BETCE EXAMINATION, 2018
(2nd Year 1st Semester Supplementary)
Signal Theory and Noise

Time: Three hours | Full Marks: 100

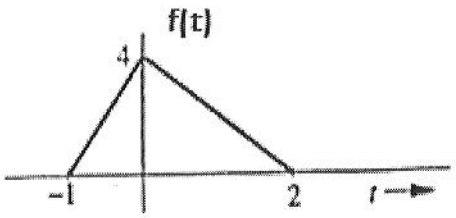
Write all the parts of a question in the same place
Answer any five questions
All the questions carry equal marks

1. a) Find and sketch the odd and even components of the following signals: (3+3)

   i) $g_1(t) = -t\,u(t)$
   ii) $g_2(t) = \cos \omega_0 t$

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

   c) A signal f(t) is illustrated below. Sketch f(t/2), f(2t - 4) and f(4-2t). (2+2+3)



   d) Differentiate between an energy signal and a power signal. (4)

2. a) State and explain the significance of Time Shifting property of Fourier transform. (4)

   b) Establish the relation between Exponential Fourier spectra and Trigonometric Fourier spectra. (4)

   c) From definition, show that the Fourier Transform of rect (t-5) is sinc $(\omega/2)\, e^{-j5\omega}$. Sketch the resulting amplitude and phase spectra. (8)

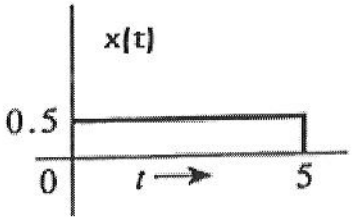
   d) If a signal m(t) is multiplied by a sinusoid $\cos \omega_c t$, what happens to the resulting signal? Explain with necessary diagrams (both time domain and frequency domain). (4)

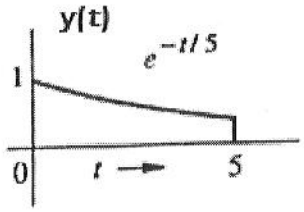
3. a) Establish that the auto-correlation function of a signal and its Energy Spectral Density (ESD) form a Fourier transform pair. (Consider only real signal). (5)

   b) State and prove the time convolution property of two signals. (4)

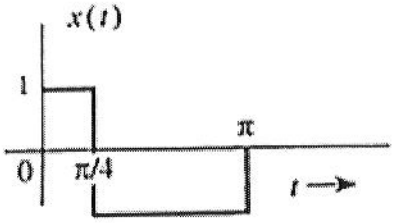
c) Define correlation coefficient (c_n) between two signals and state its significance. (3)

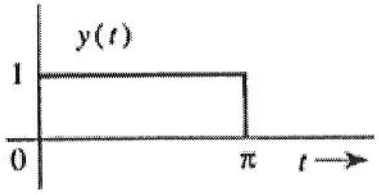
d) Find the value of c_n between the following signals as shown below: (3)





e) Find the energies of the signals x(t) and y(t) as shown below: (5)





4. a) State and prove Sampling theorem. (2+5)

b) How can you reconstruct a continuous time signal from its samples through ideal interpolation? (7)

c) Explain how the concept of sampling can fruitfully be used in pulse modulation. Considering a sinusoidal signal, draw the waveforms corresponding to Pulse Amplitude Modulation (PAM) and Pulse Width Modulation (PWM). (2+2+2)

5. a) Differentiate between i)Time Average and Ensemble Average ii) Stationary Process and Ergodic Process iii) Impulse and White noise signal. (4+4+4)

b) How can a resistor be used as a noise generator? (5)

c) Explain the term AWGN. (3)

6. a) Explain, how the following types of noise are generated within a receiver: (3+3+3)

i) Atmospheric Noise

ii) Flicker Noise

iii) Shot Noise

b) Consider the cascade of two stage amplifiers. Derive the expression for the equivalent noise resistance of the whole cascade at the input of the first stage. (5)

c) Derive the expression for the overall Noise Figure of a cascade of two stages. (6)

7. a) Consider that noise is a random process and can be represented as superposition of noise spectral components. With the necessary mathematical derivations, derive the properties of Fourier coefficients a_k and b_k associated with k^{th} frequency interval. (10)

b) Calculate the noise power at the output of an RC low-pass filter having cut-off frequency f_c. (5)

c) What do you mean by Noise Bandwidth of a filter? (5)