Introduction to Mathematical Engineering MTM1521

Prof. Dr. Fatma AYDIN AKGUN

Introduction to Mathematical Engineering

Week 1

Introduction: Mathematical Engineer

Prof. Dr. Fatma AYDIN AKGUN

fakgun@yildiz.edu.tr

02123834606

A236

Syllabus

1. Introduction to Mthematical Engineering
2. Engineer and Engineering
3. Technology
4. Ethics
5. Invited Seminar
6. Invited Seminar
7. Invited Seminar
8. First midterm
9. Invited Seminar
10. Invited Seminar
11. Invited Seminar
12. Second Midterm
13. Invited Seminar
14. Holiday
15. Make-up Exams

Mathematical modelling has played a significant role in shaping scientific and technological advancements throughout human history. This study explores how the evolution of mathematical modelling has been instrumental in solving complex innovative real-life problems from ancient civilizations to modern applications.

The origin of mathematical modelling has its roots in the ancient cultures where Babylonians, Egyptians and Greeks used early mathematical techniques to solve practical problems such as land measurement. construction and architecture. The Greeks made a significant contribution in geometry. deductive reasoning and the systematic mathematical approaches such as the mechanics, hydrostatics through the works of Euclid and Archimedes, demonstrating the pivotal role of the mathematics in understanding the natural world around us.

During the medieval period, mathematical modelling continued to evolve, particularly in the Islamic Golden Age, where Islamic scholars such as Al-Khwarizmi developed algebra, and innovations in trigonometry and algebra facilitated a powerful framework for solving more complex problems in astronomy, optics, navigations and engineering. Introduction of zero and decimal systems by Aryabhata, an Indian mathematician revolutionized calculations and modelling techniques.

The Renaissance and Enlightenment periods had remarkable advancements in mathematical modelling by the invention of calculus, enabling modelling of dynamics and mechanical systems precisely in science and engineering.

In the industrial Revolution, mathematical modelling further integrated into technological advancements, optimizing manufacturing process and infrastructure design.

In the 20th century, the advent of computational power transformed mathematical modelling to the next level, allowing it to simulate complex systems and broaden its applications across different disciplines.

As we move forward into the 21st century, the integration of mathematical modelling with data science, machine learning and artificial intelligence has the potential to address global challenges ranging from climate change to healthcare advancements.

MATHEMATICAL ENGINEERING DEPARTMENT

Mathematical Engineering: Definition

Mathematical engineering is an interdisciplinary program which adds the deep and broad theoretical infrastructure of mathematics, the oldest and most fundamental science, to the study of engineering

As department, Mathematical engineering aims to provide students with skills in analysis, algorithmic thinking, and modeling development needed in contemporary information Technologies.

In addition to providing graduates with a sound mathematical foundation to pursue an academic education in theoretical and applied mathematics, it provides a strong basis for their future professional lives in a wide range of fields. These include various engineering sciences, information technology, software, economics, finance, business, artificial intelligence, machine learning, data science, etc.

Mathematical Engineer: Definition

Mathematical Engineers:

- are equipped with basic engineering and applied mathematics knowledge.
- are capable of modeling problems encountered in engineering, economical and social fields.
- are capable of proposing solutions for the problems s/he modeled.
- are capable of developing computer softwares and using computer for solving problems
- are followers of the advancements in both science and technology as a life-long learner

Mathematical Engineering: History

- Although the roots of Mathematical Engineering went back to Simon Stevin (Engineer and Mathematician, 1548-1620) , Mathematical Engineering was introduced by Reinier Timman (1917-1975) .

