BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : IV/ADD**
BRANCH: EEE **SESSION : SP/2025**

SUBJECT: EE305 DIGITAL SIGNAL PROCESSING

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	(i) Differentiate between time-invariant & time-variant system giving suitable examples. (ii)Determine if the systems y(n)= x(-n) is causal or non-causal.	[5]	1	2
Q.1(b)	Perform the (i) linear and (ii) circular convolution of the following two sequences. x (n)= {2, 1, 2, 4}, x(n)={1, 2, 3}.	[5]	2	2
Q.2(a)	(i) Derive the radix-2 Decimation in Time - Fast Fourier Transform (DIT-FFT) algorithm to calculate the DFT of a discrete time signal. (ii) The first three points of the 4 point DFT of a real valued sequence are {6, -2+j2, -2}. Determine the remaining one points.	[5]	3	1
Q.2(b)	Given a sequence x(n)={1,2,3,4,4,3,2,1}, determine X(k) using DIT-FFT algorithm.	[5]	3	3
Q.3(a)	Explain frequency warping and causes of this effect.	[2]	4	2
Q.3(b)	Obtain the transformation formula for the bilinear transformation.	[3]	4	3
Q.3(c)	Determine H(z) for a digital Butterworth IIR filter using impulse invariant transformation that satisfies the following constraint. Assume T= 1 Sec. $\sqrt{0.5} \le \left\|H\left(e^{j\omega}\right)\right\| \le 1 \quad , 0 \le \omega \le \pi/2$ $\left\|H\left(e^{j\omega}\right)\right\| \le 0.2 \quad , 3\pi/4 \le \omega \le \pi$	[5]	4	6
Q.4(a)	Define a linear phase filter. What conditions are to be satisfied by the impulse response of a FIR system in order to have a linear phase? The transfer function of an FIR filter (M=7) is $H(z) = \sum_{n=0}^{M-1} h(n) z^{-n}$. Determine the magnitude response and show that the phase and group delays are constant.	[5]	3,4	2,3,4
Q.4(b)	The desired response of a low-pass filter is $H\left(e^{j\omega}\right) = \begin{cases} e^{-j3\omega}, -\frac{3\pi}{4} \le \omega \le \frac{3\pi}{4} \\ 0 \quad , \frac{3\pi}{4} < \left\|\omega\right\| \le \pi \end{cases}$ Determine and plot $H\left(e^{j\omega}\right)$ for M=7 using Hamming window. Obtain the system function and construct the structure of filter.	[5]	3,4,5	3,4,5,6

PTO

Q.5(a)	Explain different type of architecture used in design of DSP processor with their advantages and disadvantages.	[5]	5	4
Q.5(b)	(i) Describe the functionality of different components of DSP processor. What are the basic architectural features of DSP processors ? (ii) Given a 8 point sequence, find the percentage improvement in multiplication using DIT-FFT algorithm as compared to direct calculation of DFT using advanced digital signal processor.	[5]	5	5

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