Q.4 i. What is an LTI system? Explain its properties. **4**

ii. Check whether the following are linear, static, Time Invariant, Causal and stable **6**

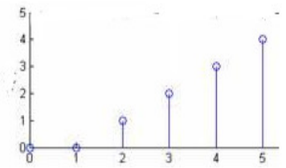
(a) $y(t)=t^2x(t-1)$ (b) $y(t)=5x(t)+10$

OR iii. For a system excited by $x(t) = e^{-2t}\,u(t)$, the impulse response is $h(t) = e^{-3t}\,u(t) - e^{-4t}\,u(t)$. Find the output y(t) for this system? **6**

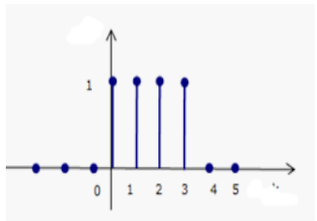
Q.5 Attempt any two:

i. (a) Define convolution sum & its two properties? **5**

(b) Perform convolution between x(n) and h(n) given in figure:



x(n)



h(n)

ii. Find the Discrete-Time System response y(n) when **5**

(a) $x(n)=u(n)$,$h(n)=\alpha^n u(n)$

(b) $x(n)=\{1,3\}$,$h(n)=\{2,4\}$

iii. Determine the Unit Impulse response of the system given by $y(n)-4y(n-1)+4y(n-2)=2x(n)$. where x(n), y(n) are input & output respectively **5**

Q.6 i. (a) Define Z-transform. Give its advantages and limitations. **4**

(b) Compare Z-transform and Laplace Transforms.

ii. Prove that sequences **6**

$x_1= a^n u(n)$ and $x_2= -a^n u(-n-1)$ have the same z-transform and different ROC. Also Plot their ROCs.

OR iii. (a) Find out Z-Transform for the following also plot their ROC. **6**

(I) $x(n)=\cos \omega n\, u(n)$ (II) $x(n)=e^{-j\omega n}$

(III) $x(n)=\{1,2,5,7,0,1\}$

(b) Find inverse Z-transform of following function

$X(z)= \frac{z}{(3z2-4z+1)}$ when ROC :|Z|>1

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Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

EC3CO01 / EI3CO01 / EE3CO06 / EX3CO06

Signals and Systems

Programme: B.Tech. Branch/Specialisation: EC/EE/EI/EX

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. $y(t) = x(t/3)$ is _____ **1**

(a) Compressed signal

(b) Expanded signal

(c) Time shifted signal

(d) Amplitude scaled signal by factor 1/3

ii. The step function u(t) is integral of _____ with respect to time t. **1**

(a) Ramp function (b) Impulse function

(c) Sinusoidal function (d) Exponential function

iii. DFT is applied to **1**

(a) Infinite sequences

(b) Finite discrete sequences

(c) Continuous infinite signals

(d) Continuous finite sequences

iv. A band pass signal extends from 1 KHz to 2 KHz. The minimum sampling frequency that is needed to retain all information of the sampled signal is _____ **1**

(a) 1 KHz (b) 4 KHz (c) 2 KHz (d) 3 KHz

v. Which of the following is true for continuous time stable systems? **1**

(a) $\int_{-\infty}^{\infty} |h(\tau)|d\tau < \infty$. (b) $\int_{-\infty}^{\infty} |h(\tau)|d\tau > \infty$

(c) $\int_{-\infty}^{\infty} |h(\tau)|d\tau \leq \infty$ (d) $\int_{-\infty}^{\infty} |h(\tau)|d\tau \geq \infty$

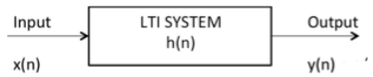
vi. When two LTI systems with impulse responses $h_a(t)$ and $h_b(t)$are cascaded then equivalent response is given by _____ **1**

