Homework 3: Carrier and Symbol Synchronization

University of Windsor
Department of Electrical and Computer Engineering
ELEC 2240 - Signals and Systems

> **Instructions**
>
> Submissions should be through Brightspace. There is a 24-hour grace period after the due date without a penalty. Late submissions and email submissions will not be accepted.

1. (5 points) Consider a five-stage self-synchronizing scrambler where the input S and output T are related as follows:

$$T(k) = S(k) \oplus T(k-3) \oplus T(k-5)$$

   (a) Design the corresponding descrambler.

   (b) If the sequence $S = 1111100000$ is applied to the input of the scrambler, find the output sequence T. Assume the initial state is 10101.

   (c) Verify that if this T is applied to the input of the descrambler, the output is sequence S.

2. (5 points) Suppose that the loop filter for a PLL in Slide 12 has the transfer function

$$G(s) = \frac{3}{2s + \sqrt{5}}$$

   (a) Determine the closed-loop transfer function $H(s)$ and indicate if the loop is stable when $K = 2$.

   (b) Determine the damping factor and natural frequency of the loop.