- Timman has played an important role in gathering the research done in both math and technology together as Mathematical Engineering

Mathematical Engineering: History

- R. Timman has divided mathematical engineering into three different levels:
  1. Applied Mathematics;
     To understand natural phenomena better
  2. Numerical Analysis;
     To turn models into suitable algorithms to solve real life problems
  3. Programming and Computer

- In 1961, Mathematical Engineering department was established at Technische Hogeschool te Eindhoven. They have added two new research directions: operational research and management science

G. Alberts, "Mathematics as an Technology: Mathematical Engineering", Report AM-R9202 January, 1992.
http://oai.cwi.nl/oai/asset/5529/5529D.pdf

https://pure.tue.nl/ws/files/2211656/veltkamp1961.pdf

Mathematical Engineering in Turkey

- I.T.U. The department accepted his first students in 1973.
- Y.T.U. First students were accepted in 1976
- K.T.U. 1974- discontinued
- Işık Uni.
- Gumushane Uni. 2012

Mathematical Engineering has served as a base for several Math-Computer Science Departments

Mathematical Engineering in YTU

Mathematical Engineering is a branch of science that trains engineers who, with the knowledge of basic and applied mathematics, establish mathematical models of the events encountered in engineering, economy and social life, produce solutions to the problems they model, and create computer software and applications for this purpose.

Mathematical Engineering in YTU

Program Outcomes

- Model Structuring by using Mathematics and Basic Engineering.
- Plays effective role in team works with other discipline(s).
- Gains to solve Mathematical Models by the using analytical, numerical and statistical techniques.
- Interprets solutions and results correctly
- Applies Algorithm Analysis and Structuring to Solve existing Problems by the use of Computer.

Mathematical Engineering in YTU

Program Outcomes

•Gains the ability and knowledge of English Language to read / understand / write and present publications.
•Makes research with industry and scientific institutions.
•Makes educational facilities.
•Have occupational responsibilities.
•Tracks current developments on the occupational areas.
•Uses the necessary technological methods and tools.
•Knows the importance of life time learning.

Mathematical Engineering in YTU

Program Educational Objectives

-To train mathematical engineers who participate in in-service/continuing education activities.

-To train mathematical engineers who work in management or application staff in national / international private sector or public institutions.

-To train mathematical engineers who continue their education at the postgraduate level in domestic / international universities.

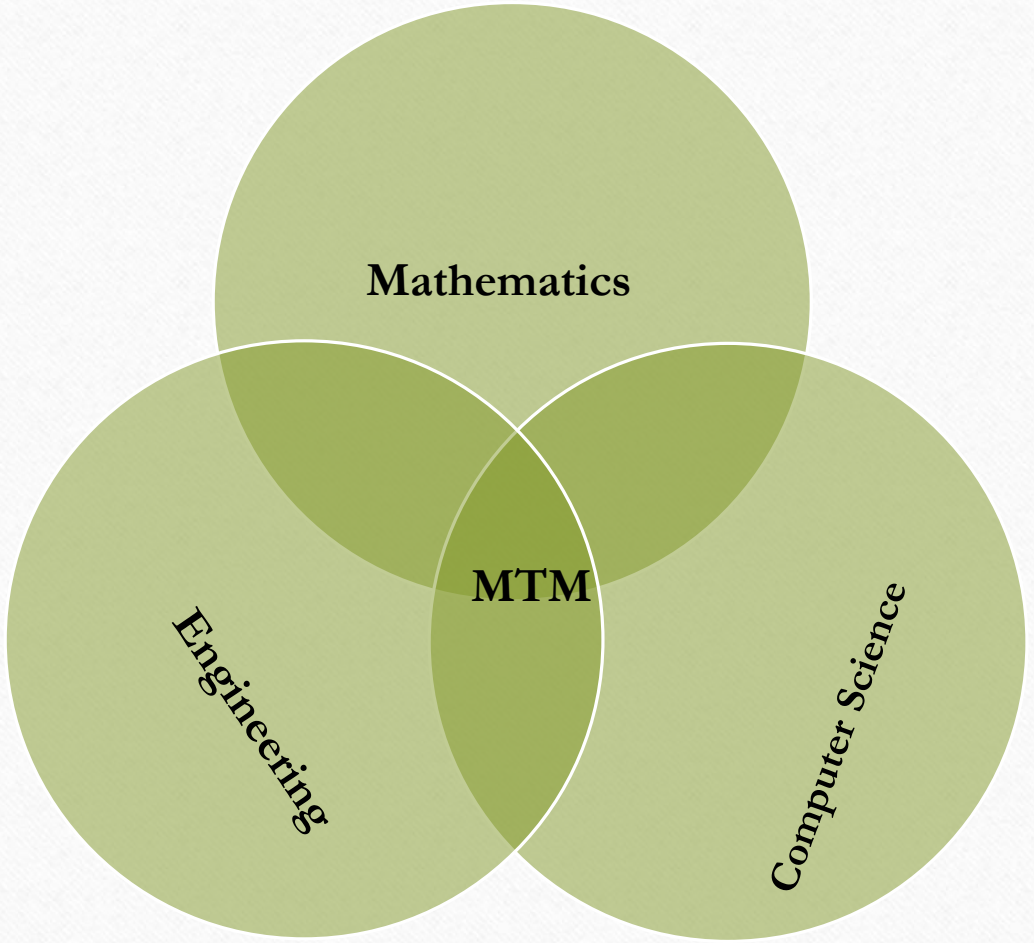
-To train mathematical engineers who work as academicians in universities.

