End Semester Examination, May 2021

B.Tech. 4th Semester

Branch: Computer Science and Engineering

Subject Name : Signals and Data Communication

Subject Code : CS207

Date : 6th May, 2021

Q. 1.

A signal $x(t)$ is defined as below. Sum of the powers of the dc, first harmonic and the third harmonic of the signal (rounded-off to four decimal place) is, [1.5 marks]

$$x(t) = \begin{cases} 1, & \text{if } |t| < \frac{1}{4} \\ 0, & \text{if } \frac{1}{4} < |t| < \frac{1}{2}. \end{cases}$$

A. 0.2275
B. 0.4575
C. 0.4725
D. 0.4752

The correct answer is Option D.

Q.2.

Nyquist rate of sampling for the signal $x(t) = \text{sinc}(100\pi t) + \text{sinc}(50\pi t)$ is, [1.5 marks]

A. 50 Hz
B. 100 Hz
C. 200 Hz
D. None of these

The correct answer is Option B.

Q. 3.

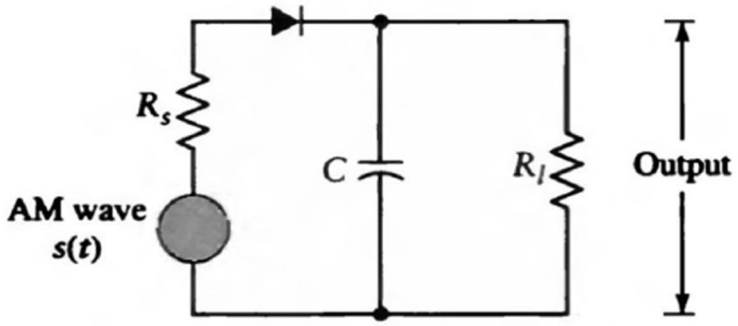
Suppose for a given discrete signal $x[n]$ it is known that $X\left(e^{j\omega}\right) = j\omega$. If $n \neq 0$, then the signal $x[n]$ is given by, [1.5 marks]

A. $(-1)^n$
B. $\frac{(-1)^n}{n}$
C. $\frac{1}{n}$
D. $n(-1)^n$

The correct answer is Option B.

Q. 4.

Consider the AM demodulator circuit shown below. Assume that R_s is the source resistance, R_l is the load resistance and the diode is an ideal one. Also, assume that ω_c and ω_m are the carrier and message signal bandwidth, respectively. Which of the following condition must be true for the circuit to operate as desired? [1.5 marks]



A. $\frac{2\pi}{\omega_c} \ll R_sC$

B. $\frac{2\pi}{\omega_m} \ll R_lC \ll \frac{2\pi}{\omega_c}$

C. $\frac{2\pi}{\omega_c} \ll R_sC \ll \frac{2\pi}{\omega_m}$

D. $\frac{2\pi}{\omega_c} \ll R_lC \ll \frac{2\pi}{\omega_m}$

The correct answer is Option D.

Q. 5.

A sinusoidal signal is modulated by AM with sensitivity of 20%. The ratio of power in each sideband to the carrier power is, [1.5 marks]

A. 1 : 4

B. 1 : 8

C. 1 : 10

D. 1 : 100

The correct answer is Option D.

Q. 6.

The output *signal-to-quantizing-noise ratio* $(SNR)_o$ in a PCM system is defined as,

$$\left(\frac{S}{N_q}\right)_{0\text{dB}} = 1.76 + 20\log L$$

where, L is the number of quantization levels. A CD recording system samples each of two stereo signals with 16-bit analog-to-digital converter (ADC) at a rate of 44.1 kilo-bit per second (Kbps). Output signal-to-quantizing-noise ratio (rounded-off to nearest integer) for the system is, [1.5 marks]

A. 90 dB

B. 95 dB

C. 98 dB

D. 100 dB

The correct answer is Option C.

