MANIPAL INSTITUTE OF TECHNOLOGY
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DECLARATION BY THE QUESTION PAPER SETTER

I, Mr. MUKUND KUMAR MENON, hereby declare that, I do not have any relatives who is/are appearing for the exam of this course, the question paper of which is set by me and have taken utmost care not to retain the copy of the paper.
I also confirm that the question paper is personally handed over to the office of the examination of our department.
Certified that this question paper is prepared to cover the entire syllabus and followed all the guidelines set by me in the form of blue print submitted during the beginning of the semester.

Semester	FOURTH
Course Code	ICE 2224
Course Title	DIGITAL SIGNAL PROCESSING

Submitted by:

Signature

Date: JUNE 04, 2024 Name: MUKUND KUMAR MENON

FOURTH SEMESTER (B.TECH) (ELECTRONICS AND INSTRUMENTATION ENGINEERING)
END SEMESTER MAKE-UP EXAMINATIONS JUNE 2024
SUBJECT: DIGITAL SIGNAL PROCESSING (ICE 2224)
Note: Answer All questions.

Time:3 Hours **14-6-2024** **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.

Q.No.	Description	M	CO	PO'S	BL
1A	Determine the inverse Z-transform of the following z-domain function if ROC is $0.2 < \|z\| < 0.6$. $$X(z) = \frac{1}{1 - 0.8z^{-1} + 0.12z^{-2}}$$	**4**	**1**	**1-3**	**3**
1B	An LTI system is described by the following equation, $$y(n) = x(n) + 0.8x(n-1) + 0.8\,x(n-2) + 0.49y(n-2).$$	**4**	**1**	**1-3**	**3**

	Find the transfer function of the system. Also, sketch the poles and zeros on the z-plane.				
1C	Using Graphical method, perform circular convolution of the following sequences: $$x(n) = \{2, 1, 2, -1\}$$ $$h(n) = \{1, 2, 3, 4\}$$	**2**	**1**	**1-4**	**3**
2A	Determine the response of a given LTI system when the input sequence is given as: $x(n) = \{-2, -1, -1, \ 0, \ 2\}$. Use radix 2 DIT FFT method. Assume, the impulse response of the system is, $h(n) = \{1, -1, -1, 1\}$.	**4**	**2**	**1-4**	**3**
2B	Using DFT, obtain the magnitude and phase spectra of the discrete-time sequence, $x(n) = \{4, 4, 0, 2\}$. Also, verify the result using the inverse DFT.	**4**	**2**	**1-4**	**3**
2C	List the similarities and also the differences (at least TWO each) between DIT and DIF Radix-2 FFT.	**2**	**2**	**1-4**	**3**
3A	Design a linear phase FIR lowpass filter with a cut-off frequency, $\omega_C = 0.45\pi$ (in rad/sample) using rectangular window by taking 7 samples of window sequence.	**5**	**3**	**1-3, 12**	**5**
3B	Convert the following expression from s-domain to z-domain using Impulse Invariant Transformation: (Assume T = 1s) $$H(s) = \frac{s + 0.1}{(s + 0.1)^2 + 9}$$	**3**	**3**	**1-3, 12**	**4**
3C	Give a brief insight into the design concept of Linear Phase FIR filters using the Fourier Series method.	**2**	**3**	**1-4**	**3**
4A	Design a symmetric FIR lowpass filter, using Hanning window, whose desired frequency response is given as: $$H_d(w) = \begin{cases} e^{-j\alpha\omega} & for \ \lvert\omega\rvert \leq \omega_c \\ 0 & otherwise \end{cases}$$ Assume that the length of the filter is 7 and the cut-off frequency, ω_c = 1 radians per sample.	**5**	**4**	**1-4**	**5**
4B	Convert the following expression from s-domain to z-domain using Bilinear Transformation: (Assume T = 1s) $$H(s) = \frac{s^3}{(s + 1)(s^2 + s + 1)}$$	**3**	**3**	**1-3, 12**	**3**

4C	Explain Bilinear Transformation (BLT) for s-plane to z-plane mapping. Illustrate how BLT introduces frequency warping.	**2**	**4**	**1-3, 6,9,12**	**2**
5A	Design a Butterworth IIR lowpass filter (Direct Form-I Structure) with the following specifications. Use bilinear transformation with T = 1s. $0.7 \le \lvert H(e^{j\omega})\rvert \le 1 \; ; \; 0 \le \omega \le 0.4\pi$ $0 \le \lvert H(e^{j\omega})\rvert \le 0.1 \; ; \; 0.7 \le \omega \le \pi$	**5**	**4**	**1-3, 12**	**5**
5B	With relevant diagrams, explain the Control Register File Extensions of the TMS320C64x DSP Processor.	**2**	**5**	**1-4, 6,9,12**	**2**
5C	Compare the Decode Phases of Pipeline in TMS320 C62x and C64x DSP families.	**3**	**5**	**1-4, 6,9,12**	**2**