

ME-500: Exam 2 (Fall 2012)

(The exam is open book, time 75 min. **SHOW ALL YOUR WORK**)

Name: _____

1. Experiments conducted during the machining of AISI-4140 steel with fixed values of depth of cut and feed yield the following results:

Cutting Speed V(m/min)	Tool Life T(min)
160	7.0
180	5.5
200	5.0

- a) Find the interpolating polynomial $p_2(V) \approx T(V)$ of degree 2 to the given data (10 points).
b) Find the piecewise linear interpolant to the given data (10 points)
c) Find an error bound or estimate for the approximation in b) (10 points)
(Hint: use the problem data to estimate the derivatives of $T(V)$)
2. Consider the integral $I = \int_0^1 \frac{dx}{2-x} \doteq 0.693147$, and the three points $x_0 = 0$, $x_1 = 1/2$ and $x_2 = 1$.
- a) Find an approximation to I using the composite trapezoidal rule in the two subintervals (10 points)
b) Find the minimum size of $h = x_i - x_{i-1}$ necessary to achieve an accuracy of 5×10^{-6} using the composite trapezoidal rule (10 points).
c) Find an approximation to I using Simpson's rule (10 points).
d) Find an approximation to I using the composite one-point Gauss quadrature (10 points).
e) Find another approximation to I using the one-point Gauss quadrature in $[0, 1]$ and use the results of d) and e) in the Richardson extrapolation formula to improve the approximation (10 points).

3. Find the finite difference approximation to $f'(x)$ of the form

$$f'(x) = Af(x-h) + Bf(x+2h)$$

and its truncation error. (20 points)