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

SIXTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)
END SEMESTER EXAMINATIONS, APRIL - 2018

SUBJECT: DIGITAL SIGNAL PROCESSING [ICE 3202]

Duration: 3 Hour   Max. Marks:50

Instructions to Candidates:

❖ Answer **ALL** the questions.
❖ Missing data may be suitably assumed.

1A A causal LTI system has following system function **5**

$$H(z) = \frac{(1 + z^{-1})}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)}$$

    i.   What is the ROC of H(z)? Is this system stable?

    ii.   Find z-transform X(z) of an input x[n] that will produce the output

        y[n]= (-1/3) (-1/4)^n u[n] – (4/3) (2)^n u[-n-1].

    iii.   Find the impulse response of the system.

1B Determine the inverse z-transform of $X(z) = \frac{1}{1 - 0.8z^{-1} + 0.12\,z^{-2}}$ **3**

     if ROC is, $0.2 < |z| < 0.6$

1C State and prove the multiplication by n property of z- transform. **2**

2A By means of DFT and IDFT, determine the response of LTI system with impulse response **5**
h[n] = {1, 2, 3} to the input x[n] = {1, 2, 2, 1}

2B State and prove the circular convolution property of DFT. **3**

2C Bring out the mathematical relation between DFT and Z transform. **2**

3A The 8-point DFT of a certain signal is **5**
$X(k) = \{20, -5.828 - j2.414,\ 0, -0.171 - j0.414,\ 0, -0.171 + j0.414,\ 0, -5.828 + j2.414\}$.
Using DIT-FFT algorithm, find the time domain representation of X[k].

3B Illustrate 4-point radix-2 DIF- FFT algorithm with signal flow diagrams. Discuss on the **3**
computational advantage of the algorithm.

3C Compute the DFT of the sequence x(n) = { 1, j, -1, -j} for N = 4. **2**

4A Explain the impulse invariant transformation method of digitizing analog filter. Using this method **5**
find H(z) for the filter having transfer function $H(s) = \frac{2}{(s+2)}$. Assume sampling frequency of 1
Hz. Illustrate the position of pole of H(z) in the z plane.

4B Determine the poles of lowpass Butterworth filter for N=3. Sketch the location of poles on s-plane **3**
and hence determine the normalized transfer function of lowpass filter.

4C Compare the impulse invariant and bilinear transformations (any 4 difference) **2**

5A It is required to have digital FIR filter with following frequency response. **5**

$$H\left(e^{jw}\right) = e^{-j3w}; \quad |w| \le \frac{\pi}{2}$$
$$= 0 \quad ; \quad \frac{\pi}{2} < |w| < \pi$$

What is the length of this filter? Determine the unit impulse response of this filter using non-recursive frequency sampling technique.

5B What is the need for spectral estimation? Explain any one method used in averaging the **3**
periodogram.

5C Compare the FIR and IIR filter (any 4 difference) **2**

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