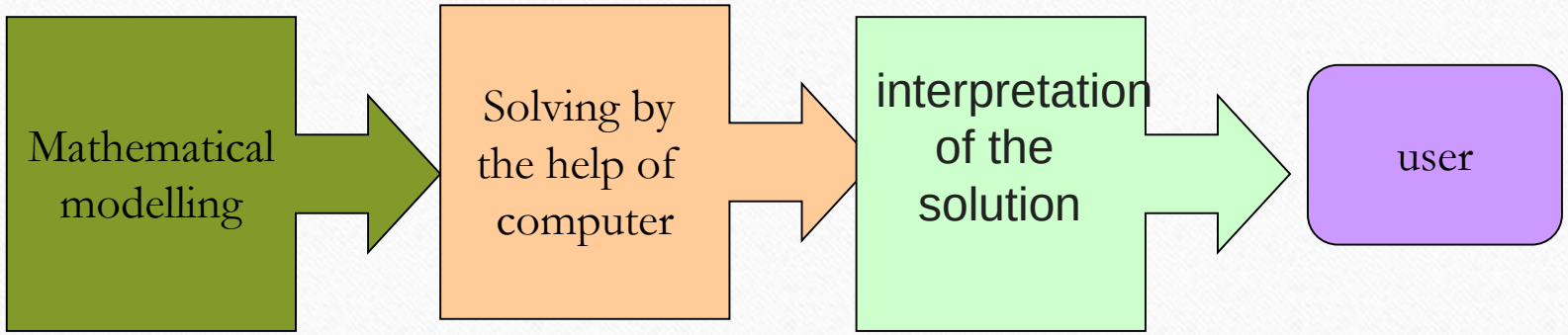
Mathematical Engineering in YTU

Professional Profile of Graduates

Persons who receive the title of Mathematical Engineer can work as Software Specialist / Engineer, Database Manager in insurance companies, industrial organizations, public or private financial institutions and IT units. They can work as Specialist / Manager, System Analyst / Business Analyst, Statistical Analyst, Information Processing Personnel / Supervisor or Mathematician.

Three Basic Formations:




Mathematical modelling
Solving by the help of computer
interpretation of the solution
user

In order to graduate, students studying in this program must have a GPA of at least 2.00 out of 4.00 and must be successful by getting at least a DC grade in all courses prescribed in the curriculum. The minimum ECTS required for graduation is 240. Students are also required to complete their compulsory internship within the specified period and quality.

Intership:

1. Computer Hardware and Basic Applications Internship(After the 4th Semester),
2. Problem Solving Techniques Internship(After 6th Semester)

Each of them is 20 working days

They are both compulsory.

Order matters.

