MODULE DESCRIPTION FORM

2023-2024

Stage 2 Course 1

Number of units	Numbers of Hours				Course Type	Course Code	Name		ت
	tota	discussion	Practica	Theoretica					
3	4	1	—	3	Required section	CMOR23-F2111	Integer and Dynamic Programming	البرمجة الصحيحة والحركية	1
3	4	1	—	3	Required section	CMOR23-F2121	Probability Theory (1)	Theoretica الاحتمالات (1)	2
3	4	—	2	2	Faculty Mandatory Course	CMOR23-F2131	Numerical Analysis (1)	تحليل عددي (1)	3
3	4	1	—	3	Faculty Elective	CMOR23-F2141	Differential Equations	معادلات تفاضلية	4
2	3	1	—	2	Department Elective	CMOR23-F2151	Quality Control	سيطرة نوعية	5
2	3	1	—	2	Required section	CMOR23-F2161	Game Theory	Theoretica المباراة	6
2	2	—	—	2	Required section	CMOR23-F2171	Sequencing Problems	مسائل تتابعية	7
18	24	5	2	17	total				

Course Description Form

Course Name numerical Analysis (1)

Course Code: **CMOR23-F2131**

Semester / Year:1nd

Description Preparation Date:2023/2024

Available Attendance Forms: In presence

Number of Credit Hours (Total):4:/ Number of Units (Total): 3

Course administrator's name (mention all, if more than one name)

Name: asmaa abdulmunem abdullh
Email: **asmaa.abd@uomosul.edu.iq**
D. manal salim
Email: manalsalim@uomosul.edu.iq

Course Objectives

To enable the student to understand the subject of numeri analysis and its uses

To facilitate the solution of linear differential equations in differ ways

To facilitate the solution of nonlinear equations using numeri methods

- **Finding optimal strategies**
- **How to build a competit model**
- **Market competition rules**

Teaching and Learning Strategies

A- Knowledge and understanding
A1- The student should mention the previous laws
A2- The student should write some terms
A3- The student should be familiar with numerical methods
A4- The student should distinguish between numerical methods
A5- The student explains numerical methods
A6- The student summarizes the steps for solving numerical metho

B - Subject-specific skills
B1 - That the student can solve differential equations
B2 - The student should reveal the amount of error between the re and numerical solution.

C- Thinking skills

C1- The student should propose solutions to linear equations and systems
C2-The student should compare analytical and numerical solution methods
C3- To plan how to use the appropriate method in the solution
D - General and transferable skills (other skills related to employability and personal development).
D1- That the student implements the method followed by manual a computer solutions
D2- To verify the method and the validity of the results
D3- Enabling the student to program numerical methods

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	4	A	Introduction to numerical analysis, sources of errors, circular cutting error, turning and cutting error	Lecture and discussion	Assignments and Observation (H.W)
2	4	A	Rounding decimal numbers using rotation, rounding integers, types of errors	Lecture and discussion	Assignments and Observation (H.W)
3	4	A&B	Absolute error, relative error, mathematical operations on errors, comprehensive	Lecture and discussion	Assignments and Observation (H.W)

				and diverse examples of the above		
	4	**4**	A&B	**Solving nonlinear equations using iterative methods, methods for finding the initial point of any nonlinear equation, drawing method**	Lecture and problem solving	Written tests
	5	**4**	**B&A**	**change the sign method (algorithm – flow chart – practical example – practical program in Mathlab language)**	Lecture and problem solving	Written tests
	6	**4**	**A & C**	**Numerical iterative methods for solving nonlinear equations – bisection method**	Lecture and discussion	Assignments and Observation (H.W)

				(method algorithm – flow chart – applied example – practical program)		
	7	4	B & C	teration and repetition method (solid point method) ((Method algorithm – Flow chart – Practical example – Practical program in Mathlab language) Electronic ecture	Lecture and discussion	Assignments and Observation (H.W)
	8	4	A& C	False position method (method algorithm – flow chart – applied example – practical program in Mathlab language)	Lecture and discussion	Assignments and Observation (H.W)

	9	**4**	**B & C**	**Newton Raphson's method for solving a nonlinear equation (algorithm – flow chart – practical example – practical program in Mathlab language)**	Lecture and problem solving	Presentation (power point)
	10	**4**	B	**Disadvantages of Newton–Raphson method – Finding the square root using Newton Raphson (practical examples, practical program in Mathlab language)**	Lecture and discussion	Assignments and Observation (H.W)
	11	**4**	D		Lecture and Project	Project(Report)
	12	**4**	**A&B**	**The general law for finding the reciprocal**		

				of a number using Newton Raphson (practical examples, practical program in Mathlab language		
	13	**4**	A &C	**Finding the nth root using Newton Raphson (practical examples, practical program in Mathlab language)**	**Lecture and problem solving**	Assignments and Observation (H.W)
	14	**4**	**A& C**	**Hornes method for solving nonlinear polynomial equations**	Lecture and discussion	Assignments and Observation (H.W)
	15	**4**	C&D	**Solutions to the problems for the numerical methods above**	**Lecture and interrogation**	TEST

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any): ن مجيد حسون الدلفي و محمود عطا الله مشكور"التحليل الهندسي والعددي التطبيقي"	
Main references (sources): Fast algorithms for solving a system of lin equations Math and logic	Operation Research (2011) gu
Recommended books and references (scientific journals, reports…)	
Electronic References, Websit https://www.bacldung.com/cs/category/core-concepts/math-logic)	www.gametheory.net

Course Description Form

Course Name: integer and Dynamic Programming
Course Code: **CMOR23-F2241**
Semester / Year:1st
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
Course administrator's name (mention all, if more than one name)
Name: dr.mohammed alkailany Email: alkailanym@uomosul.edu.iq
Course Objectives

Course Objectives	**• Finding optimal strategie** **• How to build a competit model** **• Market competition rules**

Teaching and Learning Strategies
A- Knowledge and understanding A1- The student should mention the previous laws A2- The student should write some terms A3- The student should describe the model A4- The student should distinguish between the models A5- The student explains the mathematical formula A6- The student summarizes the steps to solve the mathematical formula **B - Subject-specific skills** B1 - The student applies the model to a real situation B2 - The student must reveal the error in the form. B3 - The student tabulates the results **C- Thinking skills** C1- The student poses a problem based on reality C2- The student should compare the solution methods C3- To rearrange the solution method C4- To plan how to use the appropriate method in the solution **D - General and transferable skills (other skills related to employabili and personal development).**

D1- That the student implements the method used by the proof
D2- That the student improves the method used in the solution
D3- Verify the method
D4- Enabling the student to solve the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	3	A	Introduction	Lecture and discussion	Assignments and Observation (H.W)
2	3	A	Branch and Bound method	Lecture and discussion	Assignments and Observation (H.W)
3	3	A&B	Cutting Plane method	Lecture and discussion	Assignments and Observation (H.W)
4	3	A&B	Gomory's cutting plane	Lecture and problem solving	Written tests
5	3	B&A	Approximation Implicit enumeration method Methods	Lecture and problem solving	Written tests
6	3	A & C	approximation method	Lecture and discussion	Assignments and Observation (H.W)
7	3	B & C	Graphically methods	Lecture and discussion	Assignments and Observation (H.W)
8	3	A& C	implicit enumeration method Dynamic Programming	Lecture and discussion	Assignments and Observation (H.W)
9	3	B & C	Equion method	Lecture and problem solving	Presentation (power point)
10	3	B	Building integer Linear programing	Lecture and discussion	Assignments and Observation (H.W)

	11	**3**	D	Project(Report)	Lecture and Project	Project(Report)
	12	**3**	**A&B**	**decision making of dynamic**	**exam**	**exam**
	13	**3**	A &C	**backward**	**Lecture and problem solving**	Assignments and Observation (H.W)
	14	**3**	**A& C**	**forward**	Lecture and discussion	Assignments and Observation (H.W)
	15	**3**	C&D	**Test**	**Lecture and interrogation**	TEST

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources)	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	www.gametheory.net

Course Description Form

Course Name: Sequencing problems
Course Code: **CMOR23-F2171**
Semester / Year:First / 2024
Description Preparation Date:1-4-2024

Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total) 2/2
Course administrator's name (mention all, if more than one name)
Name: Assist.Prof.Dr.Niam Abdulmunim Abdulmajeed Email: niam.munim@uomosul.edu.iq
Course Objectives

Course Objectives	Identify sequential problems and their concepts, the scheduling problem and its types, scheduling criteria, and the most important scheduling problems for single-machine problems and parallel machines, the multi-processor task, open workshops, the flow workshop, business workshops, and scheduling resource-constrained projects, in addition to the important optimization and scheduling algorithms used in operations research. Obtain sufficient training in formulating sequential problems, various scheduling, and algorithms to solve these problems. Presenting many real-life problems that can formulated, such as sequential and tabulat problems.

Teaching and Learning Strategies	
Strategy	1. Students can learn about scheduling and sequencing problems. 2. Students are able to deal with sequencing problems. 3. Students can deal with scheduling problems. 4. Identify the optimization and scheduling algorithms used for machine and workshop scheduling problems. 5. Recognize the importance of scheduling problems and algorithms in solving practical problems in industry and production. 6. Modeling scheduling and sequencing problems. 7. Enabling the student to write and understand algorithms, solve problems, interpret results, and be able to make the optimal decision in using scheduling algorithms and applying them in real life. 8. Keeping pace with developments in the field of specialization. 9. The use of different types of algorithms that solve scheduling problems and how develop and improve them.

