Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

THIRD SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 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. Let $x(t) = r(t+2) - 2r(t) + r(t-2).$, where r(t) is unit ramp signal. Sketch the following signals. Compute energies of each of these signals.
   a. x(t)
   b. x(2t-3)
   c. x(2-t)
   d. 2x(t-1)+x(t+1)

1B. Determine whether following systems are linear, time in-variant, causal and stable.
   a. $y[n] = nx[n]$
   b. $y[n] = e^{-x[n]}$

1C. Determine whether following signal is periodic or not. If periodic, determine the fundamental period.

$$x[n] = 2\cos\left(\frac{\pi n}{4}\right) + \sin\left(\frac{\pi n}{8}\right)$$

(5+3+2)

2A. Let input to the LTI system with impulse response $h[n] = \alpha^n \{u[n-2] - u[n-13]\}$ be $x[n] = 2\{u[n+2] - u[n-12]\}$. Compute the output y[n] using convolution.

2B. A certain continuous LTI system has the unit step response given by

$$s(t) = \begin{cases} 1 - e^{-t}, t \geq 0 \\ 0, t < 0 \end{cases}$$

Compute the response of the system for an input $x(t) = e^{-3t}\{u(t) - u(t-2)\}$

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

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

(5+3+2)

3A. Certain LTI system has input $x[n]=\left(\frac{1}{2}\right)^{n}u[n]-\left(\frac{1}{2}\right)^{n-1}u[n-1]$ and has the response $y[n]=\left(\frac{1}{2}\right)^{n}u[n]$. Obtain the frequency response and the impulse response of the system. Also write the difference equation representation of the system.

3B. Consider an analog signal $x(t)=\frac{5\sin(10\pi t)}{\pi t}$, has been uniformly sampled. Compute the Nyquist rate and plot the spectrum of the sampled signal assuming that signal is sampled above the Nyquist rate.

3C. Use the appropriate properties to determine the Fourier representation of

$$x[n]=4\left(\frac{1}{2}\right)^{n}u[n]-\frac{1}{\pi n}\sin\left(\frac{\pi n}{4}\right)$$

(5+3+2)

4A. An LTI system has impulse response $h(t)=2\cos(6\pi t)\frac{\sin(\pi t)}{\pi t}$. Using Fourier transform, determine the output if the input is $x(t)=5+\sin(\pi t)+\cos(6\pi t)$.

4B. Determine the Laplace transform, ROC and location of poles and zeros for the following signals

a. $x(t)=e^{-2t}u(t)+e^{-3t}u(t)$

b. $x(t)=\sin(3t)u(t)$

4C. Give the relation between z-transform and DTFT. Use this relation to compute the DTFT of the signal x[n= u[n]-u[n-10].

(5+3+2)

5A. Consider the LTI system described by the difference equation

$$7y[n-1]-y[n-2]-12y[n]=12x[n].$$

Determine the system function and the impulse response. Obtain the pole zero plot and hence comment on the stability and causality of the system.

5B. Determine the z-transform and ROC for the following signal

$$x[n]=\sin\left(\frac{\pi n}{8}-\frac{\pi}{4}\right)u[n-2]$$

5C. Determine the time domain signal corresponding to $X(z)=(1+z^{-1})^{3}$, ROC $|z|>0$

(5+3+2)