infty} x(nT_s)\delta(t - nT_s),\ T_s = \text{sampling period}$$

The signal $x_s(t)$ is passed through an ideal low-pass filter with cut-off frequency $100\,\text{Hz}$. the output of the filter is proportional to

(A) $\cos(100\pi t)$

(B) $\cos(100\pi t) + \sin(100\pi t)$

(C) $\cos(100\pi t) - \sin(100\pi t)$

(D) $\sin(100\pi t)$

Q. 7 Consider a system with input $x(t)$ and output $y(t)$ related as follows

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

Which one of the following statements is true?

(A) The system is non-linear

(B) The system is time invariant

(C) The system is stable

(D) The system has memory

YEAR 2011 TWO MARKS

Q. 8 A square wave (amplitude $\pm 10\,\text{mV}$, frequency 5 kHz, duty cycle 50%) is passed through an ideal low-pass filter with pass-band gain and cut-off frequency of 0 dB and 10 kHz, respectively. The filtered signal is subsequently “buried” additively into a zero mean noise process of non-sided power spectral density (PSD) of 25 pW Hz^{-1} up to a frequency of 2 MHz. The PSD of the noise is assumed to be zero beyond 2 MHz. The signal to noise ratio of the output is

(A) 0 dB (B) 0.1 dB

(C) 1.0 dB (D) 3 dB

Q. 9 Consider the difference equation $y[n]-\frac{1}{3}y[n-1]=x[n]$ and suppose that $x[n]=\left(\frac{1}{2}\right)^n u[n]$. Assuming the condition of initial rest, the solution for $y[n]$, $n \geq 0$ is

(A) $3\left(\frac{1}{3}\right)^n-2\left(\frac{1}{2}\right)^n$

(B) $-2\left(\frac{1}{3}\right)^n+3\left(\frac{1}{2}\right)^n$

(C) $\frac{2}{3}\left(\frac{1}{3}\right)^n+\frac{1}{3}\left(\frac{1}{2}\right)^n$

(D) $\frac{1}{3}\left(\frac{1}{3}\right)^n+\frac{2}{3}\left(\frac{1}{2}\right)^n$

YEAR 2010 ONE MARK

Q. 10 $u(t)$ represents the unit step function. The Laplace transform of $u(t-\tau)$ is

(A) $\frac{1}{s\tau}$

(B) $\frac{1}{s-\tau}$

(C) $\frac{e^{-s\tau}}{s}$

(D) $e^{-s\tau}$

Q. 11 In a pulse code modulated (PCM) signal sampled at f_s and enclosed into an n-bit code, the minimum bandwidth required for faithful reconstruction is

(A) $2nf_s$

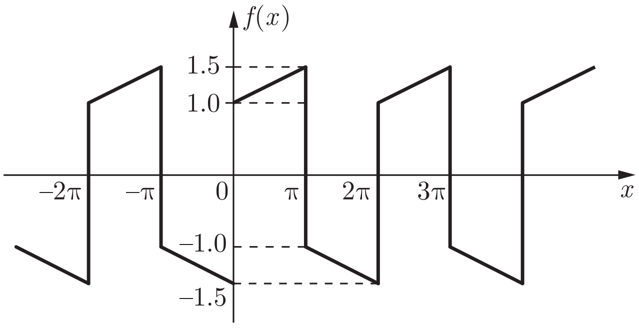
(B) nf_s

(C) $\frac{nf_s}{2}$

(D) f_s

Q. 12 $f(x)$, shown in the figure is represented by $f(x)=a_0+\sum_{n=1}^{n}\{a_n\cos(nx)+b_n\sin(nx)\}$

The value of a_0 is



(A) 0

(B) $\pi/2$

(C) π

(D) 2π

Q. 13 $H(z)$ is discrete rational transfer function. To ensure that both $H(z)$ and its inverse are stable its

(A) poles must be inside the unit circle and zeros must be outside the unit circle

(B) poles and zeros must be inside the unit circle

(C) poles and zeros must be outside the unit circle

(D) poles must be outside the unit circle and the zeros should be inside the unit circle

Q. 14 The fundamental period of $x(t)=2\sin\pi t+3\sin 3\pi t$ with t expressed in second, is

(A) 1 s

(B) 0.67 s

(C) 2 s

(D) 3 s

Q. 15 A signal with frequency components 50 Hz, 100 Hz and 200 Hz only is sampled at 150 samples/s. The ideally reconstructed signal will have frequency components(s) of

(A) 50 Hz only
(B) 75 Hz only
(C) 50 Hz and 75 Hz
(D) 50 Hz, 75 Hz and 100 Hz

YEAR 2010 TWO MARKS

Q. 16 The input $x(t)$ and the corresponding output $y(t)$ of a system are related by $y(t) = \int_{-\infty}^{5t} x(\tau) d\tau$.

