Mathematics MSc for Civil Engineers - BMEEODH90MX33

I. Subject Specification

1. Basic Data

1.1 Title

Mathematics MSc for Civil Engineers

1.2 Code

BMEEODH90MX33

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	28
Seminar	14

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Balázs Bárány
academic rank	Associate professor
email	balubs@math.bme.hu

1.8 Department

Dean's Office

1.9 Website

https://epito.bme.hu/BMEEODH90MX33
https://fiek2.mywire.org/course/view.php?id=3444

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Structural Engineering (MSc) programme

1.12 Prerequisites

1.13 Effective date

1 September 2017

Mathematics MSc for Civil Engineers - BMEEODH90MX33

---

2. Objectives and learning outcomes

2.1 Objectives

1. Linear algebra: linear equation systems, Gauss-Jordan elimination, finite dimensional vector spaces, linear independence, generator, basis, basis transformation matrix, linear transformations, basis representation, determinant, inverse of matrices, eigenvalues, eigenvectors, scalar product, symmetric matrices, Gram-Schmidt orthogonalization, trace, quadratic forms, fundamental subspaces of matrices, rank, nullity, orthogonal complement of subspaces, matrix of orthogonal projection, method of least squares, positive definite matrices, singular value decomposition, polar decomposition, spectral decomposition.
2. Partial differential equations: Fourier-sine series, vibrating string problem for finite and infinite strings, Bernoulli's and D'Alambert's solution, heat transportation problem on finite rod.
3. Vector Analysis: line integral, work, conservative vector fields, potential function, curl-test in two and three dimensions, surface integral, flux, Gauss' divergence theorem, Stoke's theorem, Green's theorem.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. The students knows the basic definitions of vector spaces, linear independence, generators, basis and the connections between them.
2. The student knows the basic definitions related to linear transformations. The inverse, basis transformations, orthogonal projections, eigenvalues, eigenvectors, determinant.
3. The students knows advanced properties of linear transformations, the rank, fundamental subspaces, nullity.
4. The student knows the properties of symmetric matrices, positive definite matrices, the spectral decomposition and singular value decomposition.
5. The student knows the partial differential equation of heat transport and vibrating string, the methods of solutions by Bernoulli and D'Alambert.
6. The student knows the basic definitions of the vector fields, line integral, gradient, potential, conservative, and the curl.
7. The student knows the surface integral of vector fields and the related Gauss', Stokes' and Green's Theorem.

B. Skills

1. The student is able to solve linear equations independently. Calculate the determinant, eigenvalues, eigenvectors and inverse of a matrix.
2. The student is able to determine the fundamental subspaces of a linear transformation, the rank, and the nullity.
3. The student is able to find orthogonal projections to a given subspace and solve equations with the

method of least squares.
4. The student is able to determine the singular values and the singular value decomposition.
5. The student is able to solve the partial differential equation of the one dimensional vibrating string by using Bernoulli's solutions. The student is able to solve the partial differential equation of the one dimensional vibrating string by using D'Alamabert's solutions.
6. The student is able to solve the partial differential equation of heat transport of a rod with 0 boundary condition.
7. The student is able to determine whether a vector field is conservative and able to find the potential function.
8. The student is able to calculate the work of a vector field on a curve.
9. The student is able to calculate the flux of a vector field on a surface.

C. Attitudes

1. The student cooperates with the teacher and fellow students in expanding the knowledge.
2. The student is constantly acquiring his/her knowledge,
3. The student seeks to learn the system of tools needed to solve mathematical problems.
4. The student strives for a transparent, accurate and error-free solution.
5. The student strives for the consistent application of mathematical knowledge in solving technical problems.

D. Autonomy and Responsibility

1. The student independently thinks through mathematical exercises and problems and solves them based on given sources.
2. The student openly accepts substantiated critical remarks.
3. The student takes a systemic approach to its thinking.

2.3 Methods

The lectures and exercises form together an integral whole. The theoretical discussion of each topic takes place together with the solution of the practical tasks presenting the applications.

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Gauss elimination, vector spaces, linear independence, basis,
2.	basis transform, linear transformation, determinant
3.	eigenvalues, eigenvectors, scalar product, orthogonal matrices, symmetric matrices, Gram-Schmidt orthogonalization,
4.	trace, quadratic form, Gauss-Jordan elimination,
5.	fundamental subspaces, dimension theorems, orthogonal

	projections,
6.	method of smallest squares, positive definite matrices, singular values, polar decomposition, spectral decomposition,
7.	Fourier-series, sine Fourier-series, vibrating string, Bernoulli's solution,
8.	D'Alambert's solution, infinite length rod, Heat equation
9.	midterm test
10.	vector analysis, line integral, conservative fields,
11.	Curl-test on plane, on space, potential function, surface integrals,
12.	retaken midterm test
13.	Gauss' theorem, Stokes' theorem
14.	Green's theorem, surfaces

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

Contemporary Linear Algebra Howard Anthon, Robert C. Buasby Wiley, 2003, ISBN 0-471-16362-7Fourier Analysis, T.W. Körner, Cambridge, 1988, ISBN 0 521 38991 7Excercises for Fourier Analysis, T.W. Körner, Cambridge 1993 ISBN 43849 7

2.6 Other information

2.7 Consultation

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

There is one midterm test during the semester, which is 45 minutes long. During the examination period there will be written exams of length 100 minutes.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Midterm	MT	A.1-A.5; B.1-B.5; C.3-C.5; D.1-D.3
Exam	E	A.1-A.7; B.1-B.9; C.3-C.5; D.1-D.3

The dates of deadlines of assignments/homework can be found in the detailed course schedule on the subject's website.

3.3 Evaluation system

Abbreviation	Score
MT	60
E	90
Sum	**100%**

3.4 Requirements and validity of signature

Those students can get the signature for the semester, who had at least 30% (i.e. 18 points) score on the midterm test. The criterion for the exam is the signature for the semester.

3.5 Grading system

Grade	Points (P)
excellent (5)	125-150
good (4)	105-124
satisfactory (3)	90-104
passed (2)	75-89
failed (1)	0-74

3.6 Retake and repeat

If someone failed on the midterm test or wants to increase the score, there will be one retaken midterm test on the 12th week.

3.7 Estimated workload

Activity	Hours/semester
Preparing for midterm	20
Preparing for exam	28
Lectures and seminars	42
Sum	**90**

3.8 Effective date

1 September 2017

This Subject Datasheet is valid for:

Inactive courses