S J P N Trust's

# HirasugarInstitute of Technology, Nidasoshi.

*Inculcating Values, Promoting Prosperity*

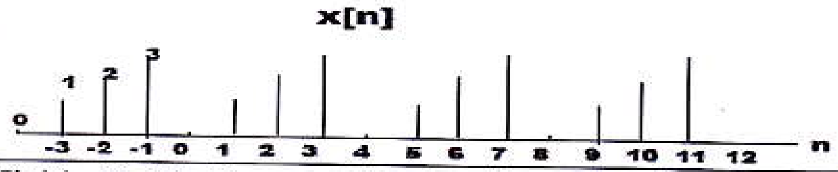
Approved by AICTE, Recognized by Govt. of Karnataka and Affiliated to VTU Belagavi.

| ECE Dept. |
| --- |
| Exam. |
| Internal Assessment |
| Even Sem(2017-18) |

## THIRD INTERNAL ASSESSMENT

| Sem : IV | Sub: Signals and Systems | Sub. Code: 15EC44 |
| --- | --- | --- |
| Date:19/05/2018 | Time: 3:00PM-4.00PM | Max. Marks: 25 |

***Note: Answer two full questions, draw sketches wherever necessary.***

| Q. No | | Discription of Question | Marks | CO | RBT LEVEL |
| --- | --- | --- | --- | --- | --- |
| 1. | a. | Find DTFS of x(n) given below   | 6 | CO212. 3 | L2 |
| | b. | Find the FS of the trigonometric function x(t) = cos4t + sin8t | 6 | CO212.3 | L1 |
| **OR** | | | | | |
| 2. | a. | Evaluate discrete_time fourier Transform of unit step signal | 6 | CO212.4 | L2 |
| | b. | Derive the following properties of Fourier transform<br>i) Linearity ii) Frequency shift | 6 | CO212.4 | L1 |
| 3. | a. | Find the z- transform of the signal $x(n) = \alpha^{\lvert n \rvert}$ | 7 | CO212.5 | L1 |
| | b. | Find the z-transform using the suitable properties of z-tranform.<br>x(n) = nsin (∏/2)n u(-n) | 6 | CO212.5 | L2 |
| **OR** | | | | | |
| 4. | a. | Find the inverse z-transform of,<br>$X(z) = \frac{1-z-1+ z-2}{\left(1-\left(\frac{1}{2}\right)z-1\right)(1-2z-1)(1-z-1)}$; with ROC 1< \|z\| <2 | 7 | CO212.5 | L3 |
| | b. | Determine the transfer function and impulse response of the causal LTI system described by difference equation.<br>y(n) = y(n-1) + y(n-2) + x(n -1) | 6 | CO212.5 | L3 |

**Course Coordinator** **Module Coordinator** **HOD**

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| Exam. |
| IA Scheme Evaluation |
| Even Sem (2017-18) |



## SCHEME OF EVALUATION

| Sem : 4 | | Subject : Signals & Systems | Sub Code : 15EC44 | Date : 19/05/18 | | |
|---|---|---|---|---|---|---|
| Q. No. | Bit | Description | | Marks | CO's | RBT LEVEL |

1. a. For the given signal $x(n)$ $\Omega_0 = \frac{2\pi}{N} = \pi/2$

$$X[k] = \frac{1}{N}\sum_{n=\langle N\rangle} x(n)e^{-jk\Omega_0 n}$$

$$= \frac{1}{4}\sum_{n=0}^{3} x(n)e^{-jk\pi/2\, n}$$

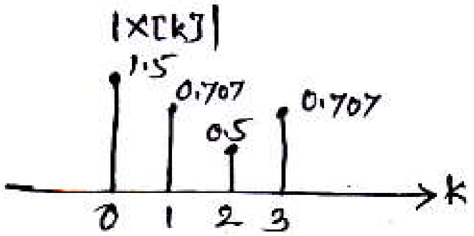
$$= \frac{1}{4}\{x(0) + x(1)e^{-j\pi/2 k} + x(2)e^{-j\pi k} + x(3)e^{-j3\pi/2 k}]$$ — 2

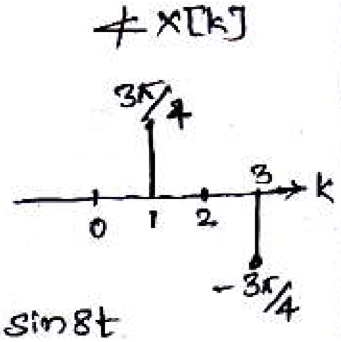
$X[0] = 1.5,\quad \measuredangle X[0] = 0.$ — CO212.3 — $L_2$

