Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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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. Suppose the input $x(t)$ and impulse response $h(t)$ of a LTI system is given by $x(t) = 2u(t-1) - 2u(t-3)$ and $h(t) = u(t+1) - 2u(t-1) + u(t-3)$. Plot $x(t)$ and $h(t)$. Use convolution integral to evaluate the output $y(t)$ of the LTI system. Plot $y(t)$.

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

(5+3+2)

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

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

2C. Find the signal $x[n]$ such that one period of its DTFT is $\frac{d^2u(\Omega-\Gamma)}{d\Omega^2}$ with $|\Gamma| < \pi$

(5+3+2)

3A. Find the inverse transforms of the following

(i) $X(e^{j\Omega}) = \frac{\frac{1}{2}e^{-j\Omega}+2}{\frac{1}{8}e^{-j2\Omega}+\frac{3}{4}e^{-j\Omega}+1}$ (ii) $X(j\omega) = \frac{2\sin(\omega)}{\omega(j\omega+1)}$

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

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

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

3C. What is the frequency response of a LTI system with output $y(t)$ as $y(t) = \frac{dx(t-T)}{dt}$ for a given input $x(t)$?

(5+3+2)

4A. 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 $x(t) = 2e^{-t}u(t)$

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

4C. Cosnider the signal $y(t) = \int_{-\infty}^{t} x(\tau)d\tau$ where $x(t)$ is periodic with period T

(i) What should be $X[0]$ if $y(t)$ has to be periodic with period T?

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

(5+3+2)

5A. Evaluate the convolution sum between the following two signals

x[n]= u[n-2]-2u[n-4] + u[n-8] and h[n] = $(0.5)^n$ (u[n]-u[n-5]).

5B. State the sampling theorem. Plot the spectrum of the signal $x(t) = \sum_{k=-\infty}^{+\infty} \delta(t - k(T/2)) \sin(2\pi t/T)$. Though the sinusoidal signal is sampled at the Nyquist rate, the resultant output is zero. Mention which condition of the sampling theorem is violated here?

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

$y[n] = 3y[n-1] + x[n]$ 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) -0.5y'(t) +y(t) = x''(t) + 0 .75x'(t) +2x(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)