

ME 209 NUMERICAL METHODS
1st EXAM QUESTIONS

Name Surname:

18.11.2024

No:

Duration: 100 min

1. (35p) To find the square root of a number 'a', one can use the following equation:

$$f(c) = c^2 - a = 0$$

where c is the square root of a .

Use **Bisection method** to determine the square root of 3 with an absolute approximate relative percentage error (ϵ_a) below 1%. Use initial guesses of $c_l = 1$ and $c_u = 2$.

2. (30p) Use **Newton-Raphson method** to determine the square root of 3 by using the same equation given in *Question 1* with an absolute approximate relative percentage error (ϵ_a) below 0.005% (4 significant digits). Use initial guess of $c_0 = 1$.

3. (35p) Brass alloys are made by adding other elements to copper to improve its properties, such as hardness or corrosion resistance. The following table shows the composition of three commonly used brass alloys, which are identified by their alloy numbers (1, 2, and 3):

Alloy #	Composition of brass alloys		
	%Cu	%Zn	%Sn
1	55	30	15
2	25	45	30
3	25	20	55

Supplies of these materials vary from week to week, so the company needs to determine a different production mix each week. For example, one week, the total amounts of materials available are **4800 tons of Cu, 5800 tons of Zn, and 5700 tons of Sn**.

a) Set up the system of linear algebraic equations modeling the production run.

b) Use **Gauss-Seidel method** to solve for the amounts of alloy 1 (x_1), alloy 2 (x_2), and alloy 3 (x_3) to be produced each week. Use initial guesses of unknowns $x_1^0 = x_2^0 = x_3^0 = 2000$ ton with the stopping criterion $\epsilon_s = 10\%$.

SOME OF THE IMPORTANT FORMULATIONS	
Bisection Method:	Approximated root: $x_r = \frac{x_l + x_u}{2}$
Newton-Raphson Method	Newton-Raphson Formula: $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$