Internship

In accordance with Yıldız Technical University (YTU) Undergraduate Education-Examination and Examination Regulations, It is a practical exercise in education. It is the practice or practical application of the theoretical knowledge and practical knowledge of the students. Internships must provide at least the following, or at least some, of the following objectives.

1- To provide a better understanding of the profession by bringing the students of Mathematical Engineering directly to the various applications of engineering,

2- To ensure that the theoretical knowledge of the learners in practice is related,

3- Directing the sources and causes of the differences between theory and practice to research,

Internship

4- To be able to define a problem related to engineering applications and determine the factors affecting the problem, the variables and constraints in the problem in detail,

5- To gather information on Mathematical Engineering in practice, to make evaluations that will arise when examining these information and practical working reports,

6- Take steps to improve the relationship between the application areas,

Total training period is 40(20+20) working days. A week is considered as 5 business days. Saturdays are considered to be the full working day in workplaces that are working as full working days (provided that they are documented). The days when the student does not have a course before 18:00 are also considered as the full working day for the internship (the student has to give the certificate to the internship committee that there is no class before 18:00).

Internships are held at academic holidays. However, students who have completed the 6th semester or who have achieved all the courses in the program can do the internship with teaching at least two free working days per week (including the course before 6 pm). 2.3)

The above rules are also valid for 2nd education and summer education

Computer Hardware and Basic Practices Practice:

- Computer Hardware and Basic Practices Practice: This is an internship aimed at examining a specific computer infrastructure belonging to an official or private organization and developing software related to this workplace. The duration is 20 working days or 4 weeks. II. It is done after half a year.

Practical Work on Problem Solving Techniques:

Engineering provides identification and analysis of problems related to solving economic problems (computer assisted if necessary). The site is 20 working days and 4 weeks. It is done after the semester

Carreer Fields

The main job opportunities for mathematical Engineers include: academic, data scientist, business analyst, software development specialist, software engineer, systems analyst, cyber security analyst, network and computer systems manager, database manager, operating system administrator, cryptologist, web interface developer, project manager, artificial intelligence expert, machine learning specialist, search engine optimization specialist (SEO), planning and optimization specialist, enterprise architecture specialist, risk analyst, financial analyst, cloud technologies specialist, mobile application developer, SAP consultant.

Sources Of Career Information

Personal Contacts

Families and friends can be extremely helpful in providing career information. While they may not always have the information needed, they may know other knowledgeable people and be able to put the job seeker in touch with them.

Libraries and Career Centers

Libraries offer a great deal of information about careers and job training.

Counselors

Counselors are professionals trained to help clients assess their own strengths and weaknesses, evaluate their goals and values, and determine what they want in a career. Counselors can be found in:

- *High school guidance offices*
- *Placement offices in private vocational or technical schools*
- *College career planning and placement offices*
- *Vocational rehabilitation agencies*
- *Counseling service offices offered by community organizations*
- *Private counseling agencies*
- *State employment service offices*

Sources Of Career Information

The Internet

The Internet provides much of the same job information that is available through libraries, career centers, and guidance offices. However, no single network or resource will contain all the desired information. As in a library search, one must look through various lists by field or discipline or by using keyword searches.

Organizations

Professional societies, trade associations, labor unions, business firms, and educational institutions offer a variety of free or inexpensive career materials.

Education and Training Information

All jobs require some kind of training, even those that primarily utilize simple, everyday skills. Many people acquire these most basic job skills during the process of growing up and through compulsory education.

ERASMUS +

Yildiz Technical University (YTU) is a part of the Erasmus+ program, a European Union program since 2004, aimed at providing more effective tools to encourage cooperation between different sectors in line with the European 2020 Strategy targets for new needs in education, youth and sports. In this respect, Erasmus+ program aims to strengthen the quality of higher education and to cooperate with higher education institutions in cooperation with each other and with the business world, by contributing to the exchange of participants in the field of higher education, to the academic recognition and transparency of the studies in the countries participating in the program.

