

Ministry of Higher Education and Scientific
research

Salahaddin University College of Engineering



Department of Aviation Engineering

College of ...Engineering....

University of Salahaddin....

Subject: Information Technology and Mathematical Modeling

Course Book 2nd year

Lecturer's name: Maikey Zaki Bia Khorani

Academic Year: 2022/2023



Introduction

Competence-Based Education (CBE)

Competency-based education is the pedagogical approach base on the student about how to master their skills, also for designing an academic program, which concentrates on competences (knowledge, skill, attitude), it clearly identifies the competencies that the student must manage, as it is an approach to teaching-learning. As with the promise of serving the students better it has increased employment. competency-based is long-lasting and transformative for education. CBE core is the student-centered learning approach, it might be a course or credit-based or not. This method meets different learning abilities and will lead to an efficient student learning outcome. CBE is a system when the learner goes to the learning process and learner can say what they can do in this learning process, we need need to change the education system as the technology changes and to integrate these changes we need to equip skills to help the society, and economy to be able to compete with others because without a good education we can not afford all of these. Some characteristics of CBE are competency-based program, producing proficient and prepared graduates, increasing student engagement, and exploring diverse learning opportunities.

To try to reflect on the possibility of applying this type of education in Kurdistan; Competency-based education is likely to be long lasting and transformative for the education in Kurdistan, as to apply the CBE in Kurdistan; we need the quality of CBE which can be satisfied in multiple ways; Workforce partners, good subjects which must be included in the competency in the faculties, cooperation with industries and foreign companies to establish good roots with sustainability to long-lasting projects.

The main challenges if this system can be applied in Kurdistan can be identified from different perspectives; first and foremost to include different criteria such as the program mission, working life, very productive curriculum, using relevant pedagogical methods, guidelines to the study for the students, assessment, all these lead to best learning outcome and competences, and if CBE will be applied in Kurdistan, there should be multiple changes, and as a teacher, we always think to improve the learning experience of the students that learn in the schools, and universities; This will prepare the students for the next stage of their life. The students must be given the support they need to master the subject and inherent skills, and this will make the students in Kurdistan moving forward based on what they are capable of, and the lead to the best learning outcome and competencies which should be



proven by action. We should start to do the grading based on the performance of each student without any bias. One of the important changes is to apply more core applied subjects in the universities rather than the general subjects, cooperating with industries for the scientific sections, and while in the literature to cooperate with very famous novel writers who have big companies and big funds, moreover with other university specialities to have contacts with similar companies. Another idea would be that the students during their studies also have a job with the same field of their studies, and learn things directly during their work as well, as well as participating in researches and development, and this can not be done without faculties instructing this by proving a good curriculum with cooperation with stakeholders with common interests.

Reflecting on the way of delivering the learning materials for the first week of this module using the same as this pedagogy course will be very beneficial, as the teachers Dr Khalil and Dr Wala were more like a facilitator to us, and this module was very well organized, as to start on with students doing presentations, and they involved all of us in it y participating, also it was very good to me to read some articles. From the beginning I learnt that; the competency-based education module is divided into three themes which are competency-based education, Bologna process, and competency-based curriculum. It was very useful to align all the references which were used in this module for us, I felt much more energetic and well prepared when I was given the content beforehand.

Competence-Based Curriculum(CBC)

The competency-based curriculum is a curriculum that is based on what the learners will do (competences) tasks rather than what the learners will be expected to know. This curriculum is learner-centred and is adaptive to the needs of students, teachers, and society

The elements and criteria of CBC are leading to the learning outcome, the first is the mission the curriculum should have a clear Mission which has sustainability, also Work relevance it should be designed based on the labour market and the skills which are needed for it, Pedagogical approach choosing the one suits the model and how choosing the right pedagogical methods e.g. seminars, problem-based learning, Guidance to the students, Assessment tools to know what kind of assessment suits this model we teach e.g. formative and summative, and Alignment which means all the criteria work together to achieve the learning outcome for all the elements mentioned above, and all elements must support each other.



