Reg. No.

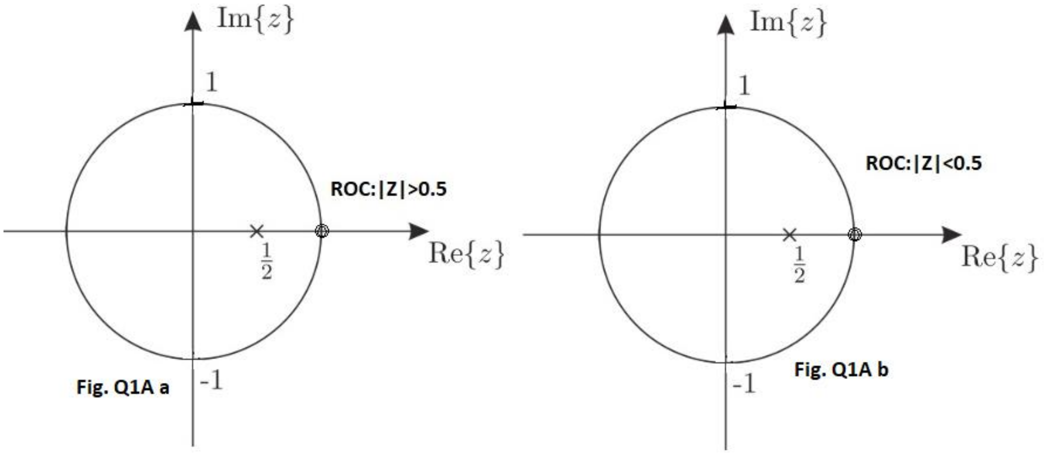
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FOURTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL/MAY 2019
SUBJECT: DIGITAL SIGNAL PROCESSING (ECE - 2203)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Pole zero plots of 2 systems are shown in **Fig Q1A**. Identify the causal system. Justify your selection. Is it stable? Write the system function of it and determine the impulse response for the same.



1B. i) Given x(n)={1,-1,1,-1}, determine y(n)=x((n-2))$_4$. Obtain 4-point DFT of y(n).
ii) Explain Overlap and add method of filtering long length data sequence.

(5+5)

2A. Deduce Goertzel algorithm for efficient computation of DFT. Comment on its computational advantages and applications.

2B. A 9 length LPF has a desired frequency response $\left|H_d(e^{j\omega})\right| = \begin{cases} 1, & 0 \le |\omega| \le \dfrac{\pi}{2} \\ 0, & elsewhere. \end{cases}$ Using non-recursive frequency sampling design technique, determine the filter coefficients.

(5+5)

3A. A second order low-pass Butterworth filter is required to meet the following specifications. $\omega_p = 0.2\pi,\ \omega_s = 0.63\pi, R_p = -2.4dB, A_s = -12.5dB.$ Determine the pre-warped analog edge frequency Ω_p *and* Ω_s, 3 dB cut off frequency Ω_c and transfer function H(s) of the filter. Obtain the digital filter system function H(z) using bilinear transformation at 8Khz sampling.

3B. Explain impulse invariant transformation method of digitising analog IIR filters. The poles of two-pole analog filter are $s_1 = -2$ *and* $s_2 = -0.5$. Obtain the transfer function of the equivalent digital filter using impulse invariant transformation. Assume sampling frequency of 100Hz.

(5+5)

4A. Obtain the system function and sketch the structure for the frequency sampling realization of the 16-length linear phase FIR filter which has frequency response samples H(2πk/16)
= 1, k=0,1
= 0.5, k=2
= 0, k=3,4,5,6,7
Also sketch the block diagram (no need for the calculation of filter coefficients) for direct form realization of the same filter and compare the computational complexity of the two structures in terms of number of multiplications required.

4B. Determine the lattice and ladder parameters for the following all pass filter. Sketch the lattice-ladder structure. Comment on the advantage and application of lattice structures.

$$H(z) = \frac{0.5 + 0.2z^{-1} - 0.6z^{-2} + z^{-3}}{1 - 0.6z^{-1} + 0.2z^{-2} + 0.5z^{-3}}$$

(5+5)

5A. Illustrate the spectral leakage and spectral resolution problems occurring in estimation of spectra from finite duration observation of signals.

5B. Describe with mathematical expressions the Welch method of PSD estimation.

5C. Highlight the principle and advantages of parametric method of PSD estimation. Mention the important system models and corresponding system function used for parametric PSD estimation.

(3+4+3)