Although in the first years of the program, YTU has sent and hosted the students in a highly representative number; YTU became a university preferred by European students in the following years as well as one of the universities that sent the most students to Europe with its vision of internationalization and practices.

Our university, which increases the success graph every year, in the 2011-2012 academic year sending the most students within the scope of Turkey-wide Student Mobility has been among the first and in the following years, it ranked among the top three in the same category.

With more than 35 countries and 239 universities and nearly 600 agreements, our university continues to increase this success every year.

Erasmus+ aims to modernise and improve higher education across Europe and the rest of the world. It gives

students and staff opportunities to develop their skills and boost their employment prospects. Good practices will

be shared between universities and businesses in Knowledge Alliances.

Higher education institutions from participating countries can work with those from neighbourhood countries, non-

EU Balkan countries, Asia, Africa and Latin America to develop their educational systems.

Opportunities for students to learn abroad,

-Studies, including at Master's level;

-Traineeships in businesses.

-Erasmus+ Master loans

Opportunities are available to the following organizations in participating countries:

- Students at higher education institutions;

- Higher education institution staff (academic and non-academic);

- Private companies.

Higher Education Institutions in neighbouring countries, non-EU Balkan countries, Asia, Africa, and Latin America

can participate in projects that take place outside the EU.

Programme Countries

1. Group	Austria, Denmark, Finland, France, Ireland, Italy, Liechtenstein, Norway, Sweden, United Kingdom
2. Group	Belgium, Crotia, Czech Republic, Cyprus (Güney Kıbrıs), Germany, Greece, Iceland, Luxemburg, The Netherlands, Portugal, Slovenia, Spain
3. Group	Bulgaria, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Macedonia

Application Procedure:

The traineeship mobility is to be carried out between 1st June N year and 30th September N+1 year, any duration on condition that not to be fewer than two months and advised not to be longer than 90 days.

1- Please contact directly the relevant department at which you wish to work or Erasmus+ Program Unit so as to see if there is an open position for a trainee.

Please check ;

For the academic units http://www.bologna.yildiz.edu.tr/index.php?r=academicunit/index

For the departmental Erasmus coordinators http://www.eu.yildiz.edu.tr/en/sayfa/8/Departmental-Coordinators/177

For Erasmus+ Program Unit: http://www.eu.yildiz.edu.tr/sayfa/6/%C4%B0leti%C5%9Fim-CONTACT/34

2- Accordingly, find a mentor and discuss what the traineeship might involve.

3- After you are accepted by a mentor, please fill out **Application Form** and **Learning agreement for traineeship**, have them signed&stamped by your home university and send it to erasmus-staj@yildiz.edu.tr with a passport photo in .jpeg format.

4- You will be sent a "**Letter of Acceptance**" When the Application Form has been received, **Letter of Acceptance** will be prepared by the Mentor and sent to Erasmus+ Program Unit who will stamp and send it to the trainee.

Necessary documents :

Note that all of documents need to be the latest version which can be downloaded from http://www.eu.yildiz.edu.tr/page/10/Forms/252 and filled out electronically (no handwriting).

- Application Form (filled electronically, signed and stamped by the applicant and the home university, scanned in pdf format)

- Learning Agreement for Traineeship (filled electronically, signed and stamped by the applicant and the home university, scanned in pdf format)

- Photo (headshot in jpg format)

Erasmus+ Program Unit: It is the central Erasmus Office and located in Davutpaşa campus. You can contact Erasmus+ Program Unit for any administrative issues: application, acceptance, confirmation at institutional basis, etc. Contact e-mail: erasmus-staj@yildiz.edu.tr

Mentor: S/he can be one of the teaching staff who accepts you as a trainee, at your registered department. You can contact her/him for any academic issues: traineeship programs, learning agreement changes, traineeship certificate.

For academic staff of the departments, http://www.yildiz.edu.tr/en/page/units
For administrative staff, http://www.yildiz.edu.tr/en/page/administrative

END OF 1ST WEEK