86

Page:12
17 April 2024

SET 1.

SCORING INDICATORS

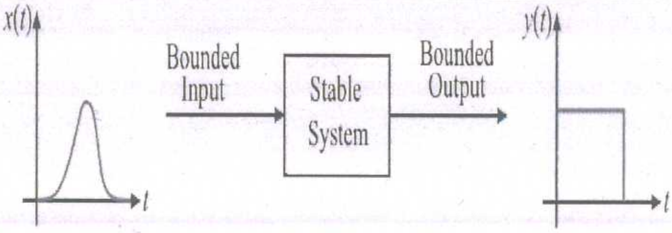
COURSE NAME: SIGNALS AND SYSTEMS
COURSE CODE: 5201

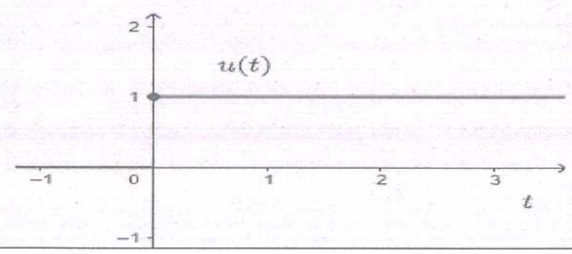
QID: **2109230107**

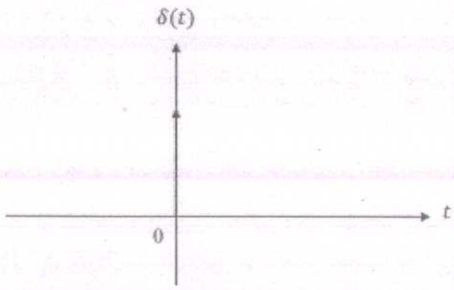
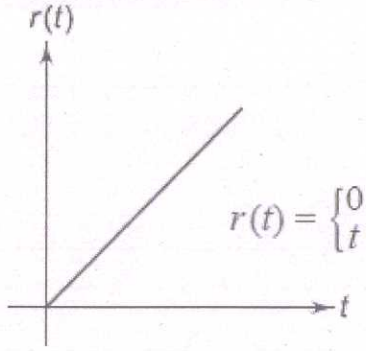
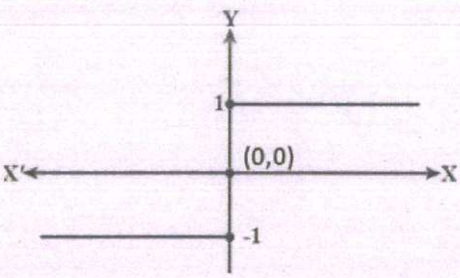
QNo	ScoringIndicators	Splitscore	SubTotal	Total score
	PART A			**9**
I.1	$\frac{1}{s}$	1	1	
I.2	$\sigma > 2 \quad or\ s > 2 \quad or\ real\{s\} > 2$	1	1	
I.3	Impulse response	1	1	
I.4	Anything that contains some information is called signals	1	1	
I.5	Present	1	1	
I.6	1	1	1	
I.7	2fm	1	1	
I.8	Bounded ,bounded	1	1	
I.9	TRUE	1	1	
	PART B			**24**
II.1	**Deterministic signals** Deterministic signals can be described by a mathematical expression, lookup table or some well-defined rule. Examples: Sine wave, cosine wave, square wave, etc. **Random signal** A signal which cannot be described by any mathematical expression is called as a random signal. Therefore, it is not possible to predict the amplitude of such signals at a given instant of time. Example: A good example of a random signal is noise in the communication signal.	3	3	
II.2	**Sampling theorem** states that "continues form of a time-variant signal can be represented in the discrete form of a signal with help of samples and the sampled (discrete) signal can be recovered to original form when the sampling signal frequency Fs having the greater frequency value than or equal to the input signal frequency Fm. **Fs ≥ 2Fm**	3	3	

