HSR London International Conference on Multidisciplinary Academic Research
(HSR-ICMAR) 2026
https://houghtonstreetreview.com/index.php/conference

ALGEBRA AND EQUATIONS

Mamatkulova Sarvinoz Sobitjon qizi ,
Rishton distirct Technikum N 2
+998908489601 sarvinozmamatqulova555@gmail.com

Abstract: This article introduces the fundamental concepts of algebra and equations for technical college students. It covers linear, quadratic, and systems of equations, presents step-by-step solution methods, and connects each topic to practical engineering and economic applications. Special attention is given to building problem-solving skills relevant to professional fields.

Keywords: algebra, linear equation, quadratic equation, system of equations, factoring, discriminant, substitution method, technical college

1. INTRODUCTION

Algebra is one of the cornerstones of mathematics. The word itself comes from the Arabic al-jabr, used in the 9th century by the mathematician Muhammad ibn Musa al-Kharizmi in his landmark treatise on solving equations. Today, algebra underpins virtually every quantitative discipline — from structural engineering to financial modelling and computer science.

For technical college students, mastering algebra means acquiring a universal language for describing relationships between quantities. Every time an engineer balances forces, a technician calibrates a sensor, or an accountant projects cash flow, algebra is at work. This article offers a concise yet thorough overview of the main types of equations and the methods used to solve them, illustrated with worked examples drawn from real professional contexts.

2. LINEAR EQUATIONS

2.1 Definition and Standard Form

A linear equation in one variable is any equation that can be written in the form:

$$ax + b = 0, \quad \text{where } a \neq 0$$

The solution is obtained by isolating the variable:

$$x = -b / a$$

Linear equations model proportional relationships: constant speed, uniform heating, straight-line depreciation of equipment, and similar phenomena where one quantity changes at a fixed rate relative to another.

2.2 Worked Example — Engineering Context

Problem: A wire of uniform resistance has a total resistance of 120 Ω. Each metre of wire contributes 4 Ω. How many metres long is the wire?

Let x = length of the wire in metres. Then:

$$4x = 120$$

$$x = \frac{120}{4} = 30 \text{ metres}$$

The wire is 30 metres long. This direct application of a linear equation is typical in electrical installation work.

3. QUADRATIC EQUATIONS

3.1 Standard Form and the Discriminant

A quadratic equation has the form:

$$ax^2 + bx + c = 0, \quad \text{where } a \neq 0$$

The solutions are found using the quadratic formula:

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

The expression under the square root, $D = b^2 - 4ac$, is called the discriminant. It determines the nature of the roots:

$D > 0 \rightarrow$ two distinct real roots

$D = 0 \rightarrow$ one repeated real root

$D < 0 \rightarrow$ no real roots (two complex roots)

3.2 Worked Example — Projectile Motion

Problem: A ball is thrown upward with an initial velocity of 20 m/s from a height of 5 m. At what time does it hit the ground? Use $h(t) = -4.9t^2 + 20t + 5$.

Set $h(t) = 0$:

$$-4.9t^2 + 20t + 5 = 0$$

Multiply through by −1 for convenience:

$$4.9t^2 - 20t - 5 = 0$$

Compute the discriminant:

$$D = (-20)^2 - 4(4.9)(-5) = 400 + 98 = 498$$

$$t = (20 \pm \sqrt{\sqrt{498}}) / 9.8$$

$$t \approx (20 + 22.3) / 9.8 \approx 4.32 \text{ s}$$

The ball reaches the ground approximately 4.32 seconds after it is thrown. The negative root is discarded because time cannot be negative.

4. SYSTEMS OF LINEAR EQUATIONS

4.1 Overview of Solution Methods

A system of two linear equations in two unknowns has the general form:

$$a_1x + b_1y = c_1$$

$$a_2x + b_2y = c_2$$

Three standard methods exist for solving such systems:

Table 1.
Comparison of solution methods for linear systems

Method	How It Works	Best Used When
Substitution	Express one variable in terms of the other; substitute into the second equation	One equation is easy to rearrange
Elimination	Add or subtract equations to cancel one variable	Coefficients are easy to match
Matrix / Cramer's Rule	Express system as Ax = b; solve using determinants or row reduction	Larger systems (3+ variables)

4.2 Worked Example — Economics Context

Problem: A factory produces two products, A and B. Product A requires 3 hours of labour and Product B requires 5 hours. The factory has 390 labour-hours available. Material costs are $8 per unit of A and $6 per unit of B, with a total budget of $480. How many units of each product should be made?

Set up the system (x = units of A, y = units of B):

$3x + 5y = 390$ (labour)

$8x + 6y = 480$ (cost)

From the first equation: $x = \frac{(390-5Y)}{3}$ Substitute into the second:

$$8 \times \frac{(390-5Y)}{3} + 6y = 480$$

$$3120 - 40y + 18y = 1440$$

$$-22y = -1680$$

$$y = 60$$

$$x = \frac{(390-300)}{3} = 30$$

The factory should produce 30 units of Product A and 60 units of Product B to exactly use all available labour and budget.

5. FACTORING AND ITS APPLICATIONS

Factoring — rewriting an algebraic expression as a product of simpler factors — is a powerful technique that simplifies equation solving, fraction reduction, and formula manipulation.

Key identities every technical student should know:

- Difference of squares: $a^2 - b^2 = (a + b)(a - b)$
- Perfect square trinomial: $a^2 + 2ab + b^2 = (a + b)^2$
- Sum / difference of cubes: $a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$

In structural engineering, factoring appears when simplifying stress formulas. In electronics, it is used to find resonant frequencies by factoring characteristic polynomials of circuit equations.

6. CONCLUSION

Algebra and equations are far more than abstract pencil-and-paper exercises. They are the precise tools with which engineers size components, economists balance budgets, programmers write algorithms, and scientists model nature. A solid grounding in linear equations, quadratic equations, systems of equations, and factoring gives technical college students a lasting advantage in their professional lives.

The worked examples in this article demonstrate that every formula carries a story: a wire to be measured, a ball in flight, a factory to be optimised. Learning to translate a real situation into an equation — and then solving it — is the fundamental skill that algebra teaches.

REFERENCES

1. Hall, H.S. & Knight, S.R. Higher Algebra. Macmillan, 2019 (reprint).
2. Stewart, J. Algebra and Trigonometry. 4th ed. Cengage Learning, 2021.
3. Mirzaev, I.M. Fundamentals of Applied Mathematics. Tashkent: Fan, 2021.
4. Sullivan, M. College Algebra. 11th ed. Pearson, 2020.
5. Xolmatov, A.X. Mathematics for Technical College Students. Tashkent: Sharq, 2022.