ii. Determine inverse Z-transform by partial fraction technique? **5**

$$X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$$

(a) R.O.C $|z|>1$ (b) R.O.C $|z|<0.5$

iii. Solve difference equation by Z-transform $y[n] + 2y[n-1] = x[n]$ **5**

with $x[n] = (\frac{1}{3})^n u[n]$ & $y[-1] = 1$.

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2018

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. 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)

ii. The signal $x(t) = A \sin(w_o t)[u(t) - u(t-2)]$ is? **1**

(a) Periodic signal (b) Neither energy nor power signal

(c) Power signal (d) A periodic & energy signal

iii. The Fourier transform of a rectangular pulse is? **1**

(a) Sampling function (b) Triangular function

(c) Another rectangular pulse (d) Impulse function

iv. The trigonometric Fourier series of an even signal will consist of? **1**

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

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

v. A system which has a unique relation between input & output is called? **1**

(a) Linear system (b) Causal system

(c) Invertible system (d) Time-variant system

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

(a) Causal, time variant system

(b) Non causal , time invariant system

(c) Causal , time invariant system

(d) Non causal ,time variant system

vii. Convolution of u[n] with u[n–4] at n=5 is: **1**

(a) 5 (b) 2 (c) 1 (d) 0

P.T.O.

viii. The system described by equation y[n] = x[2n] is: **1**
(a) Linear time variant (b) Non-linear time variant
(c) Non-linear invariant (d) Linear time invariant

ix. 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) $Y(z)= X_2(z) - X_1(z)$

x. ROC is defined as the range of values of z for which Z-transform **1**
(a) Converges (b) Diverges (c) Is infinite (d) None of these

Q.2 i. Graphically explain following signals: **3**
(a) Unit step function (b) Impulse function
(c) Signum function

ii. (a) For given signal x(t), plot and perform following operations graphically: $x(t) = u(t+4)\, u(-t+4)$ **7**
I. x(t) II. x(t – 4) III –2x(t) IV. x(– t)
(b) Determine energy and power of following signals:
I. u(t) –u(t – 4) II. $e^{-5t}u(t)$ III. $e^{-|t|}$

OR iii. (a) Justify whether following signals are periodic or not, if periodic determine fundamental time period? **7**
I. u(t) + 2sin(2t) II. cos2t + sin √3t
III. u(t) $\sin(\pi t)$ IV. $e^{j4\pi t}$
(b) A rectangular signal x(t) is defined as
$x(t) = 1$ for $0 < t < \pi$
$= -1$ for $\pi < t < 2\pi$
Approximate above rectangular signal by a sinusoid sin(t) over interval $[0,2\pi]$ such that mean square error is minimum?

Q.3 i. Define sampling theorem? **2**

ii. Determine Nyquist sampling rate for following signals? **3**
(a) $x(t)=\cos^3(200\pi t)$
(b) $x(t)=1 + \sin(400\pi t) + \cos(200\pi t)$
(c) $x(t)= \sin(100\pi t)\cos(150\pi t)$

iii. List any two Dirichlet condition for existence of Fourier series. **5**
For given periodic signal with time period '2π' find trigonometric Fourier series? $x(t) = A$ for $0 < t < \pi$
$= -A$ for $\pi < t < 2\pi$

OR iv. Discuss time-reversal and time shifting property of Fourier transform with one example of each. Determine Fourier transform of following signals? **5**
(a) $\frac{1}{1+jt}$ (b) $e^{-2|t|}$

Q.4 i. Discuss stability and time-variance property of continuous time system with example? **4**

ii. Perform graphical convolution of following signal: **6**
$x_1(t)= u(t+ 3) - u(t- 3)$ $x_2(t)= 2u(t) - 2u(t-3)$

OR iii. If x(t) denotes input & h(t) denotes impulse response to LTI system determine output y(t) for following? **6**
(a) $x(t) = e^{-2t}u(t)$ & $h(t) = e^{-4t}u(t)$
(b) $x(t) = t\, u(t)$ & $h(t) = t\, u(t)$

Q.5 i. Check for linearity and causality property of following discrete time system: **4**
(a) $y[n] = x[n^2]$ (b) $y[n] = 2x[-n] + 4$

ii. Determine closed form solution of unit impulse response h[n] for system given by : $y[n] - 0.6\, y[n-1] - 0.16\, y[n-2] = 5\, x[n]$ **6**
where x[n],y[n] are input & output respectively

OR iii. Define convolution sum & its two properties? **6**
Determine $c[n] = x[n] * g[n]$ (* denotes convolution)
$x[n]= 0.8^n\, u[n]$ $g[n] = 0.3^n\, u[n]$

Q.6 Attempt any two:

i. Find Z-transform & R.O.C for following signals? **5**
(a) $x[n] = 3\,(\frac{5}{7})^n u[n] + 2\,(\frac{-1}{3})^n u[n]$
(b) $x[n] = a^{|n|}$ $(0 < a < 1)$

P.T.O.