The system is

(A) time invariant and causal
(B) time invariant and non-causal
(C) time variant and non-causal
(D) time variant and causal

Q. 17 A digital filter having a transfer function $H(z) = \frac{p_0 + p_1 z^{-1} + p_3 z^{-3}}{1 + d_3 z^{-3}}$ is implemented using Direct From I and Direct Form II realizations of IIR structure. The number of delay units required in Direct Form I and Direct Form II realizations are, respectively

(A) 6 and 6
(B) 6 and 3
(C) 3 and 3
(D) 3 and 2

Q. 18 4-point DFT of a real discrete-time signal $x[n]$ of length 4 is given by $X[k]$, $n = 0,1,2,3$ and $k = 0,1,2,3$. It is given that $X[0] = 5$, $X[1] = 1 + j1$, $X[2] = 0.5$, $X[3]$ and $x[0]$ respectively, are

(A) $1 - j, 1.875$
(B) $1 - j, 1.500$
(C) $1 + j, 1.875$
(D) $0.1 - j\,0.1, 1.500$

YEAR 2009 ONE MARK

Q. 19 A linear time-invariant causal system has frequency response given in polar form as $\frac{1}{\sqrt{1+\omega^2}} \underline{|\tan^{-1}\omega}$. For input $x(t) = \sin t$, the output is

(A) $\frac{1}{\sqrt{2}} \cos t$
(B) $\frac{1}{\sqrt{2}} \cos\left(t - \frac{\pi}{4}\right)$
(C) $\frac{1}{\sqrt{2}} \sin t$
(D) $\frac{1}{\sqrt{2}\sin}\left(t - \frac{\pi}{4}\right)$

Q. 20 A 50% duty cycle square wave with zero mean is used as a baseband signal in an ideal frequency modulator with a sinusoidal carrier of frequency ω_c. The modulated signal is given as an input to an ideal phase demodulator (a circuit that produces an output proportional to the difference in phase of the modulated signal from that of the carrier). The output of the circuit is.

(A) a square wave
(B) a train of impulse with alternating signs
(C) a triangular wave
(D) a sinusoidal wave

YEAR 2009 TWO MARKS

Q. 21 For input $x(t)$, an ideal impulse sampling system produces the output

$$y(t) = \sum_{k=\infty}^{c} x(kT)\delta(t-kT)$$

where, $\delta(t)$ is the Dirac Delta function. The system is

(A) non-linear and time invariant
(B) non-linear and time varying
(C) linear and time invariant
(D) linear and time varying

Q. 22 The root mean squared value of $x(t) = 3 + 2\sin(t)\cos(2t)$ is

(A) $\sqrt{3}$
(B) $\sqrt{8}$
(C) $\sqrt{10}$
(D) $\sqrt{11}$

Q. 23 An analog signal is sampled at 9 kHz. The sequence so obtained is filtered by an FIR filter with transfer function $H[z] = 1 - z^{-6}$. One of the analog frequencies for which the magnitude response of the filter is zero, is

(A) 0.75 kHz
(B) 1 kHz
(C) 1.5 kHz
(D) 2 kHz

Q. 24 The transfer function $H(z)$ of a fourth-order linear phase FIR system is given by

$$H(z) = (1 + 2z^{-1} + 3z^{-2})G(z)$$

Then $G(z)$ is

(A) $3 + 2z^{-1} + z^{-2}$
(B) $1 + \frac{1}{2}z^{-1} + \frac{1}{3}z^{-2}$
(C) $\frac{1}{3} + 2z^{-1} + z^{-2}$
(D) $1 + 2z + 3z^2$

YEAR 2008 ONE MARK

Q. 25 The fundamental period of the discrete time signal $x[n] = e^{i\left(\frac{5\pi}{6}\right)n}$ is

(A) $\frac{6}{5\pi}$
(B) $\frac{12}{5}$
(C) 6
(D) 12

Q. 26 Which one of the following discrete time systems is time invariant?

(A) $y[n] = nx[n]$
(B) $y[n] = x[3n]$
(C) $y[n] = x[-n]$
(D) $y[n] = x[n-3]$

YEAR 2008 TWO MARKS

Q. 27 The Fourier transform of $x(t) = e^{-at}u(-t)$, where $u(t)$ is the unit step function,

(A) exists for any real value of a
(B) does not exist for any real value of a
(C) exists, if the real value of a is strictly negative
(D) exists, if the real value of a is strictly positive

Q. 28 Consider a discrete time LTI system with input $x[n] = \delta[n] + \delta[n-1]$ and impulse response $h[n] = \delta[n] - \delta[n-1]$. The output of the system will be given by

(A) $\delta[n] - \delta[n-2]$
(B) $\delta[n] - \delta[n-1]$
(C) $\delta[n-1] + \delta[n-2]$
(D) $\delta[n] + \delta[n-1] + \delta[n-2]$

Q. 29 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) $(-3)^n u[n]$

Q. 30 If the bandwidth of a low-pass signal $g(t)$ is 3kHz, the bandwidth of $g^2(t)$ will be

(A) $\frac{3}{2}$ kHz (B) 3 kHz

(C) (6) kHz (D) 9 kHz

Q. 31 Consider the AM signal $s(t) = [1 + m(t)]\cos(2\pi f_c t)$. It is given that the bandwidth of a real, low pass message signal $m(t)$ is 2 kHz. If $f_c = 2$ MHz, the bandwidth of the band-pass signal $s(t)$ will be