Course Catalog

1- General Information

Course Title	Information Technology and Mathematical Modeling
Course Code	9023
Department	Aviation Engineering
Prerequisites course code	
Course Coordinator	Maikey Zaki Bia Khorani
Email	maikey.bia@su.edu.krd
Other Course Teacher(s) / Tutor(s)	
Class Hours	Theoretical 2, Practical 1
Office Hours	Sunday 12:00- 14:00 (lecture 9am-12) Monday 9:00- 12:00 (lecture 12:30am- 3:30) Tuesday 9:00- 12:00 (lecture 12:30am- 3:30) Wednesday 12:00- 14:00 (lecture 9am-12) Thursday 12:00-14:00 (lecture 9am-12)
Course Type	Information Technology and Mathematical Modeling
Offer In Academic Year	Spring Semester

Course Name	Code	Regular Semester
Information Technology and Mathematical Modeling	9023	Spring

Local Credit	ECTS Credit	Lecture (hour/week)	Application (hour/week)	Laboratory (hour/week)
3	3	3	3	1

Prerequisites	:	
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Course Language	:	English		
Course Level	:	Bachelor		
Course Type	:	University	Compulsory	Elective
			X	
Course Category	:	Core Courses	Major Area Courses	General Cultural Courses
			X	
Mode of Delivery	:	Face-to-face		Distance Learning
		X		
Course Coordinator	:	Maikey Zaki Bia Khorani		
Lecturer(s)	:	Maikey Zaki Bia Khorani		
Assistant(s)	:			

2- Course Description

COURSE DESCRIPTION
<p>This scientific course Information Technology and Mathematical Modeling has theoretical and practical parts which make the students firstly understand and learn the theory then they apply it in the laboratory using programming languages either MatLab or python programming languages.</p> <p>The theoretical part introduces the students to the basics of Information Technology and Mathematical Modeling and visual information as well, as it plays an important role in almost all areas of our life.</p> <p>Today, much of this information is represented and processed digitally. Information technology and Mathematical Modeling is ubiquitous, with applications ranging from television to tomography, from photography to printing, from medicine to robotics to remote sensing in Aviation Engineering and machine learning prediction of future data of flights in Aviation Engineering.</p> <p>However, the practical part is about implementing what the students have learned in the theoretical, to apply the algorithms, and create real-life applications that can be used in Aviation Engineering, and this will improve the basic foundation of students in Information Technology and Mathematical modeling applications and which they can develop their understanding about different areas from engineering skills in creating programming algorithms for different applications in Aviation Engineering. E.g develop programs to detect flight coordinates using interpolation, to detect green areas using sentinel-hub images from ESA Sentinel Satellite images.</p>

Contents and workload hours from face to face lectures



Main topics to be covered in this course are:

Salahaddin University College of Engineering			
ACADEMIC CALENDER			
Date	PROGRA MME	Module Name and code /Content description	Work load (hrs)
00 Feb- 00 Feb.2022		Information Technology and Mathematical Modeling/9043	51
SPRING SEMESTER (#1)			
00 Feb 2022- 00 Mar2022			
00 Feb- 00 Feb.2022	Week 1	Introduction to Matlab	3
00 Feb- 00 Feb.2022	Week 2	Linear Equations	3
00 Feb- 00 Feb.2022	Week 3	Interpolation	3
00 Feb- 00 Feb.2022	Week 4	Zero and Roots	3
00 Mar- 00 Mar.2022	Week 5	Least Squares	3
00 Mar- 00 Mar.2022	Week 6	Quadrature	3
00 Mar- 00 Mar.2022	Week 7	Midterm	
00 Mar- 00 Mar.2022	Week 8	Ordinary Differential Equations,	3
00 Mar- 00 Mar.2022	Week 9	Random Numbers,	3
00 Aprl- 00 Aprl.2022	Week 10	Fourier Analysis,	3
00 Aprl- 00 Aprl.2022	Week 11	Eigenvalues and Singular Values,	3
00 Aprl- 00 Aprl.2022	Week 12	Partial Differential Equations.	3
00 Aprl- 00 Aprl.2022	Week 13	Probability Theory	3
00 May- 00 May.2022	Week 14	Solving PDEs in MATLAB using FFT, Singular value decomposition (SVD) and Data Science, SVD and facial recognition	3
00 May- 00 May.2022	Final examination (2 Weeks)		
00 May- 00 May.2022			
00 May-00 May.2020	Online Results		
SEMESTER BREAK (00 January -00 February 2022)			
SPRING SMESTER (00 February 2022- 00 May 2022)			
	Quiz date		
	assignment submission		