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

Q.1	i.	The signum function sgn(t) can be written as: (c) 2u(t)-1	**1**
	ii.	The signal x (t) = A sin (w_ot) [u (t) - u (t-2)] is? (d) Aperiodic & energy signal	**1**
	iii.	The Fourier transform of a rectangular pulse is? (a) Sampling function	**1**
	iv.	The trigonometric Fourier series of an even signal will consist of? (a) cosine terms only	**1**
	v.	A system which has a unique relation between input & output is called? (c) Invertible system	**1**
	vi.	The input output relationship for a system is given by y(t) = x (t^2) is: (d) Non causal ,time variant system	**1**
	vii.	Convolution of u[n] with u[n-4] at n=5 is: (b) 2	**1**
	viii.	The system described by equation y[n]= x[2n] is: (a) Linear time variant	**1**
	ix.	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**
	x.	ROC is defined as the range of values of z for which Z-transform (a) Converges	**1**
Q.2	i.	Graphically explain following signals: (a) Unit step function 1 mark (b) Impulse function 1 mark (c) Signum function 1 mark	**3**
	ii.	(a) Plotting x(t) 1 mark Plotting x(t-4) 1 mark Plotting -2x(t) 1 mark Plotting x(– t) 1 mark	**7**
		(b) For energy calculation 0.5 mark each (0.5 mark *3) 1.5 marks For power calculation 0.5 mark each (0.5 mark *3) 1.5 marks	
OR	iii.	(a) Justify whether following signals are periodic or not, if periodic determine fundamental time period? I. u(t) + 2sin(2t) 1 mark II. cos2t + sin $\sqrt{3}$t 1 mark III. u(t) sin(πt) 1 mark IV. $e^{j4\pi t}$ 1 mark (b) Applying correct approximation formula 1 mark Calculation 2 marks	**7**
Q.3	i.	Sampling theorem	**2**
	ii.	Determine Nyquist sampling rate for following signals? (a) $x(t)=\cos^3(200\pi t)$ 1 mark (b) $x(t)=1+\sin(400\pi t)+\cos(200\pi t)$ 1 mark (c) $x(t)=\sin(100\pi t)\cos(150\pi t)$ 1 mark	**3**
	iii.	Two Dirichlet condition 1 mark Trigonometric Fourier series calculation a_o 1 mark a_n 1.5 marks b_n 1.5 marks	**5**
OR	iv.	Time-reversal property 0.5 mark Example 0.5 mark Time shifting property 0.5 mark Example 0.5 mark Fourier transform (a) $\frac{1}{1+jt}$ 1.5 marks (b) $e^{-2\|t\|}$ 1.5 marks	**5**
Q.4	i.	Stability and time-variance property of continuous time system 2 marks Example for each property 2 marks	**4**
	ii.	Graphical plotting & shifting signals 2 marks Performing integration over time limits 4 marks	**6**

OR	iii.	If x(t) denotes input & h(t) denotes impulse response to LTI system determine output y(t) for following?		**6**
		(a) $x(t) = e^{-2t}u(t)$ & $h(t) = e^{-4t}u(t)$		
		Correct output y(t) calculation	3 marks	
		(b) $x(t) = t\,u(t)$ & $h(t) = t\,u(t)$		
		Correct output y(t) calculation	3 marks	
Q.5	i.	Linearity and causality property of following discrete time system:		**4**
		(a) $y[n] = x[n^2]$	2 marks	
		(b) $y[n] = 2\,x[-n] + 4$	2 marks	
	ii.	Roots of characteristic polynomial	2 marks	**6**
		Determination of unknown coefficients	4 marks	
OR	iii.	Convolution sum definition	1 mark	**6**
		Two properties	1 mark	
		Correctly selecting limits for convolution sum	1 mark	
		Performing sum over time limits	3 marks	
Q.6		Attempt any two:		
	i.	Find Z-transform & R.O.C for following signals?		**5**
		(a) $x[n] = 3\,(\frac{5}{7})^n u[n] + 2\,(\frac{-1}{3})^n u[n]$		
		Z-transform	2 marks	
		R.O.C	0.5 mark	
		(b) $x[n] = a^{\lvert n \rvert}\ (0 < a < 1)$		
		Z-transform	2 marks	
		R.O.C	0.5 mark	
	ii.	Inverse Z-transform by partial fraction technique	3 marks	**5**
		(a) R.O.C $\lvert z \rvert > 1$	1 mark	
		(b) R.O.C $\lvert z \rvert < 0.5$	1 mark	
	iii.	Applying Z-transform for given difference equation	1 mark	**5**
		Finding inverse Z-transform to determine y[n]	4 marks	

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