Test 2 – MANE 3351
Manufacturing Engineering Analysis
November 7, 2024

1. This examination is closed book and contains 10 pages,
2. You are allowed one four inch by six inch notecard,
3. Stratch paper is available,
4. You will need a calculator (make sure that your calculator is said to radians),
5. You have the lecture and lab periods to complete this exam,
6. The points are clearly labelled,
7. Good Luck!

Name: _____
SID: _____

1. (15 points) **Bisection Method**

   Find m_3 using three iterations of the Bisection method applied to the function $f(x) = 3 - x - s\sin(x)$ with starting values of $a = 2$ and $b = 3$.

2. (15 points) **Newton-Raphson**

Calculate three iterations of the Newton-Raphson algorithm to find the root of $f(x) = -x^3 - 6x^2 - 11x - 6.1$ starting at $x_0 = 3.5$.

3. (15 points) **Secant Method**

   If the secant method is used on $f(x) = x^3 - 2x + 2$ with $x_0 = 0$ and $x_1 = 1$, what are the values of x_2 and x_3?

4. (15 points) **Simpson's 1/3 Rule**

Use Simpson's 1/3 rule with four intervals ($n = 4$) to solve the integral shown below.

$$\int_0^3 x^2 e^x \, dx$$

5. (15 points) **Gaussian Quadrature**

Use Gaussian Quadrature with $n = 4$ to evaluate the integral shown below.

$$\int_1^2 \left(1 + \frac{1}{x}\right)^2 dx$$

$\pm x_i$	w_i
$n = 2$	
0.57735	1.0
$n = 3$	
0.0	0.88889
0.77460	0.55556
$n = 4$	
0.33998	0.65215
0.86114	0.34785
$n = 5$	
0.0	0.56889
0.53847	0.47863
0.90618	0.23693

Gaussian Quadrature

6. (25 points) **Romberg Integration**

The Romberg Integration problem will be broken into independent subparts describing different integrals. Please read each part of the question and do not assume that functions or results from previous subparts apply to the current subpart.

(a) (5 points) Find the value of $R(0,0)$ from the Romberg Integration algorithm to solve the integral shown below.

$$\int_1^3 \ln\left(\sin\left(x\right)\right)\, dx$$

Romberg Integration, part b

(b) (10 points) Find the value of $R(3,0)$ to solve the integral shown below.

$$\int_0^2 \left(e^x + e^{-2x}\right)\, dx$$

The values for $R(0,0)$ to $R(2,2)$ are provided below.

9.389
7.548 6.934
7.148 7.015 7.020

Romberg Integration, part c

(c) (10 points) Find the value of $R(3,3)$ to solve the integral provided below.

$$\int_0^3 \left(y^2 - y\right) \sin(y)\ dy$$

The values of $R(0,0)$ to $R(3,1)$ are shown below.

1.270		
1.757	1.920	
2.424	2.646	2.695
2.604	2.665	2.666