Syllabus

Search

## MAT3120-01 ( 2ND SEMESTER, 2019 )

연세대학교 YONSEI UNIVERSITY

| | | | |
|---|---|---|---|
| Created Date | 2019-07-24 01:58:29 | Last-Modified | 2019-07-24 02:00:16 |
| Course Title | LINEAR ALGEBRA(2) | Credit | 3 |
| Location | SciH227(SciH227) | Time | Mon5,6,Wed5(Wed6) |
| Instructor | KO Hyoung June | Department | 이과대학 수학 |
| Office | | Telephone | |
| e-mail & Office Hour | | | |

| | |
|---|---|
| Target Students | *MAT3120 (Linear Algebra 2) is designed for students in mathematics, biology, economics, computer graphics, engineering, cryptography, political science as well as sciences. It is a course for sophomore/junior level undergraduate students, which gives complete and comprehensive coverage of Linear Algebra. It is a honor course based on proofs and derivation, but not a problem solving math. Linear algebra is everywhere. You`ve been using it for years without naming it. Most applications of mathematics to the `real` world only work when you only look at the linear part. It is great material which will be with you always. The study of LINEAR ALGEBRA can touch almost every field of math, sciences and engineering. The course will be taught in English by request. This not only makes the class more accessible to students from abroad, it also fosters an atmosphere of global awareness and sensitivity among Yonsei students. We aim to teach you the basic facts, concepts, and skills that you need in order to think about computation, theory, and application in a clear and mathematically well-grounded way. An equally important goal is to teach you how to learn more: where to look, and how to understand what you find.<br><br>★The aim of the course can be summarized as follows:<br>?To explore a fascinating, beautiful new world of linear algebra;<br>?To deepen and extend students' knowledge and understanding of linear algebra;<br>?To help the student reach an advanced level as quickly and efficiently as possible;<br>?To learn some highly useable tools which are applicable in various areas;<br>?To develop the ability to think abstractly, and to clearly explain difficult ideas and thoughts;<br>?To gain an awareness and appreciation that the results and concepts of linear algebra play an ever more important role in various fields;<br>?To connect Linear Algebra to other fields both within and without mathematics. |
| Course Description & Goals | COURSE DESCRIPTION: MAT3120 is the second course in a two semester sequence for the sophomore/junior level undergraduate linear algebra. It helps students understand the abstraction of linear algebra. Linear Algebra is a basic language in mathematics and has many applications in every branch of mathematics. Linear algebra course covers all the topics such as vector spaces and linear transformations, matrix algebra and analysis, inner product and normed spaces in linear algebra commonly used by analysts, combinatorists, computer scientists, geometers, logicians, number theorists, or topologists.<br><br>★The major goals of MAT3120 (Linear Algebra 2) are: |

| | |
|---|---|
| | ?To develop a systematic knowledge of the elements of linear algebra described in detail in the weekly syllabus, and the ability to apply the concepts covered in classes: Fields and Vector Spaces, Linear Operators, Determinants and Eigenvalues, The Jordan Canonical Form, Orthogonality, Spectral Theory, Singular Value Decomposition, Matrix Factorization, and Infinite Dimensional Vector Spaces;<br>?To understand the elements of linear algebra with an emphasis on concepts, methods of proof, and the communication of mathematical ideas;<br>?To see how all these play a key role in many practical applications in today`s technological society; Various applications of linear algebra show how linear algebra is essential not only in solving problems involving algebra, geometry, differential equations, optimization, approximation, combinatorics, but also in the fields such as biology, economics, computer graphics, electrical engineering, cryptography, political science as well as sciences.<br>?To broaden students' horizons by learning connections of one subject to other areas of linear algebra and mathematics and by mentioning results at the forefront of research. |
| Prerequisite | The prerequisites are a good knowledge of Calculus, Linear algebra I and a willingness to think abstractly. This is a skills-oriented course: you are required to remember your previous courses and master new procedures. It is also an applications course: understanding concepts, terminology, and notation<br>is important. And it is a theory course, opening the door to higher mathematics. You will be acquiring proof skills gradually during the semester.<br>Study hours! You can not learn Linear Algebra without working problems. This course alone requires about three hours for each credit hour, possibly substantially more if your algebraic background is "less than perfect". It means that you need about 12 hours per week of your time: 4 hours in class, 8<br>hours outside of class for independent study.<br>★Course Offered in English: The course will be taught in English by request.<br>This not only makes the class more accessible to students from abroad, it also<br>fosters an atmosphere of global awareness and sensitivity among Yonsei students. |
| Course Requirements | The course will consist of three one-hour lectures and one one-hour recitation<br>session per week. The in-class discussions and activities, and classroom recitation in this course are extremely important.<br>Collaboration for homework and class preparation is highly encouraged and expected for typical in-class assignments.<br>Reading a text and mathematics is a must in learning linear algebra: You are expected to read the sections in the textbook before coming to class.<br>In Class Work: There may be some quizzes throughout the semester. Quizzes will<br>be short, in-class assignments to test comprehension of recent material. They<br>could be Vocabulary quizzes or do-it-now problems.<br>TA meets with the students once a week for 50 minutes in a recitation class or<br>discussion section. The purpose of the recitation session is to provide students with a forum for discussion and an opportunity to ask questions about<br>lectures, readings, homework and exams.<br>Absenteeism policy (and tardiness): Attendance is required and will be checked<br>daily. The 1/3 Rule is applied. It is university policy that if a student |

