

QUANTUM MECHANICS II (524)  
COMPUTATIONAL METHODS (584)  
PROBLEM SET (hand in 2/23/15)

- 1) (1/4) Evaluate the derivative of  $f(x) = \sin x$  at  $x = 1$  using the symmetric 3-point, the forward 2-point, backward 2-point, and symmetric 5-point approximation with step sizes  $h = 0.5, 0.2, 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, 0.0005, 0.0002, 0.0001, 0.00005, 0.00002, \text{ and } 0.00001$ . Tabulate the difference with the exact result and comment on the behavior of the various approximations with decreasing value of  $h$  and their relative accuracy.
- 2) (3/4) Using the material developed in class, find the negative eigenvalues of the central (Woods-Saxon) nuclear potential illustrated in class for  $N = Z = 8$  and compare each of the bound-state wave functions (by plotting) with the corresponding harmonic oscillator wave functions. There will be some flexibility as to the exact due date of this problem.