

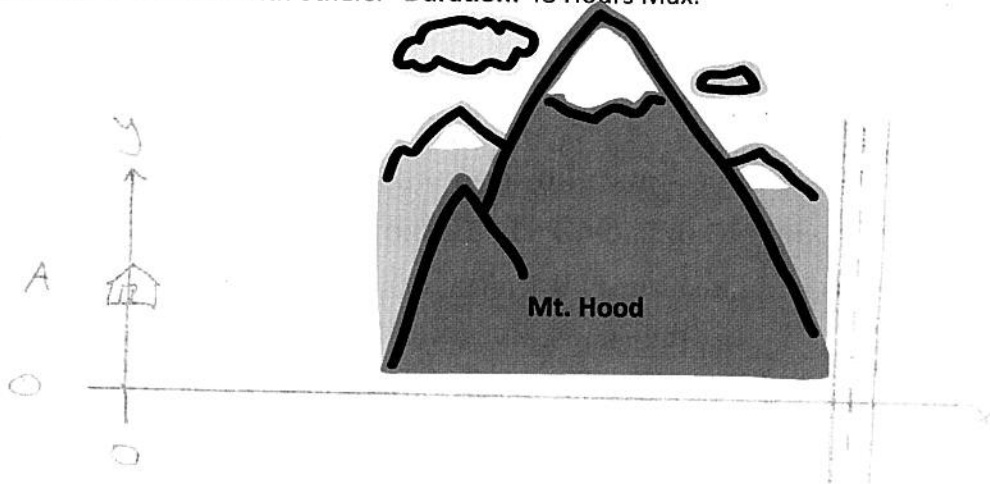
AFIT GRADUATE SCHOOL OF ENGINEERING AND MANAGEMENT

DOCTORAL EXAM COVERING OPTIMIZATION

for Mr. Tim Coon

December 2014

**Take Home.** (open notes, text and MATLAB) Do not discuss questions or solutions with anyone. You may use any MATLAB routines developed by you as well as by others, but you may no longer discuss the use of these routines with others. **Duration:** 48 Hours Max.



**Question:** You are on a trek from your house at point A to the road (which is parallel to the y axis) on the far right. You want to make the trip while expending the minimum amount of energy. Obstacles along the way cause different amounts of energy consumption. Your job is to find the path,  $y(x)$  for  $(x \geq 0)$ , that takes you from your house at A  $(x=0, y=1)$  to the road  $(x=3)$  while consuming minimum energy. The energy consumed along the way is described by:

$$E = \int_0^3 \left( 1 + \left( \frac{dy}{dx} \right)^2 \right) \left( 1 + e^{-[(x-2)^2 + (y-2)^2]} \right) dx$$

Solve this problem using a direct pseudospectral collocation method. You may, use MATLAB to assist you in solving the minimization problem. (GPOPS, Fmincon, etc) Show all work. Compare the results obtained as the number of collocation points increases.