(a) $h(t) = h_a(t) + h_b(t)$ (b) $h(t) = h_a(t) – h_b(t)$

(c) $h(t) = h_a(t)\, h_b(t)$ (d) $h(t) = h_a(t) * h_b(t)$

[2]

vii. Discrete Convolution of following system can be expressed as **1**



(a) $y(n)=\sum_{n=-\infty}^{\infty} x(k)h(n-k)$

(b) $y(n)=\sum_{n=-\infty}^{\infty} x(n-k)h(k)$

(c) y(n)=x(n)*h(n)

(d) All of these

viii. When a discrete time LTI system is said to be causal? **1**

(a) Output y[n] must not depend on x[k] for k>n

(b) Output y[n] must not depend on x[k] for k=n

(c) Output y[n] must not depend on x[k] for k<n

(d) Output y[n] must depend on x[k] for k>n

ix. The z-transform of a^k u[k] **1**

(a) $\frac{z}{z-a}$ (b) $\frac{z}{a-z}$ (c) $\frac{2z}{z-a}$ (d) $\frac{a}{z-a}$

x. The similarity between the DTFT and the z transform is that **1**

(a) Both convert frequency spectrum domain to discrete time domain

(b) Both convert discrete time domain to frequency spectrum domain

(c) Both convert analog signal to digital signal

(d) Both convert digital signal to analog signal

Q.2 i. Prove that the signal x(t) and y(t) are orthogonal over the interval [0,4] . Where **2**

$$x(t)=\begin{cases}1,0<t<1\\-1,1<t<3\\1,3<t<4\end{cases} \quad y(t)=\begin{cases}1,0<t<2\\-1,2<t<4\end{cases}$$

ii. Write the mathematical expression along with diagram for following function: **3**

(a) Signum function,

(b) Impulse function

(c) Shifted unit step function (right side shift t_0)

(d) Continuous time exponential signal

(e) Sinusoidal signal with phase φ

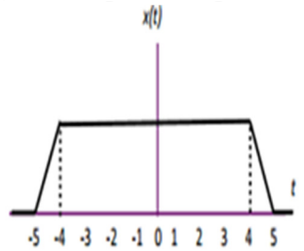
(f) Unit Ram function

iii. Examine whether the following signal are periodic. If so find fundamental period. **5**

(a) $x(t)=\cos 50\pi t+cos\ 60\pi t$ (b) $1+e^{j2\pi t}+e^{j4\pi t}$

[3]

OR iv. (a) The trapezoidal pulse $x(t)$ shown is defined by **5**



$$x(t)=\begin{cases}5-t,4\le t\le 5\\-1,-4\le t\le 4\\t+5,-5\le t\le -4\end{cases}$$

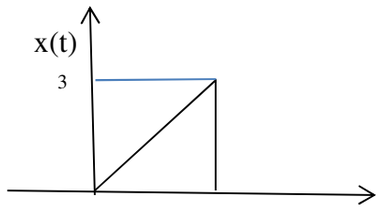
Find the total energy of $x(t)$.

(b) Perform and sketch following operations

I. x(3t+2)

II. x(-2t-1)

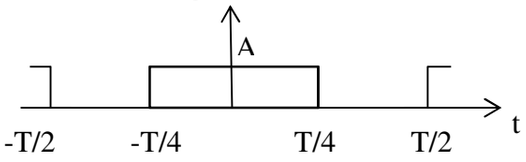
on the given signal x(t) shown in figure.



Q.3 i. What are the fundamental differences between continuous and discrete time signals explain? **2**

ii. (a) Explain any four properties of Fourier transform. **8**

(b) Obtain the Fourier component of the periodic rectangular waveform shown in figure



OR iii. (a) Determine the Fourier Transform of following function: **8**

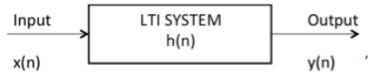
I. $100\ e^{-10t}$ II. $x(t)=\begin{cases}10,0<t<2\\0,Otherwise\end{cases}$

(b) Determine the DFS of following periodic signal

$$x[n]=\{\ldots.0,1,2,3,0,1\underset{\Downarrow}{,}2,3,0,1,2,3\ldots\}\text{where, N=4.}$$

P.T.O.

