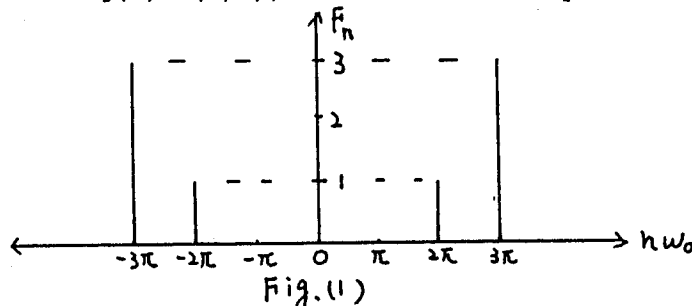1. The line spectrum, in volts, of a certain periodic function f(t) is
   shown in Fig.(1).   (15%)
   (a) What is the value of the period T?
   (b) What is the value of f(0)?
   (c) What is the value of f(1/2)?
   (d) Given a function g(t)=f(t/2), sketch the line spectrum of g(t).


Fig.(1)

2. For the sinusoidally modulated AM (DSB-LC) waveform shown in
   Fig.(2), assume the carrier and signal frequence are 600 KHz and 10
   KHz, respectively.   (15%)
   (a) Find the modulation index m.
   (b) Write the expression of ϕ(t).
   (c) Sketch a line spectrum of the waveform ϕ(t).
   (d) Find the transmission efficiency of the AM system.
   (e) Determine the amplitude and phase of the additional carrier
       which must be added to the waveform shown to attain a modulation
       index of 80%.

Fig.(2)
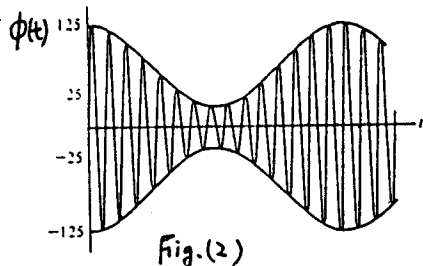
3. A Gaussian-distributed random variable X with zero mean and unit
   variance is applied to the input of a system whose output-input
   gain characteristic is $y = x^2$. Determine the probability density
   function (pdf) of the output random variable Y.   (10%)

1

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4. A physically realizable filter is matched to a signal approximated by the waveform shown in Fig.(3). (15%)
   (a) Determine and sketch the impulse response of the matched filter for minimum delay.
   (b) Determine and sketch the matched-filter output, versus time, for the minimum-delay case.

$f(t)$

1

0 Fig.(3) T t
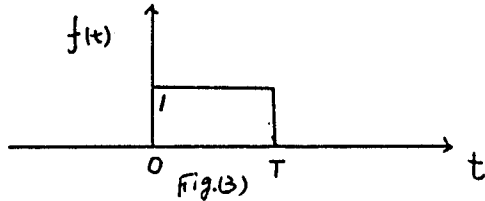
5. A given signal has a probability density

$$p(x) = \begin{cases} k \exp(-|x|) & -2<x<2 \\ 0 & \text{elsewhere} \end{cases}$$ (15%)

   (a) Determine the mean-square quantization noise for four equally space quantization levels over $(-2, 2)$. Do not assume that the distribution is constant within each interval.
   (b) Compare your answer to part (a) with that assuming a uniform distribution.

6. Sketch a comprehensive block diagram of a digital transmission and reception system and briefly describe the function of each block. (15%)

7. Explain the following terminologies: (15%)
   (a) Noise figure
   (b) Fading
   (c) Intersymbol interference
   (d) Hamming distance
   (e) Entropy