

University of Mumbai

Examination Summer 2022

Time : 2 hours 30 minutes      ECC404:SIGNALS AND SYSTEM

Max. Marks :80

Q1.	Choose the correct option for the following questions . All the questions are compulsory and carry equal marks.
1.	A discrete signal is said to be even or symmetric if $x(-n)$ is equal to
Option A	$x(n)$
Option B	$-x(n)$
Option C	$-x(-n)$
Option D	0
2.	Under what conditions the three signals $x(t)$ , $y(t)$ and $z(t)$ with period $t_1$ $t_2$ and $t_3$ respectively are periodic?
Option A	$t_1/t_2/t_3 = \text{rational}$
Option B	All the ratios of the three periods in any order is rational
Option C	$t_1/t_2$ is rational
Option D	$t_1/t_2 = t_2/t_3$
3.	What is the period of the signal: $2\cos t/6$ ?
Option A	$16\pi$
Option B	$10\pi$
Option C	$8\pi$
Option D	$12\pi$
4.	After converting the input and output to a dummy variable, the next step of convolution is _____
Option A	Shift the impulse response
Option B	Changing the dummy variables

Option C	Shifting any one of the signals to left side i.e towards the negative direction
Option D	Shift the input
5.	The continuous time system described by the equation $y(t) = x(t^2)$ comes under which category
Option A	causal, linear and time varying
Option B	non causal, linear and time-variant
Option C	non causal, non-linear and time-invariant
Option D	causal, non-linear and time varying
6.	Find auto correlation of $x(n) = \{1, 2, 3, 4\}$
Option A	4, 11, 20, 30, 11, 20, 4
Option B	4, 11, 20, 30, 20, 11, 4
Option C	4, 20, 3, 5, 11, 2, 4
Option D	4, 2, 11, 5, 3, 20, 4
7.	Find circular convolution of periodic signals $x(n) = \{1, 2, 3, 4\}$ and $h(n) = \{2, 2, 1, 1\}$
Option A	15, 13, 12, 17
Option B	17, 2, 13, 5
Option C	15, 13, 15, 17
Option D	5, 13, 2, 17
8.	What is the convolution of a signal with an impulse?
Option A	A new signal
Option B	Signal multiplied by impulse
Option C	Impulse
Option D	Signal itself
9.	Which of the following responses of an LTI system does not depend on initial conditions?

Option A	Natural response
Option B	free response
Option C	forced response
Option D	total response
10.	The Fourier transform of a function is equal to its two-sided Laplace transform evaluated _____
Option A	On the real axis of the s-plane
Option B	On the line parallel to the real axis of the s-plane
Option C	On the imaginary axis of the s-plane
Option D	On the line parallel to the imaginary axis of the s-plane
11.	Which of the following is an energy signal?
Option A	$x(t)=A e^{j\Omega t}$
Option B	$x(t)=A \sin \Omega t$
Option C	$x(t)=B \cos \Omega t$
Option D	$x(t)=e^{-at} u(t)$
12.	$Y(t) = x(t/5)$ is _____
Option A	Amplitude scaled signal by factor 1/5
Option B	Time shifted signal
Option C	Expanded signal
Option D	Compressed signal
13.	The Fourier transform of a $x(t)= e^{7t} u(-t)$ function is given as:
Option A	$F(j\omega) = 1/(7+j\omega)$
Option B	$F(j\omega) = 7/(1+j\omega)$
Option C	$F(j\omega) = 7/(1-j\omega)$
Option D	$F(j\omega) = 1/(7-j\omega)$
14.	In the equation $x(t) = be^{at}$ if $a < 0$ , then it is called _____

Option A	Decaying exponential
Option B	Both Growing and Decaying exponential
Option C	Complex exponential
Option D	Growing exponential
15.	Find the Z-transform of $\delta(n+3)$ .
Option A	1
Option B	$z$
Option C	$z^2$
Option D	$z^3$
16.	The step function $u(t)$ is integral of _____ with respect to time $t$ .
Option A	Exponential function
Option B	Impulse function
Option C	Ramp function
Option D	Sinusoidal function
17.	Find the Z-transform of $u(-n)$ .
Option A	$1/(1-z)$
Option B	$1/(1+z)$
Option C	$z/(1-z)$
Option D	$z/(1+z)$
18.	For what kind of signals one sided z-transform is unique?
Option A	All signals
Option B	Anti-causal signal
Option C	Causal signal
Option D	Non-causal
19.	What is the one-sided z-transform of $x(n)=\delta(n-k)$ ?