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	2		Sequencing problems, sequence, scheduling, Directed Acyclic Graph Model, homogeneous and heterogeneous processors, types of scheduling, scheduling criteria	Lecture, discussion and interrogation	written tests
2	2		The resource-constrained project scheduling problem with examples	Lecture, discussion and interrogation	written tests
3	2		Machine scheduling, basic concepts, machine scheduling problems	Lecture, discussion and interrogation	written tests
4	2		Single machine (processor) scheduling algorithms ,First Come First Server Scheduling Algorithm Short Job First Scheduling algorithm	Lecture, discussion and interrogation	written tests
5	2		Priority Scheduling Algorithm , Round Robin Scheduling Algorithm	Lecture, discussion and interrogation	written tests
6	2		Earliest Due Date Scheduling Algorithm Moore's Algorithm	Lecture, discussion and interrogation	written tests
7	2		Parallel Machine Scheduling	Lecture, discussion and interrogation	written tests
8	2		Multi-machine (multiprocessor) scheduling algorithms, Independent Jobs scheduling algorithms Longest Processing Time Scheduling Algorithm, Shortest Processing Time Scheduling Algorithm	Lecture, discussion and interrogation	written tests
9	2		Multiprocessor Scheduling Algorithms With Out Communication Cost	Lecture, discussion and interrogation	written tests

			Highest Level First With Estimated Time) Scheduling Algorithm		
10	2		Smallest Co – Level First With Estimated Time Scheduling Algorithm CP/ MISF (Critical Path/ Most Immediate Successors First) Scheduling Algorithm	Lecture, discussion and interrogation	written tests
11	2		Shop Scheduling Flow Shop Scheduling	Lecture, discussion and interrogation	written tests
12	2		Johansen's algorithm for the n/2/F//F_{max} problem	Lecture, discussion and interrogation	written tests
13	2		Open Shop Scheduling	Lecture, discussion and interrogation	written tests
14	2		Multi-Processor task Scheduling	Lecture, discussion and interrogation	written tests
15	2		A week of preparation before the final exam		

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W.)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	Lectures prepared by the lecturer
Main references (sources)	P.K. Gupta & D.S.Hira,2008,Operations Resear S.Chand & Company Ltd. New Delhi.
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	https://www.youtube.com/watch?v=pGRZ8laY-2U

Course Description Form

Course Name: Differential equations
Course Code: COMOR23-F2141

Semester / Year: The first semester of the second stage
Description Preparation Date: 4/2/2024
Available Attendance Forms: Recording the student's attendance in theoretical lectures
Number of Credit Hours (Total) / Number of Units (Total): 60 hours of theory (4 hours per week for 15 weeks, 2 theory, 2 discussion)/number of units (3)
Course administrator's name (mention all, if more than one name)
Name: Manal Salim Hamdi Email: E-mail manalsalim@uomosul.edu.iq
Course Objectives

Course Objectives	1- Enabling the student to recognize the types of differential equations. 2- To have an excellent tool to feel the close relationship between pure mathematics and the physical or engineering sciences. 3- Interpreting some laws of natural phenomena and working to solve their problems……

Teaching and Learning Strategies

Strategy	How to give a lecture 1- Using the blackboard to explain differential equations and solve questions. 2- Continuous discussion by asking questions and answers in the hall and motivating the student to self-think and thus to self-learning. 3- Requesting assignments and discussions to be sent via the online class, Google Classroom. 4- Requiring the writing of scientific reports in the specialty, discussing those reports, and pointing out their strengths and weaknesses to achieve the desired goal.

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3	Re-explaining the methods of integrals (partial)	Examples with exercises	Lecture using the blackboard	Short exams, and Quarterly and final

2	3	Fractional, radical	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
3	3	Definition of differential equations (degree and rank) general solution and special solution	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
4	3	Prove the solution to the differential equation	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
5	3	Linear differential equations (including separable, homogeneous	Examples with exercises	The blackboard The blackboard	Short exams, and Quarterly and final
6	3	(complete, incomplete)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
7	3	Differential and linear equations of first order and first order	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
8	3	Bernoulli equations	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
9	3	Re-explaining the methods of integrals (partial)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
10	3	Reduced order differential equation Equations that can be solved by direct integration	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
11	3	Reducing the rank of the differential equation is the case in which the dependent variable does not appear	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
12	3	Reducing the rank of the differential equation is the case in which the independent variable does not appear	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
13	3	Differential equations of order n, case one, two, and three	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
14	3	The linear coefficients of order n are heterogeneous in the first and second cases	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
15	3	Examples of applications of differential equations	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final

Course Evaluation	
Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources)	
Recommended books and references (scientific journals, reports…)	Parman and Gupta ,Differential equations and Differentia geometry,(2008)

Electronic References, Websites	1http://www.alfreedph.com/2017/06/Ordinary- 2-https://download-learning-pdf-ebooks.com/12099-fr book

Course Description Form

Course Name:
Probability theory 1
Course Code:
CMOR23-F2121
Semester / Year:
Description Preparation Date:
1/4/2024
Available Attendance Forms:
In presence
Number of Credit Hours (Total) / Number of Units (Total)
4hours / 3 units
Course administrator's name (mention all, if more than one name)
Name: **Saifuldeen Dheyauldeen Saeed Alrefaee** Email: **saifldeen.alrefaee@uomosul.edu.iq**
Course Objectives

Course Objectives	Grasp the set theory fundamentals: Learn subsets, complements, unions, intersections, and set partitioning. Explore theorems and proofs for deeper understanding. Developing the student's abilities on counting methods to reach sets theory as well as the binomial expansion law. Acquire probability theory knowledge: Introduce concepts like sample space, events, and connections to random experiments. Explore Classical and Axiomatic approaches and utilize tools for understanding the events. Realization of conditional probability and axioms: Learn theoretical foundations, practical calculations, and their application in problem-solving. Explore Bayes' theory and applications: Introduce valuable tools for advanced probability work and real-world utilization. Provide a solid foundation for advanced work on probability and its applications, and is essential to understanding many applied fields.

	Overall, the objectives of this module include building a strong foundation in set theo developing proficiency in combinatorics and probability, and introducing advan topics like conditional probability and Bayes' theory.

Teaching and Learning Strategies	
Strategy	The main strategy that will be adopted in introducing this unit is to encourage students participate in the exercises while improving and expanding their critical thinking skills at the sa time by getting acquainted with the theory of probability, in the first part and expanding student's mind. This will be achieved through classes and interactive educational programs learn about sets theory and counting methods for it, and through learning about the rand experiment and sample space in forming sets, as well as using basic probabilistic laws application in its various forms, which will be the basis for the student for his future stages.

Teaching and learning outcomes

A- Knowledge and understanding
A1- The student should mention the previous laws and terminology
A2- The student should distinguish between the types of probability, including conditional and unconditiona
A3- That the student understands the special formulas and proofs used in probability
A4- The student should summarize the steps of the solution

B - Subject-specific skills
B1 - The student applies it to a real situation
B2 - The student must reveal the error in the solution, if any.
B3 - The student tabulates the results

C- Thinking skills
C1- The student poses a problem based on reality
C2-The student should compare the solution methods
C3- The student must determine the appropriate method for the solution
C4- That the student applies the correct rules in the solution

D - General and transferable skills (other skills related to employability and personal development).
D1- The student implements the method used by the proof
D2- The student improves the method used in the solution
D3- Verify the method

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4	A	Introduction of the Probability and Basic set theory.	Lecture and discussion	Note
2	4	A	Basic Set theory, definitions of set theor	Lecture and discussion	Note
3	4	A & B	Some Fundamental Theorems, Fundamental laws of set theory with theorems.	Lecture and interrogation	Oral exams
4	4	A & B	Sequence and limits, with theorems.	Lecture and problem-solvin	Written tests

5	4	A & B & C	Field, σ-Field, and Power of the set.	Lecture discussion a	Note
6	4	A & B & C	Techniques of Counting, Tree Diagrams and Arrangement	Lecture discussion a	Note
7	4	A & B & C	Techniques of Counting, Permutations.	Lecture interrogation a	The exams Editorial
8	4	A & B	Techniques of Counting, Combinations with theorems.	Lecture problem-solvin a	Note
9	4	B & C	Combinations and Binomial theorem and Multinomial Expansion.	Lecture discussion a	Note
10	4	B & C	Probability Introduction, Random Experiment, Events Kinds, Sample Spac and Probability a law.	Lecture discussion a	Note
11	4	B & C	Axiomatic Approach of Probability	Lecture discussion a	Observation and written tests
12	4	A & B & D	Probabilistic models according to the ba laws of set theory with theorems.	Lecture problem-solvin a	Note
13	4	B & C	Independent events, Conditional Probability.	Lecture discussion a	Note
14	4	A & B & C	Conditional Probability, Bayes' law, and Bayes' Theorem	Lecture interrogation a	Oral exams
15	4	A & B & C & D	Applications of Bayes' Theorem.	discussion	Note

