

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 * $e^{-\text{\#days late}}$

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