Option A	0
Option B	1
Option C	$z^{-k}$
Option D	$z^k$
20.	Linear convolution between two sequences $x_1(n) = \{-1, 1, 2, -2\}$ and $x_2(n) = \{0.5, 1, -1, 2, 0.75\}$ is
Option A	$\{-0.3, -0.6, 3, -2, -2.75, 6.75, -2.5, -1.6\}$
Option B	$\{-0.1, -0.5, 3, -4, -2.75, 9.75, -2.5, -1.5\}$
Option C	$\{-0.5, -0.5, 3, -2, -2.75, 6.75, -2.5, -1.5\}$
Option D	$\{-0.5, -0.4, 1, -2, -2.75, 6.75, -2.5, -1.5\}$
21.	Find the final value, $x(\infty)$ in time domain for the s-domain signal $X(s) = s/(s^2+4)$ .
Option A	0
Option B	1
Option C	0.25
Option D	1.25
22.	Which of the following systems is stable?
Option A	$y(t) = \exp(x(t))$
Option B	$y(t) = \log(x(t))$
Option C	$y(t) = tx(t) + 1$
Option D	$y(t) = \sin(x(t))$
23.	The convolution of $u(n)$ with $u(n-4)$ at $n=5$ is
Option A	5
Option B	2
Option C	1

Option D	0
24.	The samples of a cosine wave at zero frequency are equivalent to samples of
Option A	Sine wave
Option B	A DC signal
Option C	A cosine wave
Option D	An unknown signal
25.	Determine whether the signal, $x(t)=3 \cos 2 t + 7 \cos 5 \pi t$ is periodic or not
Option A	Non-Periodic
Option B	Periodic
Option C	Rational
Option D	Irrational
26.	If input to a system is not bounded , then system is
Option A	stable
Option B	Unstable
Option C	Cannot be tested
Option D	ideal
27.	Which one of the following systems is causal?
Option A	$y(t)=x(t)+x(t-3)+x(t^2)$
Option B	$y(n)=x(n+2)$
Option C	$y(t)=x(t-1)+x(t-2)$
Option D	$y(n)=x(2n^2)$
28.	Find the Nyquist rate and Nyquist interval for the signal $f(t)=(\sin 500\pi t) / \pi t$ .
Option A	500 Hz, 2 sec
Option B	500 Hz, 2 msec
Option C	2 Hz, 500 sec

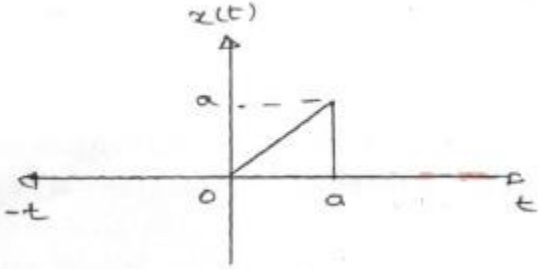
Option D	2 Hz, 500 msec
29.	The impulse response $h(t)$ of an LTI system is given by $e^{-2t}u(t)$ . What is the step response?
Option A	$y(t) = \frac{1}{2}(1 - e^{-2t})u(t)$
Option B	$y(t) = \frac{1}{2}(1 - e^{-2t})$
Option C	$y(t) = (1 - e^{-2t})u(t)$
Option D	$y(t) = \frac{1}{2}(e^{-2t})u(t)$
30.	Fourier transform is evaluation of Laplace transform along the_____axis in s-plane.
Option A	Real
Option B	Imaginary
Option C	Z domain
Option D	S domain
31.	Determine the convolution of $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-6t}u(t)$ , using Fourier Transform?
Option A	$0.25(e^{-2t} - e^{-6t})u(t)$
Option B	$0.15(e^{-2t} - e^{-6t})u(t)$
Option C	$0.25(e^{-3t} - e^{-6t})u(t)$
Option D	$0.35(e^{-2t} - e^{-5t})u(t)$
32.	In IIR systems, the_____structure will give direct relation between time domain and z domain.
Option A	Direct form-I
Option B	Direct form
Option C	Linear phase
Option D	Direct form-II
33.	Where does the maximum value of auto-correlation function of a power signal occur?
Option A	At unity

