Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2018

EE3CO06/EX3CO06 Signals & Systems

Programme: B.Tech. Branch/Specialisation: EE/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. For a signal $x(t)\ \delta$ (t–t_o),the value of integral $\int_{-\infty}^{+\infty} x(t)\ \delta$ (t–t_o) is : **1**

(a) 0 (b) x(t_o) (c) x(t– t_o) (d) δ (t)

ii. The signum function sgn(t) can be written as: **1**

(a) u(t) –1 (b) 1– u(t) (c) 2u(t) – 1 (d) u(t)+u(– t)

iii. The Fourier transform of unit impulse signal δ (t) is: **1**

(a) 1 (b) 0 (c) ω (d) 1/ ω

iv. The trigonometric Fourier series of an odd signal will consist of: **1**

(a) Cosine terms only (b) Sine terms only

(c) Both sine & cosine terms (d) None of these

v. The input output relationship for a system is given by $y(t)=x^2(t)$ is: **1**

(a) Linear time invariant system

(b) Non-linear time variant system

(c) Linear time variant system

(d) Non-linear time invariant system

vi. If the impulse response of a system is h(t),for any arbitrary input x(t),the output y(t) will be: (×, $*$ denotes multiplication & convolution respectively) **1**

(a) x(t) $*$ h(t) (b) x(t)×h(t) (c) δ (t)×h(t) (d) x(t)× δ(t)

vii. The system described by equation y[n]= n x[n] is: **1**

(a) Linear time varying & stable

(b) Non-linear time varying & unstable

(c) Non-linear time varying & stable

(d) Linear time varying & unstable

viii. The unit step response of an LTI system with impulse response h[n]= δ [n] – δ [n– 1] is: **1**

(a) δ [n– 1] (b) δ [n] (c) u[n–1] (d) u[n]

P.T.O.

ix. While mapping from s-plane to z-plane, imaginary axis in s-plane correspond to : **1**
(a) A circle of unit radius in z-plane.
(b) Interior to circle of unit radius in z-plane.
(c) Exterior to circle of unit radius in z-plane.
(d) None of these

x. If '$*$' denotes convolution of discrete time sequence & $y[n]= x_1[n] * x_2[n]$ then Z-transform of y[n] will be: **1**
(a) $Y(z)= X_1(z) \times X_2(z)$ (b) $Y(z)= X_1(z)+X_2(z)$
(c) $Y(z)= X_1(z) -X_2(z)$ (d) $Y(z)= X_2(z) -X_1(z)$

Q.2 i. Explain graphically: **3**
(a) Unit step signal (b) Ramp signal (c) Impulse signal

ii. Plot the following signal graphically and determine energy and power in each case: **7**
(a) $x_1(t) = [(t-1)u(t-1)]-[(t-2)u(t-2)]-[(t-3)u(t-3)]+[(t-4)u(t-4)]$
(b) $x_2(t) = u(t-2) - u(t-4)$

OR iii. (a) For given signal $x(t)= 2u(t)+ 2u(t-1) - 4u(t-2)$ **7**
Perform following operations and plot graphically :
I. $x(t- 2)$ II. $2x(t)$ III. $x(2t)$ IV. $x(- t)$
(b) Determine periodicity for following signals:
I. $x1(t) =2+ \cos(\pi t)$ II. $x_2(t) = \sin^2(2\pi t)$

Q.3 i. List any two Dirichlet condition for existence of Fourier series? **2**

ii. Define sampling and Nyquist sampling theorem? Determine Nyquist rate corresponding to following signals: **8**
(a) $x(t)= \sin(200\pi t)$
(b) $x(t)= \sin(100\pi t)\cos(150\pi t)$
(c) $x(t)=\sin(400\pi t) + \cos(200\pi t)$
(d) $x(t)=\cos^3(200\pi t)$

OR iii. What is the condition of R.O.C in Laplace transform for a L.T.I system to be stable & causal? Give one example of each. **8**
For following system function determine inverse Laplace transform & check whether system is causal & stable? (σ denotes R.O.C)
(a) $H_1(s)= \frac{1}{s^2- s- 6}$ $\sigma > 3$ (b) $H_2(s)= \frac{1}{s^2- s- 6}$ $-2 > \sigma > 3$

Q.4 i. Discuss continuous time system properties (any two) with example? **4**

ii. Graphically evaluate convolution of following signals? **6**
$x_1(t)= u(t- 2) - u(t- 4)$
$x_2(t)= u(t- 3) - u(t- 5)$

OR iii. Determine output y(t) for given differential equation with x(t) as input: **6**
$(D^2 +3D +2)\, y(t) = D\, x(t)$
Input $x(t) =t^2+5t+3$. Initial conditions are $y(0^+)=2$ $\frac{dy}{dt}(0^+)=3$

Q.5 Attempt any two:

i. Discuss classification of discrete time system with example for **5**
(a) Linear & non-linear system (b) Causal & non-causal system

ii. Determine closed form solution of unit impulse response h[n] for system given by: (x[n],y[n] are input & output respectively) **5**
$y[n] - 0.6y[n- 1] - 0.16y[n-2]=5x[n]$

iii. Define convolution for discrete time signal. Perform convolution graphically for $y[n] = u[n] * u[n]$? **5**

Q.6 i. Define Z-transform for discrete time signal? List any three properties of Z-transform? **4**

ii. A causal discrete time LTI system is given by **6**
$y[n] - \frac{3}{4} y[n- 1] + \frac{1}{8} y[n- 2] = x[n]$
where x[n] & y[n] are input & output respectively.
(a) Determine impulse response h[n] by Z-transform method?
(b) Determine step response s[n] by Z-transform method?