$X[1] = 0.707 \quad \measuredangle X[1] = 3\pi/4$

$X[2] = 0.5 \quad \measuredangle X[2] = 0$

$X[3] = 0.707 \quad \measuredangle X[3] = 3\pi/4$ — 2




— 2

b. Given $x(t) = \cos 4t + \sin 8t$

$\omega_{01} = 4, \quad \omega_{02} = 8$

$\omega_0 = \text{gcd of } (\omega_1, \omega_2)$

$= \text{gcd of } (4, 8) = 4$ — 1

$$\therefore x(t) = \frac{1}{2}e^{j4t} + \frac{1}{2}e^{-j4t} + \frac{1}{2j}e^{j8t} - \frac{1}{2j}e^{-j8t}$$

$$= \frac{1}{2}e^{j(1)4t} + \frac{1}{2}e^{j(-1)4t} + \frac{1}{2j}e^{j(2)4t} - \frac{1}{2j}e^{j(-2)8t}$$ — 2 — CO212.3 — $L_1$.

$$x(t) = \sum_{k=-\infty}^{\infty} X[k]e^{jk\omega_0 t}$$

$\Rightarrow X[-1] = 1/2;\ X[1] = 1/2,\ X[-2] = -1/2j;\ X[2] = \frac{1}{2j}$

Staff-In Charge — Module Coordinator — HOD

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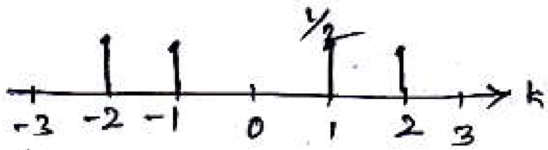
| Sem : 4 | Subject : Signals and Systems. | Sub Code : 15EC44 | Date : 19/05/18 |
|---|---|---|---|

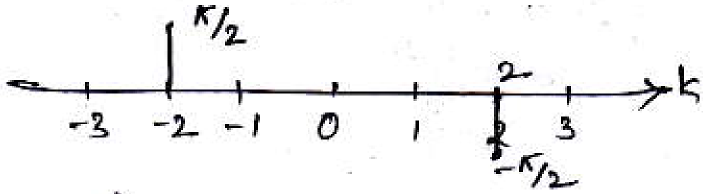
| Q. No. | Bit | Description | Marks | CO's | RBT LEVEL |
|---|---|---|---|---|---|

1. b.

$|X[k]|$



$\angle X[k]$



— 2   CO212.3   $L_1$

2 a. DTFT of unit step sequence

$$x(n) = u(n)$$
$$= \delta(n) + \delta(n-1) + \delta(n-2) + \cdots + \cdots$$
$$= \sum_{k=0}^{\infty} \delta(n-k)$$

Put $n-k = m$.

$$x(n) = u(n) = \sum_{m=-\infty}^{n} \delta(m)$$ — 2

$$y(n) = \sum_{k=-\infty}^{\infty} x(k) \xleftrightarrow{DTFT} \frac{X(e^{j\Omega})}{1-e^{-j\Omega}} + \pi X(e^{j0}) \sum_{k=-\infty}^{\infty} \delta(\Omega - 2\pi k)$$

$$\delta(n) \xleftrightarrow{DTFT} 1$$ CO212.4   $L_2$

by summation property, — 2

$$u(n) = \sum_{k=-\infty}^{\infty} \delta(k) \longleftrightarrow \frac{1}{1-e^{-j\Omega}} + \pi \sum_{k=-\infty}^{\infty} \delta(\Omega - 2\pi k)$$

$$\therefore u(n) \xleftrightarrow{DTFT} \frac{1}{1-e^{-j\Omega}} + \pi \sum_{k=-\infty}^{\infty} \delta(\Omega)$$ — 2