| | |
|---|---|
| | has<br>accumulated 33% or more absences by the end of the course, a final letter grade of "F" can be turned in. Be on time to class. The Two Tardies Equals One Absence Rule is applied. |
| Grading Policy(Absolute) | Your final grade in this course will be determined on the basis of 500 points<br>according to the YSG grading distribution for the common test grade and individual class grade distributed as follows:<br>A. Test Grade: 70%<br>First Midterm: Friday, Oct 4,, 19:00~21:00; 100 points(20%)<br>Second Midterm: Friday, Nov 8, 19:00~21:00; 100 points(20%)<br>Final Exam: Friday, December 13, 19:00~21:00 150 points (30%).<br>You will have two 2-hour common midterm tests on dates to be arranged. And one<br>comprehensive 2-hour common Final Exam will be given<br>Academic Integrity: No make-up exams will be given for any reason. If you have<br>a valid excuse cleared with me ahead of time, you would get 80% of the earlier<br>grade you got. Student photo ID is required at the midterms and final exam.<br>B. Individual Class Grade: 30%<br>Attendance, Presentations and Recitation Participation-75 points (15%)<br>Homework, Assignments, Quizzes, Class Activity - 75 points (15%)<br>Homework: Homework problem sets are assigned in the Syllabus on the class website YSCEC. Further homework problems and the assignments will be assigned<br>in classes or posted in the Problem Sets section of the class website YSCEC. They will be due on Monday of the following week at 1:00 PM sharp, the beginning of the class, except as stated otherwise (e.g., except for the first<br>two Mondays and the weeks of the midterms).<br>"Do you believe that in the end, the grade you take is equal to the grade you<br>make?" |
| Texts & References | ○ Finite-dimensional linear algebra/Gockenbach, Mark S/CRC Press/2010<br><br>○ [주교재FDLA] Mark S. Gockenbach, Finite-Dimensional Linear Algebra, CRC press,<br>May 06, 2010<br>1. Howard Anton & Robert Busby, 최신선형대수, 학술정보, 2004<br>2. Sterling K. Berberian, Linear Algebra, Oxford Science Publications, 1990 [Algebraic Approach]<br>3. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence, Linear Algebra,<br>4Ed., Prentice Hall, 2003[Mathematical Approach]<br>4. Jimmie Gilbert and Linda Gilbert, Linear Algebra and Matrix Theory,2nd Ed.,<br>Thomson 2004 [Math Approach]<br>5. Kenneth Hoffman and Ray Kunze, Linear Algebra, Prentice-Hall, Englewood Cliffs, NJ, 2nd ed.,1971 ISBN 978-0-13-536797-1, [Mathematical Approach]<br>6. Steven J. Leon, Linear Algebra with Applications, 8th ed., Pearson Prentice-<br>Hall, 2010[Numerical Version]<br>7. Seymour Lipschutz and Marc Lipson, Schaum`s Outline of Theory and Problems of Linear Algebra, 5th Edition(Schaum`s Outline Series), McGraw-Hill<br>Companies, 2008, [Solved Problems Series]<br>8.Martin Moskowitz and Fotios Paliogiannis, Functions ofSeveral real variables, World Scientific, 2011<br>9.John Srdjan Petrovic, Advanced Calculus Theory and Practice, CRC Press, |