Course Evaluation	
Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	1-Introduction to probability theory, Dr. Dhafir H. Rasheed,1999,2-nd edition, Baghdad University probability, Dr.kubais S. A Fahady Dr. Pirlanty J. Shamoon, Ministry of Higher Education and Scientific Research University of Mosul
Main references (sources)	A first Course in probability, Sheldon Ross, 2010, Eighth edition.
Recommended books and references (scientific journals, reports…)	Probability, scheme series
Electronic References, Websites	https://www.Coursera.org/learn/probability-theory-foundation-for-data-science? https://www.khanacademy.org/math/statistics-probability

Stage 2 Course 2

Numbers of Units	Numbers of Hours				Course Type	Course Code	Name		C
	total	discussion	Practical	theoretical					
3	4	1	—	3	Required section	CMOR23-F2211	Probability Theory (2)	Theoretical الاحتمالاتة (2)	1
3	4	—	2	2	Faculty Elective	CMOR23-F2221	Numerical Analysis (2)	تحليل عددي (2)	2
3	4	1	—	3	Required section	CMOR23-F2231	Assignment Problems	مسائل التخصيص	3
3	4	1	—	3	Required section	CMOR23-F2241	Data Mining	تنقيب بينات	4
2	4	2	—	2	Department Elective	CMOR23-F2251	Time Series	سلاسل زمنية	5
2	2	—	—	2	University Elective	CMOR23-F2261	Elementary of Economic	مبادئ الاقتصاد	6
2	2	—	—	2		CMOR23-F2271	English Language (2)	لغة انكليزية (2)	7
18	24	5	2	17	total				

Course Description Form

Course Name numerical Analysis (2)
Course Code: **CMOR23-F2221**
Semester / Year:2nd
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total):4:/ Number of Units (Total): 3
Course administrator's name (mention all, if more than one name)
Name: asmaa abdulmunem abdullh Email: **asmaa.abd@uomosul.edu.iq** **D. manal salim** **Email: manalsalim@uomosul.edu.iq**
Course Objectives

To enable the student to understand the subject of numeri analysis and its uses **To facilitate the solution of linear differential equations in differ ways** **To facilitate the solution of nonlinear equations using numeri methods**	**Finding optir strategies** **How to build competitive model** **Market competition ru**

Teaching and Learning Strategies

A- Knowledge and understanding
A1- The student should mention the previous laws
A2- The student should write some terms
A3- The student should be familiar with numerical methods
A4- The student should distinguish between numerical methods
A5- The student explains numerical methods
A6- The student summarizes the steps for solving numerical methods

B - Subject-specific skills
B1 - That the student can solve differential equations
B2 - The student should reveal the amount of error between the real and numerical solution.

C- Thinking skills
C1- The student should propose solutions to linear equations and systems
C2-The student should compare analytical and numerical solution methods
C3- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employabilit and personal development).
D1- That the student implements the method followed by manual and computer solutions
D2- To verify the method and the validity of the results
D3- Enabling the student to program numerical methods

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	**4**	A	**Cramer's method (practical examples – practical program)**	Lecture and discussion	Assignments and Observation (H.W)

	2	**4**	A	**Newton Raphson's method for solving a system of nonlinear equations using the Jacobi matrix (algorithm – flow chart – applied examples – practical program in Mathlab)**	Lecture and discussion	Assignments and Observation (H.W)
	3	**4**	A&B	**The improvement Newton–Raphson method for solving a system of nonlinear equations (algorithm – flow chart – applied examples – practical program in Mathlab)**	Lecture and discussion	Assignments and Observation (H.W)
	4	**4**	A&B	**Trigonometric analysis method (explanation of the method –**	Lecture and problem solving	Written tests

				applied examples)		
	5	4	B&A	Jacobi's general method (explanation of the method – applied examples, a practical program in the Mathlab language	Lecture and problem solving	Written tests
	6	4	A & C	Jacobi's special (trigonometric) method (explanation of the method – applied examples, a practical program in the Mathlab language)	Lecture and discussion	Assignments and Observation (H.W)
	7	4	B & C	General causs–Seidel method (explanation of the method – applied examples, practical program in	Lecture and discussion	Assignments and Observation (H.W)

				Mathlab anguage)		
	8	4	A& C	- causs–Seidel's method practical (explanation of the method – applied examples, practical program in Mathlab language)	Lecture and discussion	Assignments and Observation (H.W)
	9	4	B & C	Inclusion and interpolation: polynomials (quadratic inclusion, cubic inclusion)	Lecture and problem solving	Presentation (power point)
	10	4	B	Inclusion and interpolation: polynomials (quadratic inclusion, cubic inclusion) language)	Lecture and discussion	Assignments and Observation (H.W)
	11	4	D		Lecture and Project	Project(Report)
	12	4	A&B	Lagrange Inclusion Parametric (Explanation of the method, example, practical		

				program in Mathlab language		
	13	**4**	A &C	Solutions to the numerical methods problems above	**Lecture and problem solving**	Assignments and Observation (H.W)
	14	**4**	**A& C**	**Solutions to the numerical methods problems above**	Lecture and discussion	Assignments and Observation (H.W)
	15	**4**	C&D	**Solutions to the numerical methods problems above**	**Lecture and interrogation**	TEST

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any): ن مجيد حسون الدلفي و محمود عطا الله مشكور"التحليل الهندسي والعددي التطبيقي"	
Main references (sources): Fast algorithms for solving a system inear equations Math and logic	Operation Research (20 gupta
Recommended books and references (scientific journals, eports…)	
Electronic References, Websit https://www.bacldung.com/cs/category/core-concepts/math-logic)	www.gametheory.net

Course Description Form

Course Name: Time Series
Course Code: COMOR23-F2251
Semester / Year: The first semester of the second stage
Description Preparation Date: 4/2/2024
Available Attendance Forms: Recording the student's attendance in theoretical lectures
Number of Credit Hours (Total) / Number of Units (Total): 60 hours of theory (4 hours per week for 15 weeks, 2 theory, 2 discussion)/number of units (3)
Course administrator's name (mention all, if more than one name)
Name: Manal Salim Hamdi Email: E-mail manalsalim@uomosul.edu.iq
Course Objectives

Course Objectives	1- Enabling the student to recognize the types of time series so that he has an excellent tool to feel the close relationship between time series and their applications different journals. 2- Interpreting some laws of natural phenomena and working to solve their problems.
Teaching and Learning Strategies	
Strategy	How to give a lecture 1- Using the blackboard to explain differential equations and solve questions. 2- Continuous discussion by asking questions and answers in the hall and motivating the student to self-think and thus to self-learning. 3- Requesting assignments and discussions to be sent via the online class, Google Classroom.

	4- Requiring the writing of scientific reports in the specialty, discussing those reports, a pointing out their strengths and weaknesses to achieve the desired goal.

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4	Introduction to time series	Examples with exercises	Lecture using the blackboard	Short exams, and Quarterly and final
2	4	Types of time series	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
3	4	Time series models	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
4	4	Measure the general trend	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
5	4	The general nonlinear trend (part one)	Examples with exercises	The blackboard The blackboard	Short exams, and Quarterly and final
6	4	The general non-linear trend (Part Two)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
7	4	Excluding the effect of the general trend (Part One)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
8	4	Excluding the effect of the general trend (Part Two)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
9	4	Seasonal changes (part one)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
10	4	Seasonal changes (Part Two)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
11	4	Periodic changes (part one)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
12	4	Periodic changes (Part Two)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
13	4	Random changes (part one)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final
14	4	Random changes (part two)	Examples with exercises	Lecture using The blackboard	Short exams, and Quarterly and final

Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

Learning and Teaching Resources

Required textbooks (curricular books, if any)	
Main references (sources)	

Recommended books and references (scientific ournals, reports…)	Parman and Gupta ,Differential equations and Differentia geometry,(2008)
Electronic References, Websites	1http://www.alfreedph.com/2017/06/Ordinary- 2-https://download-learning-pdf-ebooks.com/12099-fr book

Course Description Form

Course Name: Assignment Problems	
Course Code: **CMOR23-F2231**	
Semester / Year: Second / 2024	
Description Preparation Date: 1-4-2024	
Available Attendance Forms: In presence	
Number of Credit Hours (Total) / Number of Units (Total) 4/3	
Course administrator's name (mention all, if more than one name)	
Name: Assist.Prof.Dr.Niam Abdulmunim Abdulmajeed Email: niam.munim@uomosul.edu.iq	
Course Objectives	
Course Objectives	Identify the different types of transportation and assignment problems. Developing drafting skills in transportation moc and finding optimal solutions. Understanding ways to solve various transportat and assignment problems.
Teaching and Learning Strategies	
Strategy	1. The use of transportation and assignment models in industry and business. 2. Formulating the transportation and assignment problems. 3. Knowledge of the assignment problem and its assumptions. 4. Solve the assignment problem using the Hungarian method. 5. Know and determine whether the optimal solution includes alternative or multiple solutions. 6. How to deal with the state of degenerate and imbalance in transportation and assignment problems. 7. Application of transportation and assignment models in business and real-life application.

	3. Recognize the importance of transportation and assignment problems in solving practical problems in industry and production. 9. Interpret solutions of transportation and assignment models and derive solutions to real-world problems.

