Test 2 – MANE 3351
Manufacturing Engineering Analysis
November 13, 2023

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) **Gaussian Quadrature**

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

$$\int_1^3 e^{-\sin(y)}\, dy$$

$\pm x_i$	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

2. (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.

$$\int_1^2 \sqrt{1+x^{-4}}\,dx$$

Romberg Integration, part b

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

$$\int_1^4 \frac{e^y \ln y}{y}\, dy$$

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

28.383
20.889 18.391
18.318 18.157 18.141

Romberg Integration, part c

(c) (10 points) Find the value of $R(3, 2)$ to solve the integral provided below.

$$\int_5^7 \sqrt{x \cos x}\, dx$$

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

3.488
4.144 4.363
4.320 4.377 4.378
4.364 4.379

3. (42 points) **Simpson's 1/3 Rule**

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

$$\int_1^3 \ln(x+1)\ dx$$

4. (14 points) **Newton-Raphson**

Calculate three iterations of the Newton-Raphson algorithm to find the root of $f(x) = -x^3 + 5x^2 - 4x - 6$ starting at $x_0 = -2.5$.

5. (42 points) **Bisection Method**

   Find m_3 for the function $f(x) = 2 + x - e^x$ with starting values of $a = 1$ and $b = 2$.

6. (42 points) **Secant Method**

   If the secant method is used on $f(x) = x^5 + x^3 + 3$ with $x_0 = 0$ and x_1, what are the values of x_2 and x_3?