| | |
|---|---|
| | 2014<br>10. Edoardo Sernesi, Linear Algebra, Chapman & Hall, London, 1993[Geometric Approach]<br>11. Ian Stewart, Cabinet of mathematical Curiosities (호기심 케비닛, 한티미디어, 2012.12), Profile Books, 2008<br>12. Gilbert Strang, Introduction to Linear Algebra, 4th edition. Wellesley-Cambridge Press and SIAM , 2009<br>13. Treil, Sergei, Linear Algebra Done Wrong , Brown University, online (http://www.math.brown.edu/~treil/papers/LADW/LADW.html) |
| Instructor's Profile | Instructor: Professor H.J. KO<br>Department of mathematics<br>Science Hall 206<br>Tel 02)2123-2594<br>e-mail hjko@yonsei.ac.kr<br>http://web.yonsei.ac.kr/hjko/ |
| TA's Name & Contact Information | Graduate Student Teaching Assistant[TA] :[]<br>●Office hours:<br>Take advantage of recitations! Each student enrolled in a lecture section must also attend a recitation section. TAs will consider homework problems in<br>the recitations and that is the primary place to get questions answered. In recitation classes there will be a quiz. They are your last chance during the<br>week to understand the material covered; don`t leave any gaps and share with your TA any questions or difficulties that you have! |
| Syllabus in English | Unit2:<br>Orthogonality and its most important application of best approximation: Norms<br>and inner products, The adjoint of a linear operator, Orthogonal vectors and bases, The projection theorem, The Gram-Schmidt process, Orthogonal complements, Complex inner product spaces, More on polynomial approximation,<br>The energy inner product and Galerkin`s method, Gaussian quadrature, The Helmholtz decomposition<br>The spectral theory of symmetric matrices and Hermitian matrices: The spectral<br>theorem for symmetric matrices, The spectral theorem for normal matrices, Optimization and Hessian matrix, Lagrange multipliers, Spectral methods for differential equations<br>The singular value decomposition: Introduction to the SVD, The SVD for general<br>matrices, Solving least-squares problems using the SVD, The SVD and linear inverse problems, The Smith normal form of a matrix<br>Matrix factorizations and numerical linear algebra: The LU factorization, Partial pivoting, The Cholesky factorization, Matrix norms, The sensitivity of linear systems to errors, Numerical stability, The sensitivity of the least-<br>squares problem, The QR factorization, Eigenvalues and simultaneous iteration,<br>The QR algorithm<br>Infinite dimensional vector spaces and Analysis in vector spaces: Analysis in<br>R^n, Infinite-dimensional vector spaces, Functional analysis, Weak convergence |

| Week | Period | Weekly Topic & Contents | Course Material Range & Assignments | Reference |
|---|---|---|---|---|
| 1 | 2019-09-02<br>2019-09-08 | Introductions, course overview,<br>syllabus review | [FDLA]6.1: 3, 4, 7, 11, 12, | (9.2.) Fall semester classes begin |

