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# MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
*A Constituent Institution of Manipal University*

**THIRD SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION**
**NOV/DEC 2017**
**SUBJECT: SIGNALS AND SYSTEMS (ECE -2104)**

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

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

1A. Determine whether following systems are linear, time in-variant, causal and stable.

1. $y(t) = \dfrac{dx(t)}{dt}$
2. $y[n] = 2x[n]u[n]$
3. $y(t) = x(2-t)$

1B. Sketch the waveform for the following signal.

1. $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$
2. $x(t) = r(t+1) - r(t) + r(t-2)$

1C. Determine whether following signals are periodic or not. If periodic, determine the fundamental periods.

$x(t) = v(t) + v(-t)$ where $v(t) = \sin(t)u(t)$

(5+3+2)

2A. The impulse response of a circuit is given as $h(t) = e^{-t}u(t)$. This circuit is excited by an input of $x(t) = e^{-3t}\{u(t) - u(t-2)\}$, Determine the output of the system.

2B. The impulse response of a discrete time system is given by $h[n] = \dfrac{1}{2}\delta[n] + \delta[n-1] + \dfrac{1}{2}\delta[n-2]$. Determine the frequency response and step response of the system.

2C. Draw the DF-1 and DF-II structures for an LTI system represented by the following differential equation.

$$\frac{d^3}{dt^3}y(t) + 2\frac{d}{dt}y(t) + 3y(t) = x(t) + 3\frac{d}{dt}x(t)$$

(5+3+2)

3A. A discrete LTI system is described by the following difference equation.

$$y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = x[n] - \frac{1}{3}x[n-1]$$

Determine the frequency response of the system, impulse response of the system and output of the system for an input

$$x[n] = \delta[n] - \frac{1}{4}\delta[n-1]$$

3B. Determine the output of the system whose frequency response is $H(j\omega) = e^{\left(\frac{-\omega^2}{2}\right)}$ due to an input $x(t) = 1 + 2\cos(\sqrt{2})t) - \cos(2t)$.

3C. Evaluate x(t) if

$$X(jw) = \frac{jw}{(2 + jw)^2}$$

(5+3+2)

4A. The signal $x(t) = 2 + \cos\left(\frac{\pi t}{4}\right) - \sin\left(\frac{3\pi}{4}\right) + \cos\left(\frac{3\pi}{2}t\right)$ is passed through the filter with impulse response $h(t) = \frac{\sin \pi t}{\pi t}$. Determine the output of the filter.

4B. Determine the Laplace transform, ROC of the following signals

a. $x(t) = e^{j\omega_0 t}u(t)$

b. $x(t) = e^{5t}u(-t+3)$

4C. Determine the Z-transform of the following sequence.

$x[n] = (0.2)^n[u[n] - u[n-4]]$

(5+3+2)

5A. Compute the response of the system $y[n] = o.7y[n-1] - 0.12y[n-2] + x[n-1] + x[n-2]$ to the input $x[n] = nu[n]$. Is the system stable?

5B. Certain continuous-time signal has the spectrum given by

$$X(j\omega) = \begin{cases} -j, & \frac{\pi}{2} \le \omega \le \pi \\ +j, & -\pi \le \omega \le \frac{-\pi}{2} \\ 0, & otherwise \end{cases}$$

The signal is sampled with sampling interval $T_s$. Obtain and plot the spectrum of the sampled signal if

(a) $T_s$=1/4 (b) $T_s$ =4

5C. Determine the even and odd component of the signal $x(t) = e^{jt}$

(5+3+2)