Course Title: **Precalculus**

Lecturer: Tomohiro Uchiyama

Lecture time: Monday 10:45-12:15 & Wednesday 9:00-10:30  
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**Course Description:**

A very gentle introduction to calculus, trigonometry and algebra. Emphasis on setting up mathematical models of problems, solving them and interpreting the solutions. Applications to the physical, life and earth sciences as well as to commerce and the humanities. This course makes a good review of high school mathematics.

This course covers the basic ideas of functions and their graphs, trigonometry, limits, and linear algebra. We introduce the concept of a mathematical model and discuss setting up mathematical models to solve problems. Examples are drawn from the physical, life and earth sciences as well as commerce and the humanities. Skills are practised in lectures, assignments, and using online learning software.

Emphasis is placed on understanding through examples, and you will use the methods taught to study a variety of practical problems. In the process your algebra and calculus skills will improve, and you will gain insight into the usefulness of these techniques. The course aims to build your confidence and foster your enjoyment of mathematics.

**Learning Outcomes:**

A student who successfully completes this course will:

- understand the rules of exponents
- be able to use basic algebra to simplify expressions and rearrange equations
- understand the concept of a function, and recognise and use function notation and operations
- be able to identify, graph and interpret polynomial, exponential, logarithmic and trigonometric relationships in both mathematical and real world contexts using appropriate applications
- be able to solve both linear and non-linear equations
- understand the key concepts in solving systems of linear equations and in matrix algebra
- understand the concept of limits
• have the ability to express mathematics in written form to communicate mathematical ideas and solutions to problems

Textbooks:
The text for this course is: James Stewart, Lothar Redlin, Saleem Watson, Precalculus, Mathematics for Calculus, Cengage Learning.

Assessment:

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<tr>
<th>Assessment</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Quizzes (weekly)</td>
<td>60%</td>
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<tr>
<td>Final Examination</td>
<td>40%</td>
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Course Outline:

Week 1,2. Fundamentals:
Real numbers, Exponents and radicals, Algebraic expressions, Rational expressions, Equations, Complex numbers, Inequalities, The coordinate plane, Graphs of equations, Circles, Lines.

Week 3. Functions:
Functions, Graphs of functions, Average rate of change of a function, Linear functions, Transformations of functions, Combining functions, One-to-one functions and their inverses.

Week 4. Polynomial and rational functions:
Quadratic functions, Polynomial functions and their graphs, Dividing polynomials, Real zeros of polynomials, Complex zeros and the fundamental theorem of algebra, Rational functions, Polynomial and rational inequalities.

Week 5. Exponential and logarithmic functions:

Week 6. Trigonometric functions: Unit circle approach:
The unit circle, Trigonometric functions of real numbers, Trigonometric graphs, Inverse trigonometric graphs.

Week 7. Trigonometric functions: Right triangle approach:
Angle measure, Trigonometry of right triangles, Trigonometry functions of angles, Inverse trigonometric functions and right triangles, The law of sines, The law of cosines.

Week 8. Analytic trigonometry:
Trigonometric identities, Addition and subtraction formulas, Double-angle, half-angle, and product-sum formulas, Basic trigonometric equations.

Week 9. Polar coordinates and parametric equations:
Polar coordinates, Graphs of polar equations, Polar form of complex numbers; De Moivre’s Theorem, Plane curves and parametric equations.
Week 10. Vectors in two and three dimensions:
Vectors in two dimensions, The dot product, Three-dimensional coordinate geometry, Vectors in
three dimensions, The cross product, Equations of lines and planes.

Week 11. Systems of equations and inequalities:
Systems of linear equations in two variables, Systems of linear equations in several variables, Ma-
trices and systems of linear equations, The algebra of matrices, Inverses of matrices and matrix
equations, Determinants and Cramer’s rule.

Week 12. Conic sections:
Parabolas, Ellipses, Hyperbolas, Shifted conics, Rotation of axes, Polar equations of conics.

Week 13. Sequences and series:
Sequences and summation notation, Arithmetic sequences, Geometric sequences, Mathematical in-
duction, The binomial theorem.

Week 14. A preview to calculus:
Finding limits numerically and graphically, Finding limits algebraically, Tangent lines and deriva-
tives, Limits at infinity, Areas.

Week 15. Final Examination:
Review for the final examination