Lund University
Department of Electrical and Information Technology

Systems and Signals, EITF75
Task 1 (out of 2)

Deadline: Complete the task, and hand it in in the course mailbox at the third floor no later than Monday October 7, 08.00.

Observe: To simplify the grading procedure:
- Solve one problem per paper sheet
- Write your name on every paper

Statements must be well motivated by reasoning and/or equations
Points from the tasks will be added to the examination score
Maximum total score (exam + 2 tasks) = 5.0+0.5+0.5=6.0p
Exam Grading: 3 (>2.9p), 4 (>3.9p), 4 (>4.9p)

1. **In this problem we study the integral $\int_{-0.5}^{0.5} \frac{b}{1+a^2-2a\cos(2\pi f)} df$. The integrand is closely related to the magnitude response of an example in Lecture 7.**

   a) For $a = b = \sqrt{0.5}$, solve the integral by other means than direct computation of the integral. The intention is that you should use relations taught in the course that allows you to solve the integral without finding the primitive function (anti-derivative). If you solve it using a primitive function, you will score zero points.

   b) Is the integral convergent for |a|>1 ?

2. **This problem considers the relationship between the Z-transform and Discrete time Fourier Transform. All signals are assumed causal. A DTFT is assumed to be finite in magnitude in this problem.**

   a) Calculate the z-transform (if it exists) for the following signals
      i. $x(n) = u(n)$
      ii. $x(n) = n^2 u(n)$
      iii. $x(n) = 2^n u(n)$
      iv. $x(n) = n^n u(n)$

   b) Consider the statement "That the Discrete time Fourier transform exists is a stronger guarantees that the z-transform exists." Is this statement true?

   c) An engineer claims "If I substitute $z = e^{j\omega}$, then I always obtain the DTFT." Is the statement true? If not, sharpen it.

   d) Provide a sufficient and necessary condition for the system transfer function H(z) so that the system is stable?

   e) We know that if H(z) has poles outside the unit circle, then, h(n) is unstable. An engineer claims "If the poles are outside the unit circle, then the DTFT can be computed at the unit circle, since there are no poles there. Therefore, I can obtain H(f), which is finite in magnitude. Therefore, I can compute h(n) which must be stable." **Correct the engineer. Also, find the flaw in his/her arguments.**