Reg. No.										

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION - OCT. / NOV. 2017

SUBJECT: SIGNAL PROCESSING (EC 244)

(BRANCH: EC)

Tuesday, 31 October 2017

Time: 3 Hours **Max. Marks: 100**

✓ **Answer ANY FIVE FULL Questions.**

1A. Consider the signal $x(t)=u(t+4)+u(t+2)+u(t+1)-u(t-1)-u(t-2)-u(t-4)$, where u(t) is the unit step function. Sketch and compute the energies of x(t), -x(t), x(2t-3), and 2x(1-2t).

1B. Consider a LTI system having impulse response $h[n]=u[n]-u[n-5]$. Compute the response of the system for the input $x[n]=u[n-2]-u[n-8]+u[n-11]-u[n-17]$ using time-domain convolution. Clearly show all the steps. **(10+10)**

2A. Find the step response of an LTI system having impulse response $h(t)=e^{-|t|}$ using time-domain convolution.

2B. Obtain the direct form-I and direct form-II implementations for the following LTI systems. (i) $2\frac{d^2\,y(t)}{dt}+\frac{1}{2}\frac{d\,y(t)}{dt}-y(t)=\frac{d\,x(t)}{dt}$

(ii) $2y[n]+3y[n-1]-y[n-2]-2x[n-1]+4x[n-2]=0$. **(10+10)**

3A. Explain linearity, time-invariance and causality properties of systems. Determine whether the systems characterized by the following equations have these properties or not. (i) $y(t)=\log(x(t))$ (ii) $y[n]=x[n]\cos(\omega_0 n)$

3B. Using the suitable properties of Fourier transform, determine time signals for the following frequency domain functions.

(i) $X(j\Omega)=\frac{j\Omega}{(2+j\Omega)^2}$ (ii) $X(j\Omega)=e^{-2|\Omega|}$. **(10+10)**

4A. Derive the conditions to be satisfied by the impulse response in order for the continuous-time system to be causal, stable and invertible. Also determine whether the system described by $h(t)=e^{-2|t|}$ is causal and stable.

4B. State and prove linearity, time-shifting, differentiation and convolution properties of Fourier transform. **(10+10)**

5A. Determine the inverse Fourier representation of, $X(e^{j\omega})=\begin{cases}1, & |\omega|\le 0.4\pi \\ 0, & Otherwise\ in\ -\pi\le\omega\le\pi\end{cases}$.

5B. Use the suitable properties to obtain the appropriate Fourier representation for the signal,

$x[n]=\frac{\sin\left(\frac{\pi n}{4}\right)}{\pi n}*\frac{\sin\left(\frac{\pi(n-8)}{4}\right)}{\pi(n-8)}$. Also obtain magnitude and phase plots.

(Note: * denotes convolution operation). **(10+10)**

6A. Find the frequency response and the impulse response of a causal discrete-time system described by the difference equation $y[n-2]+5y[n-1]+6y[n]=8x[n-1]+18x[n]$.

6B. Give the frequency responses of analog Butterworth and Chebyshev Type-I low-pass filters and compare them. Also, distinguish between FIR and IIR filters. **(10+10)**

7A. Compute the 8-point DFT of sequence x[n] = {0.5 0.5 0.5 0 0 0 0 0}.

7B. State and prove the sampling theorem. Support your proof with suitable signal and spectral plots and hence describe the Nyquist frequency. **(10+10)**

8A. A causal LTI system has input $x[n]=\delta[n]+\frac{1}{4}\delta[n-1]-\frac{1}{8}\delta[n-2]$ and output $y[n]=\delta[n]-\frac{3}{4}\delta[n-1]$. Using Z-transform find its impulse response.

8B. Given $X(z)=\dfrac{1}{1-1.5z^{-1}+0.5z^{-2}}$, indicate all possible ROC's and determine corresponding time domain signals. **(10+10)**