	OR Nyquist sampling theorem states that the sampling signal frequency should be double the input signal's highest frequency component to get distortion less output signal			
II.3	y(t)=x(t) check t with a positive number ,negative number and zero t=0 y(0)=x(0) -------present t=2 y(2)=x(2) -------future t=-3 y(-3)=x(-3) -------past system depends future value of the input so system is a non causal system	Check-2 Result-1	3	
II.4	**Dirichlet conditions for existence of Fourier series** **Condition 1:** For a periodic signal to have Fourier series expansion, the signal should have a finite number of maxima and finite number of minima over the range of time period. **Condition 2:** A periodic signal should have a finite number of discontinuities over the range of time period. The discontinuities are the high to low or low to high transition. **Condition 3:** Periodic signal should be absolutely integrable over the range of time period.	1+1+1	3	
II.5	$$X(s) = \frac{7s+6}{s(3s+5)}$$ FVT x(0)= $\lim_{s\to 0} sX(s)$ $= \lim_{s\to 0} s\,\frac{7s+6}{s(3s+5)}$ $= \lim_{s\to 0} \frac{7s+6}{(3s+5)}$ $= \frac{6}{5}$	FVT equation -1 Evaluation-1 Result-1	3	

II.6	**Statement** – The linearity property of Fourier transform states that the Fourier transform of a weighted sum of two signals is equal to the weighted sum of their individual Fourier transforms. Therefore, if $$x_1(t) \overset{FT}{\leftrightarrow} X_1(\omega) \text{ and } x_2 \overset{FT}{\leftrightarrow} X_2(\omega)$$ Then, according to the linearity property of Fourier transform, $$ax_1(t) + bx_2(t) \overset{FT}{\leftrightarrow} aX_1(\omega) + bX_2(\omega)$$ Where, a and b are constants. **Statement** – The time shifting property of Fourier transform states that if a signal (t) is shifted by t_0 in time domain, then the frequency spectrum is modified by a linear phase shift of slope $(-\omega t_0)$. Therefore, if, $$x(t) \overset{FT}{\leftrightarrow} X(\omega)$$ Then, according to the time-shifting property of Fourier transform, $$x(t - t_0) \overset{FT}{\leftrightarrow} e^{-j\omega t_0} X(\omega)$$	Statement or equation -3	3	
II.7	$x(n) = \{1,2,3\}$ $$X(e^{i\omega}) = \sum_{n=-\infty}^{\infty} x(0)e^{-i\omega}$$ $= \ldots \ldots + x(0)e^{-i\omega 0} + x(1)e^{-i\omega} + x(2)e^{-2i\omega} + \cdots \ldots$ $= 1 + 2e^{-i\omega} + 3e^{-2i\omega}$	Equation -1 Result-2	3	
II.8	**Stable System or BIBO Stable System** A system is called a BIBO **(bounded input bounded output) stable system** or simply **stable system**, if and only if every bounded input produces a bounded output. The output of a stable system does not change unreasonably.	Definition -2 Examples 1	3	

<table>
<tr><td></td><td>

Unstable System
If a system does not satisfy the BIBO stability condition, the system is called the unstable system. Therefore, for a bounded input, it is not necessary that the unstable system produces a bounded output. Thus, we can say that a system is unstable even if one bounded input generates an unbounded output.</td><td></td><td></td><td></td></tr>
<tr><td>II.9</td><td>Discrete-Time Fourier Transform
$$F[x(n)] = X(\omega) = \sum_{n=-\infty}^{\infty} x(n)e^{-j\omega n}$$
Inverse Discrete-Time Fourier Transform
$$x(n) = \frac{1}{2\pi}\int_{-\pi}^{\pi} X(\omega)e^{j\omega n}\, d\omega$$</td><td>DTFT-1
IDFT-2</td><td>3</td><td></td></tr>
<tr><td>II.10</td><td>Both are invertible system
a) y(t)=logx(t)
inverse system is y(t)=$e^{x(t)}$
b) y(t)= $\sqrt{x(t)}$
inverse system is y(t)=$x^2(t)$</td><td>1+2</td><td>3</td><td></td></tr>
<tr><td></td><td>PARTC</td><td></td><td></td><td>42</td></tr>
<tr><td>III</td><td>a) unit step function
$$u(t) = \begin{cases} 0, & t < 0 \\ 1, & t \geq 0. \end{cases}$$