(A) 2.004 MHz (B) 2 MHz

(C) 4 kHz (D) 2 kHz

Q. 32 The region of convergence of the z-transform of the discrete time signal $x[n] = 2^n u[n]$ will be

(A) $|z| > 2$ (B) $|z| < 2$

(C) $|z| > \frac{1}{2}$ (D) $|z| < \frac{1}{2}$

Q. 33 The step response of a linear time invariant system is $y(t) = 5e^{-10t}u(t)$, where $u(t)$ is the unit step function. If the output of the system corresponding to an impulse input $\delta(t)$ is $h(t)$, then $h(t)$ is

(A) $-50e^{-10t}u(t)$ (B) $5e^{-10t}\delta(t)$

(C) $5u(t) - 50e^{-10t}\delta(t)$ (D) $5\delta(t) - 50e^{-10t}u(t)$

Q. 34 Ten, real, band-pass message signals, each of bandwidth 3kHz, are to be frequency division multiplexed over a band-pass channel with band width B kHz. If the guard band in between any two adjacent signals should be of 500 Hz width and there is no need to provide any guard band at the edge of the band-pass channel, the value of B should be at least

(A) 30 (B) 34.5

(C) 35 (D) 35.5

YEAR 2007 ONE MARK

Q. 35 Let $x(t)$ be a continuous time, 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) $8F$

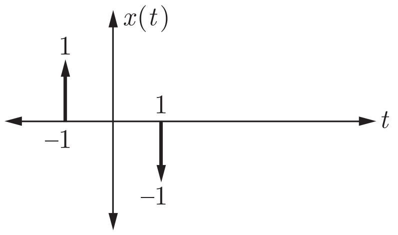
Q. 36 Consider the periodic signal $x(t) = (1 + 0.5\cos 40\pi t)\cos 200\pi t$, where t is in second. Its fundamental frequency in Hz, is

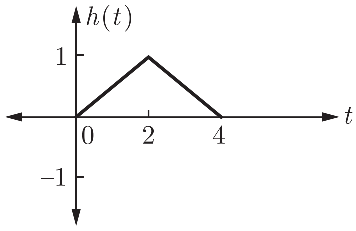
(A) 20 (B) 40

(C) 100 (D) 200

YEAR 2007 TWO MARKS

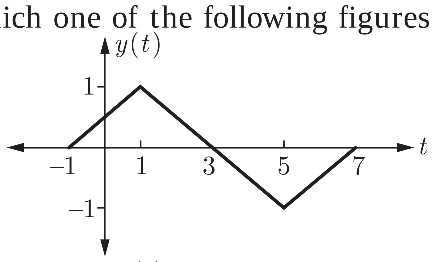
Q. 37 The signals $x(t)$ and $h(t)$ shown in the figures are convolved to yield $y(t)$.



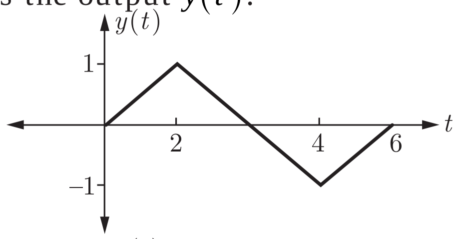


Which one of the following figures represents the output $y(t)$?

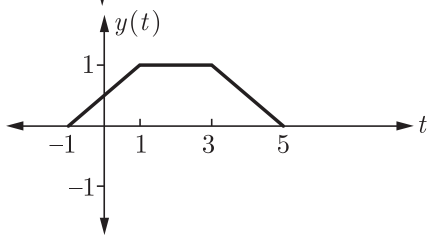
(A)



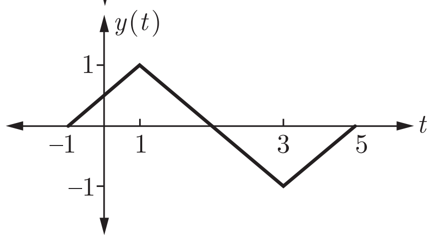
(B)



(C)



(D)



Q. 38 Consider the discrete time signal $x(n) = \left(\frac{1}{3}\right)^n u(n)$, where $u(n) = \begin{cases} 1, & n \geq 0 \\ 0, & n < 0 \end{cases}$. Define the signal $y(n)$ as $y(n) = x(-n)$, $-\infty < n < \infty$. Then $\sum_{n=-\infty}^{\infty} y(n)$ equals

(A) $-\frac{2}{3}$ (B) $\frac{2}{3}$

(C) $\frac{3}{2}$ (D) 3

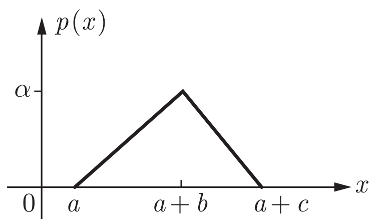
Q. 39 Let the signal $x(t)$ have the Fourier transform $X(\omega)$. Consider the signal $y(t) = \frac{d}{dt}[x(t - t_d)]$, where t_d is an arbitrary delay. the magnitude of the Fourier transform of $y(t)$ is given by the expression

