BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP/2023)

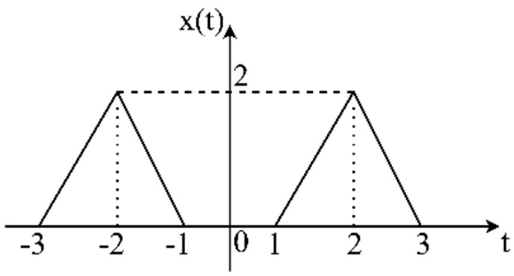
CLASS: **BTECH** **SEMESTER : IV**
BRANCH: **EEE** **SESSION : SP/2023**

SUBJECT: EE305 DIGITAL SIGNAL PROCESSING

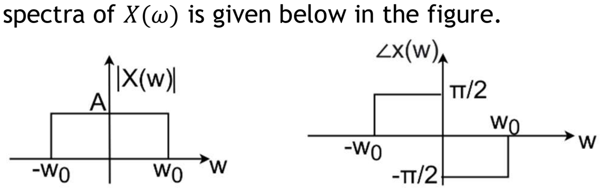
TIME: **02 Hours** **FULL MARKS: 25**

INSTRUCTIONS:
1. **The question paper contains 5 questions each of 5 marks and total 25 marks.**
2. **Attempt all questions.**
3. **The missing data, if any, may be assumed suitably.**
4. **Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	The signal Cos (10π t + π/4) is ideally sampled at a sampling frequency of 15 Hz. The sampled signal is passed through a filter with impulse response Sinc(t). Cos (40π t - π/2). Calculate the output of filter in time domain?	[2]	CO2 & CO3	03
Q.1(b)	A Continuous time signal x(t) is represent as x(t) = -1[1+Sgn(t+2)] + 1.5[1+Sgn(t)] + [1+Sgn(t-2)] -2[1+Sgn(t-4)] + 0.5[1+Sgn(t-5)] {where Sgn(t) is Signum signal}. The energy of signal x(t) is 'X'. The energy of signal y(t) = -x(-2t+3) is 'Y'. The energy of signal z(t) = - x (- 4t + 5) is 'Z'. Calculate the ratio of ${}^{(X)}/_{(YZ)}$. Also find the energy of $x(n) = \left(\frac{1}{3}\right)^n u(n) + \left(\frac{1}{5}\right)^n u(n)$.	[3]	CO2 &CO3	04
Q.2(a)	Consider a signal continuous time signal as shown in figure. If x(t) has continuous Fourier transform is X(ω) then calculate the value of $\int_{-\infty}^{+\infty} \omega X(\omega) e^{-j2.5\omega} d\omega$.	[2]	CO1 &CO2	02



Q.2(b)	Given the finite length $x(n)$ and the corresponding finite length output $y(n)$ of a Linear Time Invariant system having impulse response $h(n)$. Where $x(n) = 0, for\ n < 0, n > 1. x(n)$ = {1, -1}; $y(n) = 0, for\ n < -1, n > 2. y(n)$ = {1, -1, 1, -1}. The value of $h(1) = A$ and the length of $h(n)$ is equal to B. Find out the product of AxB. A discrete time signal $x(n) = e^{j(\frac{5\pi}{3})} + e^{j(\frac{\pi}{4})}$ is down-sampled to the signal $x_d(n) = x(4n)$. Evaluate the fundamental period of the down-sampled signal $x_d(n)$?	[3]	CO4	05
Q.3(a)	Find the inverse Fourier transform of $X(\omega)$ for which the magnitude and phase spectra of $X(\omega)$ is given below in the figure.	[2]	CO3 & CO4	



Q.3(b)	Let the signal $f_1(t) = Tri[t], f_2(t) = \frac{df_1(t)}{dt}$ and $x(t) = -2f_2(t-3)$. Let $y(t)$ is the even part of signal and $z(t)$ is the odd part of the signal $x(t)$. Find the Fourier transform, and Laplace transform of signal $x(t)$. Find the Area of the $y(t)$ & $z(t)$ signal.	[3]	CO4 & CO5	6

PTO

Q.4(a)	The following information about a signal ***x(t)***: (i) x(t) is a real. (ii) x(t) is periodic with period T=6 and has Fourier coefficients X_n. (iii) $X_n = 0\ for\ n = 0\ and\ n > 2$.(iv) $x(t) = -x(t-3)$. (v) $\frac{1}{6}\int_{-3}^{3}\|x(t)\|^2\,dt = \frac{1}{2}$. (vi) X_1 is a positive real number. Find ***x(t)***.	[2]	CO3 &CO4	4
Q.4(b)	Let $x(n)$ be a periodic signal with period N = 8 and Fourier series coefficients $X_k = -X_{k-4}$. A signal $y(n) = \left(\frac{1+(-1)^n}{2}\right)x(n-1)$ with period N = 8 is generated. Denoting the Fourier series coefficients of $y(n)\ be\ Y_k$, Determine a function such that $Y_k = f(k)\,X_k$.	[3]	CO2 & CO3	3
Q.5(a)	Find the inverse z-transform of $X(z) = \frac{3(1-z^{-1})}{1-2.5z^{-1}+z^{-2}}$ assuming that(i) the signal is causal and (ii) the signal has a DTFT.	**[2]**	CO1 & CO2	2
Q.5(b)	Given that $x(n)$ has Fourier transform $X(e^{j\omega})$, express the Fourier transform of the following signals in the terms of $X(e^{j\omega})$. (i) $x_1(n) = (n-1)^2x(n)$ (ii) $x_2(n) = e^{j\left(\frac{\pi}{2}\right)n}x(n+2)$	**[3]**	CO4	4

Determine the inverse DTFT of

$$X(e^{j\omega}) = \frac{1}{(1-\alpha e^{-j\omega})^2}, |\alpha| < 1$$

::::::23/02/2023::::::M