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4		Transportation Problems (Models) Definitions and basic concepts, formulation of the transportation problem (model), mathematical model	Lecture, discussion and interrogation	written tests
2	4		Methods for finding the feasible basic solution to the transportation problem North west corner method, least cost method	Lecture, discussion and interrogation	written tests
3	4		Vogel's method	Lecture, discussion and interrogation	written tests
4	4		Methods for finding the optimal solution to the transportation problem (optimality test) Multipliers Method	Lecture, discussion and interrogation	written tests
5	4		Stepping Stone Method	Lecture, discussion and interrogation	written tests
6	4		Assignment Problems Definitions, basic concepts and applications	Lecture, discussion and interrogation	written tests
7	4		Methods of solving assignment problems Complete enumeration method	Lecture, discussion and interrogation	written tests
8	4		Hungarian Method	Lecture, discussion and interrogation	written tests
9	4		Linear programming method, Transportation method	Lecture, discussion and interrogation	written tests

10	4		Special cases of assignment problems Maximization Problems Unbalanced Problems Handing unaccepted Assignment	Lecture, discussion and interrogation	written tests
11	4		A job-Assignment Problem	Lecture, discussion and interrogation	written tests
12	4		Formulating the assignment matrix	Lecture, discussion and interrogation	written tests
13	4		Standard assignment problem (typical)	Lecture, discussion and interrogation	written tests
14	4		Travelling Salesman Problem Basic concepts, Traveling salesman idea, mathematical model, applications	Lecture, discussion and interrogation	written tests
15	4		A week of preparation before the final exam	Lecture, discussion and interrogation	written tests

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W.)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	Lectures prepared by the lecturer
Main references (sources)	P.K. Gupta & D.S.Hira,2008,Operations Resear S.Chand & Company Ltd. New Delhi
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	https://www.youtube.com/watch?v=rfu2Zbjc7q8

Course Description Form

Course Name: Data Mining
Course Code: CMOR23-F2161
Semester / Year:2nd
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)/2
Course administrator's name (mention all, if more than one name)
Name: Lec. Ahmed N. Alkhateeb Email: ahmed.alkhateeb@uomosul.edu.iq
Course Objectives

Course Objectives	**• Finding optimal strateg** **• How to build competitive model** **• Market competition rul**

Teaching and Learning Strategies

A- Knowledge and understanding
A1- The student should mention the previous laws
A2- The student should write some terms
A3- The student should describe the model
A4- The student should distinguish between the models
A5- The student explains the mathematical formula
A6- The student summarizes the steps to solve the mathematical formula

B - Subject-specific skills
B1 - The student applies the model to a real situation
B2 - The student must reveal the error in the form.
B3 - The student tabulates the results

C- Thinking skills
C1- The student poses a problem based on reality
C2- The student should compare the solution methods
C3- To rearrange the solution method
C4- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employabilit and personal development).

D1- That the student implements the method used by the proof
D2- That the student improves the method used in the solution
D3- Verify the method
D4- Enabling the student to solve the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	3	A	Origin of data mining	Lecture and discussion	Assignments and Observation (H.W)
2	3	A	Classification	Lecture and discussion	Assignments and Observation (H.W)
3	3	A&B	Clustering	Lecture and discussion	Assignments and Observation (H.W)
4	3	A&B	Types of data	Lecture and problem solving	Written tests
5	3	B&A	Samples, feature selection	Lecture and problem solving	Written tests
6	3	A & C	Data transformation	Lecture and discussion	Assignments and Observation (H.W)
7	3	B & C	Measures distance	Lecture and discussion	Assignments and Observation (H.W)
8	3	A& C	Similarity measures	Lecture and discussion	Assignments and Observation (H.W)
9	3	B & C	Skewness	Lecture and problem solving	Presentation (power point)
10	3	B	Kurtosis	Lecture and discussion	Assignments and Observation (H.W)
11	3	D	Half exam	Lecture and Project	Project(Report)
12	3	A&B	Clustering analysis (1)		
13	3	A &C	Clustering analysis (2)	Lecture and problem solving	Assignments and Observation (H.W)
14	3	A& C	Hierarchical Clustering	Lecture and discussion	Assignments and Observation (H.W)

	15	**3**	C&D	**Non-Hierarchical Clustering**	**Lecture and interrogation**	TEST

Course Evaluation	
Written tests Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources): Data Mining: Concepts and techniq 2012	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…): Artificial Intelligence in Data Mining_ Theories and Applications-Elsevier_ Academic Press (2021)	
Electronic References, Websites	www.gametheory.net

Course Description Form

Course Name:
Probability theory 2
Course Code:
CMOR23-F2211
Semester / Year:
Description Preparation Date:
1/4/2024
Available Attendance Forms:
In presence
Number of Credit Hours (Total) / Number of Units (Total)
4hours / 3 units
Course administrator's name (mention all, if more than one name)
Name: **Saifuldeen Dheyauldeen Saeed Alrefaee** Email: **saifldeen.alrefaee@uomosul.edu.iq**

Course Objectives	
Course Objectives	Gain a clear understanding of the concept of random variables, including discrete and continuous types, and learn about their probability and distribution functions in this module. Acquire the skills to compute the probability mass function (p.m.f.) for discrete random variables and the probability density function (p.d.f.) for continuous random variables. This module covers the necessary formulas and techniques for calculating these functions. Discover discrete and continuous distributions. Learn their characteristics and applications. Gain insight into mathematical expectation by studying definitions, properties, and calculations for various distributions, and explore related properties. Developing the student's role in benefiting from the generated functions and developing problem-solving skills through these functions. Provide a solid foundation for advanced work on probability and its applications, and is essential to understanding many applied fields. Overall, the objectives of this module include gaining a solid understanding of rand variables, probability functions, and distribution functions. Students will learn calculate p.m.f. and p.d.f., explore various discrete and continuous distributio understand mathematical expectations, and work with moments and the mome generating function (MGF) to analyze random variables.
Teaching and Learning Strategies	
Strategy	The main strategy that will be adopted in introducing this unit is to encourage students participate in the exercises while improving and expanding their critical thinking skills at the sa time by getting acquainted with the theory of probability, in the first part and expanding student's mind. This will be achieved through classes and interactive educational programs learn about random variables and their distributions, and more through learning about mathematical expectation and moment generating function as well as using it in some rand distributions its various forms, which will be the basis for the student for his future stages.
Teaching and learning outcomes	
A- Knowledge and understanding A1- The student should mention the previous laws and terminology A2- The student should distinguish between the types of probability, including conditional and unconditiona A3- That the student understands the special formulas and proofs used in probability A4- The student should summarize the steps of the solution	
B - Subject-specific skills B1 - The student applies it to a real situation B2 - The student must reveal the error in the solution, if any. B3 - The student tabulates the results	
C- Thinking skills C1- The student poses a problem based on reality C2-The student should compare the solution methods C3- The student must determine the appropriate method for the solution C4- That the student applies the correct rules in the solution	
D - General and transferable skills (other skills related to employability and personal development). D1- The student implements the method used by the proof	

D2- The student improves the method used in the solution
D3- Verify the method

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4	A	The concept of Random variable.	Lecture and discussion	Note
2	4	A	Discrete Random variable, Probability mass function (p.m.f), and its Distributio function (c.d.f).	Lecture and discussion	Note
3	4	A & B	Continuous Random variable, Probabilit density function (p.d.f), and its Distribution function (c.d.f).	Lecture and interrogation	Oral exams
4	4	A & B	Some discrete distribution; Uniform & Bernoulli distribution.	Lecture and problem-solvin	Written tests
5	4	A & B & C	Some discrete distributions; Binomial & Poisson distribution.	Lecture discussion	Note
6	4	A & B & C	Some discrete distributions; Geometric, Hypergeometric distribution & Negative Binomial.	Lecture discussion	Note
7	4	A & B & C	Some Continuous distribution; Uniform continuous distribution.	Lecture interrogation	The exams Editorial
8	4	A & B	Some Continuous distribution; Exponential distribution.	Lecture problem-solvin	Note
9	4	B & C	Some Continuous distribution; Normal distribution.	Lecture discussion	Note
10	4	B & C	Some Continuous distribution; Gamma Beta distribution.	Lecture discussion	Note
11	4	B & C	Mathematical expectation.	Lecture discussion	Observation and written tests
12	4	A & B & D	Mean and Variance.	Lecture problem-solvin	Note
13	4	B & C	The moment and central moment.	Lecture discussion	Note
14	4	A & B & C	The moment generating function (m.g.f)	Lecture interrogation	Oral exams
15	4	A & B & C & D	Applications of the moment generating function on Some distribution (m.g.f).	discussion	Note

Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

Learning and Teaching Resources

Required textbooks (curricular books, if any)	1-Introduction to probability theory, Dr. Dhafir H. Rasheed,1999,2-nd edition, Baghdad University probability, Dr.kubais S. A Fahady Dr. Pirlanty J. Shamoon, Ministry of Higher Education and Scientific Research University of Mosul
Main references (sources)	A first Course in probability, Sheldon Ross, 2010, Eighth edition.
Recommended books and references (scientific ournals, reports…)	Probability, scheme series
Electronic References, Websites	https://www.Coursera.org/learn/probability-theory-foundation-for-data-science? https://www.khanacademy.org/math/statistics-probability https://www.Coursearena.io/topic/free-probability-theory-Courses

Course Description Form

Course Name: game theory
Course Code: CMOR23-F2271
Semester / Year:2nd
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
Course administrator's name (mention all, if more than one name)
Name: Zainab Qusay Ahmed Taqi AL Oraibi Email: Zainab.q@uomosul.edu.iq
Course Objectives
Course Objectives • To be able to read books with understanding • To be able to speak English • To be able to compose freely and independently in speech and writing
Teaching and Learning Strategies
A- Speaking skill A1- He must have the ability to think and speak in English A2- The ability to speak English fluently

A3- The ability to formulate sentences correctly

B - Reading skill

B1 - The ability to read sentences correctly

B2 - Correct pronunciation of words.