</td><td>(1+2+2+2)</td><td>7</td><td></td></tr>
</table>

	b) unit impulse function  $\delta\,(\mathrm{t}) = 0, \mathrm{t} \neq 0,$ $\delta\,(\mathrm{t}) = 1(area), \mathrm{t} = 0,$ **c) unit ramp function**  $r(t) = \begin{cases} 0 & \text{for } t<0 \\ t & \text{for } t \geq 0 \end{cases}$ Ramp function **d) signum function** $Sgn(x) = \begin{cases} -1, & if\ x<0 \\ 0, & if, x=0 \\ 1, & if, x>0 \end{cases}$ **Graph of Signum Function**  	2 2 2		
IV ~~III 2~~	a) cos(6π/t) not in standard form so signal isnon periodic b) sin(6πt) ---periodic $T = \frac{2\pi}{\omega} = \frac{2\pi}{6\pi} = \frac{1}{3}$	1 (1+2+2+2) 2	7	

c) cos12t

---periodic

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{12} = \frac{\pi}{6}$$

2

d) sin(3πt)+ cos(4πt)

---periodic

$$T1 = \frac{2\pi}{\omega 1} = \frac{2\pi}{3\pi} = \frac{2}{3}$$

2

$$T2 = \frac{2\pi}{\omega 2} = \frac{2\pi}{4\pi} = \frac{1}{2}$$

T=lcm(T1,T2)

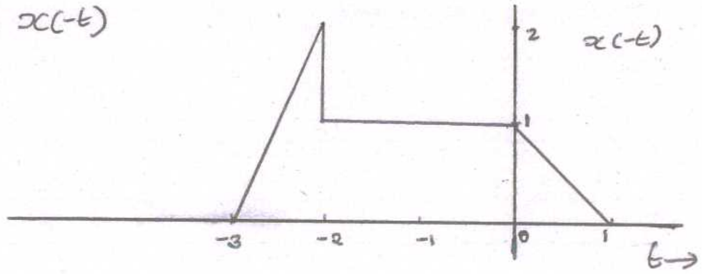
$$= \frac{2}{3} * \frac{1}{2} \qquad = \frac{1}{3}$$

