Department of Electrical Engineering, IITD

EL L311, Comm. Engg., Minor - I, M.M.: 25, Dur: 1 hr.

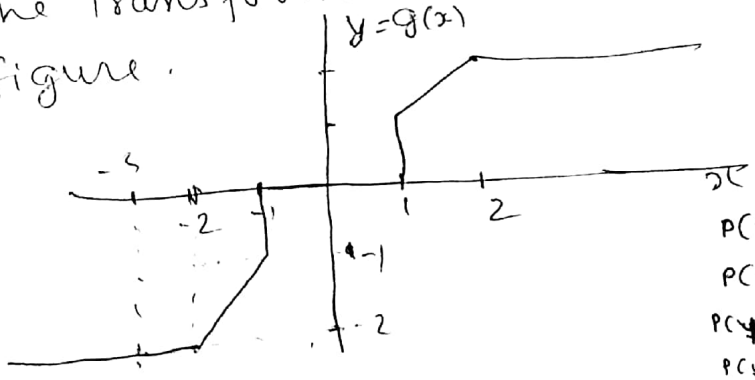
MAKE ASSUMPTIONS, IF REQUIRED

Prob. 1 : Let a signal $m(t) = A_1 \cos w_1 t + A_2 \cos w_2 t$ is used to frequency modulate a carrier at w_c. Find & plot the spectrum of modulated signal. (5)

Prob. 2 : Let an FM signal $x(t) = A \cos\left(w_c t + k_f \int m(\lambda) d\lambda\right)$ be passed through a nonlinear system $y = a_0 + a_1 x + a_2 x^2$. Is it possible to recover $m(t)$? If yes provide the system. & if not then quantify amount of distortion of $m(t)$. (5)

Prob. 3(a) Suppose in the "dice" experiment, we are interested in two events $A = \{1, 2, 3, 4\}$ & $B = \{3, 4, 5, 6\}$, what is the smallest σ-algebra of our interest.

(b) A random variable X (with $f_X(x) = \frac{1}{10}\left(u(x+5) - u(x-5)\right)$) undergoes the transformation $y = g(x)$ as given in figure. (9)



Prof. SD Joshi

$P(-\infty < y < -2) = 0$

$P(y = -2) = P(x \le -2) = \frac{3}{10}$

$P(y = y) = P(x = y)$

$P(y = 0) = \frac{2}{10}$ $P(y=y) = P(x=y)$

Find & plot $f_Y(y)$.

Prob. 4 : Let a signal $x(t)$ be as given below:

$$x(t) = \begin{cases} A\cos(2\pi \times 10^6 t) & \text{for } -\infty < t < -1 \\ A\cos\left(2\pi(10^6 + 10^3)t + \pi 10^3\right) & \text{for } -1 \le t \le 0 \\ A\cos\left(2\pi(10^6 - 10^3)t + \pi 10^3\right) & 0 \le t \le 1 \\ A\cos(2\pi \times 10^6 t) & \text{for } t \ge 1 \end{cases}$$

Find its approximate bandwidth. (6)

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