(A) $|X(\omega)||\omega|$ (B) $|X(\omega)|\omega$

(C) $\omega^2|X(\omega)|$ (D) $|\omega||X(\omega)|e^{-j\omega t_d}$

YEAR 2006 ONE MARK

Q. 40 Probability density function $p(x)$ of a random variable x is as shown below. The value of α is



(A) $\frac{2}{c}$ (B) $\frac{1}{c}$

(C) $\frac{2}{(b+c)}$ (D) $\frac{1}{(b+c)}$

YEAR 2006 TWO MARKS

Q. 41 The plot of a function $f(x)$ is shown in the following figure. A possible expression for the function $f(x)$ is

(A) $\exp\, x$ (B) $\exp\left(\frac{-1}{x}\right)$

(C) $\exp(-x)$ (D) $\exp\left(\frac{1}{x}\right)$

Q. 42 Given, $x(t) * x(t) = t\exp(-2t)u(t)$, the function $x(t)$ is

(A) $\exp(-2t)u(t)$ (B) $\exp(-t)u(t)$

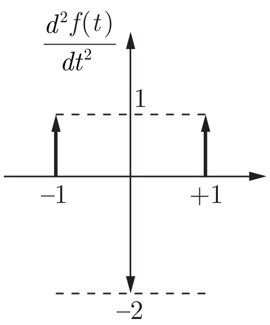
(C) $t\exp(-t)u(t)$ (D) $0.5t\exp(-t)u(t)$

Q. 43 The Fourier series for a periodic signal is given as
$x(t) = \cos(1.2\pi t) + \cos(2\pi t) + \cos(2.8\pi t)$.
The fundamental frequency of the signal is

(A) 0.2 Hz (B) 0.6 Hz

(C) 1.0 Hz (D) 1.4 Hz

Q. 44 If the waveform, shown in the following figure, corresponds to the second derivative of a given function $f(t)$, then the Fourier transform of $f(t)$ is



(A) $1 + \sin\omega$ (B) $1 + \cos\omega$

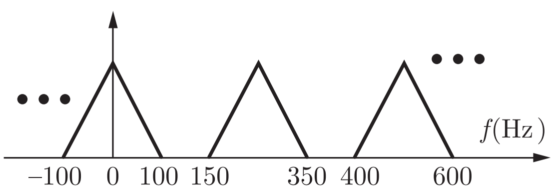
(C) $\frac{2(1-\cos\omega)}{\omega^2}$ (D) $\frac{2(1+\cos\omega)}{\omega^2}$

Q. 45 The Fourier transform of a function $g(t)$ is given as $G(\omega) = \frac{\omega^2+21}{\omega^2+9}$. Then the function $g(t)$ is given as

(A) $\delta(t) + 2\exp(-3\ t\ )$ (B) $\cos 3\omega t + 21\exp(-3t)$

(C) $\sin 3\omega t + 7\cos\omega t$ (D) $\sin 3\omega t + 21\exp(3t)$

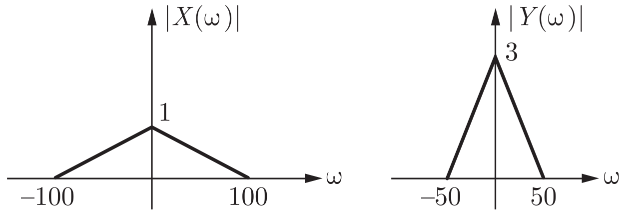
Q. 46 The spectrum of a band-limited signal after sampling is shown below. The value of the sampling interval is



(A) 1 ms (B) 2 ms

(C) 4 ms (D) 8 ms

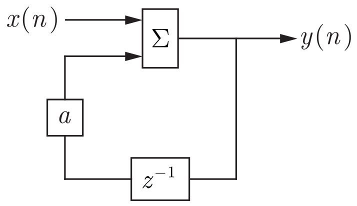
Q. 47 The magnitude of Fourier transform $X(\omega)$ of a function $x(t)$ is shown below in Fig. (a). the magnitude of Fourier transform $Y(\omega)$ of another function $y(t)$ is shown below in Fig. (b). the phases of $X(\omega)$ and $Y(\omega)$ are zero for all ω. The magnitude and frequency units are identical in both the figures. The function $y(t)$ can be expressed in terms of $x(t)$ as



(a) (b)

(A) $\frac{2}{3}\times\left(\frac{t}{2}\right)$
(B) $\frac{3}{2}\times(2t)$
(C) $\frac{2}{3}\times(2t)$
(D) $\frac{3}{2}\times\left(\frac{t}{2}\right)$

Q. 48 In the IIR filter shown below, a is a variable gain. For which of the following cases, the system will transit from stable to unstable condition?