C- Writing skill

C1- The ability to write sentences in English correctly

The ability to express ideas through writing

D - Listening skills.

D1- Developing the student's listening skill

D2-The ability to distinguish words while listening

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	**2**	A	Introduction: Review about Study materials.	Lecture and discussion	Observation
2	**2**	A	Quantities, wh-questions and answers.	Lecture and problem-solving	Assignments and Observation
3	**2**	A&B	Articles, reading (about shopping).	Lecture and discussion	Assignments and Observation
4	**2**	A&B	Vocabulary: Shopping, prices.	Lecture and discussion	Observation and participation
5	**2**	**B&A**	Grammar: Verb patterns, making questions.	Lecture and problem-solving	Observation and participation
6	**2**		Mid-term Exam		
7	**2**	**B & C**	Future: Going to/will, practices, reading (Hollywood kids).	Lecture and discussion	Assignments and Observation
8	**2**	**A& C**	Grammar: hot verbs, listening, everyday English: how do you feel?.	Lecture and discussion	Presentation and Observation
9	**2**	**B & C**	Grammar: What ….. like? , Comparative and superlative	Lecture and problem-solving	Presentation

			adjectives big, bigger, practices.		
10	**2**	B	Vocabulary: Synonyms and antonyms.	Lecture and discussion	Assignments and Observation
11	**2**	D	everyday English about directions, listening and reading, and practices.	Lecture and discussion	Presentation
12	**2**	**A&B**	Present tense, simple present, present continuous, practices.	**Lecture and problem–solving**	Presentation and Observation
13	**2**	A &C	Grammar: for/ since, practices, questions.	**Lecture and problem–solving**	Assignments and Observation
14	**2**	**A& C**	Adverbs, word pairs, practices.	Lecture and discussion	Assignments and Observation
15	**2**	C&D	Everyday English about short answers (Question tags).	**Lecture and interrogation**	TEST

Course Evaluation
Written tests Participate Assignments and Observation
Learning and Teaching Resources
Required textbooks (Headway pre-intermediate plus student's book (john and Lize Soars))
Main references (sources)
Recommended books and references (Headway pre-intermediate plus work's book)
Websites

Stage 3 Course 1

Number of units	Number of hours				Course Type	Course Code	Name		ت
	total	discussion	Practical	theoretical					
3	4	1	__	3	Required section	CMOR23-F3111	Unconstrained Optimization (1)	امثلية غير مقيدة(1)	1
3	4	1	__	3	Required section	CMOR23-F3121	Stochastic Processes (1)	Practicalات تصادفية(1)	2
3	4	1	__	3	Required section	CMOR23-F3131	Fuzzy Logic (1)	منطق مضبب (1)	3
3	4	—	2	2	Faculty Elective	CMOR23-F3141	Intelligent Techniques (1)	تقنيات ذكائية (1)	4
2	3	1	__	2	Required section	CMOR23-F3151	Inventory Models (1)	نماذج الخزين (1)	5
2	3	1	__	2	Required section	CMOR23-F3161	Regression Analysis (1)	تحليل الانحدار (1)	6
2	3	1	__	2	Required section	CMOR23-F3171	Decision Theory	Theoreticalة القرارات	7
18	25	6	2	17	total				

Course Description Form

Course Name: Stochastic process(1)
Course Code: **CMOR23-F3121**
Semester / Year:1nd
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
Course administrator's name (mention all, if more than one name)
Name: Hind talaat Email: hindtalaat48@uomosul.edu.iq hind talaat48@uomosul.edu.iq
Course Objectives

Course Objectives Introducing the student to the stochastic process and characteristics • Enable the student to solve Markov chain models	• **Finding optimal strateg** • **How to build a competit model**

• Introducing the student to the simple and higher transit probability matrix • Introducing the student to the concept of primary distribut and solving illustrative examples of it • Introducing the student to the properties of Markov chains • Enable the student to classify Markov chains and their states. • Introducing the student to the stationary distribution of Mark chains and solving examples of it	**Market competition rule**

Teaching and Learning Strategies

A- Knowledge and understanding

A1- The student should know the stochastic process and mention its m prominent characteristics

A2- The student knows the Markov chain and cites an example that explains

A3- The student solves a Markov chain model

A4- The student should distinguish between the matrix of simple and high transitional probabilities

A5- The student should solve examples of the transitional probability matri

A6- State the characteristics of the Markov chain

A7- Find the stability distribution of the Markov chain

B - **Subject-specific skills**

B1 - To classify the given Markov chain

B2 - To classify the states of the Markov chain for the given transition matri

B3 - The student should test whether the given Markov chain has a sta distribution

C- Thinking skills

C1- The student solves a real-life problem using a Markov chain

C2- The student should compare the solution methods

C3- To rearrange the solution method

C4- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employabil and personal development).

D1- That the student implements the method used in the proof

D2- That the student improves the method used in the solution

D3- To verify the method

D4- Enabling the student to solve the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	4	A	Review of probability theory	Lecture and discussion	Assignments and Observation (H.W)
2	4	A	Definitions of stochastic processes .	Lecture and discussion	Assignments and Observation (H.W)

				Specification of Stochastic processes .		
	3	**4**	A&B	Examples of stochastic processes Properties of stochastic process	Lecture and discussion	Assignments and Observation (H.W)
	4	**4**	A&B	Markov Chain . Definition and examples of Markov Chain .	Lecture and problem solving	Written tests
	5	**4**	**B&A**	The one and m-steps transition probabilities . Transition probability matrix with examples . Complete proof for the theorem about specification of homogenous Markov chain by its transition probability and the initial distribution	Lecture and problem solving	Written tests
	6	**4**	**A & C**	ntroduction of Random walk Definition and examples of Random walk	Lecture and discussion	Assignments and Observation (H.W)
	7	**4**	**B & C**	**Mid-term Exam.** Higher transition probability .	Lecture and discussion	Assignments and Observation (H.W)
	8	**4**	**A& C**	Theorems for the n-th step transition matrix with two states (complete proof) Derivation of chapman -	Lecture and discussion	Assignments and Observation (H.W)

				kolmogrov equation .		
	9	**4**	**B & C**	nitial distribution Theorem about Prob. distribution of the system or process after n-step later. Examples of initial distribution	Lecture and problem solving	Presentation (power point)
	10	**4**	B	Transition Diagram & Transition Tree Classification of Chains accessible and communicate states with examples .	Lecture and discussion	Assignments and Observation (H.W)
	11	**4**	D	Properties of communicate states . rreducible chain , closed set of states absorbing state, rreducible and reducible chain Remarks	Lecture and Project	Project(Report)
	12	**4**	**A&B**	Examples of how to classify a Markov chain		
	13	**4**	A &C	Classification of States Definitions of First Passage and mean recurrence time Recurrent and Transient states Positive and null recurrent periodic and aperiodic	**Lecture and problem solving**	Assignments and Observation (H.W)

				states , Ergodic with examples . Remarks		
	14	**4**	**A& C**	Examples of how to classify states of a Markov chain	Lecture and discussion	Assignments and Observation (H.W)
	15	**4**	C&D	Stationary distribution of a Markov chain . Definition of stationary distribution and theorem and examples	**Lecture and interrogation**	TEST

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources)	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	www.gametheory.net

Course Description Form

Course Name: Fazzy logic
Course Code: **CMOR22-F3231**
Semester / Year:3nd
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
Course administrator's name (mention all, if more than one name)
Name: dr.neaam alfahady Email: neam.alfahady@uomosul.edu.iq
Course Objectives

Course Objectives: • his Course deals with the ba concept of fuzzy logic and classical. le the student to recognize fuzzy logic. ave a basic idea of why fuzzy logic is used ify the types of fuzzy functions, their representation in problems. rpreting some life problems and working on mak decisions and solving their problems	**Finding optimal strategies** **How to build a competitive mo** **Market competition rules**

Teaching and Learning Strategies
A- Knowledge and understanding A.1.Know the difference between fuzzy logic and classic ogic. A.2. An answer to the question: Why is fuzzy logic used? A.3. Recognize classic collections and distinctive functio A.4. Identify fuzzy sets and their properties. A.5 Identify organic functions and ways to represent hem. A.6. Identify the types of organic functions. **B - Subject-specific skills** B 1. Modeling life problems for decision making using unctions. B.2. To learn about operations in fuzzy sets. B.3. Solve problems using classical and fuzzy relationsh **C- Thinking skills** C.1. Use Cartesian multiplication for the fuzzy elationship.

C.2. The difference between operations in classical relations and operations in fuzzy relations

D - General and transferable skills (other skills related to employability and personal development

D.1 Know what mixed relationships are in fuzzy logic.

D.2- Dealing with fuzzy matrices.

