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EX/ET/T/213/2017(S)

B.ETCE Supplementary Examination 2017
(2nd Year 1st Semester)
Signal Theory & Noise

Time: Three hours | Full Marks: 100

Answer any five questions
All the questions carry equal marks
Answer all the parts of a question in the same place

1. a) State sampling theorem. How can you reconstruct a continuous time signal from its samples through ideal interpolation? (3+7)

   b) State the time shift property and the width property of convolution integral. (2+2)

   c) Find the convolution of two signals $f(t) = e^{-t}u(t)$ and $h(t) = e^{-2t}u(t)$. (6)

2. a) Consider a rectangular function of width τ and calculate its Fourier transform. Draw the corresponding spectrum and note down your observation in this regard. (4+2+4)

   b) Estimate the essential bandwidth of the above rectangular pulse where the essential bandwidth is to contain at least 95% of the pulse energy. (5)

   c) Find the energies of the signals as defined below: (2.5+2.5)
   i) $f_1(t) = \cos t$
   ii) $f_2(t) = -\sin t$

3. a) Define auto-correlation function of a signal. (4)

   b) Establish that Energy Spectral Density (ESD) of a signal is equal to the Fourier transform of the autocorrelation function of the same signal. (6)

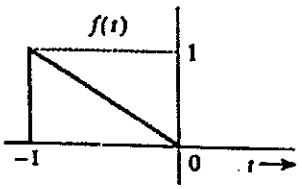
   c) How will you determine the energy of a signal through Parseval's theorem? (5)

   d) Draw odd and even components of the signal described by $f(t) = e^{-at}u(t)$ (5)

4. a) Find the exponential Fourier series for the signal $g(t) = e^{-t/2}$ over $0 \leq t \leq \pi$ and draw its corresponding spectra. (10)

b) Sketch the signal $y(t) = (t - 2)\,[u(t - 3) - u(t - 4)]$ (5)

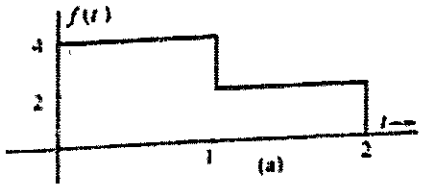
c) Sketch the signals f(t/2) and f(t-4) corresponding to the signal f(t) as shown below: (2.5+2.5)



5. a) State and explain the significance of time shifting property and frequency shifting property of Fourier transform. (4+4)

b) If G(f) represents the Fourier transform of g(t), then show that (4)
$g(t+T) + g(t-T) \leftrightarrow 2G(f) \cos 2\pi fT$

c) Find the Fourier transform of the signal as shown below: (8)



6. Explain how the following types of noise are generated? (5x4)

a) Atmospheric noise
b) Thermal noise
c) Cosmic noise
d) Shot noise
e) Transit-time noise

7. a) Establish the relationship between input and output Power Spectral Density (PSD) of a filter placed before the demodulator of a communication system to restrict noise power delivered to it. (6)

b) Use the above expression to derive the expressions for noise power at the output of the following filters: (4.5+4.5+5)

a) RC low-pass filter
b) Differentiating filter
c) Integrator

8. a) Derive the expression for equivalent resistance of a two-stage amplifier connected in cascade. (6)

b) Define Noise Figure of an amplifier. Derive the expression for equivalent Noise Figure of a two-stage amplifier connected in cascade. (6)

c) Consider the narrowband representation of noise and derive the expressions for its in-phase and quadrature components. Also state the significance of this representation. (6+2)