Q. 7.

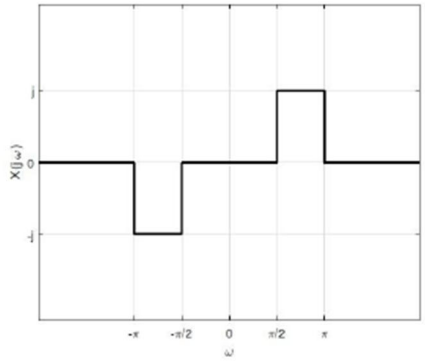
Convolution of two functions $y_1[n] = \alpha^n u[n]$ and $y_2[n] = \alpha^{-n} u[-n]$, for $0 < \alpha < 1$ results into, [1.5 marks]

A. an even function
B. an odd function
C. neither even nor odd
D. None of these

The correct answer is Option A.

Q. 8.

Consider the FT of a signal shown below. FT of the sampled version of the continuous time signal will be _____and _____signal if the sampling interval is set to $\frac{1}{2}$ and 2, respectively. [1.5 marks]



A. even, even
B. even, odd
C. odd, even
D. odd, odd

The correct answer is Option D.

Q. 9.

Consider the signal $x(t) = \sin(4\pi t) + \cos\left(6\pi t + \frac{\pi}{4}\right)$. The non-zero FS coefficients of the signal are, [1.5 marks]

A. $a_1, a^*_{-1}, a_2, a^*_{-2}$
B. $a_2, a^*_{-2}, a_3, a^*_{-3}$
C. $a_1, a^*_{-1}, a_3, a^*_{-3}$
D. a_3, a^*_{-3}

The correct answer is Option B.

Q. 10.

The main difference between narrow-band frequency modulation and amplitude modulation is, [1.5 marks]

A. change in amplitude
B. change in frequency
C. change in phase
D. None of these

The correct answer is Option C.

Q. 11.

Consider a system whose input and output, $x(t)$ and $y(t)$, respectively, are related by, [1.5 marks]

$$\frac{dy(t)}{dt} + ay(t) = x(t)$$

Given that a is a constant, the system will be linear if,

A. a is 1 and $y[0] > 0$
B. $a < 0$ and $y[0] \neq 0$
C. $y[0] = 0$
D. $y[0] \neq 0$

The correct answer is option C.

Q. 12.

A PCM system uses uniform quantizer followed by a 7-bit binary encoder.The bit rate of the system is 50 Mbps. The system can support maximum message bandwidth (rounded-off to two decimal place) of _____for satisfactory operation. [1.5 marks]

A. 3.42 MHz
B. 3.49 MHz
C. 3.53 MHz
D. 3.57 MHz

The correct answer is Option D.

Q. 13.

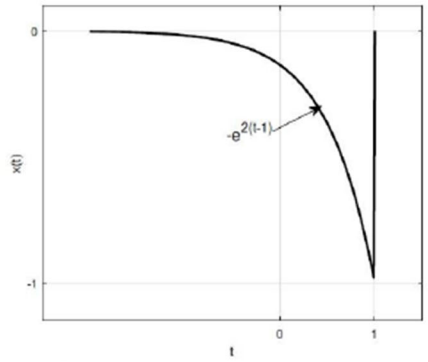
Consider an angle modulated signal, $x(t) = 10\cos\left[(10)^8\pi t + 5\sin(2\pi(10)^3 t)\right]$. Maximum frequency deviation of the signal is, [1.5 marks]

A. 2 KHz
B. 5 KHz
C. 10 KHz
D. 12 KHz

The correct answer is Option B.

Q. 14.

A system with impulse response $h(t) = u(t+1)$ is applied with the following input signal, [1.5 marks]



The system's steady state response is,

A. 0

B. -1.0

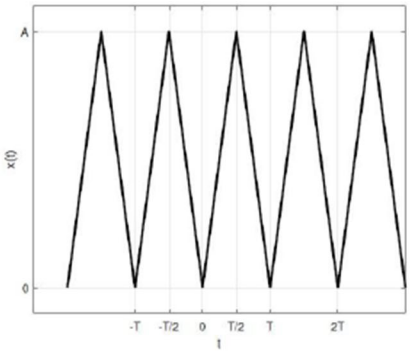
C. 1.0

D. -0.5

The correct answer is Option D.

