EE 703: Digital Message Transmission (Autumn 2020)
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Assignment 2: 20 points — Date: September 4, 2020

1. 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.

2. Let X be a Gaussian random variable with mean $\mu = -3$ and variance $\sigma^2 = 4$. Express the folllowing probabilities in terms of the Q function with positive arguments.
   (a) [1 point] $P[X > 5]$
   (b) [1 point] $P[X < -1]$
   (c) [1 point] $P[1 < X < 4]$
   (d) [2 points] $P[X^2 + X > 2]$

3. [5 points] If $X_1 \sim \mathcal{N}(\mu_1, \sigma_1^2)$ and $X_2 \sim \mathcal{N}(\mu_2, \sigma_2^2)$ are independent Gaussian random variables, show that $X_1 + X_2 \sim \mathcal{N}(\mu_1 + \mu_2, \sigma_1^2 + \sigma_2^2)$. *Hints: What is the pdf of the sum of independent random variables? It is enough to show that* $X_1 + X_2 - \mu_1 - \mu_2 \sim \mathcal{N}(0, \sigma_1^2 + \sigma_2^2)$.