(A) $0.1 < a < 0.5$
(B) $0.5 < a < 1.5$
(C) $1.5 < a < 2.5$
(D) $2 < a < \infty$

Q. 49 A digital filter has the transfer function

$$H(z) = \frac{z^2+1}{z^2+0.81}$$

If this filter has to reject a 50 Hz interference from the input, then the sampling frequency for the input signal should be

(A) 50 Hz
(B) 100 Hz
(C) 150 Hz
(D) 200 Hz

Q. 50 A digital measuring instrument employs a sampling rate of 100 samples/s. The sampled input $x(n)$ is averaged using the difference equation

$$y(n) = [x(n)+x(n-1)+x(n-2)+x(n-3)]/4$$

For a step input, the maximum time taken for the output to reach the final value after the input transition is

(A) 20 ms
(B) 40 ms
(C) 80 ms
(D) ∞

Q. 51 The solution of the integral equation

$$y(t) = t\exp(t) - 2\exp(t)\int_0^t \exp(-\tau)y(\tau)d\tau \text{ is}$$

(A) $\frac{1}{2}(\exp(t)-\exp(-t))$
(B) $\frac{1}{2}(\exp(t)+\exp(-t))$
(C) $\frac{(\exp(t)-\exp(-t))}{(\exp(t)+\exp(-t))}$
(D) $\frac{(\exp(-t)+\exp(t))}{(\exp(-t)-\exp(t))}$

YEAR 2005 ONE MARK

Q. 52 Given the discrete time sequence

$$x[n] = [2, 0, -1, -3, 4, 1, -1], X(e^{j\pi})$$
$$\uparrow$$

(A) 8 (B) 6π

(C) 8π (D) 6

Q. 53 The continuous time signal $x(t) = \frac{1}{a^2 + t^2}$ has the Fourier transform $\frac{\pi}{a}\exp(-a|\omega|)$

The signal $x(t)\cos bt$ has the Fourier transform

(A) $\frac{\pi}{2a}[\exp(-a\ \omega - b\ ) + \exp(-a\ \omega + b\ )]$

(B) $\frac{\pi}{2a}[\exp(-a\ \omega\ ) + \exp(-a\ \omega\ )]$

(C) $\frac{\pi}{a}[\exp(-a\ \omega\ )\cos b\omega]$

(D) $\frac{\pi}{2a}[\exp(-a\ \omega - b\ ) - \exp(-a\ \omega + b\ )]$

YEAR 2005 TWO MARKS

Q. 54 The fundamental period of the sequence

$$x[n] = 3\sin(1.3\pi n + 0.5\pi) + 5\sin(1.2\pi n) \text{ is}$$

(A) 20 (B) $\frac{2\pi}{1.3\pi}$

(C) $\frac{2\pi}{1.2\pi}$ (D) 10

Q. 55 An analog low-pass filter is needed with the following specifications:

Pass-band : $0.9 \le |H(j\omega)| < 1,\ 0 \le \omega \le 2\pi \times 1000$

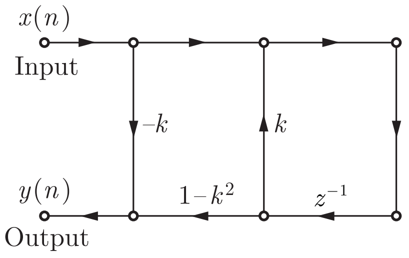
Stop-band : $|H(j\omega)| \le 0.2,\ |\omega| \ge 2\pi \times 1500$

The minimum order N of the Butterworth filter to approximate the above is

(A) 6 (B) 11

(C) 12 (D) 15

Q. 56 A discrete time system is shown in the figure. The system function $H(z)$, of the network is given by



(A) $\frac{-k + z^{-1}}{1 - (1 - k^2)z^{-1}}$ (B) $\frac{(1 - k^2) + z^{-1}}{1 - kz^{-1}}$

(C) $\frac{1 - (1 - k^2)z^{-1}}{1 - kz^{-1}}$ (D) $\frac{-k + z^{-1}}{1 - kz^{-1}}$

YEAR 2004 ONE MARK

Q. 57 If the Fourier transform of $x[n]$ is $X(e^{j\omega})$, then the Fourier transform of $(-1)^n x[n]$ is

(A) $(-j)^{\omega} X(e^{j\omega})$a

(B) $(-1)^{\omega} X(e^{j\omega})$

(C) $X(e^{j(\omega-\pi)})$

(D) $\frac{d}{d\omega}(X(e^{j\omega}))$

Q. 58 The Nyquist rate of sampling of an analog signal $s(t)$ for alias free reconstruction is 5000 samples/s. For a signal $x(t) = [s(t)]^2$ the corresponding Nyquist sampling rate in samples/s is

(A) 2500

(B) 5000

(C) 10000

(D) 25000

Q. 59 A signal $x(t) = 5\cos(150\pi t - 60)$ is sampled at 200 Hz. The fundamental period of the sampled sequence $x[n]$ is

(A) $\frac{1}{200}$

(B) $\frac{2}{200}$

(C) 4

(D) 8

YEAR 2004 TWO MARKS

Q. 60 Due to an amplitude modulation by a sine wave, if the total current in the antenna increases from 4A to 4.8 A the depth of modulation in percentage is