Pedagogical Methods

1. Presentation
2. Exhibits
3. Brainstorm and Practice
4. Games
5. Simulations
6. Role-playing
7. Discussion
8. Interaction
9. Modeling
10. Facilitation
11. Collaboration
12. Scientific Trips (Visiting companies with similar interests)
13. Motivation
14. Flipped classroom

Assessment

Using formative assessment, by using the survey to know the basic knowledge of students in mathematics and programming applications. Assessment for the learners before the progress of teaching, and moving to the next step.

- 4 Quizzes 5 %
- 4 Homeworks 5 %
- 1 Seminar 5 %
- 1 report 5%
- Practical Midterm 10 %
- Midterm 20 %
- Final Practical 10 %
- Final Theoretical Exam 40 %

Using summative assessment in a kind of a survey, which asks the opinions of my students about the lecture. And in their ideas about improving the course for better.

ECTS

Information Technology and Mathematical Modeling has 3 ECTS



Salahaddin University Erbil College of Engineering							
Program: Diploma (ECTS)		5					
Total No. of Weeks/Semester:		14 weeks					
Department name:	Aviation Engineering				X	Y	Z
Module Name:	Information Technology and Mathematical Modeling				2	1	0
Module Code:	9023						
ECTS Workload Calculation Form							
Activity	S	Description		Activity Type	No.	Time Factor	Workload
Course	1	Theory	In class	f	<u>14</u>	2	28
	2		Online	f			0
	3	Preparation (1.5 theory)		h	<u>14</u>	3	42
	4	Practical		f	<u>14</u>	1	14
	5	Preparation (0.5 practical)		h	<u>1</u>	0.5	0.5
	6	Tutorial		f	<u>14</u>	0	0
Assignment	7	Homework		h	<u>7</u>	1.5	10.5
	8	Report		h	1	2	2
	9	Seminar		h	1	3	3
	10	Paper		h	1	8	8
	11	Essay		h		6	0
	12	Project		h	0	8	0
Assessment	13	Quiz		h	<u>4</u>	0.5	2
	14	Mid Term	Theory	f	<u>1</u>	2	2
	15		Preparation	h	<u>1</u>	6	6
	16		Practical	f	<u>1</u>	0	0



	17		Preparation	h	<u>1</u>	2	2
	18	Final	Theory	f	<u>1</u>	2	2
	19		Preparation	h	<u>1</u>	6	6
	20		Practical	f	<u>1</u>	0	0
	21		Preparation	h	<u>1</u>	2	2
Face to face hours (f)/12 week			3.83	Face to face hours (f)			46
Home hours (h)/14 week			5.25	Home hours (h)			84
Total hours/14 week			8.13	Total hours			130
ECTS (Total hours/ 27)							5

*f: Face to face activity hours

h: Household activity hours

X: Theoretical class hours/ week

Y: Practical hours/ week

Z: Tutorial hours/ week

** Underlined numbers must not be changed.

Course Learning Outcomes (CLOs)

On the successful completion of this course, the students will be able to:

1. Apply basic algorithms to be used also in Mathematical Modeling and Information Technology.
2. Design and implement Mathematical Modeling of Aviation Engineering Application, and implement algorithms by using matlab or python programming languages.
3. Apply and recognize Mathematical algorithms and use them in real applications for human computer interaction.
4. Analyze Mathematical Modeling algorithms, and videos (Object detection, and tracking).
5. Demonstrate a Mathematical Modeling application that is used in Aviation Engineering.
6. Applying different Modeling and functions and how to handle the information technology in Aviation Engineering.
7. Design Matlab application tools (making algorithms) that can be used to simulate an airplane and follow the trajectories.
8. Theoretical foundations and modern applications in Information Technology and Mathematical Modeling.
9. Applying Mathematical Modeling fundamentals and Information Technology using Programming with Matlab/Python functions.



10. Build Matlab optional toolboxes including Aviation Simultun, and apply the build up functions.
11. Apply Mathematical Modeling, and decompose an image into its sine and cosine components, such as analysis, filtering, reconstruction and compression on images.

Course teaching and learning activities

This course's main point is making students apply in practice what they received in the theoretical part. So, the practical part will apply programming Matlab or python on computers, which they learn during the theoretical part.

And in this way, students will be the center of the class and will learn how to create applications that will be useful tools to apply in scientific and Aviation Engineering careers.

This will be followed by a theoretical part which will include an introduction and explanation about each algorithm separately and its functions as well.

And all of the students will be encouraged to apply these activities in the practical class practically and will be given time to complete this application they choose by the end of the semester, and this class will encourage the students to be creative and critical thinkers to invent other useful algorithms and design built up functions and tools in Matlab to be used later by the next generations as well.

Course Assessment tools

Assessment tools	Descriptions	weight
Class Quizzes (4)	Students will be encouraged to prepare for the class in parallel with the teacher.	5 %
Class Homeworks (4)	Students will be encouraged to prepare themselves at home for the next class in parallel with the teacher.	5 %
Class Report (1)	Students will choose a topic related to Mathematical Modeling and will discover the applications and programs that can be beneficial to apply in real life applications	5 %
Class Seminar (1)	Students will be encouraged to work as a group, and as a team, and will be participating to deliver the materials in the class and will make the students feel more responsible.	5 %
Practical exam	Students will have a laboratory exam related to the previous practices and materials practically	10 %
Midterm	Students will have a written exam related to the previous practices and materials theoretically 20%	20 %
Final Practical	Students will select a real life application which can be used and will facilitate	10%



	the human, besides it will consume time, money and efforts either in the science or engineering sector. Then they will design and implement this application together as a group. There will be guidelines and steps to follow up for the students to facilitate their work at this application and make it more fun.(the students can also choose a company to apply their practical work there, maximum 2 students)	
Final Exam	Students will have an oral exam at the end of the semester if they get a signature from the teacher, and if they accomplished all the previous assessments one by one, this oral exam is to make sure that they students applied and put in action the application they created and put a sustainable goal behind it.	40%

In term studies	Number	Percentage of Grade
Attendance	14	
Lab Quizzes	1	5 %
Report	1	5 %
Special Course Internship		
Homework Assignments	4	5 %
Presentations		
Seminar	1	5 %
Practical Midterm	1	10 %
Midterm	1	20 %
Final Practical	1	10 %
Final	1	40 %
Total		100 %
Percentage of in_term studies		50 %
Percentage of finals		50 %
Total		100%



