ECE 3614: Introduction to Communication Systems

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Dr. Pushkin Kachroo

The Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA 24061-0111,
pushkin@vt.edu

1. Derive $x_c(t) = A\sum_{n=-\infty}^{\infty} J_n(\beta)\cos(\omega_c + n\omega_m)t$ for tone modulation for frequency and phase modulation. (10 points)
2. Show that DSB(AM) modulation is a linear scheme where as the PM modulation scheme is nonlinear. (5 points)
3. An angle modulated signal is described by $x_c(t) = 10\cos[2\pi(10^6)t + 0.1\sin 1000\pi t]$. If this signal is a PM signal with $k_p = 10$, then find $m(t)$. If this signal is an FM signal with $k_f = 10\pi$, then find $m(t)$. (10 points)
4. In a tone modulated angle modulation, the modulated signal is $x_c(t) = A\cos(\omega_c t + \beta\sin\omega_m t)$. Find the spectrum of this signal when $\beta << 1$, i.e. when we have an NB (narrow band) modulation. (5 points)
5. Show that for an FM signal demodulation using zero crossing detector $k_f m(t) \approx \frac{\pi}{\Delta t} - \omega_c$ where Δt is the time between two zero crossing. (5 points)