(A) 93.8

(B) 80.1

(C) 40.4

(D) 20.2

Q. 61 Given, $X(z) = \frac{\frac{1}{2}}{1-az^{-1}} + \frac{\frac{1}{3}}{1-bz^{-1}}$, $|a|$ and $|b| < 1$ with the ROC specified as $|a| < |z| < |b|$, $x[0]$ of the corresponding sequence is given by

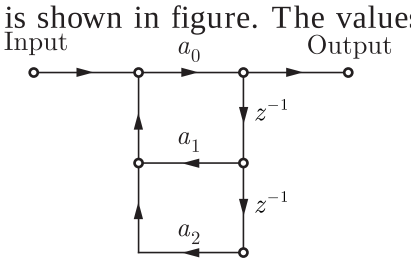
(A) $\frac{1}{3}$

(B) $\frac{5}{6}$

(C) $\frac{1}{2}$

(D) $\frac{1}{6}$

Q. 62 A direct form implementation of an LTI system with $H(z) = \frac{1}{1-0.7z^{-1}+0.13z^{-2}}$ is shown in figure. The values of a_0, a_1 and a_2 are respectively,



(A) 1.0, 0.7 and – 0.13

(B) – 0.13, 0.7 and 1.0

(C) 1.0, – 0.7 and 0.13

(D) 0.13, – 0.7 and 1.0

Q. 63 A low-pass filter has a sampling frequency $f_T = 10$ kHz. The pass-band (f_p) and stop-band (f) edge frequencies are 2 kHz and 3 kHz respectively. the frequency axis is pre-warped before applying bilinear transformation to get new angular frequencies, $\tilde{\Omega}_P$ and $\tilde{\Omega}_s$. the ratio of the warped edge frequencies $(\tilde{\Omega}_s / \tilde{\Omega}_p)$ is

(A) – 1.213

(B) 1.213

(C) 1.575

(D) 1.894

Q. 64 A casual, analog system has a transfer function $H(s) = \frac{a}{s^2 + a^2}$. Assuming a sampling time of T second, the poles of the transfer function $H(z)$ for an equivalent digital system obtained using impulse invariance method are at

(A) (e^{aT}, e^{-aT})

(B) $\left(j\frac{a}{T}, -j\frac{a}{T}\right)$

(C) (e^{jaT}, e^{-jaT})

(D) $(e^{aT/2}, e^{-aT/s})$

Q. 65 A discrete time signal $x[n]$, suffered a distortion modelled by an LTI system with $H(z) = (1 - az^{-1})$, a is real and $|a| > 1$. The impulese response of a stable system that exactly compensates the magnitude of the distortion is

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

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

(C) $a^n u[n]$

(D) $a^n u[-n-1]$

Q. 66 A digital notch filter with a notch frequency of 60 Hz is to be transformed into one operating at a new notch frequency of 120 Hz. the sampling frequency is 400 Hz. A low-pass to low-pass transformation $z^{-1} = \frac{j - \alpha\hat{z}}{\hat{z} - \alpha}$ is used on the first to obtain the new notch filter. Then the value of α should be

(A) – 0.95

(B) 0.95

(C) – 0.46

(D) 0.46

YEAR 2003 ONE MARK

Q. 67 A real function $f(t)$ has a Fourier transform $F(\omega)$. The Fourier transform of $[f(t) - f(-t)]$ is

(A) zero

(B) real

(C) real and odd

(D) imaginary

Q. 68 A sinusoidal signal of frequency 1 kHz is used to produce an FM signal with a modulation index $\beta = 5$. The bandwidth (where 98% of power is contained) of the FM signal is

(A) 2 kHz

(B) 3 kHz

(C) 6 kHz

(D) 12 kHz

Q. 69 Given, $x[n] = \frac{\sin \omega_c n}{\pi n}$, the energy of the signal given by $\sum_{n=-\infty}^{\infty} |x[n]|^2$ is

(A) $\frac{\omega_c}{\pi}$

(B) $\pi\omega_c$

(C) ∞

(D) $2\pi\omega_c$

YEAR 2003 TWO MARKS

Q. 70 A linear time invariant system with system function $H(z) = 1 + z^{-1} + z^{-2}$ is given an input signal sampled at 18 kHz. The frequency of the analog sinusoid which cannot pass through the system is

(A) $\frac{12}{\pi}$ kHz

(B) 6 kHz

(C) 12 kHz

(D) $\frac{6}{\pi}$ kHz

Q. 71 A discrete time system with input $(x[n])$, output $(y[n])$ relation $(y[n] = x[n] - 2x[n-1] + x[n-2])$ is a good approximation to a

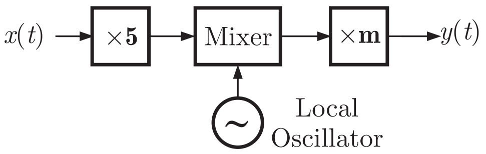
(A) high-pass filter

(B) band-stop filter blocking $\frac{\pi}{8} \le |\omega| \le \frac{\pi}{4}$

(C) low-pass filter

(D) band-pass filter passing $\frac{\pi}{8} \le |\omega| < \frac{\pi}{4}$

Q. 72 The scheme shown in Fig. is used for the generation of wideband FM from a narrow band FM. The multiplier box multiplies the input frequency by the factor shown. The input $x(t)$ is a narrow band FM signal of carrier of 100 kHz and frequency deviation of 25 Hz. The local oscillator frequency in kHz and the multiplication constant m to achieve an output $y(t)$ with a carrier of 2.0 MHz and a frequency deviation of 1.0 kHz are respectively :



(A) 750, 4

(B) 1000, 4

(C) 750, 8

(D) 1000, 8

Q. 73 Given $h[n] = [\underset{\uparrow}{1},2,2]$, $f[n]$ is obtained by convolving $h[n]$ whith itself and $g[n]$ by correlating $h[n]$ with itself.

