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MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FOURTH SEMESTER B.Tech. (I & C E) DEGREE END SEMESTER EXAMINATION
May/June 2016
SUBJECT: SIGNALS AND SYSTEMS (ICE - 2201)

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 property of systems. Mention the status of the following systems with respect to the above properties.
(i) $y(n) = nx(n)$ (ii) $y(n) = x(-n)$

1B. Categorize the following signals as power or energy and evaluate the same.
(i) $x(t) = t\,u(t)$ (ii) $x(t) = \cos^2(t)$

1C. Sketch the signal $y(t) = r(t+2) - 2r(t+1) + r(t-1) + r(t-2)$

(5+3+2)

2A. Input x(t) and impulse response h(t) of a LTI system is given by $x(t) = u(t+2) - u(t-2)$ and $h(t) = u(t-3) - u(t-10)$. Use convolution integral to evaluate the output y(t) of the system and sketch $y(t)$.

2B. Draw direct form I and direct form II implementations for the system
$y[n] + 2y[n-1] - 8y[n-2] = 2x[n] + x[n-1]$

2C. Evaluate the step response of LTI System with impulse response $\mathrm{h}(n) = (0.5)^n u(n)$

(5+3+2)

3A. Find the natural response, forced response and hence the complete response of the system described by the differential equation for $x(t) = e^{-0.5t}u(t)$

$$\frac{\mathrm{d}^2\mathrm{y}(t)}{dt^2} + 3\frac{\mathrm{dy}(t)}{dt} + 2y(t) = 2x(t) + \frac{\mathrm{dx}(t)}{dt}\ ;\ \mathrm{y}(0-) = 1 \text{ and } \frac{dy(0-)}{dt} = 2$$

3B. Evaluate appropriate Fourier representation and sketch magnitude and phase specta of
$x(n) = 1 + \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right)$.

3C. Obtain the appropriate Fourier representation of $x(t) = \sum_{k=-\infty}^{+\infty}(-1)^k\,\delta(t-2k)$

(5+3+2)

4A. A LTI system is described by $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2\frac{dx(t)}{dt} + x(t)$. Determine the frequency response and impulse response of the system.

4B Find DTFT of (i) $x[n] = \frac{\sin\left(\frac{\pi}{4}n\right)}{\pi n} * \frac{\sin\left(\frac{\pi}{4}(n-2)\right)}{\pi(n-2)}$ (ii) $x(n) = (0.5)^n u(n)$

4C Determine the time domain representation of the spectra $X(j\omega) = \text{sinc}^2(2\omega)$

(5+3+2)

5A. A signal $x(t) = 1+\cos(\frac{\pi}{4}t)+\cos\left(\frac{3\pi}{2}t\right)$ is passed through the filter with impulse response $h(t) = \frac{\sin \pi t}{\pi t}$.

Determine FT of x(t) and h(t). Using this determine the output of the filter.

5B. Obtain DTFT of $x(n) = \sin\left(\frac{4\pi}{15}n\right)+\cos\left(\frac{10\pi}{15}n\right)$

5C. Identify Nyquist sampling rate for the signal $x(t) = z(t)y(t)$ where

$Z(j\omega) = u(\omega+\pi/2T)-u(\omega-\pi/2T)$ and $Y(j\omega) = u(\omega+\pi/4T)-u(\omega-\pi/4T)$

(5+3+2)

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