| | | | | |
|---|---|---|---|---|
| | | Chapter 6 Orthogonality and best approximation<br>6.1 Norms and inner products<br>6.2 The adjoint of a linear operator | 16<br>6.2: 1, 3, 9, 10, 13, 14 | (9.5. - 9.9.) Course add and drop period |
| 2 | 2019-09-09<br>2019-09-15 | 6.3 Orthogonal vectors and bases<br>6.4 The projection theorem | [FDLA]6.3: 2, 3, 7, 9, 13, 14, 15<br>6.4:EEx1, MEx3, 5, 8, 14, 19 | (9.5. - 9.9.) Course add and drop period<br>(9.6.) Upon Professor`s approval, class may be replaced by Yon-Kojeon<br>(9.12. - 9.14.) Chuseok Holiday |
| 3 | 2019-09-16<br>2019-09-22 | 6.5 The Gram-Schmidt process<br>6.6 Orthogonal complements<br>6.7 Complex inner product spaces | [FDLA]6.5: 1, 5, 6, 9<br>6.6: 1, 3, 5, 6, 10, 15<br>6.7: 2, 5, 7, 12, 13 | |
| 4 | 2019-09-23<br>2019-09-29 | 6.8 More on polynomial approximation(*)<br>6.9 The energy inner product and Galerkin`s method(*)<br>6.10 Gaussian quadrature(^)<br>6.11 The Helmholtz decomposition | [FDLA] | |
| 5 | 2019-09-30<br>2019-10-06 | Chapter 7 The spectral theory of symmetric matrices<br>7.1 The spectral theorem for symmetric matrices<br>7.2 The spectral theorem for normal matrices | [FDLA]7.1: 2, 3, 5, 7, 8<br>7.2: 2, 3, 7, 16 | (10.1. - 10.4.) Course withdrawal period<br>(10.3.) National Foundation Day |
| 6 | 2019-10-07<br>2019-10-13 | 7.3 Optimization and Hessian matrix<br>7.4 Lagrange multipliers<br>7.5 Spectral methods for differential equations(*) | [FDLA]7.3: 3, 5, 8<br>7.4: 1, 2, 3 | (10.9.) Hangul Proclamation Day<br>(10.10.) First third of the semester ends |
| 7 | 2019-10-14<br>2019-10-20 | Chapter 8 The singular value decomposition<br>8.1 Introduction to the SVD<br>8.2 The SVD for general matrices | [FDLA]8.1: 1, 3, 5, 6, 11, (12)13<br>8.2: 2, 3, 8, 10, 13(pseudo inverse)) | |
| 8 | 2019-10-21<br>2019-10-27 | Lee Way | [FDLA] | (10.21. - 10.25.) Midterm Examinations |
| 9 | 2019-10-28<br>2019-11-03 | 8.3 Solving least-squares problems using the SVD<br>8.4 The SVD and linear inverse problems (*)<br>8.5 The Smith normal form of a matrix | [FDLA]8.3: 3, 7, 9,<br>8.5: 1, 3, 4, 7 | |
| 10 | 2019-11-04<br>2019-11-10 | Chapter 9 Matrix factorizations and numerical linear algebra<br>9.1 The LU factorization<br>9.2 Partial pivoting | [FDLA]9.1: 2, 7, 10<br>9.2: 1(sol=(2,1,-1), 5, 6, | |
| 11 | 2019-11-11<br>2019-11-17 | 9.3 The Cholesky factorization<br>9.4 Matrix norms | [FDLA]<br>9.3: 1, 3, 6<br>9.4: 1, 2, 3, 5, 9 | (11.15.) Second third of the semester ends |
| 12 | 2019-11-18<br>2019-11-24 | 9.5 The sensitivity of linear systems to errors(*)<br>9.6 Numerical stability(*) | [FDLA] | |

| | | | | |
|---|---|---|---|---|
| | | 9.7 The sensitivity of the least-squares problem(*) | | |
| 13 | 2019-11-25<br>2019-12-01 | 9.8 The QR factorization<br>9.9 Eigenvalues and simultaneous iteration(*)<br>9.10 The QR algorithm(*) | [FDLA]<br>9.8: 1, 6, 7 | |
| 14 | 2019-12-02<br>2019-12-08 | Chapter 10 Analysis in vector spaces<br>10.1 Analysis in R^n<br>10.2 Infinite-dimensional vector spaces | [FDLA]<br>10.1: 1, 3, 4, 6 8, 10, 12<br>10,2: 2, 4 | |
| 15 | 2019-12-09<br>2019-12-15 | 10.3 Functional analysis<br>10.4 Weak convergence | [FDLA]<br>10.3: 2, 5, 7, 8 | (12.9. - 12.20.) Self-study and Final Examinations |
| 16 | 2019-12-16<br>2019-12-22 | Lee Way<br>*Important Note: The above given syllabus is only for a guideline. We may not follow the same linearly. All items on this syllabus are subject to change. Any in-class announcement, verbal or written, is considered official addendum to this syllabus. | [FDLA]<br>(*) means if time permits. | (12.9. - 12.20.) Self-study and Final Examinations |

* Notice for changes in semester based Regular Exchange/Visiting Program
During midterm and final exam period, students who do not have exams should do self-studying or take lectures.
* According to the University regulation section 57-2, students with disabilities can request special support related to attendance, lectures, assignments, or exams by contacting the course professor at the beginning of semester.Upon request, students can receive such support from the course professor or from the Office for Students with Disabilities(OSD). The following are examples of types of support available in the lectures, assignments, and exams:
(However, actual support may vary depending on the course.)
[Lecture]
- Visual Impairment: alternative, braille, enlarged reading materials, note-taker
- Physical Impairment: alternative reading materials, access to classroom, note-taker, assigned seat
- Hearing Impairment: note-taker/stenographer, recording lecture
- Intellectual Disability/Autism: note-taker, study mentor
[Assignments and Exam]
- Visual, Physical, Hearing Impairment: extra days for submission, alternative type of assignment, extended exam time, alternative type of exam, arranging separate exam room, and proctors, note-taker
- Intellectual Disability/Autism: personalized assignments, alternative type of evaluation