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

CLASS: B.Tech **SEMESTER : 5th /ADD**
BRANCH: ECE **SESSION : MO/2025**

SUBJECT: EC305: SIGNAL PROCESSING TECHNIQUES

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)	Distinguish between linear convolution, circular (periodic) convolution, and deconvolution in discrete-time signal processing. By means of circular convolution, determine the response of the FIR filter with impulse response h(n) = {4, 1, 3} to the input sequence x(n) = {2, 5, 0, 4}	[5]	1	2,3
Q.1(b)	What is the differentiation property of the z-transform? Use the differentiation property of the z-transform to find the z-transform of g(n) = $n\,a^n\,u(n)$	[5]	1	2,3
Q.2(a)	Explain the conversion of direct form-I structure to direct form-II structure with an example. Compare the computational complexity in the direct form-I and direct form-II structures of IIR filters	[5]	2	2,3
Q.2(b)	Obtain the direct form I and II realisation structures for the following system: $y(n) = -0.1\,y(n-1) + 0.72\,y(n-2) + 0.7\,x(n) - 0.25\,x(n-2)$	[5]	2	1,2,3
Q.3(a)	Differentiate between the Butterworth and Chebyshev filters. Describe the frequency transformation in the analog & digital domain.	[5]	3	2,3
Q.3(b)	A digital Butterworth filter has to be designed using bilinear transformation. The filter specifications are as follows: $0.9 \le \lvert H(e^{j\omega})\rvert \le 1 \quad 0 \le \omega \le 0.5\pi$ $\lvert H(e^{j\omega})\rvert < 0.2 \quad 0.75\pi < \omega < \pi$ Find the filter order N and the cut-off frequency Ω_c	[5]	3	2,3,4
Q.4(a)	Derive the relation between analog and digital frequency in impulse invariant transformation	[5]	4	1,2
Q.4(b)	For the analog transfer function, $H(s) = \frac{1}{s^2+3s+2}$, determine H(z) using bilinear transformation if T = 1 second	[5]	4	2
Q.5(a)	Describe multi rate signal processing. Explain Decimation and interpolation with suitable example.	[5]	5	1,2
Q.5(b)	The transfer function of an FIR filter is $H(z) = 0.2 + 0.7\,z^{-1} + 0.8\,z^{-2} + 0.15\,z^{-3} + 0.6\,z^{-4} + 0.32\,z^{-5} + 0.5\,z^{-6} + 0.4\,z^{-7} + 0.9\,z^{-8}$ Perform polyphase decomposition of $H(z)$ to decompose into 2 sections	[5]	5	2,3

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