EE 703: Digital Message Transmission (Autumn 2021)
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Assignment 2: 20 points — Date: August 13, 2021

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1. Let a random process be defined as $X(t) = A\cos(2\pi f_c t) + B\sin(2\pi f_c t)$ where f_c is a constant and A and B are independent **real** random variables with mean zero and variance σ^2. Assume that $E[A^3] \neq 0$ and $E[B^3] \neq 0$.
   (a) [2 points] Find the mean function of $X(t)$.
   (b) [2 points] Find the autocorrelation function of $X(t)$.
   (c) [3 points] Prove or disprove the wide-sense stationarity of $X(t)$.
   (d) [3 points] Prove or disprove the strict-sense stationarity of $X(t)$. *Hint: Try calculating* $E\left[X^3(t)\right]$.

2. Consider
$$u(t) = \sum_{n=-\infty}^{\infty} b_n p(t - nT)$$
   where $p(t) = I_{[0,T)}(t)$. Recall that $I_A(t)$ is the indicator function of the set A.
   (a) [5 points] Prove that $u(t)$ is a cyclostationary random process with respect to period T if $\{b_n\}$ is a discrete-time stationary random process.
   (b) [5 points] Prove that $u(t)$ is a wide-sense cyclostationary random process with respect to period T if $\{b_n\}$ is a discrete-time wide-sense stationary random process.