

## **Syllabus for Further Linear Algebra MT2175**

A course for the undergraduate students on specialization Mathematics and Economics

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### **Prerequisites**

Mathematical Methods for Economists

### **Abstract**

This course is a continuation of Algebra **MT1 173** which is taught for the second-year students. It lasts for one (fall) semester. Upon completion of Further Linear Algebra students will have to take the University of London (UoL) exam at the end of the fourth semester of their studies at ICEF.

### **Learning Objectives & Outcomes**

The discipline is intended to:

- Enable students to acquire further skills in the techniques of linear algebra,
- Prepare students for further courses in mathematics and related subjects like econometrics and actuarial science.

### **Teaching Methods**

The course program consists of:

- lectures,
- classes,
- regular self-study that includes the work on home assignment.

### **Topics covered**

Broadly speaking, the topics are:

- The application of diagonalization to solving differential equations, the Jordan normal form and its application for DE,
- Inner products and orthogonality,
- Orthogonal diagonalization and its applications,
- Direct sums and projections,
- Generalized inverses,
- Complex matrices and complex vector spaces.

### **Assessment and grade determination**

Control takes the following forms:

- written home assignments posted and turned in by the students once a month (4 in total);
- mid-term test on the 8<sup>th</sup> week of classes (80 min);
- December exam (120 min) similar to external UoL exam on Further Linear Algebra MT2 175.

$$G = 0.25G_{ha} + 0.25 G_{mt} + 0.5G_e$$

The cumulative final grade is comprised of:

- average grade for the home assignments (25%);
- Mid-term test grade (25%);
- December exam (50%).

All grades are given initially out of 100. The final grades are also transferred to 10- and 5-points grades in accordance with the ICEF Grading Regulations (par.3) available at [https://icef-info.hse.ru/goto\\_icef\\_file\\_29833\\_download.html](https://icef-info.hse.ru/goto_icef_file_29833_download.html)

Retakes are organized in accordance with the [HSE Interim and Ongoing Assessment Regulations](#) (incl. Annex 8 for ICEF). Grade determination after retakes is done in accordance with ICEF Grading Regulations (par. 5) available at [https://icef-info.hse.ru/goto\\_icef\\_file\\_29833\\_download.html](https://icef-info.hse.ru/goto_icef_file_29833_download.html)

## **Main Reading**

1. Antony, M. and M. Harvey. *Linear Algebra: Concepts and Methods* (Cambridge University Press, 2012). Abbreviation **AH** will be used further on.
2. Anton, H. and C. Rorres. *Elementary Linear Algebra* (International Student Version). (John Wiley & Sons (Asia) Plc Ltd, 2010) tenth edition. Abbreviation **AR** will be used further on.
3. Anthony M., Harvey M., *Algebra MT2 175, Study Guide*, LSE, University of London, 2014.

## **Internet resources**

University of London Exam papers and Examiners reports for the last three years [http://www.londonexternal.ac.uk/current\\_students/programme\\_resources/lse/index.shtml](http://www.londonexternal.ac.uk/current_students/programme_resources/lse/index.shtml)

Current course materials and sample materials for knowledge assessment are post at the ICEF information system <http://info-icef.hse.ru>

## **Course outline**

1. Diagonalization, Jordan normal form and differential equations (Study Guide, pp. 9-28), **AH** Chap.8 and Chap.9. **AR** Section 5.4.

2. Inner products and orthogonality. **AH** Chap.10. **AR** Sections 6.1.,6.2.,6.3.
3. Orthogonal diagonalization and its applications. **AH** Chap.11. **AR** Sections 7.1.,7.2.,7.3.
4. Direct sums and projections. **AH** Chap.12. **AR** Section 6.4 and 6.5.
5. Generalized inverses. (Study Guide, pp. 73-100).
6. Complex matrices and vector spaces. **AH** Chap.13 and Chap.9. **AR** Sections 5.3. and 7.7.

### **Distribution of hours**

<b>№</b>	<b>Topic</b>	<b>Total</b>	<b>Lectures</b>	<b>Classes</b>	<b>Self study</b>
1.	Diagonalization, Jordan normal form and differential equations.	16	4	4	8
2.	Inner products and orthogonality.	16	4	4	8
3.	Orthogonal diagonalization and its applications.	16	4	4	8
4	Direct sums and projections.	24	6	6	8
5	Generalized inverses.	24	6	6	12
6	Complex matrices and vector spaces.	24	6	6	12
	<b>Total:</b>	<b>120</b>	<b>30</b>	<b>30</b>	<b>60</b>