Q. 15.

Consider the signal below. If the signal is expressed as complex exponential Fourier series, The coefficients c_{-2} and c_1 will be, [1.5 marks]



A. $0, 0$

B. $\frac{T}{4}\left(\frac{A}{\pi}\right)^2, 0$

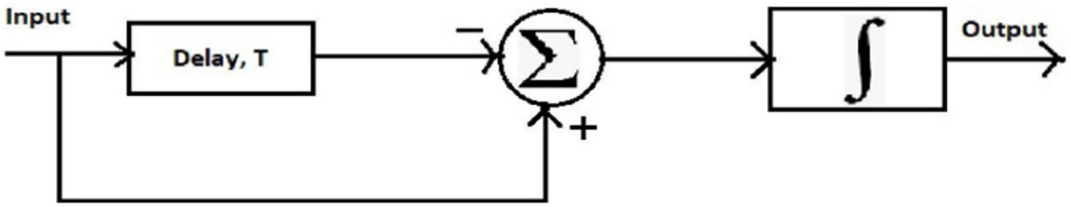
C. $0, -T\left(\frac{A}{\pi}\right)^2$

D. $0, -\frac{T}{2}\left(\frac{A}{\pi}\right)^2$

The correct answer is Option C.

Q. 16.

Consider the zero-order hold circuit shown below. The circuit acts as a _____filter. [1.5 marks]



A. Low-pass
B. High-pass
C. Bandpass
D. All pass

The correct answer is Option A.

Q. 17.

Relation between sequences $y[n]$ and $x[n]$ is given below. It is known that $X(\Omega)$ denote DTFT of $x[n]$. Therefore, expression of $Y(\Omega)$ is given by, [1.5 marks]

$$y[n] = \begin{cases} x[n], & \text{if } n \text{ even} \\ 0, & \text{if } n \text{ odd.} \end{cases}$$

A. $\frac{1}{2}\left[X(\Omega) - X(\Omega - \pi)\right]$
B. $\frac{1}{2}\left[X(\Omega + \pi) - X(\Omega)\right]$
C. $\frac{1}{2}\left[X(\Omega + \pi) + X(\Omega)\right]$
D. $\frac{1}{2}\left[X(\Omega) + X(\Omega - \pi)\right]$

The correct answer is Option D.

Q. 18.

Consider the periodic signal $x[n] = 2\sin\left(\frac{14\pi}{19}n\right) + \cos\left(\frac{10\pi}{19}n\right) + 1$. If the signal is expressed in exponential Fourier series, the Fourier coefficient for $k = 2$ is, [1.5 marks]

A. 0
B. $-j$
C. j
D. 1

The correct answer is Option A.

Q. 19.

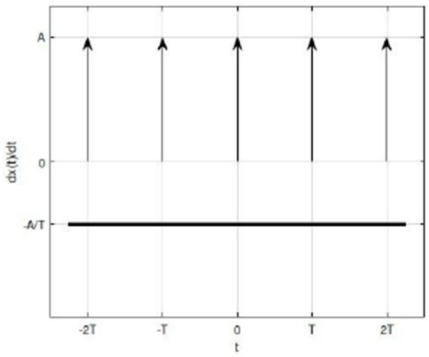
Consider an angle modulated signal, $x(t) = 10\cos\left[2\pi(10)^6\pi t + 0.1\sin((10)^3\pi t)\right]$. Assuming that the signal has been frequency modulated with $k_f = 10\pi$, amplitude of the message signal is, [1.5 marks]

A. 1
B. 2
C. 5
D. 10

The correct answer is Option D.

Q. 20.

Consider a signal $x(t)$ whose first derivative is shown below. If the signal $x(t)$ is expressed in trigonometric Fourier series, the coefficient a_0 is, [1.5 marks]



A. 0
B. $\frac{A}{2}$
C. $-\frac{A}{2}$
D. A

The correct answer is Option D.