

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

I SEMESTER M.TECH. (INDUSTRIAL AUTOMATION AND ROBOTICS, MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: SIGNAL PROCESSING AND APPLICATIONS [MTE 5140]

REVISED CREDIT SYSTEM

(01/12/2016)

Time: 3 Hours

MAX. MARKS: 50

5

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Instructions to Candidates:

Answer **ALL** the questions.

- Missing data may be suitable assumed.
- **1A.** A finite impulse response filter is having the system transfer function.

$$H(z) = 0.5 - 0.3183 (z + z^{-1}) - 0.104 (z^2 + z^{-2}) - 0.026(z^3 + z^{-3}).$$

Realize the filter.

1B. Express the digital form of the system using impulse invariant transformation **3** with T = 1 sec.

$$H(s) = \frac{2}{(s+1)(s+2)(s+3)}$$

- **1C.** Brief about the advantages of digital filters.
- 2A. The linear positioning system of a hydraulic actuator system has to be 3 deigned. Determine whether the system designed difference equation is y(n) = x(n) + x(n-1) is causal, linear and time invariant
- **2B.** The FPGA laboratory kit is performing following signal manipulations to the input signals in Channel A and Channel B. Obtain the final output in all the cases, if Channel A input is $x(n) = [1 \ 0 \ (3) \ -2]$ and Channel B input is $y(n) = [2 \ (0) \ 0 \ 1]$

1. x(n) + y(2n)	3. 2 ⁿ x(n)
2. x(n) + y(n-2)	4. 3y(n/2)

- **2C.** The input signal to a digital controller is $y(t) = 0.2 t + 4t^2 3$. Obtain the discretized signal obtained from the sample and hold circuit before the controller, for a time period of $0 \le t \le 5$ sec, with a sampling period of T = 1 sec.
- **3A.** Find the convolution of the signal y(n) = h(n) * x(n)1. x(n) = [1 2 (1) 1] h(n) = [(0) 1 2 0]2. x(n) = u(n+2) $y(n) = 2^n u(n) + u(n-3)$
- **3B.** Find the inverse z transforms of 1. $H(z) = \frac{3z^{-1}+z^0}{z^{-2}+3z^{-1}+2z^0}$ **2.** $H(z) = (6z^2 + 3z^{-2} + 2(z^{-3} + z^{-4}))$
- **3C.** Explain with mathematical expressions of basic step, ramp and parabolic **2** signals
- 4A. A temperature control systems the temperature of the process is obtained through the resistor variations in Pt100 (platinum). The sensor input has to be conditioned to obtain a proper temperature reading. The conditioning circuit is supposed to have the following frequency characteristics.
 -2 dB attenuation at a frequency of 34 rad/ sec and -10 db attenuation at 20 rad/sec. Design the circuit.

4B.	Digitalize the signal conditioning circuit designed in 4A.	2
4C.	Realize the system designed in the 4B.	4
5A.	Describe with required sketches any one application of signal processing	5
5B.	Explain the significance of modeling in the z domain?	3
5C.	Find the z transforms of the $x(n) = 3^n u(n-4)$. Also mention the region of convergence	2

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