Which one of the following statements is true?

(A) $f[n]$ is causal and its maximum value is 9

(B) $f[n]$ is non-causal and its maximum value is 8

(C) $g[n]$ is causal and its maximum value is 9

(D) $g[n]$ is non-causal and its maximum value is 9

Q. 74 Bilinear transformation avoids the problem of aliasing encountered with the use of impulse-invariance through

(A) mapping the entire imaginary axis of the s-plane on to the unit circle in the z-plane

(B) prefiltering the input signal to impose bank-limitedness

(C) mapping zeros of the left half of the s-plane inside the unit circle in the z-plane

(D) up-sampling the input signal so the the bandwidth is reduced

Q. 75 A linear phase FIR system with impulse response real has a zero at $z = \frac{1}{2}e^{j\frac{\pi}{4}}$. The largest set of remaining zeros that can be obtained from the above information is

(A) $\frac{1}{2}e^{j\frac{\pi}{2}}, \frac{1}{2}e^{j\frac{3\pi}{4}}, \frac{1}{2}e^{j\frac{\pi}{2}}$

(B) $\frac{1}{2}e^{-j\frac{\pi}{2}}, \frac{1}{2}e^{-j\frac{3\pi}{4}}, \frac{1}{2}e^{-j\frac{\pi}{2}}$

(C) $2e^{-j\frac{\pi}{4}}, 2e^{j\frac{\pi}{4}}, \frac{1}{2}e^{-j\frac{\pi}{4}}$

(D) $2e^{j\frac{\pi}{4}}, \frac{1}{2}e^{-j\frac{\pi}{4}}$

Q. 76 Given, $x = [a, b, c, d]$ as the input, a linear time invariant system produces an output $y = [x, x, x, x, ..., < \text{repeated } N \text{ times} >]$. The impulse response of the system is

(A) $\sum_{i=0}^{N-1} \delta[n - 4i]$

(B) $u[n] - u[n - N]$

(C) $u[n] - u[n - N - 1]$

(D) $\sum_{i=0}^{N-1} \delta[n - i]$

Q. 77 The sequence $x[n]$ whose z-transform is $X(z) = e^{1/z}$, is

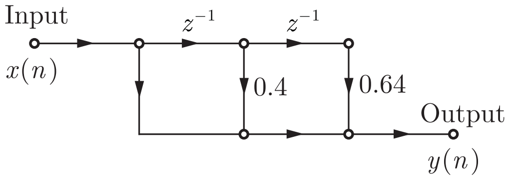
(A) $\frac{1}{n!} U[n]$

(B) $\frac{1}{-n!} u[-n]$

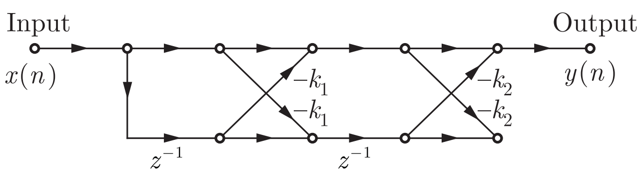
(C) $(-1)^n \frac{1}{n!} u[n]$

(D) $\frac{1}{-(n+1)!} u[-n-1]$

Q. 78 Direct form implementation of the FIR structure shown in Fig. (a) is also implemented in Fig. (b) in lattice form. The coefficients k_1 and k_2 are respectively,



(a)



(b)

(A) 0.640 and – 0.244

(B) 0.640 and 0.244

(C) 0.244 and 0.640

(D) – 0.244 and – 0.640

Q. 79 The response of a system to a unit impulse is $y(t) = e^{-5(t-1)}$. Which one of the following is the correct statement about the system?

(A) The system is non-linear

(B) The system is unstable in open-loop

(C) The steady state gain of the system for a unit step input is 0.2

(D) The steady state gain of the system for a unit step input is 1.0

YEAR 2002 ONE MARK

Q. 80 The bilinear transformation $\omega = \frac{z-1}{z+1}$

(A) maps the inside of the unit circle in the z-plane to left half of the ω-plane

(B) maps the outside of the unit circle in the z-plane to left half of the ω-plane

(C) maps the inside of the unit circle in the z-plane to right half of the ω-plane

(D) maps the outside of the unit circle in the z-plane to right half of the ω-plane

YEAR 2001 ONE MARK

Q. 81 Which one of the following sequences is not a power signal?

(A) Unit step sequence
(B) $e^{j\omega_0 n}$
(C) A periodic sequence
(D) Unit ramp sequence

