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 2018
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. Consider an discrete time LTI system having 3 poles at z = -3, z = -0.5, z = 2 and one zero at z = 1.

i) Indicate ROC of system function H(z) to be stable. Determine H(z) and impulse response h(n) such that H(z) = 1 at z = 0. Also write the difference equation for the system.

ii) Can the system be causal stable system?

1B. Determine the response at $n \geq 0$ of discrete time LTI system described by the following difference equation for the unit step input. The system has the initial condition $y[-1] = \frac{2}{9}$

y[n] = -0.8 y(n-1) + x(n)

1C. Determine N-point DFT of rectangular window given by $w(n) = 1;\ 0 \leq n \leq N-1$

(5+3+2)

2A. Describe in detail frequency sampling design of FIR filters. Compare recursive and non-recursive sampling methods.

2B. Describe overlap-save method of filtering long length sequences using DFT.

2C. Draw the basic butterfly computation flow diagram of radix-2 DIF FFT. Determine total number of multiplications required for 32-point DIF FFT.

(5+3+2)

3A. Certain IIR Butterworth LPF has the following specification

$$-1.5dB \leq 20\log_{10}\left(\left|H(e^{j\omega})\right|\right) \leq 0dB,\ \ 0 \leq \omega \leq \frac{\pi}{3}$$

$$20\log_{10}\left(\left|H(e^{j\omega})\right|\right) \leq -10dB,\qquad \frac{\pi}{2} \leq \omega \leq \pi$$

Assume sampling frequency of 1Hz. Obtain the pre-warped analog frequency specifications Ω_p *and* Ω_s, Minimum order of the filter, 3 dB cut-off frequency and transfer function H(s).

3B. Explain bilinear transformation method of s-plane to z-plane mapping. Discuss the frequency warping effect.

3C. Highlight the condition on the impulse response and location of the zeroes of the system function for FIR filter to exhibit linear phase response.

(5+3+2)

4A. Derive Goertzel algorithm and implement the filter using direct form-II.

4B. Convert the analog filter into its equivalent digital filter whose system function is given by $H(s) = \frac{s+1}{s^2+2s+17}$ using impulse invariant method. Assume F_s=1Hz.

4C. Determine the poles and zeroes of IIR resonator with center frequency 100 Hz and bandwidth 10Hz. The sampling frequency is 500 Hz.

(5+3+2)

5A. Consider a causal FIR system with system function $H(z) = 1 - 0.6z^{-1} + 0.2z^{-2} + 0.5z^{-3}$

Determine the lattice parameters for this filter. Sketch lattice and tapped delay line structures.

5B. With mathematical relations, explain the key steps of Welch method of PSD estimation. Explain why variance of the estimate is improved.

5C. List the three different parametric modelling methods. Write the system function for each case.

(5+3+2)