b. i) Linearity If $x(t) \xleftrightarrow{FT} X(j\omega)$

$y(t) \xleftrightarrow{FT} Y(j\omega)$ — 3   CO212.4   $L_1$

$$z(t) = ax(t) + by(t) \xrightarrow{FT} aX(j\omega) + bY(j\omega)$$

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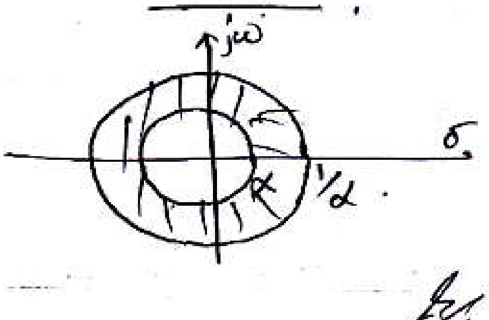
|---|---|---|---|---|---|---|
| **Q. No.** | **Bit** | **Description** | | **Marks** | **CO's** | **RBT LEVEL** |
| 2. | b. | ii) Freq. shift. | | | | |
| | | If $x(t) \longleftrightarrow X(j\omega)$ | | | | |
| | | then $y(t) = e^{j\beta t}x(t) \xleftrightarrow{FT} Y(j\omega) = X(j(\omega-\beta))$ | | | | |
| | | <u>Proof.</u> $Y(j\omega) = \int_{-\infty}^{\infty} y(t)e^{-j\omega t}dt$ | | | | |
| | | $= \int_{-\infty}^{\infty} e^{j\beta t}x(t)e^{-j\omega t}dt = \int_{-\infty}^{\infty} x(t)e^{-j(\omega-\beta)t}dt$ | | | | |
| | | $Y(j\omega) = X(j(\omega-\beta))$. | | 3 | CO212.4 | $L_1$ |
| 3 | a. | Z-transform of $x(n) = \alpha^{\lvert n\rvert}$ | | | | |
| | | $X(z) = \sum_{n=-\infty}^{\infty} x(n)z^{-n} = \sum_{n=-\infty}^{\infty} \alpha^{\lvert n\rvert}z^{-n}$ | | | | |
| | | $= \sum_{n=-\infty}^{-1} \alpha^{-n}z^{-n} + \sum_{n=0}^{\infty} \alpha^{n}z^{-n}$ | | 2 | | |
| | | $= \sum_{n=1}^{\infty} (\alpha z)^n + \sum_{n=0}^{\infty} (\alpha z^{-1})^n$ | | | | |
| | | $= \frac{\alpha z}{1-\alpha z} + \frac{1}{1-\alpha z^{-1}} = \frac{1-\alpha^2}{(1-\alpha z^{-1})(1-\alpha z)}$ | | 2 | CO212.5 | $L_2$ |
| | | When $\lvert\alpha z^{-1}\rvert<1$ & $\lvert\alpha z\rvert<1$ | | | | |
| | | $\Rightarrow \lvert z\rvert > \alpha$ $\quad \lvert z\rvert < 1/\lvert\alpha\rvert$ | | | | |
| | | $\therefore$ ROC $\lvert\alpha\rvert < \lvert z\rvert < 1/\lvert\alpha\rvert$ | | | | |
| | | $\therefore$ <u>$\alpha<1$.</u> | | 3 | | |
| | |  | | | | |



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# SCHEME OF EVALUATION

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|---|---|---|---|---|---|
| **Q. No.** | **Bit** | **Description** | **Marks** | **CO's** | **RBT LEVEL** |
| 3. | b. | z - transform of, $x(n) = n\sin(\frac{\pi}{2})n u(-n)$.<br>$x(n) = -n\sin(-\frac{\pi}{2}n)u(n)$.<br>$\Rightarrow X_1(z)$ of $\sin\frac{\pi}{2}n\, u(n) = \frac{\sin\frac{\pi}{2} z^{-1}}{1-2\cos\frac{\pi}{2} z^{-1}+z^{-2}}$<br>$X_1(z) = \frac{z}{z^2+1}$<br>$n\sin\frac{\pi}{2}n\, u(n) \xleftrightarrow{z} -z\frac{d}{dz}\left\{\frac{z}{z^2+1}\right\}$<br>$= \frac{z^3-z}{(z^2+1)^2}$<br>With time reversal property<br>$-n\sin(-\frac{\pi}{2}n)u(-n) \longleftrightarrow \frac{z(1-z^2)}{(z^2+1)^2}$ | 2<br>2<br>3 | CO212.5 | L2 |
| 4 | a. | $X(z) = \frac{1-z^{-1}+z^{-2}}{(1-\frac{1}{2}z^{-1})(1-2z^{-1})(1-z^{-1})}$ ; $1<\|z\|<2$<br>Using partial fraction expansion method<br>$X(z) = \frac{A}{(1-\frac{1}{2}z^{-1})} + \frac{A_2}{(1-2z^{-1})} + \frac{A_3}{(1-z^{-1})}$<br>$= \frac{1}{(1-\frac{1}{2}z^{-1})} + \frac{2}{(1-2z^{-1})} - \frac{2}{(1-z^{-1})}$<br>for $1<\|z\|<2$<br>$x(n) = (\frac{1}{2})^n u(n) - 2u(n) - 2(2)^n u(-n-1)$ | 3<br>2<br>2 | CO212.5 | L3 |
| | b. | $y(n) = y(n-1) + y(n-2) + x(n-1)$<br>$Y(z) = z^{-1}Y(z) + z^{-2}Y(z) + z^{-1}X(z)$.<br>$H(z) = \frac{Y(z)}{X(z)} = \frac{z^{-1}}{1-z^{-1}-z^{-2}} = \frac{z}{(z+0.62)(z-1.62)}$<br>$\therefore H(z) = \frac{-0.45}{(1+0.62z^{-1})} + \frac{0.45}{(1-1.62z^{-1})}$<br>Taking inverse we get, $h(n) = -0.45(-0.62)^n u(n) + 0.45(1.62)^n u(n)$ | 2<br>2<br>2 | CO212.5 | L3 |

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