Q. 82 The discrete LTI system with the following impulse response is non-causal

(A) $a^n u(n-2)$
(B) $a^{n-2}u(n)$
(C) $a^{n+2}u(n)$
(D) $a^n u(n+2)$

YEAR 2001 TWO MARKS

Q. 83 The 3 dB cut-off frequency of a first order analog high-pass filter is ω_c. For a signal $0.5\sin\omega_c t$, the output will have a phase shift of

(A) $-\frac{\pi}{2}$
(B) $-\frac{\pi}{4}$
(C) $\frac{\pi}{4}$
(D) $\frac{\pi}{2}$

Q. 84 For a suppressed carrier amplitude modulator (AM-SC) system, the carrier and the modulating inputs are $x_c(t) = \cos\omega_c t$ and $x_m(t) = 0.5\sin\omega_m t$, respectively. The output of the system is proportional to

(A) $\sin(\omega_c + \omega_m)t - \sin(\omega_c - \omega_m)t$
(B) $\sin(\omega_c + \omega_m)t + \cos(\omega_c - \omega_m)t$
(C) $(1 + 0.5\sin\omega_m t)\cos\omega_c t$
(D) $(1 - 0.5\sin\omega_m t)\cos\omega_c t$

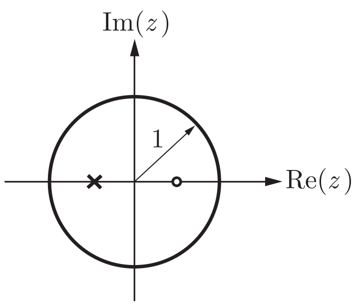
Q. 85 In a frequency modulated system, the carrier and the output signals are $x_c(t) = \cos\omega_c t$ and $y(t) = \cos(\omega_c t + \sin 2t - \cos t)$, respectively. The modulating input $x_m(t)$ is proportional to

(A) $2\cos 2t + \sin t$
(B) $\sin 2t - \cos t$
(C) $\cos 2t + \sin t$
(D) $2\cos 2t - \sin t$

Q. 86 The impulse response of a discrete LTI system is $u(n)$. The system

(A) is unstable in the sense of bounded input bounded output
(B) produces bounded outputs for all bounded inputs
(C) produces bounded inputs for all bounded outputs
(D) stability properties cannot be commented upon

Q. 87 A discrete time transfer function has a pole-zero plot as shown in figure. It is a



(A) low-pass filter
(B) high-pass filter
(C) band-pass filter
(D) notch filter

Q. 88 The impulse response of a discrete LTI system is $a^n u(n)$. Its response is given by

(A) $\sum_{j=0}^{n} a^j$

(B) $\sum_{j=0}^{\infty} a^j$

(C) $\frac{1}{1-a}$

(D) $\sum_{j=-\infty}^{\infty} a^j$

YEAR 2000 ONE MARK

Q. 89 A real valued random variable lying between 0 and 100 has a uniform probability density function. The probability that the value of the variable is greater than 20 is

(A) $\frac{1}{5}$

(B) $\frac{1}{2}$

(C) $\frac{4}{5}$

(D) 1

Q. 90 In an FM broadcast, the maximum frequency deviation allowed is 75 kHz and the maximum modulation frequency is 15 kHz. The bandwidth is closest to

(A) 180 kHz

(B) 60 kHz

(C) 105 kHz

(D) 120 kHz

Q. 91 The transfer function $T(z) = \frac{1-0.8\,z^{-1}}{1+0.8\,z^{-1}}$ represents

(A) auto regressive filter

(B) moving average filter

(C) auto regressive moving average filter

(D) FIR flter

****

ANSWER KEY

COMMUNICATION SYSTEM									
1	2	3	4	5	6	7	8	9	10
(B)	(B)	(C)	(B)	(D)	(B)	(D)	()	(B)	(C)
11	12	13	14	15	16	17	18	19	20
(C)	(A)	(B)	(C)	()	(C)	(B)	(A)	(D)	(C)
21	22	23	24	25	26	27	28	29	30
(C)	(D)	(C)	(A)	(B)	(D)	(C)	(A)	(A)	(C)
31	32	33	34	35	36	37	38	39	40
(C)	(A)	(D)	(B)	(C)	(A)	(D)	(C)	(B)	(A)
41	42	43	44	45	46	47	48	49	50
(B)	(A)	(A)	(C)	(A)	(C)	(D)	(B)	(D)	(B)
51	52	53	54	55	56	57	58	59	60
(C)	(D)	(A)	(A)	(A)	(D)	(C)	(C)	(D)	(A)
61	62	63	64	65	66	67	68	69	70
(C)	(A)	(D)	(C)	(D)	(A)	(D)	(D)	(A)	(B,C)
71	72	73	74	75	76	77	78	79	80
(A)	(C)	(D)	(A)	(C)	(A)	(A)	(D)	(C)	(A)
81	82	83	84	85	86	87	88	89	90
(D)	(D)	(B)	(A)	(A)	(A)	(B)	(A)	(C)	(A)
91									
(C)									