ME 8213 – Fall 2023
Homework #3

- Recommended format is 1 or more files of raw code for each problem + 1 word document containing a brief report of your results and comments. Code may be in any language/software.

Problem 1:

The gamma function is an extension of the factorial function to the real numbers such that for all positive integers:

$$\Gamma(n) = (n-1)!$$

Defined by:

$$\Gamma(n) = \int_0^\infty t^{n-1} e^{-t} dt$$

Find:

(a) Γ(5) using Gauss-Laguerre quadrature
(b) Γ(1.5) to 6 decimal places using Romberg integration. You will need to select some finite but sufficiently large upper bound for the numerical integral.

Problem 2: Evaluate the following integral numerically using Romberg integration. How many intervals do you need to calculate it to 6-digit precision? Is there a transformation you can use to improve this?

$$\int_0^{\frac{\pi}{4}} \frac{dx}{\sqrt{\sin x}}$$

Problem 3:

Material toughness describes the ability of a material to absorb energy before fracture and is defined as the area under the stress-strain curve:

$$A = \int_0^{\varepsilon_f} \sigma d\varepsilon$$

Using the following stress-strain results, approximate the toughness of the specimen (note the irregular spacing in strain intervals. Remember also that you know what the stress at zero strain is.).

Strain	0.001	0.025	0.045	0.068	0.089	0.122	0.150=ε_f
Stress (MPa)	586	662	765	841	814	122	150