Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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THIRD SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION NOV/DEC 2016

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 causality, stability, linearity and time-invariance properties of system. Determine whether or not the following systems are linear, time-invariant and causal.

(i) $y[n] = \cos(x[n])$

(ii) $y(t) = tx(t)$

(iii) $y[n] = e^{-|x[n]|}$

1B. Certain signal is defined by $x(t) = r(t+1) - 2r(t-1) + r(t-3)$, where *r(t)* is the unit ramp signal. Sketch and compute the energies of *x(t), x(2t-3), and 2x(1-2t).*

1C. Determine whether the signal $x[n] = \cos\left(\frac{\pi n}{3}\right)\sin\left(\frac{\pi n}{5}\right)$ is periodic or not. Calculate the period if periodic. What are the even and odd components of *x[n]* ?

(5+3+2)

2A. Consider a discrete-time system with impulse response $h[n] = n\{u[n+2] - u[n-3]\}$ and a continuous-time system with impulse response $h(t) = -u(t-2) - u(t-1) + u(t+1) + u(t+2)$. Let $x[n] = 0.5^n\{u[n+2] - u[n-3]\}$ and $x(t) = e^{-2t}u(t-3)$ be the inputs to the discrete-time and continuous-time systems respectively. Using convolution evaluate the output of the systems.

2B. What are the building blocks of discrete-time LTI systems? Obtain the direct form-I and direct form-II implementations for the LTI system defined by $y(t) + 2\frac{dy(t)}{dt} - 4\frac{d^2y(t)}{dt^2} = \frac{dx(t)}{dt}$.

2C. Given the impulse response of a LTI system $h[n] = n\left(\frac{1}{2}\right)^n u[n]$, determine if the system is causal and stable.

(5+3+2)

3A. The impulse response of a discrete time system is given by $h[n] = \frac{1}{4}\sin c\ (n/4)$. Apply properties of Fourier representations and obtain output to the input.

$x[n] = 2 + \cos(\pi/8\, n) + \sin(\pi/2\, n) - 2\cos(\pi/3\, n)$

3B. A signal $x(t) = e^{-\pi t^2}$ is applied to a system that has its impulse response h(t) = x(*t*). Compute Fourier transform of the output signal *y*(*t*).

3C. Using duality determine the signal *x*(t) if its spectrum is $X(j\omega) = \dfrac{1}{1+\omega^2}$

(5+3+2)

4A. i) For a system shown in Figure Q4A.1, sketch Fourier transform of $x_p(t)$ *if* $p(t) = \sum_{k=-\infty}^{\infty} \delta(t - k\Delta)$ and $\Delta = \pi / 2w_m$. The signal *x(t)* has a spectrum as shown in Figure Q4A.2.

ii) Sketch $Y(j\omega)$ and obtain *y(t)* in terms of *x(t)* for H(jw) as shown in Figure Q4A.3. Determine the range of Δ for which system cannot recover the original signal *x(t)*.

4B. Determine an impulse response of discrete-time causal inverse system to eliminate the effect of echo received along with the signal. The echo is one unit time delayed with strength half of the input signal.

4C. Determine the difference equation of the system defined by the impulse response, $h[n] = \delta[n] + 2(\frac{1}{2})^n u[n] + (-\frac{1}{2})^n u[n]$.

(5+3+2)

5A. Define z-domain convolution and z-domain differentiation properties of Z-transform. Determine Z-transform of $x[n] = \{n(-0.25)^n u[n]\} * \{(0.5)^{-n} u(-n)\}$. Plot the poles and zeroes in z-plane and indicate ROC.

5B. Describe the relation between Z-transform and DTFT. Use Z-transform to determine DTFT of $x[n] = u[n] - u[n-N]$.

5C. Determine the bilateral Laplace Transform and ROC for the signal $x(t) = \sin(2t)u(t)$.

(5+3+2)

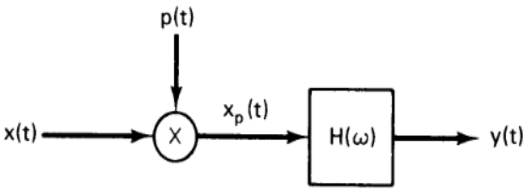

Figure Q4A.1

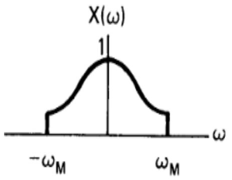

Figure Q4A.2

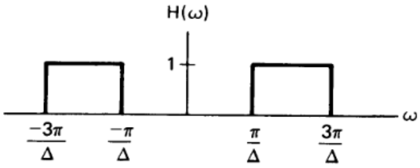

Figure Q4A.3