E9-251: Signal Processing for Data Recording Channels

Home Work #1 (Due 6th September 2012 in class)

Late Submission Policy: Points scored = Correct points scored * $e^{-\#days\ late}$

Part: A (Recording)

1) Solve problem 2.1 from Bergmans book (10 pts)
2) (a) Using Matlab or any suitable software, sketch the contours of the Karlqvist head field equations in 2-D. Include both the horizontal and perpendicular field components in your plot.
   (b) Using the field equations, obtain the conditions on the locations along x-axis where the field "gradient" is maximum. Your answer must not contain any coercivity term. Simplify your results as best as you can. (20 pts)
3) It is desired to have an optical recording density of 2 Gb/Square-inch. Assume that the numerical aperture of the objective lens is 0.45. Calculate the minimum resolvable spot size and the associated wavelength.
   (Hint: Assume that the spot size is circular in size) (10 pts)
4) The impulse response of a certain optical recording channel is given by

   $$h(t) = \frac{2}{t_0\sqrt{\pi}} e^{-\left(\frac{2t}{t_0}\right)^2} \qquad -\infty \leq t \leq \infty$$

   $where, t_0$ is 1/e of the spot size. (a) Sketch the impulse shape. (b) Derive conditions for the impulse response to have unit energy. (10 pts)

Part: B (Signals and Systems Basics)

1) Solve problems 1.2, 1.19 and 1.20 from Bergmans book (20+10 +20pts)