V

~~II.5~~

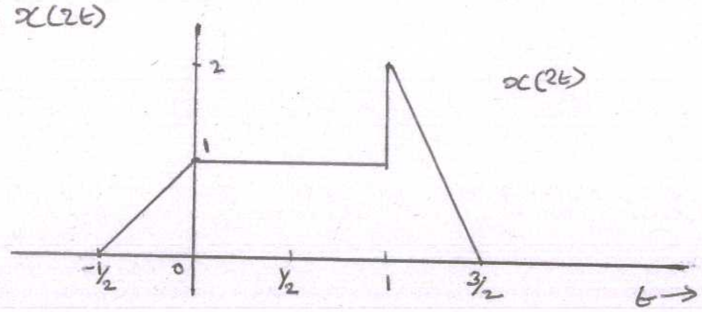
~~2121211~~

a, $x(-t)$



1

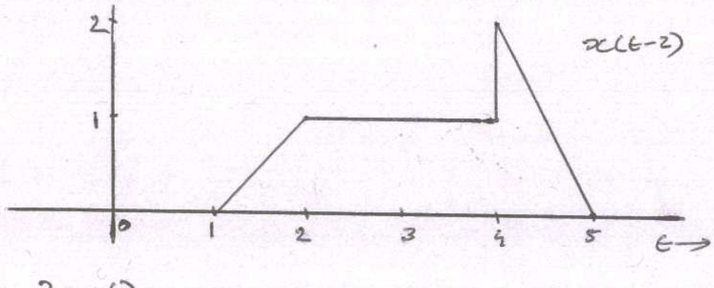
b, $x(2t)$



2

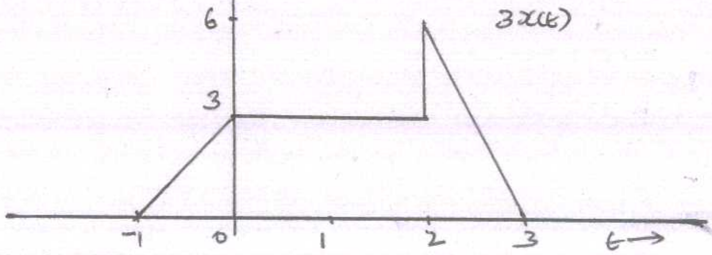
7

c, $x(t-2)$

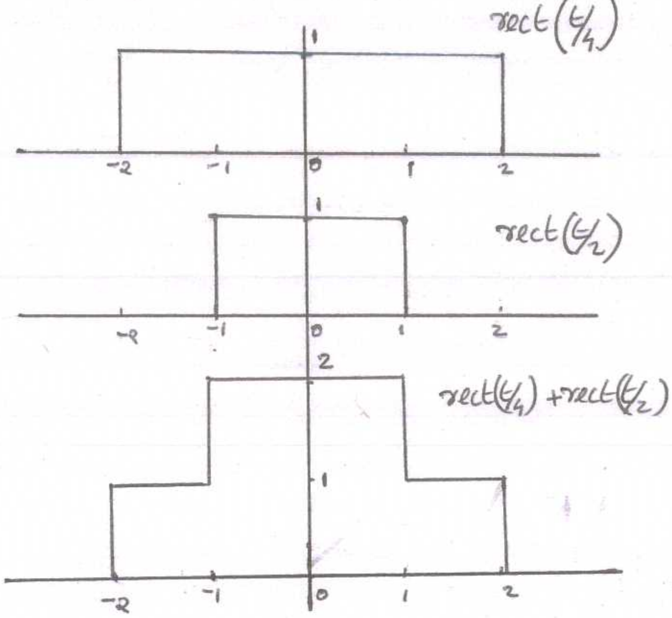
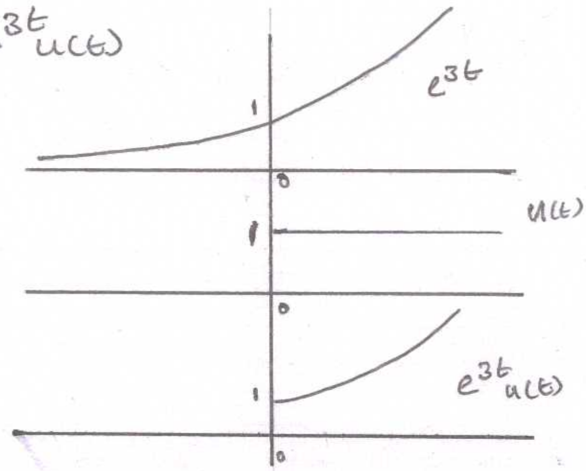
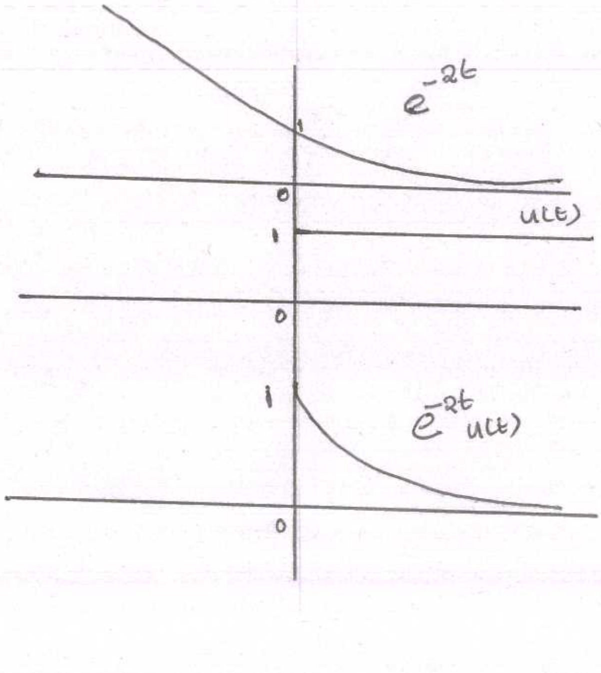


