



**Institute of Technology of Cambodia**

**Department of Applied Mathematics and Statistics**

**Syllabus of Course**

**Mathematical Modeling**

**Year 2022-2023**

## Course Information

Course: Mathematical Modeling  
 Semester: 1..... Year: ...3.....  
 Instructor's name Dr. SIM Tepmony  
 Pre-requisites  
 Tel: +855 81 988 778

Course's Code: AMSI31MAM  
 Number of Credit: 2  
 Latest Degree Obtained: Ph.D  
 Real-value function  
 Email: tepmony.sim@itc.edu.kh

### I. Course Description

Applications of a variety of mathematical techniques across many different areas. Discrete and continuous models theoretical and empirical models, deterministic and probabilistic models, and analytic and simulation models will be considered. Tools for the course include computer software as well as hand-held technology.

### II. Course Learning Outcomes (CLOs)

Upon completion of this course, students will be able to:

No	Course Learning Outputs (CLOs)	PLOs	Bloom's taxonomy
CLO1	Understand the mechanics, uses, and limitations of the modeling process	PLO1	Analyzing, Applying, Remembering
CLO2	Clearly explain various methods used to model data	PLO1, PLO10	Analyzing, Applying, Remembering
CLO3	Apply problem-solving strategies confidently to reach viable solutions to real-world problems	PLO1, PLO6, PLO11, PLO12, PLO15, PLO16	Analyzing, Applying, Remembering

### III. Teaching Approaches

- Give Lecture
- Practice tutorial
- Make group discussion and Presentation
- Give homework
- Give project/Assignment
- Have Quiz

### IV. Assessment Policy

No	Assessment Task	Weighting (%)	Responded Course Learning Outcomes
1	Attendance	10%	
2	Class Activities and Quiz	10%	CLO1, CL02, CLO3
3	Assignment/Report and Presentation	10%	CLO1, CL02, CLO3
4	Midterm	30%	CLO1, CL02
5	Final	40%	CL03, CLO4

## **V. Grading and Evaluation Criterion**

In order to pass this subject, students need to

- Get a total score of at least 30 (in 100) if the average score is lower than 50%
- Get a total score of at least 50 (in 100) if the average score is more than 50%
- Otherwise will be judged by a jury of the department.

## VI. Details of Contents, CLOs, LLOs, Teaching and Learning Activities, Assessment, and Supported Materials

Weeks	Sessions	CLOs	LLOs	Content	Teaching Activities	Learning Activities	Assessment	Materials
1-2	1-6	CLO1	<ul style="list-style-type: none"> <li>• Ability to understand the introduction Modeling change with different equations</li> <li>• Ability to illustrate the approximating change with difference equations</li> <li>• Ability to solve the Solutions to dynamic systems</li> <li>• Ability to solve System of differential equation</li> </ul>	<b>Module 1 (Chapter 1)</b> Modeling Change	<ul style="list-style-type: none"> <li>• Lecture/tutorial,</li> <li>• Lab practices</li> <li>• Web search,</li> <li>• Case study,</li> <li>• Individual work</li> <li>• group discussion</li> </ul>	<ul style="list-style-type: none"> <li>• Listen and Note Taking</li> <li>• Individual Homework</li> <li>• Group Discussion and Presentation</li> <li>• Report/Project Presentation</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance</li> <li>• Class Activities</li> <li>• Formative Assessment</li> <li>• Quiz and Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Slide Presentation</li> <li>• LCD Projector</li> <li>• Laptop</li> <li>• Slide Pointer</li> <li>• Writing Board</li> </ul>
3-4	7-12	CLO2 CLO3	<ul style="list-style-type: none"> <li>• Ability to understand the mathematical models</li> <li>• Ability to explant Modeling using proportionality</li> <li>• Ability to solve Modeling using geometric similarity</li> <li>• Ability to solve Automobile gasoline mileage</li> <li>• Ability to solve Body weight and height, strength and agility</li> </ul>	<b>Module 2 (Chapter 2)</b> The Modeling Process, proportionality, and Geometric Similarity	<ul style="list-style-type: none"> <li>• Lecture Presentation</li> <li>• Tutorials Practice</li> <li>• Class Facilitating</li> <li>• Case Study</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Listen and Note Taking</li> <li>• Individual Homework</li> <li>• Group Discussion and Presentation</li> <li>• Report/Project Presentation</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance</li> <li>• Class Activities</li> <li>• Formative Assessment</li> <li>• Quiz and Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Slide Presentation</li> <li>• LCD Projector</li> <li>• Laptop</li> <li>• Slide Pointer</li> <li>• Writing Board</li> </ul>
4-5	13-18	CLO2 CLO3	<ul style="list-style-type: none"> <li>• Ability to understand the fitting models to data graphically</li> </ul>	<b>Module 3 (Chapter 3)</b> Model Fitting	<ul style="list-style-type: none"> <li>• Lecture Presentation</li> <li>• Tutorials Practice</li> <li>• Class Facilitating</li> <li>• Case Study</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Listen and Note Taking</li> <li>• Individual Homework</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance</li> <li>• Class Activities</li> <li>• Formative Assessment</li> <li>• Quiz and Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Slide Presentation</li> <li>• LCD Projector</li> <li>• Laptop</li> <li>• Slide Pointer</li> <li>• Writing Board</li> </ul>

