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 - 209)

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

Instructions to candidates

- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. The input to a discrete time system is given by $x[n]=\cos\left(\frac{\pi}{4}n\right)+\sin\left(\frac{3\pi}{4}n\right)$. Using DTFT, find the output of the system if its impulse response is $h[n]=(-1)^n\frac{\sin\left(\frac{\pi}{2}n\right)}{\pi n}$

1B. Given the spectrum of a signal x(t) as $X(j\omega)=\frac{1}{2}\exp\left(\frac{-(\omega-\omega_0)^2}{2}\right)+\frac{1}{2}\exp\left(\frac{-(\omega+\omega_0)^2}{2}\right)$, determine the signal x(t)

1C. Give the output of a system whose frequency response is $H(j\omega)=\exp(-\omega^2/2)$ due to an input $x(t)=1+2\cos((\sqrt{2})t)-\cos(2t)+3\cos(4t)$

(5+3+2)

2A. Find the inverse transforms of the following

(i) $X(e^{j\Omega})=\dfrac{\frac{1}{2}e^{-j\Omega}+2}{\frac{1}{8}e^{-j2\Omega}+\frac{1}{4}e^{-j\Omega}+1}$ (ii) $X(j\omega)=\dfrac{2\sin(\omega)}{\omega(j\omega+1)}$

2B. Plot the signal $x[n]=\sum_{k=-\infty}^{+\infty}(-1)^n\delta(n-2k)$. Obtain its appropriate Fourier representation.

2C. Find the signal x(t) such that its Fourier transform is $X(j\omega)=\dfrac{d^2u(\omega-\gamma)}{d\omega^2}$

(5+3+2)

3A. The input x[n] and the impulse response h[n] of a LTI system is given by
x[n]=-u[n]-2u[n-3]-u[n-6] and h[n]=u[n+1]-u[n-10].
Plot x[n] and h[n]. Use convolution sum to evaluate the output y[n] of the LTI system. Plot y[n].

3B. Find the inverse z transform of the following:

i) $\mathrm{X(Z)}=\mathrm{e}^{\mathrm{Z}^2}$ ROC: all Z except $|Z|=\infty$

ii) $\mathrm{X(Z)}=\ln(1+\mathrm{Z}^{-1})$ ROC: $|Z|>0$

3C. What is the frequency response of a system with output $y(t)=\int_{-\infty}^{t}x(\tau-T)d\tau$ for an input x(t)?

(5+3+2)

4A. Evaluate and plot the convolution of x(t)= u(t)+u(t-1) -2u(t-2) with h(t) = u(t-1)-u(t-4).

4B. A system is defined by $y[n]-2y[n-1]=x[n]$. Check whether a stable and causal inverse exists? If exist find its impulse response.

4C. Cosnider the signal $y[n]=\sum_{k=-\infty}^{n} x[k]$ where x[n] is periodic with period N

(i) What should be the DTFS coefficient X[0] if y[n] has to be periodic with period N?

(ii) If y[n] is periodic, what is the value of $y[\infty]$?

(5+3+2)

5A. Obtain the natural response, forced response and the total response of the system described by the following differential equation.

$y''(t) + 5y'(t) + 6y(t) = 2x(t) + x'(t)$ for the input $x(t) = 2e^{-t}u(t)$

5B. State the sampling theorem. Plot the spectrum of the signal $x(t)=\sum_{k=-\infty}^{+\infty}\delta(t-k(T/2))\cos(2\pi t/T)$. Though the sinusoidal signal is sampled at the Nyquist rate, the signal cannot be reconstructed from its samples. Mention which condition of the sampling theorem is violated here?

5C. Solve the following difference equation using Z transforms.

y(n) = 3 y(n-1) + x(n) for the input u(n) and with y(-1) = 1

(5+3+2)

6A. Draw a neat diagram of the direct form I and direct form II implementations for the following equations.

(i) y[n] + 0.3 y[n-1] + 0.6 y[n-2] = x[n] + x[n-1] + 0.75x[n-2].

(ii) $y''(t)+5y'(t)+4y(t) = x'(t)$

6B. Find the impulse response and difference equation of an LTI system defined by

$$H[e^{j\Omega}]=\frac{5+e^{-j\Omega}+e^{j\Omega}}{7/6+1/3\,e^{-j\Omega}+1/2\,e^{j\Omega}}:$$

Can this system be implemented?

6C. Using the Fourier transform of step function, evaluate $\int_0^\infty \cos(\omega t)dt$ and express the result as a function of ω

(5+3+2)