GD

Data Communication (IE30006)

Department of Electrical Engineering

Mid-Semester examination (Spring, 2016-2017)

No. of students: 96 (EE, EEDD, IE)

Date:

Instruction: Answer all questions

Total marks: 30 **Total time: 2 hours**

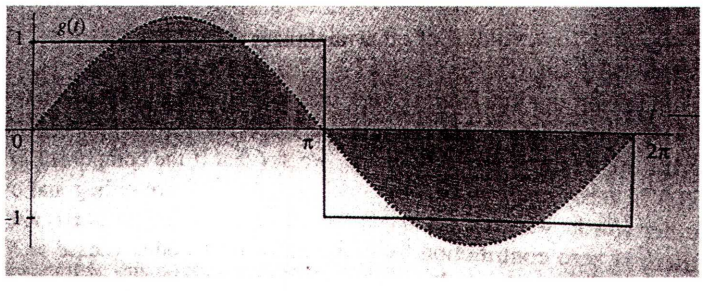
Q1. **(a)** Consider the problem of approximating a real signal $g(t)$ in terms of another real signal $x(t)$ over an interval $[t_1, t_2]$:

$$g(t) \simeq cx(t) \qquad t_1 \leq t \leq t_2$$

Derive the expression for the optimum value of c for best approximation of $g(t)$ with $x(t)$.

(3 marks)

(b) For the square signal $g(t)$ shown in the Figure below, approximate $g(t)$ in terms of $sin(t)$ so that the energy of the error signal is the minimum.



(3 marks)

Q2. **(a)** Obtain the Fourier transform of the sign function, $sgn(t) = \begin{cases} 1 & t > 0 \\ -1 & t < 0 \end{cases}$. Justify the use of the approximation you make.

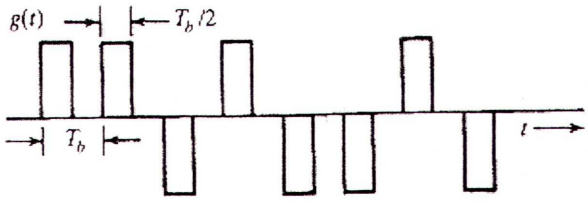
(3 marks)

(b) Plot the function $e^{-a(|t-t_0|)}$ with respect to time. Obtain the Fourier transform of this function and plot its magnitude and phase spectra.

(3 marks)

Q3. **(a)** Estimate essential bandwidth W in rad/s of the signal $e^{-at}u(t)$ if the essential band is required to contain 95% of the signal energy.

(3 marks)



(b) The figure above shows a random binary pulse train $g(t)$. The pulse width is $T_b/2$ and one binary digit is transmitted every T_b seconds. A binary 1 is transmitted by the positive pulse and a binary 0 is transmitted by the negative pulse. The two symbols are equally likely and occur randomly. Determine the auto-correlation function. (Assume that N pulses occur in the averaging interval T.)

(4 marks)

Q4. **(a)** Why is linear phase response a requisite for distortionless signal transmission?

(3 marks)

(b) Can all-pass systems be considered to be really distortionless? Justify you answer mathematically.

(2 marks)

Q5. **(a)** For the case of tone modulation with a carrier using DSB-SC scheme obtain the modulated spectrum and also sketch it. What is the meaning of the term "*suppressed carrier*" in this context?

(2 marks)

(b) Determine the power efficiency, η, for an AM wave for tone modulation when $\mu = 0.5$. What is the maximum value of η possible and what is that corresponding value of μ ?

(2 marks)

Q6. Derive the expression for the general SSB signal $\phi_{SSB}(t)$ using Hilbert transform.

(2 marks)