COURSE SYLLABUS

<MTH00051> – <Applied Mathematics and Statistics>

1. GENERAL INFORMATION

Course name:	Applied Mathematics and Statistics
Course name (in Vietnamese):	Toán ứng dụng và thống kê
Course ID:	MTH00051
Knowledge block:	General Education Knowledge
Number of credits:	4
Credit hours for theory:	45
Credit hours for practice:	30
Credit hours for self-study:	90
Prerequisite:	none
Prior-course:	none
Instructors:	

2. COURSE DESCRIPTION

Systematize math knowledge learned in the first 3 semesters of university (calculus, linear algebra, probability-statistics), introduce algorithmic skills to be able to solve problems related to data analysis. Specifically, including 3 blocks of knowledge:

- Computational methods for matrix algebra.
- Computational methods for convex optimization
- Probability models

3. COURSE GOALS

At the end of the course, students are able to

ID	Description	Program LOs
G1	Be able to work on an individual and team level.	2.2, 2.3.1
G2	Be able to explain terminologies in data science.	2.4.3, 2.4.5
G3	Be able to explain terminologies in computer science.	1.4, 3.3
G4	Be able define applied mathematical problems.	1.3.6, 1.4
G5	Be able to apply math knowledge to solve CS problems.	5.1.1, 5.1.3, 5.2.1, 5.2.2, 5.3.1, 6.1.1
G6	Python programming.	1.3.6

4. COURSE OUTCOMES

CO	Description	I/T/U
G1.1	Establish, organize, operate, and manage the team.	I
G1.2	Participate in group discussions.	I, T
G1.3	Writing a technical report.	U
G2.1	Be able to explain terminologies.	I
G2.2	Reading English lectures and textbooks.	I
G3.1	Be able to explain basic concepts.	I
G3.2	Ethics.	I
G3.3	Be able to self study.	I
G4.1	Be able to use the learned models.	I, T
G5.1	Be able to describe the learned mathematical and statistical methods	I, T
G5.2	Be able to design an algorithm.	I, T, U

5. TEACHING PLAN

ID	Topic	Course outcomes	Teaching/Learning Activities (samples)
1	System of linear equations . Introduction to system of linear equations . System of linear equations and matrices – A**x** = **b** . Equation systems of the special form . Generic equation systems . Gaussian elimination		Lecturing Q&A, Group discussion QZ1: Quiz 1 (Chapter 1)
2	Vector . Vector and vector operations . Norm, Dot product, Distance in R^n . Basis and Orthogonal Basis . Gram-Schmidt process		Lecturing Demonstration, Q&A QZ2: Quiz 2
3	Matrix . Matrix and matrix operations . Special matrix forms (sparse, Symmetrical, triangular, diagonal matrices) . Invertible matrices . Determinant . Matrix equations		Lecturing Demonstration, discussion
4	Matrix decompositions . LU decomposition . QR decomposition using Gram-Schmidt		Lecturing Demonstration, discussion

ID	Topic	Course outcomes	Teaching/Learning Activities (samples)
	. Eigenvalues and Eigenvectors . Diagonalization . Introduction to Singular Value Decomposition		
5	Applications . some applications in Information Technology . some applications in Physics/Chemistry . some applications in Polynomial interpolation		Lecturing Demonstration
6	Midterm review		Question & answer Case study and discussion
7	Introduction to optimization . One variable optimization . Sensitivity and Robustness . Multivariable optimization		Lecturing Demonstration
8	Convex optimization . Convex and concave functions . Least square method . Data fitting		Lecturing Q&A, discussion
9	Introduction to probability . Axiom of probability . Random variables . Conditional probability formular		Lecturing
10	Probability models		Case study, discussion

ID	Topic	Course outcomes	Teaching/Learning Activities (samples)
	. Introduction to statistics . Markov chains		Demonstration
11	Review		Lecturing Q&A, Discussion Project submitted

For the practical laboratory work, there are 10 weeks which cover similar topics as it goes in the theory class. Each week, teaching assistants will explain and demonstrate key ideas on the corresponding topic and ask students to do their lab exercises either on computer in the lab or at home. All the lab work submitted will be graded. There would be a final exam for lab work.

6. ASSESSMENTS

ID	Topic	Description	Course outcomes	Ratio (%)
A1	**Assignments**			**0%**
	Weekly homework: HW#1, HW#2, HW#3, HW#4, HW#5	HW#1: System of linear equations. HW#2: Vector and Matrix HW#3:Matrix decompositions. HW#4: Least square optimization. HW#5: Markov chain.		0%
A2	**Projects**			**15%**

ID	Topic	Description	Course outcomes	Ratio (%)
	Weekly labs: Lab#1, Lab#2, Lab#3, Lab#4, Lab#5	Lab#1: Gaussian algorithm. Lab#2: QR process. Lab#3: Applications. Lab#4: Data fitting. Lab#5: Markov chains.		15%
A3	**Exams**			**85%**
A31	Lab final exam	In-class programming exam on computer		25%
A32	Midterm exam	Closed book exam. Describe the understanding of different topics, analyze & program to solve problems		30%
A33	Final exam	Closed book exam. Describe the understanding of different topics, analyze & program to solve problems		30%

7. RESOURCES

Textbooks

- Stephen Boyd, Lieven Vandenberghe, *Introduction to Applied Linear: Algebra, Matrices, and Least Squares*, Cambridge University Press, 2018 (available in internet).

Others

- [1] G. H. Golub, C. F. Van Loan, *Matrix computations*, 4th edition, Johns Hopkins University Press, 2013.
- [2] Y. Saad, *Iterative methods for sparse linear systems*, 2nd edition, Society for Industrial and Applied Mathematics, 2003.

- [3] S. Boyd, L. Vandenberghe, *Convex optimization*, 7th edition, Cambridge University Press, 2009.
- [4] R. V. Hogg, J. W. McKean, A. T. Craig, *Introduction to mathematical statistics*, 7th edition, Pearson, 2013.
- [5] Đ. Đ. Trọng, Đ. N. Thanh, *Lý thuyết thống kê*, NXB ĐHQG Tp HCM, 2016.
- [6] Đ. N. Thanh et. al., *Bài tập và thực hành lý thuyết thống kê*, NXB ĐHQG Tp HCM, 2016.
- [7] Zed Shaw, *Learn Python: The Hard Way*. Addison Wesley, 3rd Edition, 2014

8. GENERAL REGULATIONS & POLICIES

- All students are responsible for reading and following strictly the regulations and policies of the school and university.
- Students who are absent for more than 3 theory sessions are not allowed to take the exams.
- For any kind of cheating and plagiarism, students will be graded 0 for the course. The incident is then submitted to the school and university for further review.
- Students are encouraged to form study groups to discuss on the topics. However, individual work must be done and submitted on your own.