Reg. No.					



MANIPAL INSTITUTE OF TECHNOLOGY Manipal University



THIRD SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION NOV/DEC 2015 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. Explain linearity, causality and time-invariance property. Mention whether the systems characterized by the following equations have these properties.

(i) $y(t) = x^2(t) + dx(t)/dt$ (ii) $y[n] = e^{x[-n]}$

```
(iii) y(t) = 2x(t) + 4dx(t)/dt.
```

- 1B. Consider a signal x[n] = 3n/4 in the interval $0 \le n \le 4$ and 0 otherwise. Plot x[2n], x[2-n] and -2x[n+2]
- 1C. Determine whether the signals $x(t)=e^{-t/4}u(t+2)$ and $x[n] = \cos^2(100\pi n)$ are energy or power signals and find their energy or power (whichever is applicable)

(5+3+2)

- 2A. Consider the signals $x(t) = e^{-2t}u(t-3)$ and $x[n] = 0.5^n(u[n+2] u[n-3])$ with impulse responses h(t) = -u(t-2)-u(t-1)+u(t+1)+u(t+2) and h[n] = n(u[n+2]-u[n-3]) respectively. Evaluate the output of the systems.
- 2B. If a discrete time system has to be stable, causal and memoryless, derive the necessary conditions to be satisfied by the impulse response of that system.
- 2C. Obtain the direct form 1 and direct form 2 implementations for the following LTI system. 2x[n] = y[n]+7y[n-1]-y[n-2]

(5+3+2)

- 3A. Obtain appropriate Fourier representation for $x(t) = e^{-t^2/2}$. With the help of Fourier representation, evaluate the convolution of x(t) with itself.
- 3B. Give the time domain representation of the following spectra. $X(j\omega) = 1$ for $0.1\pi < |\omega| < 0.3\pi$, and zero otherwise.

3C. Using ideas from Fourier representation of signals, evaluate $\int_{-\infty}^{\infty} \operatorname{sinc}(t/T) dt$

(5+3+2)

- 4A. An LTI system has impulse response $h(t) = \operatorname{sinc}(2t)$. Let the input to this system be a periodic square wave defined as x(t) = 1 for -1/4 < t < +1/4 and zero otherwise for one period. The fundamental period of x(t) is 1.5 time units. Determine the output y(t) of the system.
- 4B. Identify Nyquist sampling rate for the signal x(t) = sinc(4t) and plot its spectrum if the signal is sampled at the Nyquist rate.
- 4C. What is the relation between Laplace transform and Fourier transform.

(5+3+2)

- 5A. Determine the system function and the impulse response for the LTI system described as 12x[n] = -12y[n]+7y[n-1]-y[n-2]. Also plot the poles and zeros.
- 5B. Find the inverse z transform of the following signal. Show the ROC and location of poles and zeroes on the z plane.

$$X(z) = 1/(1 - 0.2z^{-1})$$

5C. Describe how the stability and causality of the system can be interpreted from the pole-zero plot of the system function.

(5+3+2)