			<ul style="list-style-type: none"> <li>• Ability to Analytic methods of modeling fitting</li> <li>• Ability to illustrate how to Apply the least-squares criterion</li> <li>• Ability to understand how to Choosing the best model</li> </ul>			<ul style="list-style-type: none"> <li>• Group Discussion and Presentation</li> <li>• Report/Project Presentation</li> <li>• Q&amp;A</li> </ul>		
6-7	19-24	CLO2 CLO3	<ul style="list-style-type: none"> <li>• Ability to remember Simulation deterministic behavior: Area under a curve</li> <li>• Ability to remember A Generating random numbers</li> <li>• Ability to solve the Simulating probabilistic behavior</li> <li>• Ability to illustrate Inventory models: Gasoline and consumer demand</li> <li>• Ability to solve Queuing methods</li> </ul>	<b>Module 4 (Chapter 4)</b> Experimental Modeling	<ul style="list-style-type: none"> <li>• Lecture Presentation</li> <li>• Tutorials Practice</li> <li>• Class Facilitating</li> <li>• Case Study</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Listen and Note Taking</li> <li>• Individual Homework</li> <li>• Group Discussion and Presentation</li> <li>• Report/Project Presentation</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance</li> <li>• Class Activities</li> <li>• Formative Assessment</li> <li>• Quiz and Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Slide Presentation</li> <li>• LCD Projector</li> <li>• Laptop</li> <li>• Slide Pointer</li> <li>• Writing Board</li> </ul>
8-9	25-32	CLO3 CLO4	<ul style="list-style-type: none"> <li>• Ability to understand Response Surface Methodology</li> <li>• Ability to understand the Standard Designs for Second Order Models</li> <li>• Ability to Creating Standard Response Surface Designs in R</li> </ul>	<b>Module 5 (Chapter 5)</b> Simulation Modeling	<ul style="list-style-type: none"> <li>• Lecture Presentation</li> <li>• Tutorials Practice</li> <li>• Class Facilitating</li> <li>• Case Study</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Listen and Note Taking</li> <li>• Individual Homework</li> <li>• Group Discussion and Presentation</li> <li>• Report/Project Presentation</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance</li> <li>• Class Activities</li> <li>• Formative Assessment</li> <li>• Quiz and Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Slide Presentation</li> <li>• LCD Projector</li> <li>• Laptop</li> <li>• Slide Pointer</li> <li>• Writing Board</li> </ul>

			<ul style="list-style-type: none"> <li>• Ability to solve the Non-Standard Response Surface Designs</li> <li>• Ability to solve the Fitting the Response Surface Model with R</li> <li>• Ability to Determining Optimum Operating Conditions</li> <li>• Ability to explain Blocked Response Surface (BRS) Designs</li> <li>• Ability to explain the R tutorials for Response surface designs</li> </ul>					
10-11	33-40	CLO3 CLO4	<ul style="list-style-type: none"> <li>• Ability to remember an overview of optimization modeling</li> <li>• Ability to solve Linear programming, I: Geometric solutions</li> <li>• Ability to solve Linear programming II: Algebraic solutions</li> <li>• Ability to solve Linear programming II: The Simplex method</li> <li>• Ability to explain Linear programming IV: Sensitivity analysis</li> </ul>	<b>Module 6 (Chapter 7)</b> Optimization of Discrete Models	<ul style="list-style-type: none"> <li>• Lecture Presentation</li> <li>• Tutorials Practice</li> <li>• Class Facilitating</li> <li>• Case Study</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Listen and Note Taking</li> <li>• Individual Homework</li> <li>• Group Discussion and Presentation</li> <li>• Report/Project Presentation</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance</li> <li>• Class Activities</li> <li>• Formative Assessment</li> <li>• Quiz and Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Slide Presentation</li> <li>• LCD Projector</li> <li>• Laptop</li> <li>• Slide Pointer</li> <li>• WritingnBoard</li> </ul>