OR iii. Determine the inverse Z-transform of **6**
$X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$
(a)R.O.C $|z|>1$ (b) R.O.C $|z| <0.5$ (c) R.O.C $0.5 < |z| < 1$

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Marking Scheme
EE3CO06/EX3CO06 Signals & Systems

Q.1	i.	For a signal $x(t)\ \delta$ (t–t_o),the value of integral $\int_{-\infty}^{+\infty} x(t)\ \delta$ (t–t_o) is : (b) x(t_o)	**1**
	ii.	The signum function sgn(t) can be written as: (c) 2u(t)-1	**1**
	iii.	The Fourier transform of unit impulse signal δ (t) is: (a) 1	**1**
	iv.	The trigonometric Fourier series of an odd signal will consist of: (b) Sine terms only	**1**
	v.	The input output relationship for a system is given by $y(t)=x^2(t)$ is: (d) Non-linear time invariant system	**1**
	vi.	If the impulse response of a system is h(t),for any arbitrary input x(t),the output y(t) will be: (×;$*$ denotes multiplication & convolution respectively) (a) x(t) $*$ h(t)	**1**
	vii.	The system described by equation y[n]= n x[n] is: (d)Linear time varying & unstable	**1**
	viii.	The unit step response of an LTI system with impulse response h[n]= δ [n] – δ [n– 1] is: (b) δ [n]	**1**
	ix.	While mapping from s-plane to z-plane, imaginary axis in s-plane correspond to : (a) A circle of unit radius in z-plane.	**1**
	x.	If '$*$' denotes convolution of discrete time sequence & y[n]= $x_1[n] * x_2[n]$ then Z-transform of y[n] will be (a) $Y(z)= X_1(z) \times X_2(z)$	**1**

Q.2	i.	One marks for each part (a), (b), (c).	(1 mark * 3)	**3**
	ii.	(a) Signal plotting	1.5 mark	**7**
		Energy power calculation	2 marks	
		(b) Signal plotting	1.5 mark	
		Energy power calculation	2 marks	
OR	iii.	(a)		**7**
		(i) Plotting x(t– 2)	1 mark	
		(ii) Plotting 2x(t)	1 mark	
		(iii) Plotting x(2t)	1 mark	
		(iv) Plotting x(– t)	1 mark	
		(b)		
		(i) Time-period calculation	1.5 mark	
		(ii) Time-period calculation	1.5 mark	
Q.3	i.	Two Dirichlet condition 1 mark each	(1 mark * 2)	**2**
	ii.	Sampling definition	1 mark	**8**
		Nyquist sampling theorem	1 mark	
		Nyquist rate 1.5 marks each (1.5 mark * 4)	6 marks	
OR	iii.	Stability condition	1 mark	**8**
		Example	0.5 mark .	
		Causality condition	1 mark	
		Example	0.5 mark.	
		Inverse Laplace transform 1.5 marks each (1.5 *2)	3 marks	
		Checking stability & causality condition for given R.O.C		
		1 mark for each (1 mark * 2)	2 marks	
Q.4	i.	Two continuous time system properties	2 marks	**4**
		Example for each property	2 marks	
	ii.	Graphical plotting & shifting signals	2 marks	**6**
		Performing integration over time limits	4 marks	

OR	iii.	Natural response calculation	2 marks	**6**
		Forced response calculation	4 marks	
Q.5		Attempt any two:		
	i.	(a) Linear & non linear system definition and example		**5**
			2.5 marks	
		(b) Causal & non-causal system definition and example		
			2.5 marks	
	i.	Roots of characteristic polynomial	2 marks	**5**
		Determination of unknown coefficients	3 marks	
	iii.	Convolution definition for discrete time	1 mark	**5**
		Graphical plotting & shifting signals	1.5 marks	
		Performing sum over time limits	2.5 marks	
Q.6	i.	Z-transform	1 mark	**4**
		Properties of Z-transform (any 3) (1 mark * 3)	3 marks	
	ii.	(a) Impulse response h[n] by Z-transform method:	3 marks	**6**
		(b) Step response s[n] by Z-transform method:	3 marks	
OR	iii.	Inverse Z-transform	3 marks	**6**
		x[n] for given R.O.C 1 mark each (1 mark * 3)	3 marks	