D.3- Programming chapter topics in MATLAB

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	3	A	The concept of fuzzy logic and classical logic.	Lecture and discussion	Assignments and Observation (H.W)
2	3	A	Why is fuzzy logic used?	Lecture and discussion	Assignments and Observation (H.W)
3	3	A&B	Mystery collection and classic collections	Lecture and discussion	Assignments and Observation (H.W)
4	3	A&B	Membership function	Lecture and problem solving	Written tests
5	3	B&A	Fuzzy group	Lecture and problem solving	Written tests
6	3	A & C	Types of membership	Lecture and discussion	Assignments and Observation (H.W)
7	3	B & C	Operations in a fuzzy set.	Lecture and discussion	Assignments and Observation (H.W)
8	3	A& C	Classic and blurry relationships	Lecture and discussion	Assignments and Observation (H.W)
9	3	B & C	Cartesian multiplication of the fuzzy relation.	Lecture and problem solving	Presentation (power point)
10	3	B	Processes in classical relations and processes in fuzzy relations.	Lecture and discussion	Assignments and Observation (H.W)
11	3	D	Characteristics of classic and ambiguous relationships.	Lecture and Project	Project(Report)

	12	**3**	**A&B**	Mixed relations in fuzzy logic.	**exam**	**exam**
	13	**3**	A &C	Mysterious matrix	**Lecture and problem solving**	Assignments and Observation (H.W)
	14	**3**	**A& C**	Examples of arrays	Lecture and discussion	Assignments and Observation (H.W)
	15	**3**	C&D	A week of preparation before the final exam	**Lecture and interrogation**	TEST

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources)	Operation Research (2011) gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	www.gametheory.net

Course Description Form

Course Name: Intelligent Techniques (1)
Course Code: CMOR23-F3141
Semester / Year:First / 2024
Description Preparation Date: 1-4-2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total) 4/3
Course administrator's name (mention all, if more than one name)
Name: Assist.Prof.Dr.Niam Abdulmunim Abdulmajeed

Email: niam.munim@uomosul.edu.iq

Course Objectives

Course Objectives	Learn about the term artificial intelligence, its ba concepts, its components, and the various applicati t includes to solve many problems. This Course deals with research methods and search algorithms (or computer programs) that simulate human mental abilities or other behavioral patterns to give the computer the ability to learn and deduce situations that the machine has not learned. Learn about artificial intelligence algorithms (metaheuristics algorithms) and their applications o find the optimal solution in scientific and optimization research.

Teaching and Learning Strategies

Strategy	1. Knowledge in the field of artificial intelligence and intelligent technologies and their importance. 2. Employing intelligent technologies and artificial intelligence to serve society. 3. Introducing the applications of intelligent technologies. 4. Use search algorithms and intuitive and supra-intuitive algorithms. 5. The student graduates as Agent. Marathi output 6. Knowledge skills. 7. Memorization and analysis skills. 8. Skills for use and development. 9. Publishing research and participating in local and international conferences. 10. Participation in seminars and workshops. 11. Keeping pace with developments in the field of specialization. 12. Analysis of artificial intelligence technologies, benefits and challenges. 13. Enabling the student to write programs in artificial intelligence and its algorith solve problems, interpret results, and be able to make the optimal decision in us algorithms in operations research and optimization.

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4		Artificial Intelligence, basic definitions and concepts	Lecture, discussion and interrogation	written tests
2	4		Simon-Noel model, data, information and knowledge	Lecture, discussion and interrogation	written tests

3	4		epresenting knowledge by logic	Lecture, discussion and nterrogation	written tests
4	4		Logical deduction, semantic networks	Lecture, discussion and nterrogation	written tests
5	4		Search Methods Basic concepts with examples	Lecture, discussion and nterrogation	written tests
6	4		Water Jug Problem Problem 8-Puzzle	Lecture, discussion and nterrogation	written tests
7	4		Search Strategies Basic concepts	Lecture, discussion and nterrogation	written tests
8	4		Blind Search Algorithms – basic concepts Depth-First Search Algorithm – Basic concepts with examples Apply Depth-First search algorithm to 8-puzzle problem	Lecture, discussion and nterrogation	written tests
9	4		Breadth-First Search Algorithm – Basic concepts with examples	Lecture, discussion and nterrogation	written tests
10	4		Apply Breath-First search algorithm to 8-puzzle problem	Lecture, discussion and nterrogation	written tests
11	4		Heuristic Search Algorithms Hill Climbing Algorithm	Lecture, discussion and nterrogation	written tests
12	4		Apply Hill Climbing algorithm to 8-puzzle problem	Lecture, discussion and nterrogation	written tests
13	4		Best-First Search Algorithm Apply Best-First Search algorithm to 8-puzzle problem	Lecture, discussion and nterrogation	written tests
14	4		A^* Algorithm Game Playing algorithms MINIMAX Algorithm, Alpha-	Lecture, discussion and nterrogation	written tests

			Beta Pruning Algorithm		
15	4		A week of preparation before the final exam		

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W.)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	Lectures prepared by the lecturer
Main references (sources)	S.sumathi&Surekha P.,2010,Computational Intellige Paradigms Theory and Applications Us MATLAB,CRC Press.
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	https://www.youtube.com/watch?v=qv0iE8nmxRU

Course Description Form

Course Name: unconstrained optimization (1)
Course Code: CMOR23-F3111
Semester / Year:
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total) 4 Hours / 3 Units
Course administrator's name (mention all, if more than one name)
Name: Ghalya tawfeeq Basheer Email: ghalia.tawfeek@uomosl.edu.iq
Course Objectives

Providing the student with skills in solving unconstrain optimization problems with one variable using different methods	**Finding optimal strategi** **How to build a competit model** **Market competition rule**

Teaching and Learning Strategies
A- Knowledge and understanding A1- The student should mention the basic definitions A2-The student should write some optimization formulas A3- The student should describe the method A4- The student should distinguish between optimization methods A5- The student explains the mathematical formula of the method A6- The student should summarize the steps to solve the method **B - Subject-specific skills** B1 - The student applies the method to a numerical problem B2 - The student should reveal the error in the method. B3 - The student tabulates the results **C- Thinking skills** C1- That the student chooses the best method. C2-The student should compare the solution methods. C3- That the student converts the method and steps for solving the problem from one form to another. C4- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employabili
and
personal development).

D1- That the student can discover errors himself and solve them.
D2- That the student improves the method used in the solution
D3- Enabling the student to analyze the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	**4**	A	**Basic concepts**	Lecture and discussion	Observation
2	**4**	A	**Taylor' s series expansions necessary and sufficiency conditions**	Lecture and discussion	Observation
3	**4**	A&B	**Statement of an optimization problem**	Lecture and interrogation	(H.W)
4	**4**	A&B	**one variable unconstrained optimization problems**	Lecture problem solving	Written tests
5	**4**	B&C	**Concave and convex functions of one variable**	Lecture and discussion	Written tests
6	**4**	B&C	**Necessary and sufficient condition of one variable**	Lecture and discussion	Observation
7	**4**	B&C	**Dichotomous search method**	Lecture and discussion	Observation
8	**4**	B&C	**Interval halving method**	Lecture and discussion	Observation
9	**4**	A&B	**Fibonacci method**	Lecture and problem solving	Observation
10	**4**	B&C	**Golden section method**	Lecture and discussion	(H.W)
11	**4**	B	**Quadratic interpolation method**	Lecture and project	Observation

	12	**4**	D	**Cubic interpolation method**	Lecture and discussion	(H.W)
	13	**4**	A&B	**Newton's method**	Lecture and problem solving	Observation
	14	**4**	A&C	**Quasi newton method**	Lecture and discussion	Observation
	15	**4**	A&C	**Secant method**	Lecture and interrogation	TEST

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any) Operation Resea (2011) gupta	
Main references (sources) Engineering optimization theory a practice (2009) Rao	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	www.gametheory.net

Course Description Form

Course Name: Regression Analysis (1)
Course Code: **CMOR23-F3161**
Semester / Year: first Course
Description Preparation Date: 1/9/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total): 2
Course administrator's name (mention all, if more than one name)
Name: Salih Mooaed Shaker Email: salih.mooaed@uomosul.edu.iq
Course Objectives

Course Objectives	**Determine relationships between variables** **Estimate regression parameters** **Prediction of the estimated model** **Controlling dependent variables**
Teaching and Learning Strategies	
Strategy	1- Identify the concepts of regression analysis 2- Determine the analysis hypotheses 3- Data modeling and analysis using estimation methods 4- Characteristics of capabilities 5- Create a variance analysis table 6- Identify the formation of confidence limits and the path of the regression l 7- Identify the correlation coefficient and the coefficient of determination 8- Testing hypotheses and identifying deviations in analysis assumptions 9- Testing the extent to which the model matches the data 10- Testing homogeneity and independence of errors
Course Structure	

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3	1	Definition of regression analysis, uses and causal relationships	Lecture and discussi	watching
2	3	2	Analysis assumptions that must be met In the linear model	Lecture and discussi	watching
3	3	3 و4	Estimating regression parameters and the characteristics of capabiliti	Lecture and exercis	watching
4	3	5	Hypothesis testing and tabl Analysis of variance	Lecture and exercis	watching
5	3	6	Estimate confidence intervals.	Lecture and exercis	Oral exams
6	3	6	Regression through the ori	Lecture and exercis	watching
7	3	7	Coefficient of determinatio and correlation coefficient Simple and its characteristics	Lecture and exercis	watching
8	3	7	Correlation coefficient: its relationship to the regressi coefficient	Lecture and exercis	watching
9	3	8	Violations and defects in th analysis assumptions	Lecture and exercis	watching
10	3	8	Test whether the analysis hypotheses Generally available	Lecture and exercis	Written tests
11	3	9	Test whether the relationsh between... Variables X and y linear	Lecture and exercis	watching
12	3		Mid-Course exam		
13	3	9	Lack of fit test	Lecture and exercis	watching
14	3	10	Test whether the error variance Stable and homogeneous	Lecture and exercis	watching
15	3	10	Test whether the errors are independent	Lecture and exercis	watching

Course Evaluation	
Written tests the report Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	Al-Rawi, Khashi Mahmoud, 1987, Introduction Regression Analysis, University of Mosul, Iraq.
Main references (sources)	1-Draper, N. R. and Smith H. 1981. Applied Regress Analysis, 2nd.ED.

Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	https://www.Coursera.org/learn/predictive-modeling-model-fitting-regression-analysis

Course Description Form

Course Name: game theory
Course Code: CMOR23-F3171
Semester / Year:3 rd
. Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
. Course administrator's name (mention all, if more than one name)
Name: Zainab Qusay Ahmed Taqy ALOraibi Email: Zainab.q@uomosul.edu.iq
. Course Objectives

Course Objectives	**• Finding optimal strategie**
• To be able to speak English. • To be able to compose freely and independently in speech a writing. • To be able to read books with understanding	**• How to build a competit model** **• Market competition rules**

. Teaching and Learning Strategies
A- Speaking skill A1- He must have the ability to think and speak in English A2- The ability to speak English fluently A3- The ability to formulate sentences correctly **B - Reading skill** B1 - The ability to read sentences correctly B2 - Correct pronunciation of words. **C- Writing skill** C1- The ability to write sentences in English correctly The ability to express ideas through writing **D - Listening skills.** D1- Developing the student's listening skill D2-The ability to distinguish words while listening

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	**2**	A	Introduction: about study materials of Headway Pre-intermediate Plus.	Lecture and discussion	Assignments and Observation
2	**2**	A, B, D	Grammar: Have (got) to, practices.	Lecture and discussion	Assignments and Observation
3	**2**	A, B, D	Should/must, questions and answers. Reading.	Lecture and discussion	Assignments and Observation
4	**2**	A, B	Vocabulary: words that go together, everyday English at the doctor.	Lecture	Written tests
5	**2**	**A, D**	Grammar: verb patterns and infinitives, practices.	Lecture and problem-solving	Assignments and Observation
6	**2**	**A, D**	Time and conditional clauses, practices (when, as soon as). listening and speaking/ life in 2050.	Lecture and discussion	Assignments and Observation
7	**2**		Mid-term Exam		
8	**2**	**B, D**	Reading and speaking/ the world's first megalopolis.	Lecture and discussion	Assignments and Observation
9	**2**	**B, C**	Vocabulary: Hot verbs/ take- get- do and make.	Lecture and problem-solving	Assignments and Observation
10	**2**	B	Vocabulary: -ed/ -ing adjective,	Lecture and discussion	Assignments and Observation

				reading about (Into the wild).		
	11	**2**	**A, D**	Expressions about exclamations with so and such.	Lecture and discussion	Assignments and Observation
	12	**2**	**A, B**	Grammar: actives and passives voice, practices.		
	13	**2**	**A, C**	Verbs and nouns that go together, practices.	**Lecture and problem–solving**	Assignments and Observation
	14	**2**	**A, B**	Reading: about the discovery of DNA., expressions about(notices).	Lecture and discussion	Assignments and Observation
	15	**2**	**D, C**	Study material review	**Lecture**	Observation

. Course Evaluation	
Written tests Assignments and Observation (H.W)	
. Learning and Teaching Resources	
Required textbooks (Headway pre-intermediate plus student's bo (john and Lize Soars))	
Main references (Headway pre-intermediate plus work's book)	Operation Research (20 gupta
eferences (scientific journals, reports…)	
Websites https://7esl.com/ , https://worldenglishblog.com/hasnt-doesnt-have-pdf/	www.gametheory.net

Stage 3 Course 2

Numbers of Units	Numbers of Hours				Course Type	Course Code	Name		ت
	total	discussion	Practical	theoretical					
3	4	1	__	3	Required section	CMOR23-F3211	Unconstrained Optimization (2)	امثلية غير مقيدة(2)	1
3	4	1	__	3	Required section	CMOR23-F3221	Stochastic Processes (2)	Practicalات تصادفية(2)	2
3	4	1	__	3	Required section	CMOR23-F3231	Fuzzy Logic (2)	منطق مضبب (2)	3
3	4	—	2	2	Required section	CMOR23-F3241	Intelligent Techniques (2)	تقنيات ذكائية (2)	4
2	3	1	__	2	Department Elective	CMOR23-F3251	Inventory Models (2)	نماذج الخزين (2)	5
2	3	1	__	2	Department Elective	CMOR23-F3261	Regression Analysis (2)	تحليل الانحدار (2)	6
2	2	__	__	2		CMOR23-F3271	English Language (3)	لغة انكليزية (3)	7
18	24	5	2	17	total				

Course Description Form

. Course Name: Stochastic process(2)
. Course Code: **CMOR23-F3221**
. Semester / Year:2nd
. Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
. Course administrator's name (mention all, if more than one name)
Name: Hind talaat Email: hindtalaat48@uomosul.edu.iq hind talaat48@uomosul.edu.iq
. Course Objectives

Course Objectives	**Finding optim strategies**
Enable the student to solve Markov chains using MATLAB	

• Enable the student to solve the profit analysis problem and traveling salesman problem using the MATLAB program • Introducing the student to the counting process, the Poiss process, and its hypotheses • Enable the student to solve problems related to the Poiss process • Introducing the student to the distributions associated with Poisson process with proof • Introducing the student to the characteristics of the Poiss process with proofs • Enable the student to employ the characteristics of the Poiss process in solving various problems of this process. • Introducing the student to the heterogeneous Poisson process	• **How to build competitive model** • **Market competition ru**

. Teaching and Learning Strategies

A- Knowledge and understanding

A1- Write a program to calculate the transition matrix, solve the profit analy problem, or solve the traveling salesman problem

A2- That the student knows the counting process and mentions its m prominent characteristics

A3- The student should know the Poisson process and mention its m prominent characteristics

A4- The student should mention the distributions associated with the Poiss process

A5- To compare the structure of the Poisson process and the difference betwe two Poisson processes, whether they follow the Poisson distribution or not.

A6- The student should mention when the Poisson distribution is the Binor distribution

A7- Explain the nonhomogeneous Poisson process

B - Subject-specific skills

B1 - The student must prove the distribution mechanism of the Poisson proc

B2 - The student should solve problems related to the homogeneous a heterogeneous Poisson process

B3 - To prove that the time between the occurrence of two Poisson distribut events is distributed exponentially

B4- Prove that the waiting time follows a kamma distribution

C- Thinking skills

C1- The student solves a real-life problem using the Poisson distribution

C2- The student should compare the solution methods

C3- To rearrange the solution method

C4- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employabil and personal development).

D1- That the student implements the method used in the proof

D2- That the student improves the method used in the solution

D3- To verify the method

D4- Enabling the student to solve the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	4	A	Calculating the higher order transition matrix using MATLAB Calculate the initial distribution using MATLAB A program to compute a Markovian chain consisting of numbers A program to calculate a Markovian chain consisting of symbols Explain the topic of profit analysis and write a program to solve the problem	Lecture and discussion	Assignments and Observation (H.W)
2	4	A	Explain the subject of the traveling salesman problem and write a program for it Definition and examples about Counting Process	Lecture and discussion	\Assignments and Observation (H.W)
3	4	A&B	Poisson process . Assumption of Poisson Process. Derivation the P. d. f. of a Poisson process (complete proof) .	Lecture and discussion	Assignments and Observation (H.W)
4	4	A&B	Examples of Poisson Process	Lecture and problem solving	Written tests
5	4	B&A	Distributions Related with Poisson process Theorem about the interval time between two events of a Poisson process has	Lecture and problem solving	Written tests

			an exponential distribution (complete proof) .		
6	**4**	**A & C**	Theorem about the waiting time has gamma distribution (complete proof) .	Lecture and discussion	Assignments and Observation (H.W)
7	**4**	**B & C**	**Mid-term Exam** Properties of a Poisson process .	Lecture and discussion	Assignments and Observation (H.W)
8	**4**	**A& C**	Additive property (complete proof) . Difference of two independent Poisson process (complete proof)	Lecture and discussion	Assignments and Observation (H.W)
9	**4**	**B & C**	Decomposition of a Poisson process (complete proof)	Lecture and problem solving	Presentation (power point)
10	**4**	B	Poisson process and binomial distribution (with proof) .	Lecture and discussion	Assignments and Observation (H.W)
11	**4**	D	Examples about the Properties of a Poisson process	Lecture and Project	Project(Report)
12	**4**	**A&B**	Non –Homogeneous Poisson process. Exercises .		
13	**4**	A &C	Some special stochastic processes Bernoulli Process Examples about Bernoulli Process	**Lecture and problem solving**	Assignments and Observation (H.W)
14	**4**	**A& C**	Winer Process	Lecture and discussion	Assignments and

				Examples about Winer Process		Observation (H.W)
	15	**4**	C&D	**Preparatory week before the final Exam**	**Lecture and interrogation**	TEST

. Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
. Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources)	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	www.gametheory.net

Course Description Form

Course Name: Intelligent Techniques (2)	
Course Code: CMOR23-F3241	
Semester / Year: Second / 2024	
Description Preparation Date: : 1-4-2024	
Available Attendance Forms: : In presence	
Number of Credit Hours (Total) / Number of Units (Total) 4/3	
Course administrator's name (mention all, if more than one name)	
Name: Assist.Prof.Dr.Niam Abdulmunim Abdulmajeed Email: niam.munim@uomosul.edu.iq	
Course Objectives	
Course Objectives	1-Learn about algorithms inspired by nature, ncluding evolutionary algorithms, swarm ntelligence, basic concepts and components, and

	he various applications they contain to solve many problems. 2- This Course deals with the genetic algorithm, its components, particle swarm optimization, and basic concepts. 3- Employing genetic algorithm, particle swarm optimization, and applications to find the optimal solution in optimization and operation research.

