Code No: R7210404 **R7**

II B.Tech I Semester(R07) Supplementary Examinations, May/June 2010
SIGNALS AND SYSTEMS
(Common to Electronics & Communication Engineering, Electronics & Instrumentation Engineering and Electronics & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) The two periodic functions $f_1(t)$ and $f_2(t)$ with zero dc components have arbitrary waveforms with periods T and $\sqrt{2T}$ respectively. Show that the component in $f_1(t)$ of waveform $f_2(t)$ is zero in the interval (-$\alpha < t <$ a).
   (b) complex Sinusoidal signal x(t) has the following components.
   $\mathrm{Re}\{x(t)\} = x_R(t) = A\cos(\omega t+\theta)$
   $\mathrm{I_m}\{x(t)\} = x_I(t) = A\sin(\omega t+\theta)$
   The amplitude of x(t) is given by the square root of $x_R^2(t) + x_I^2(t)$. Show that this amplitude equals A and is therefore independent of the phase angle θ. [8+8]

2. (a) Explain the concept of generalized Fourier series representation of signal f(t).
   (b) State the properties of Fourier series. [8+8]

3. (a) Explain the concept of continuous spectrum.
   (b) Describe the following functions:
      i. Unit Step function
      ii. Dirac Delta function
      iii. Sampling function
      Obtain Fourier Transform and draw the spectrum for above functions.

   [4+12]

4. The input and the output of a causal LTI system are related by the differential equation: $\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = 2x(t)$
   (a) Find the impulse response of this system.
   (b) What is response of this system if x(t) = t e^{-2t} x(t). [8+8]

5. (a) Explain briefly detection of periodic signals in the presence of noise by correlation.
   (b) Explain briefly extraction of a signal from noise by filtering. [8+8]

6. (a) Let x(t) be a signal with Nyquist rate ω_0. Also let y(t) = x(t) p(t-1), where $p(t) = \sum_{n=-\infty}^{\infty} \delta_1(t - nT),$ *and* $\frac{2\pi}{\omega_0}$
   Specify the constraints on the magnitude and phase of the frequency response of a filter that gives x(t) as its output when y(t) is the input.
   (b) Explain the Sampling theorem for Band Limited Signals with analytical proof.

   [8+8]

7. (a) State the properties of the ROC of Laplace Transforms.
   (b) Determine the function of time x(t) for each of the following Laplace transforms and their associated regions of convergence. [8+8]
      i. $\frac{(s+1)^2}{s^2 - s + 1}$ $\quad \mathrm{Re}\{S\} > 1/2$
      ii. $\frac{s^2 - s + 1}{(s+1)^2}$ $\quad \mathrm{Re}\{S\} > -1$

8. (a) Determine the unilateral Z transform of the following signals, and specify the corresponding Regions of convergence:
      i. $x_1[n] = \left(\frac{1}{4}\right)^n u(n+5)$
      ii. $x_2[n] = \left(\frac{1}{2}\right)^{|n|}$
      iii. $x_3[n] = \delta[n+3] + \delta[n] + 2^n u[-n]$
   (b) Give the discrete time signal representation using complex exponential and sinusoidal components. [12+4]

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