Marking Scheme
EC3CO01 / EI3CO01 / EE3CO06 / EX3CO06
Signals and Systems

Q.1	i.	y(t) = x(t/3) is _____ (b) Expanded signal	**1**
	ii.	The step function u(t) is integral of _____ with respect to time t. (b) Impulse function	**1**
	iii.	DFT is applied to (b) Finite discrete sequences	**1**
	iv.	A band pass signal extends from 1 KHz to 2 KHz. The minimum sampling frequency that is needed to retain all information of the sampled signal is _____ (c) 2 KHz	**1**
	v.	Which of the following is true for continuous time stable systems? (a) $\int_{-\infty}^{\infty} \lvert h(\tau)\rvert d\tau < \infty$.	**1**
	vi.	When two LTI systems with impulse responses $h_a(t)$ and $h_b(t)$are cascaded then equivalent response is given by _____ (d) $h(t) = h_a(t) * h_b(t)$	**1**
	vii.	Discrete Convolution of following system can be expressed as  (d) All of these	**1**
	viii.	When a discrete time LTI system is said to be causal? (a) Output y[n] must not depend on x[k] for k>n	**1**
	ix.	The z-transform of $a^k u[k]$ (a) $\frac{z}{z-a}$	**1**
	x.	The similarity between the DTFT and the z transform is that (b) Both convert discrete time domain to frequency spectrum domain	**1**
Q.2	i.	Prove that the signal x(t) and y(t) are orthogonal over the interval [0,4] .	**2**
	ii.	Write the mathematical expression along with diagram for following function:0.5 mark for each (0.5 mark * 6)	**3**
	iii.	(a) $x(t) = \cos 50\pi t + cos\ 60\pi t$ 2.5 marks (b) $1+e^{j2\pi t}+ e^{j4\pi t}$ 2.5 marks	**5**
OR	iv.	(a) Find the total energy of $x(t)$ 2.5 marks (b) Perform and sketch following operations I. x(3t+2) 1.25 marks II. x(-2t-1) 1.25 marks	**5**
Q.3	i.	Fundamental differences b/w continuous and discrete time signals	**2**
	ii.	(a) Any four properties of Fourier transform. 3 marks (b) Obtain the Fourier component of the periodic rectangular waveform 5 marks	**8**
OR	iii.	(a) Determine the Fourier Transform of following function: I. $100\ e^{-10t}$ 1.5 marks II. $x(t)=\begin{cases}10, 0<t<2\\0, Otherwise\end{cases}$ 1.5 marks (b) Determine the DFS of following periodic signal 5 marks	**8**
Q.4	i.	Definition of LTI system 1 mark Its properties 3 marks	**4**
	ii.	(a) $y(t)=t^2x(t-1)$ 3 marks. (b) $y(t)=5x(t)+1$ 3 marks	**6**
OR	iii.	Find the output y(t) for this system Stepwise marking	**6**
Q.5		Attempt any two:	
	i.	(a) Define convolution sum & its two properties 2.5 marks (b) Perform convolution between x(n) and h(n) 2.5 marks	**5**
	ii.	Find the Discrete-Time System response y(n) when (a) $x(n)=u(n)$,$h(n)=\alpha^n u(n)$ 2.5 marks (b) $x(n)=\{1,3\}$,$h(n)=\{2,4\}$ 2.5 marks	**5**
	iii.	Determine the Unit Impulse response of the system Stepwise marking	**5**
Q.6	i.	(a) Definition Z-transform with advantages and limitations 2 marks (b) Compare Z-transform and Laplace Transforms 2 marks	**4**
	ii.	Prove the sequences 3 marks Plot their ROCs 3 marks	**6**
OR	iii.	(a) Find out Z-Transform for the following also plot their ROC. 3 marks (b) Find inverse Z-transform of following function 3 marks	**6**

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