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I SEMESTER M.TECH. (MECHATRONICS ENGINEERING) END SEMESTER EXAMINATIONS, NOV 2018

SUBJECT: SIGNAL PROCESSING AND APPLICATIONS [MTE5140]

REVISED CREDIT SYSTEM (27/11/2018)

Time: 3 Hours

MAX. MARKS: 50

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Instructions to Candidates:

- ✤ Answer all questions.
- Data not provided may be suitably assumed
- 1A. Design a low pass digital filter using Fourier series method to approximate the ideal specifications given by $H(e^{j\omega})$. Where f_p is the passband frequency and F is the sampling frequency.

$$H(e^{j\omega}) = -\begin{bmatrix} 1, \text{ for } | f | \le f_p \\ 0, f_p < | f | \le F/2 \end{bmatrix}$$

1B. Apply log division method and determine the inverse z transform of

$$X(z) = (1+2Z^{-1})/(1-2Z^{-1}+Z^{-2})$$

- **2A.** Compute a four point DFT of the following sequence $X(n) = \{1, -2, 3, 4\}$. **05**
- **2B.** Synthesis the digital filter from an analog filter using Impulse invariance method. Take T=1s

 $H(s) = (S+0.2)/((S+0.2)^2+9)$

3A A digital filter with a 3dB bandwidth of 0.25π is to be designed from the analog filter whose system response is H(s). Use bilinear transformation and obtain H(z). **05**

$$H(s) = \Omega_c / (s + \Omega_c)$$

3C Obtain the cascaded and lattice form structure of the following sequence

$$Y(n) = (3/4) y(n-1) - (1/8) y(n-2) + x(n) + (1/3) x(n-1)$$

4A Define Z transform of a discrete time sequence and name any four properties 02

- **4B.** Determine the z transform of the discrete time sequence $X(n) = \{1,2,0, -4,3,2,1,6,5\}$
- **4C.** Determine the filter coefficients h(n) for M=7, using type I frequency sampling technique for the given low pass filter response $H_d(e^{-j3\omega})$

$$H_{d} \left(e^{-j3\omega} \right) = - \begin{cases} e^{-j3\omega} & 0 \le \omega < \pi/2 \\ 0 & \pi/2 \le \omega \le \pi \end{cases}$$

5A. Determine H(z) for a Butterworth filter satisfying the following constraints. Use impulse invariance method and take T=1s

$$\begin{split} \sqrt{0.5} &\leq |\operatorname{H}(e^{j\omega})| \leq 1 \qquad 0 \leq \omega \leq \pi/2 \\ &|\operatorname{H}(e^{j\omega})| \leq 0.2 \qquad 3\pi/4 \leq \omega \leq \pi \end{split} \tag{05}$$

5B. Construct the direct form I and II structure of the following Z domain sequence $H(z) = 1 + 3Z^{-1} + 2Z^{-3} - 4Z^{-4}$

03