



Shanghai Jiao Tong University

MA261 Mathematics IB

<b>Instructor Information:</b>	TBD		
<b>Term:</b>	December 16, 2019 - January 7, 2020	<b>Credits:</b>	4 units
<b>Class Hours:</b>	Monday through Friday, 160 mins per teaching day		
<b>Discussion Sessions:</b>	2 hours each week, conducted by teaching assistant(s)		
<b>Total Contact Hours:</b>	64 contact hours (1 contact hour = 45 mins, 2880 mins in total)		
<b>Required Texts (with ISBN):</b>	Textbook1: Poole, D., Linear Algebra: a Modern Introduction 4th edition (Cengage Learning) Textbook2: Stewart, J., Calculus 8th edition (metric version) (Cengage Learning)		
<b>Prerequisite:</b>	Mathematics IA		



## Course Overview

This course, together with Mathematics IA, provides an introduction to the basic concepts and techniques of calculus and linear algebra, emphasising their inter-relationships and applications to engineering, the sciences and financial areas, introduces students to the use of computers in mathematics, and develops problem solving skills with both theoretical and practical problems. Topics covered are: Calculus: Differential equations, sequences and series, power series, calculus in two variables. Algebra: Subspaces, rank theorem, linear transformations, orthogonality, eigenvalues and eigenvectors, singular value decomposition, applications of linear algebra.

## Course Goals

On successful completion of this course students will be able to:

- Demonstrate understanding of concepts in linear algebra, relating to vector spaces, linear transformations, orthogonality, eigenvalues and eigenvectors and diagonalisation.
- Demonstrate understanding of concepts in calculus, relating to differential equations, sequences, series and convergence and multivariable calculus.
- Employ methods related to these concepts in a variety of applications. Apply logical thinking to problem-solving in context.
- Demonstrate an understanding of the role of proof in mathematics. Use appropriate technology to aid problem-solving.
- Demonstrate skills in writing mathematics.

## Grading Policy

Assignments	10%
Participation	5%
Mid Semester Test	15%
Exam	70%



Grading Scale is as follows

Number grade	Letter grade	GPA
90-100	A	4
85-89	A-	3.7
80-84	B+	3.3
75-79	B	3
70-74	B-	2.7
67-69	C+	2.3
65-66	C	2
62-64	C-	1.7
60-61	D	1
≤59	F (Failure)	0



### Class Schedule

Date	Lecture	Textbook
Day 1	Algebra-Further Results on $\mathbb{R}^n$ Revision of subspaces, linear independence, basis, dimension. Row and column space, null space of a matrix. Rank and rank theorem.	Textbook1
Day 2	Algebra-Further Results on $\mathbb{R}^n$ Scalar product, distance. Length and angle. Orthogonality, Gram-Schmidt process	Textbook1
Day 3	Algebra-Linear Transformations Kernel and range, the matrix of a linear transformation. Dimension theorem.	Textbook1
Day 4	Algebra- Symmetric Matrices General quadratic equation in 2 variables, conics. Revision of eigenvalues, eigenvectors and diagonalization.	Textbook1
Day 5	Algebra- Symmetric Matrices Orthogonal diagonalization of real symmetric matrix. Applications.	Textbook1
Day 6	Calculus-Differential Equations First order DE's: separable, linear. Linear second order DE's with constant coefficients. Applications. Modelling. The logistic equation.	Textbook2
Day 7	Calculus-Limits Definition and uniqueness of limit, limit laws. Squeeze Theorem, trigonometric limits, one-sided limits, limits at infinity, unbounded functions.	Textbook2
Day 8	Calculus-Limits Improper integrals. Linear approximation. L'Hopital's rule.	Textbook2
Day 9	Calculus-Continuity Continuity, classification of discontinuities, continuity and differentiation. Intermediate Value Theorem. Newton's Method.	Textbook2



Day 10	Calculus-Applications of the Derivative Extrema of continuous functions, applied max-min problems. Rolle's Theorem, Mean Value Theorem and consequences.	Textbook2
Day 11	Calculus-Applications of the Derivative Graphing: First and second derivative tests, concavity and inflection points.	Textbook2
Day 12	Calculus-Taylor Series Taylor and Maclaurin polynomials, Taylor's Theorem, error terms. Power series, geometric series, convergence of power series, interval and radius of convergence.	Textbook2
Day 13	Calculus-Taylor Series Taylor and Maclaurin series, binomial series, differentiation and integration of power series.	Textbook2
Day 14	Calculus-Calculus of More than One Variable Surfaces: planes, cylinders, quadric surfaces. Functions of more than one variable, limits and continuity. Partial derivatives, derivatives of higher order.	Textbook2
Day 15	Calculus-Chain rules, directional derivative, gradient. Tangent planes, local maxima and minima. Second derivative test for functions of 2 variables.	Textbook2