2

d, $3x(t)$



2

IV	a) $\mathrm{rect}(t/4) + \mathrm{rect}(t/2)$ 	3 (1+2)		
	b) $e^{3t}u(t)$ 	2 (1+1) ~~3+2+2~~		7
		2 (1+1)		

	a) $y(t) = x^2(t)$ $y_1(t) = x_1^2(t)$ $y_2(t) = x_1^2(t)$ $y_1(t) + y_2(t) = x_1^2(t) + x_2^2(t)$ —— ① $y_3(t) = (x_1(t) + x_2(t))^2$ —— ② ① ≠ ② so Non Linear	2 (1+1)		
VII	b) $y(t) = t\,x(t)$ $y_1(t) = t\,x_1(t)$ $y_2(t) = t\,x_2(t)$ $y_1(t)+y_2(t) = t\,x_1(t) + t\,x_2(t)$ —— ① $y_3(t) = t\,(x_1(t) + x_2(t))$ —— ② ① = ② so Linear	2 (1+1)	7	
	c) $y(t) = \sin x(t)$ $y_1(t) = \sin x_1(t)$ $y_2(t) = \sin x_2(t)$ $y_1(t) + y_2(t) = \sin x_1(t) + \sin x_2(t)$ —— ① $y_3(t) = \sin(x_1(t) + x_2(t))$ —— ② ① = ② so Linear	3 (2+1)		
	a) $y(t) = x(t)$ $y(t-t_0) = x(t-t_0)$ —— ① $y(t, t_0) = x(t-t_0)$ —— ② ① = ② so the S/m is Time Invariant	2 (1+1)		
VIII	b) $y(t) = t\,x(t)$ $y(t-t_0) = (t-t_0)\,x(t-t_0)$ —— ① $y(t,t_0) = t \cdot x(t-t_0)$ —— ② ① ≠ ② so the S/m is Time variant	2 (1+1)	7	
	c) $y(t) = x(2t)$ $y(t-t_0) = x(2(t-t_0))$ —— ① $y(t,t_0) = x(2t-t_0)$ —— ② ① ≠ ② so the S/m is Time variant	3 (2+1)		

IX ~~III 7~~	$x(t) = e^{-5t}u(t)$ $X(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$ $= \int_{-\infty}^{\infty} e^{-5t}u(t)\, e^{-j\omega t}\, dt$ $= \int_{0}^{\infty} e^{-(5t + j\omega t)}\, dt$ $= \int_{0}^{\infty} e^{-(5+j\omega)t}\, dt$ $= \left. \frac{e^{-(5+j\omega)t}}{-(5+j\omega)} \right\vert_{0}^{\infty}$ $= \frac{-1}{(5+j\omega)} \left[e^{-\infty} - e^{-0} \right]$ $= \frac{-1}{5+j\omega} [0-1] = \frac{-1}{5+j\omega} \times -1$ $= \frac{1}{5+j\omega}$ //	Steps - 5 Result - 2	7		
X ~~III 8~~	$x(t) \xrightarrow{FS} a_K$ $y(t) \xrightarrow{FS} b_K$ Linearity $a x(t) + b y(t) \xrightarrow{FS} a \cdot a_K + b \cdot b_K$ Time shifting $x(t-t_0) \xrightarrow{FS} a_K \cdot e^{-jK\omega_0 t_0}$ Frequency shifting $e^{jM\omega_0 t} x(t) \xrightarrow{FS} a_{K-M}$ Time Reversal $x(-t) \xrightarrow{FS} a_{-K}$ Time scaling $x(at) \xrightarrow{FS} a_K \quad T = \frac{\omega_0}{a}$ Differentiation $\frac{d\, x(t)}{dt} \xrightarrow{FS} jK\omega_0 a_K$	Any four	7		

