

University of Mumbai
Examinations Summer 2022

Time: 2 hour 30 minutes

Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks. (2 marks each) (20 Marks)
1.	If $x(-t) = x(t)$ then the signal is said to be _____
Option A:	Even signal
Option B:	Odd signal
Option C:	Periodic signal
Option D:	Non periodic signal
2.	Given a unit step signal $u(n)$, the time difference $[u(n)-u(n-1)]$ is equal to
Option A:	a unit impulse signal
Option B:	another step signal
Option C:	a unit ramp signal
Option D:	None of there
3.	The unit impulse is defined as
Option A:	$\delta(t) = \infty; t = 0$
Option B:	$\delta(t) = \infty; t = 0$ $=0; t \neq 0$
Option C:	$\delta(t) = \infty; t = 0$ and $\int_{-\infty}^{\infty} \delta(t) dt = A$
Option D:	$\delta(t) = \infty; t = 0$ $=0; t \neq 0$ And $\int_{-\infty}^{\infty} \delta(t) dt = 1$
4.	A periodic signal $x(n)$ of period $N1$ is added to another periodic signal of period $N2$. Then the period of the resulting signal is always
Option A:	$N1+N2$
Option B:	$N1N2$
Option C:	LCM of $N1$ and $N2$
Option D:	GCD of $N1$ and $N2$
5.	What does the zero-state response of the system means?
Option A:	Response of the system when initial state of the system is zero
Option B:	Response of the system due to input alone
Option C:	Response of the system due to input alone when initial state of the system is zero
Option D:	Response of the system due to input alone when initial state is neglected
6.	For $H(z)$ the ROC of the stable LTI system is given as
Option A:	Entire z -plane, except at $z=0$
Option B:	Entire z -plane, except at $z=\infty$
Option C:	Contain unit circle
Option D:	ROC does not exist
7.	An LTI system is said to be causal when
Option A:	the value of an impulse response is zero for all negative values of time

Option B:	the value of an impulse response is unity for all negative values of time
Option C:	the value of an impulse response is infinity for all negative values of time
Option D:	the value of an impulse response is negative for all negative values of time
8.	A LTI system is _____ if $\sum h(n) < \infty$. Here the summation is absolutely summable
Option A:	stable
Option B:	causal
Option C:	unstable
Option D:	time invariant
9.	The IIR filter designing involves
Option A:	Designing of digital filter into digital domain and transforming into analog domain
Option B:	Designing of analog filter into digital domain and transforming into analog domain
Option C:	Designing of digital filter into analog domain and transforming into digital domain
Option D:	Designing of analog filter into analog domain and transforming into digital domain
10.	A filter is said to be linear phase filter if the phase delay and group delay are _____
Option A:	High
Option B:	Moderate
Option C:	Low
Option D:	Constant

Q2.	Solve any Four out of Six. (5 marks each)	(20 Marks)
A	Determine Even and Odd parts of the signal $x(n) = \{2, -2, 6, -2\}$	
B	Explain any five properties of Z transform	
C	Find the Trigonometric Fourier series for the periodic signal shown in figure	
D	Find IDFT of $X(K) = \{4, -j2, 0, j2\}$ using DFT by matrix method.	
E	State the advantages and limitations of digital filters.	
F	Find the order of the IIR filter for a given specification using Bilinear Transformation method.	
$0.8 \leq H(e^{j\omega}) \leq 1 \text{ ----- } 0 \leq \omega \leq 0.2\pi$ $ H(e^{j\omega}) \leq 0.2 \text{ ----- } 0.6\pi \leq \omega \leq \pi$		

Q3.	Solve any Two Questions out of Three. (10 marks each) (20 Marks)
A	Determine the impulse response and step response of the causal system given below and discuss on stability $y(n) - y(n-1) - 2y(n-2) = x(n-1) + 2x(n-2)$
B	Find DFT of the sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using radix-2 DIT FFT algorithm
C	Discuss the design procedure for low pass digital Butterworth IIR filter.

Q4.	(20 Marks)
A	Solve any Two. (5 marks each)
i.	Check whether the system $y(n) = x(n) x(n-2)$ is 1.Static or dynamic 2.Linear or nonlinear 3.Causal or non-causal, and 4.Shift-invariant or shift-variant
ii.	Design an FIR digital filter to approximate an ideal low pass filter with passband gain of unity, cut off frequency of 850 Hzs and working at a sampling frequency of $f_s = 5000$ Hz. The length of the impulse response should be 5. Use a rectangular window.
iii.	Discuss Rectangular and Hamming windows used to design FIR filters.
B	Solve any One. (10 marks each)
i.	Determine the inverse Z-transform of $X(Z) = \frac{z}{3z^2 - 4z + 1}$ if the ROC are: <ol style="list-style-type: none"> 1. $z > 1$, 2. $z < \frac{1}{3}$ 3. $\frac{1}{3} < z < 1$
ii.	A linear shift invariant system is described by the difference equation, $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1)$ with $y(-1) = 0$ and $y(-2) = -1$. Find the natural response of the system