Option B	At origin
Option C	At extremities
Option D	At infinity
34.	Determine the Time period of: $x(t)=3 \cos(20t+5)+\sin(8t-3)$ .
Option A	2/5 sec
Option B	1/10 sec
Option C	1/20 sec
Option D	2/4 sec
35.	Which among the following is a LTI system?
Option A	$y(t)=x(t)\cos\pi t$
Option B	$y(n)=x(n)+nx(n-1)$
Option C	$dy(t)/dt+ty(t)=x(t)$
Option D	$y(n)=x^3(n+1)$
36.	$\partial(at) = 1/a \partial(t)$ , this property of unit impulse is called _____
Option A	Time scaling property
Option B	Time shifting property
Option C	Time reversal property
Option D	Amplitude scaling property
37.	For energy signal _____ Select one
Option A	$E = \infty$
Option B	$E = 0$
Option C	$P = 0$
Option D	$P = \infty$
38.	The impulse response of a continuous time LTI system is $H(t) = e^{-t} u(t-2)$ . The system is _____



Option A	Neither causal nor stable
Option B	Causal but not stable
Option C	Stable but not causal
Option D	Causal and stable
39.	Find the value of $h[n]*d[n-5]$ , $d[n]$ being the delta function
Option A	$h[n-4]$
Option B	$h[n-5]$
Option C	$h[n-2]$
Option D	$h[n+5]$
40.	Which of the following is not a fourier transform pair?
Option A	$u(t) \leftrightarrow \pi\delta(\omega) + 1/j\omega$
Option B	$\text{sgn}(t) \leftrightarrow 2/j\omega$
Option C	$A \leftrightarrow 2\pi\delta(\frac{\omega}{2})$
Option D	$G(t) \leftrightarrow \text{sinc}(\frac{\omega\tau}{2})$

Q2	Questions of 5 marks each
1	State and prove any two properties of Fourier Transform.
2	Determine the following systems are memory less, causal, linear or Time invariant $y(t)=5x(t) + 2$
3	Using Laplace Transform, determine the natural response of the system represented by the following equations. $(d^2y(t)/dt^2) + 10 (dy(t)/dt) + 21 y(t) = 8 x(t)$ , $y(0)=2$ , $(dy(t)/dt) = -3$ at $t=0$
4	Explain in brief the ROC conditions in Laplace Transform.
5	Determine the autocorrelation of the CT signal given by $x(t)=A \text{ rect } (t/2)$ .
6	The Impulse response of DT system is given by $h[n] = \{1, 2, 3\}$ and the output response is given by $y[n] = \{1, 1, 2, -1, 3\}$ , Using Z-Transform, determine $x[n]$ by long division method.
7.	Determine energy and power of signal $x(t) = \cos 5\omega t$

8.	Test the given system for linearity, causality, stability and time variance $y(t) = x\left(\frac{t}{2}\right)$
9.	Find initial and final value of given Z domain signal $X(Z) = \frac{2Z^{-1}}{1 - 1.8Z^{-1} + 0.8Z^{-2}}$
10.	Realize the following FIR system with minimum number of multipliers $h(n) = \{-0.5, 0.8, -0.5\}$
11.	List any 5 properties of Z transform
12.	Find the response of time invariant system with impulse response $h(n) = \{1, 2, 1, -1\}$ to an input signal $x(n) = \{1, 2, 3, 1\}$
13.	Explain any five types of elementary signals with mathematical equations and graphical plot.
14.	Find the fundamental period of the signal $x(t) = \sin\left(\frac{2\pi t}{6}\right) - \cos \pi t$
15.	Find $x(-2t)$ and $x(3t+2)$ 
16.	Find the even and odd part of following signals 1) $x(t) = 3 + 2t + 5t$ 2) $\sin 2t + \cos t + \sin t \cos 2t$
17.	Determine energy and power of unit step signal
19.	Find laplace transform of $u(t) - u(t-a)$
20.	Find inverse Z transform of $X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$
21.	Determine initial and final value using initial and final value theorems for $X(s) = \frac{s+1}{s^2+2s+2}$

<b>Q3.</b>	<b>Questions of 10 marks each</b>
1.	Consider a causal LTI system with $H(j\omega) = (j\omega + 2)^{-1}$ . For a particular input $x(t)$ , this system produces output $y(t) = e^{-2t} u(t) - e^{-3t} u(t)$ . Find out $x(t)$ using Fourier Transform.
2.	A LTI system has the following transfer function