			<ul style="list-style-type: none"> <li>• Ability to illustrate Numerical search methods</li> </ul>					
12-14	41-48	CLO3 CLO4	<ul style="list-style-type: none"> <li>• Ability to remember Population growth</li> <li>• Ability to remember Prescribing drug dosage</li> <li>• Ability to solve Braking distance revisited</li> <li>• Ability to solve Graphical solutions of autonomous differential equations</li> <li>• Ability to explain the Numerical approximation methods</li> <li>• Ability to explain the Separation of variables</li> <li>• Ability to solve Linear equations</li> </ul>	<b>Module 7 (Chapter 11 &amp;12)</b> Modeling with Differential Equations and System of Differential Equations	<ul style="list-style-type: none"> <li>• Lecture Presentation</li> <li>• Tutorials Practice</li> <li>• Class Facilitating</li> <li>• Case Study</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Listen and Note Taking</li> <li>• Individual Homework</li> <li>• Group Discussion and Presentation</li> <li>• Report/Project Presentation</li> <li>• Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance</li> <li>• Class Activities</li> <li>• Formative Assessment</li> <li>• Quiz and Q&amp;A</li> </ul>	<ul style="list-style-type: none"> <li>• Slide Presentation</li> <li>• LCD Projector</li> <li>• Laptop</li> <li>• Slide Pointer</li> <li>• Writing Board</li> </ul>
15			Prepare for Final Exam					
16			Final Exam					

## VII. Internal Regulation Related to Students' Learning and Assessment

To preserve the learning good environment in our classrooms, students are expected to adhere to the following rules:

- Students are expected to come to class punctually and regularly. Punctuality reflects that you are ready and willing to undertake the task at hand and are respectful of others involved. If you are late, please come in quietly and take a seat in the back of the room.
- Treat everyone in the classroom with respect and be tolerant of questions asked by classmates. This is a diverse community, and we must respect each other's differences.
- Be respectful when engaging in online discourse.
- Pay attention and participate actively in the classroom conversation. Participation in class discussions is highly encouraged.
- Refrain from talking to other students during class or interrupting others. No "sidebars."
- Come to class prepared: always have your assignments, textbook, notebook, and pen.
- Turn off all cell phones and other electronic devices not used for educational purposes during class.
- If you must leave during class, exit and re-enter as quietly as possible.
- Do not leave class during exam sessions.
- Do not litter in the classroom. Clean up around your desk before you leave.
- Wait until the class has ended before you pack up your bags

## VIII. References

### Main Books

- Frank, R. G., William, G.F., and Steven, B. H.. A First Course in Mathematical Modeling, fifth edition, Brooks/Cole, Boston, USA, 2014.
- James Stewart. *Calculus*, Brooks/Cole, 8th Edition, 2015.
- W. J. Kaczor, and M. T. Nowak. *Problems in Mathematical Analysis II: Continuity and Differentiation*, American Mathematical Society, 2001.

### Other related course materials

- Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, *Probability and Statistics for Engineering and Scientists*, Ninth Edition, Pearson, 2011.
  - Robert. V. Hogg, Joseph W. McKean, Allen T. Craig, *Introduction to Mathematical Statistics*, Sixth Edition, Pearson, 2005.
  - Hogg, Tanis, Zimmerman, *Probability and Statistical Inference*, Ninth Edition, 2015
- Other course materials
- <https://www.khanacademy.org/>
  - <https://www.wolframalpha.com/>
  - [https://www.youtube.com/channel/UCYO\\_jab\\_esuFRV4b17AJtAw](https://www.youtube.com/channel/UCYO_jab_esuFRV4b17AJtAw)
  - <https://www.youtube.com/user/khanacademy>

**Remark:** This syllabus is intended to provide guidance as to students and the instructor's obligations for this course, and to provide an outline of topics to be covered during the semester. However, the instructor reserves the right to modify syllabus items as needs arise. Students will be notified in advance of any modifications.