Course Assessment Tools

Course learning outcome and assessment mapping course learning outcome mapping

<i>Mapping</i>					
Mapping of assessment tools to the learning outcome					

No	Course learning Outcome	*Level of contribution				
		1	2	3	4	5
1	Theoretical foundations and modern applications in Information technology and Mathematical Modeling.				X	
2	Apply basic algorithms to be used also in Mathematical Modeling and Information Technology.					X
3	Design and implement processings on images, and implement algorithms by using matlab or python programming languages.				X	
4	Apply and recognize image processing algorithms and use them in real applications for human computer interaction.			X		
5	Analyze Mathematical Models in Aviation using images, and videos (Object detection, and tracking).		X			
6	Demonstrate an application of Aviation Engineering detecting plane trajectories.				X	
7	Applying Information Technology and Mathematical Modeling and how to handle image data files.					X
8	Design Matlab application tools (making algorithms) that can be used to process applications used in Aviation Engineering.					X
9	Applying Mathematical Modeling fundamentals and processing				X	



	Programming					
10	Build Matlab optional toolboxes including Mathematical Modeling processing, and applying the build up functions in Aviation application.			X		
11	Apply processing in different Mathematical Modeling, and decompose an application into its sine and cosine components, such as analysis, filtering, reconstruction and compression on images.					X

Course/Module LOs, Content, Assessment Mapping

No	Course Topics	Weeks	Learning Outcome
1	Introduction to Matlab	Week1	1
2	Linear Equations	Week2	1, and 9
3	Interpolation	Week3	1, 2, 3, 4, and 5
4	Zero and Roots	Week4	1, 9, and 11
5	Least Squares	Week5	1, 2, 3 , 7, and 9
6	Quadrature	Week6	3, 7, 8, and 9
7	Midterm	Week7	
8	Ordinary Differential Equations,	Week8	1, 5, 6, 8,and 9
9	Random Numbers,	Week9	1 ,5, 6 ,8,and 9
10	Fourier Analysis,	Week10	5,and 8
11	Eigenvalues and Singular Values,	Week11	4, 5, and 8
12	Partial Differential Equations.	Week12	1, 5, and 8
13	Probability Theory	Week13	1, 8, and 10
14	Solving PDEs in MATLAB using FFT, Singular value decomposition (SVD) and Data Science, SVD and facial recognition	Week14	1, and 10



15	Recap	Week15	
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Assessment Tools	Weeks	LOs	Weight
4 Quizzes	3,5,9, and 13	Students will do brainstorm in theoretical and apply these in practice in the laboratories (1, 2, 3)	5 %
4 Homeworks	2, 4, 10, and 12	Students will apply at home to put out in action and apply these LOs in practical(1, 5, 8, 9, and 11)	5 %
1 Report	6	Students will apply more in practice what they researched for their report (3, 7, 8, and 9)	5 %
1 Seminar	11	Students will be responsible with the teacher to deliver and apply these LOs (4, 5, and 8)	5 %
Practical Midterm	6	Students will apply at home to put out in action and apply these LOs in practical(9,10,11)	10 %
Midterm	7	Students will research and apply for a project with one of the companies or a faculty or will perform a midterm exam to demonstrate their abilities(4, 5, 6, and 10)	20 %
Practical Final	13	Students will apply at home to put out in action and apply these LOs in practical(2,3,6)	10 %
Final Exam	14	The students will do an oral exam to know which application can be maintained and performed in this module(1 to 11)	50 %



References

1. Moler, C.B., 2011. *Experiments with MATLAB*. Society for Industrial and Applied Mathematics.
2. Fossen, T.I., 2011. Mathematical models for control of aircraft and satellites. *Department of Engineering Cybernetics Norwegian University of Science and Technology*, pp.54-58.
3. Talukder, S., 2011. Mathematicle modelling and applications of particle swarm optimization.

Webpages

<http://stengel.mycpanel.princeton.edu/MAE331.html>

<http://stengel.mycpanel.princeton.edu/FlightDynamics.html>

Note//

Excel sheet link calculation for ECTS and workload, assignments, quizzes, ...

<https://docs.google.com/spreadsheets/d/1E7mUe3jeLv3UPQu1axbIyD8Sew97szok/edit?usp=sharing&oid=113794216519074746182&rtpof=true&sd=true>