	$H(z) = \frac{z}{(z - \frac{1}{4})(z + \frac{1}{4})(z - \frac{1}{2})}$ <p>Give all possible ROC condition  a) Show pole-zero diagrams  b) Find impulse response of system  c) Comment on the system stability and causality for all possible ROC's</p>
3.	<p>Obtain Inverse Laplace Transform of the function <math>X(s) = (3s+7)/(s^2 - s - 12)</math> for following ROCs, also comment on the stability and causality of the systems for each of the ROC conditions.  Support your answer with appropriate sketches of ROCs.</p> <p>i. <math>\text{Re}(s) &gt; 4</math>  ii. <math>\text{Re}(s) &lt; -3</math></p>
4.	<p>A discrete time signal is given by <math>x[n] = \{1, 1, 1, 1, 2\}</math>  Sketch the following signals a) <math>x[n-2]</math> b) <math>x[n+1]</math> c) <math>x[3-n]</math> d) <math>x[n]u[n-1]</math> e) <math>x[n-1]\delta[n-1]</math></p>
5.	<p>Find the autocorrelation, power and PSD of  <math>x(t) = 3 \cos t + 4 \cos 3t</math></p>
6.	<p>Find inverse laplace transform of</p> $X(s) = \frac{4}{(s+2)(s+4)}$ <p>if ROC is  i) <math>-2 &gt; \text{Re}\{s\} &gt; -4</math> ii) <math>\text{Re}\{s\} &lt; -4</math> iii) <math>\text{Re}\{s\} &gt; -2</math></p>
7.	<p>Using Laplace transform determine complete response of system described by following equation</p> $\frac{d^2 y(t)}{dt^2} + 6 \frac{dy(t)}{dt} + 8y(t) = \frac{dx(t)}{dt} + x(t)$ <p>where <math>y(0) = 1</math> <math>\frac{dy(0)}{dt} = 3</math> for input <math>x(t) = u(t)</math></p>
8.	<p>Determine the convolution of <math>x_1(t) = e^{-3t}u(t)</math> and <math>x_2(t) = e^{-5t}u(t)</math> using fourier transform</p>
9.	<p>Find the digital network in cascade and parallel form realizations for the system described by the difference equation</p> $y(n) = \frac{-3}{8}y(n-1) + \frac{3}{32}y(n-2) + \frac{y(n-3)}{64} + x(n) + 3x(n-1) + 2x(n-2)$

10.	Find linear phase realization of $H(z)$ $H(z) = \frac{1}{4} + \frac{z^{-1}}{2} + \frac{3z^{-2}}{4} + \frac{z^{-3}}{2} + \frac{z^{-4}}{4}$
11.	Find fourier transform of $\text{sgn}(t)$
12.	Find the impulse response $h(n)$ of the system if the spectrum is given by $H(e^{jw}) = \frac{1}{3} (1 + \cos w)$
13.	Determine fourier transform of the gate function $x(t) = A$ for $ t  \leq \frac{\tau}{2}$
14.	Find initial and final value using laplace transform $X(s) = \frac{7s+6}{s(3s+5)}$
15.	Explain relation of ESD, PSD with autocorrelation
16.	Find response of LTI system if impulse response of the system is $h(t) = 2e^{-3t}u(t)$ for input $x(t) = 2e^{-5t}u(t)$ using fourier transform
17.	Determine fourier transform of $x(t) = 1-t^2$ ; for $ t  < 1$ $= 0$ ; for $ t  > 1$
18.	Sketch the following signals for the given signal shown 1) $x(-t)$ 2) $x(2t+5)$ 3) $x(2t)$ 4) $x(t/2)$ 5) $-2x(t)$ 
19.	Given DT sequence: $x(n) = 0.4\delta(n+2) + 0.2\delta(n+1) + 0.1\delta(n) + 0.2\delta(n-1) + 0.4\delta(n-2)$ Determine the following: i. $Xe^{jw}$ ii. $ Xe^{jw} $ iii. Phase $\{X(e^{jw})\}$ iv. $\int_0^{2\pi}  X(e^{jw}) ^2 dw$

## University of Mumbai

Examination Summer 2022

Time : 2 hours 30 minutes

Max. Marks :80

Question	Correct Option
Q1.	A
Q2.	B
Q3.	D
Q4.	C
Q5.	B
Q6.	B
Q7.	C
Q8.	D
Q9.	C
Q10.	C
Q11.	D
Q12.	C
Q13.	D
Q14.	A
Q15.	D
Q16.	B
Q17.	A
Q18.	C
Q19.	C
Q20.	C
Q21.	A
Q22.	D

Q23.	B
Q24.	B
Q25.	A
Q26.	B
Q27.	C
Q28.	B
Q29.	A
Q30.	B
Q31.	A
Q32.	A
Q33.	B
Q34.	A
Q35.	D
Q36.	A
Q37.	C
Q38.	D
Q.39.	B
Q.40	D