XI	a) $x(t) = e^{3t}u(t)$ $\mathcal{L}\{e^{at}u(t)\} = \frac{1}{s-a}$; $\sigma > a$ $\mathcal{L}\{x(t)\} = X(s) = \frac{1}{s-3}$; $\sigma > 3$ b) $x(t) = e^{-2t}u(t)$ $\mathcal{L}\{e^{-at}u(t)\} = \frac{1}{s+a}$; $\sigma > -a$ $\mathcal{L}\{x(t)\} = \frac{1}{s+2}$; $\sigma > -2$ c) $x(t) = e^{3t}u(t) + e^{-2t}u(t)$ $\mathcal{L}\{e^{3t}u(t)\} = \frac{1}{s-3}$ $\mathcal{L}\{e^{-2t}u(t)\} = \frac{1}{s+2}$ $\mathcal{L}\{x(t)\} = X(s) = \frac{1}{s-3} + \frac{1}{s+2}$	2 (1+1) 2 (1+1) 3 (1+1+1)		7
XI	a) $X(s) = \frac{1}{s} + \frac{1}{s+2}$ $u(t) \longleftrightarrow 1/s$ $e^{-at}u(t) \longleftrightarrow \frac{1}{s+a}$ $e^{-2t}u(t) \longleftrightarrow \frac{1}{s+2}$ $ILT\{X(s)\} = x(t) = u(t) + e^{-2t}u(t)$ b) $X(s) = \frac{1}{s-2} + \frac{1}{s+3}$ $e^{-at}u(t) \longleftrightarrow \frac{1}{s+a}$ $e^{2t}u(t) \longleftrightarrow \frac{1}{s-2}$ $e^{-3t}u(t) \longleftrightarrow \frac{1}{s+3}$ $ILT\{X(s)\} = x(t) = e^{2t}u(t) + e^{-3t}u(t)$	3 (1+1+1) 4 (1+1+2)		7

XIII	a) unit impulse function $L\{\delta(t)\} = \int_{-\infty}^{\infty} \delta(t)\, e^{-st}\, dt$ $= e^{-st}\Big\vert_{t=0} = 1$ b) unit ramp function $x(t) = r(t) = t\,u(t)$ $t^n u(t) \longleftrightarrow \frac{n!}{s^{n+1}}$ $t\,u(t) \longleftrightarrow \frac{1!}{s^{1+1}}$ $= \frac{1}{s^2}$ $L\{r(t)\} = 1/s^2$ c) unit parabolic function $x(t) = p(t) = \frac{t^2}{2} u(t)$ $t^n u(t) \longleftrightarrow \frac{n!}{s^{n+1}}$ $t^2 u(t) \longleftrightarrow \frac{2!}{s^{2+1}}$ $= \frac{2 \times 1}{s^3}$ $= \frac{2}{s^3}$ $t^2 u(t) \longleftrightarrow \frac{2}{s^3}$ $\frac{t^2}{2} u(t) \longleftrightarrow \frac{1}{2} \cdot \frac{2}{s^3} = \frac{1}{s^3}$	1 3 (2+1) 3 (2+1)			7
XIV	$X(s) = \frac{2}{s^2+4} + \frac{s}{s^2+9} + \frac{1}{s-2}$ $e^{at} u(t) \longleftrightarrow \frac{1}{s-2}$				7

	$e^{2t}u(t) \longleftrightarrow \frac{1}{s-2}$			
	$\sin at\, u(t) \longleftrightarrow \frac{a}{s^2+a^2}$			
	$\sin 2t \cdot u(t) \longleftrightarrow \frac{2}{s^2+4}$	7		
	$\cos at \cdot u(t) \longleftrightarrow \frac{s}{s^2+a^2}$	(2+2+2+1)		
	$\cos 3t \cdot u(t) \longleftrightarrow \frac{s}{s^2+9}$			
	$x(t) = ILT\{X(s)\}$			
	$= ILT\left\{\frac{2}{s^2+4}\right\} + ILT\left\{\frac{s}{s^2+9}\right\} + ILT\left\{\frac{1}{s-2}\right\}$			
	$= \sin 2t \cdot u(t) + \cos 3t\, u(t) + e^{2t}u(t)$			

Muhammed Thaha . K
Lecturer in EC
AKNM GPC Thirurangadi

Sreeraj K.P
Lecturer in EC.
GPC Kalamassery