Teaching and Learning Strategies

Strategy	1. Knowledge in the field of intelligent techniques and algorithms. 2. Employing intelligent techniques to serve society. 3. The student has knowledge of individual intelligent agents for modeling industrial, social, and biological systems. 4. Use evolutionary algorithms and heuristic and metaheuristic algorithms. 5. The student graduates as Agent. 6. Knowledge of modeling evolutionary algorithmic agents and social swarm intelligence agents in complex designs and problems. 7. Knowledge of evolutionary algorithms and swarm intelligence inspired by different natural systems. 8. The student has skills in using and developing intelligent individual agents to solve optimization problems with complex structures. 9. The student has skills in developing simulation models based on swarms of intelligent agents or agents. 10. Skills in using evolutionary algorithms (genetic algorithm) and swarm intelligence algorithms to solve operations research problems and real optimization problems

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4		Evolutionary algorithms - definition of evolutionary algorithms, concept of genetic algorithm, idea of genetic algorithm, basic (biological) terms of genetic algorithm, basic steps of genetic algorithm, flow chart	Lecture, discussion and interrogation	written tests
2	4		Elements of genetic algorithm, encoding	Lecture, discussion and interrogation	written tests

			and its types with examples		
3	4		Fitness Function with examples	Lecture, discussion and interrogation	written tests
4	4		Selection and selection methods with examples	Lecture, discussion and interrogation	written tests
5	4		Crossover and its types with examples	Lecture, discussion and interrogation	written tests
6	4		Mutation and its types with examples, stopping measures	Lecture, discussion and interrogation	written tests
7	4		Applications and examples of genetic algorithm in operations research and optimization	Lecture, discussion and interrogation	written tests
8	4		Swarm Intelligence – basic concepts, idea of swarm intelligence, historical development of swarm intelligence	Lecture, discussion and interrogation	written tests
9	4		Principles of collective behavior in swarms, types of swarm intelligence	Lecture, discussion and interrogation	written tests
10	4		Particle swarm optimization algorithm – definitions, idea of PSO	Lecture, discussion and interrogation	written tests
11	4		Advantages, disadvantages and applications of particle swarm optimization algorithm	Lecture, discussion and interrogation	written tests
12	4		Basic components of the particle swarm optimization algorithm, basic concepts of the particle swarm optimization algorithm	Lecture, discussion and interrogation	written tests
13	4		Parameters of the particle swarm optimization algorithm Basic steps and flowchart of particle swarm optimization algorithm	Lecture, discussion and interrogation	written tests

14	4		Applications and problems in operations research and optimization	Lecture, discussion and interrogation	written tests
15	4		A week of preparation before the final exam		

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W.)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any	Lectures prepared by the lecturer
Main references (sources)	Xin-She Yang,2020, Nature-Inspired Optimizat Algorithms, Second edition, Elsevier.
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	https://www.youtube.com/watch?v=wQm9mFw02mU

Course Description Form

. Course Name: Queuing theory (2)
. Course Code: **CMOR23-F4221**
. Semester 2 / 2024
. Description Preparation Date:1/4/2024
Available Attendance Forms: In presence
Number of Credit Hours (4) / Number of Units (3)
. Course administrator's name (mention all, if more than one name)
Name: Asst. Prof. Dr. Ghazwan Hani Mahmood Em ghazwan.alsoufi@uomosul.edu.iq Name: Dr. Oday Abdulrahman Jarjies Email: odayjarjies@uomosul.edu
. Course Objectives

To develop problem solving skills and an understanding of queuing theory through applying formulas to solve some examples. **To recognize different kind of queuing models.**	**Find optimal strategies**

To understand the efficiency metrics for different types of queuing models. **To analysis some the queuing models.** **To perform some the queuing models.** **This is the advance subject for all types of queuing models.**	**How to buil competitive model** **Market competition rules**

. Teaching and Learning Strategies

A- Knowledge and understanding
A1- The student should mention the previous laws
A2- The student should write some terms
A3- The student should describe the model
A4- The student should distinguish between the models
A5- The student explains the mathematical formula
A6- The student summarizes the steps to solve the mathematical formula
B - Subject-specific skills
B1 - The student applies the model to a real situation
B2 - The student must reveal the error in the form.
B3 - The student tabulates the results

C- Thinking skills
C1- The student poses a problem based on reality
C2- The student should compare the solution methods
C3- To rearrange the solution method
C4- To plan how to use the appropriate method in the solution
D - General and transferable skills (other skills related to employability and personal development).
D1- That the student implements the method used by the proof
D2- That the student improves the method used in the solution
D3- Verify the method
D4- Enabling the student to solve the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	4	A	Differential-Difference equations of (M/M/C) :(GD/∞/∞) Model.	Lecture and discussion	Assignments and Observation (H.W)
2	4	A	Probability distribution of Pn.	Lecture and discussion	Assignments and Observation (H.W)
3	4	A&B	Expected number of units in queue and system.	Lecture and discussion	Assignments and

					Observation (H.W)
4	4	A&B	Waiting time distribution in queue and system.	Lecture and problem solving	Written tests
5	4	B&A	Numerical examples.	Lecture and problem solving	Written tests
6	4	A & C	Differential-Difference equations of (M/M/C) :(GD/N/∞) Model.	Lecture and discussion	Assignments and Observation (H.W)
7	4	B & C	Probability distribution of Pn and expected number of units in queue and system.	Lecture and discussion	Assignments and Observation (H.W)
8	4	A& C	Waiting time distribution in queue and system.	Lecture and discussion	Assignments and Observation (H.W)
9	4	B & C	Numerical examples.	Lecture and problem solving	Presentation (power point)
10	4	B	Probability distribution of Pn for (M/M/1) :(GD/∞/N) Model	Lecture and discussion	Assignments and Observation (H.W)
11	4	D	Expected number of units and waiting time in queue and system.	Lecture and Project	Project(Report)
12	4	A&B	Numerical examples.		
13	4	A &C	Probability distribution of Pn for (M/M/C):(GD/N/N) Model and expected number of units for model.	Lecture and problem solving	Assignments and Observation (H.W)
14	4	A& C	Waiting time in queue and system and numerical examples.	Lecture and discussion	Assignments and Observation (H.W)
15	4	C&D	Probability distribution of Pn for (M/M/∞) :(GD/∞/∞) Model and	Lecture and interrogation	TEST

				Numerical example.		

. Course Evaluation		
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)		
. Learning and Teaching Resources		
Required textbooks (curricular books, if any)		
Main references (sources)	**- جزاع، عبد ذياب. (1986). بحوث الPracticalات. وزارة التعليم العالي، جامعة بغداد. الطبعة الثانية.** **2- الشمرتي، حامد سعد نور. والزبيدي، خليل. (2007). مدخل الى بح الPracticalات. المملكة الاردنية الهاشـ دار مجدلاوي للنشر والتوز**	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…)	1- Adan, I., & Resing, J. (2002). Queueing theory. 2- Sztrik, János, (2012). Basic queueing theory. *University of Debrecen, Faculty of Informatics*	
Electronic References, Websites	https://samehar.files.wordpress.co 2022/03/queueing-theory-1.pdf	www.gamethe y.net

Course Description Form

Course Name: unconstrained optimization (2)
Course Code: CMOR23-F3211
Semester / Year:2nd
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total) 4 Hours / 3 Units
Course administrator's name (mention all, if more than one name)
Name: Ghalya tawfeeq Basheer Email: ghalia.tawfeek@uomosl.edu.iq

Course Objectives

Providing the student with skills in solving unconstrain multivariate optimization problems using different methods

Finding optimal strategi
How to build a competit model
Market competition rule

Teaching and Learning Strategies

A- Knowledge and understanding
A1- The student should mention the basic definitions
A2-The student should write some optimization formulas
A3- The student should describe the method
A4- The student should distinguish between optimization methods
A5- The student explains the mathematical formula of the method
A6- The student should summarize the steps to solve the method
B - Subject-specific skills
B1 - The student applies the method to a numerical problem
B2 - The student should reveal the error in the method.
B3 - The student tabulates the results

C- Thinking skills
C1- That the student chooses the best method.
C2-The student should compare the solution methods.
C3- That the student converts the method and steps for solving the problem from one form to another.
C4- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employabilit and personal development).
D1- That the student can discover errors himself and solve them.
D2- That the student improves the method used in the solution
D3- Enabling the student to analyze the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	**4**	A	**Multivariable unconstrained optimization**	Lecture and discussion	Observation
2	**4**	A	**Basic concepts**	Lecture and discussion	Observation
3	**4**	A&B	**Necessary and sufficient condition of Multivariable unconstrained optimization**	Lecture and interrogation	(H.W)

	4	**4**	A&B	**Concave and convex of Multivariable unconstrained optimization**	Lecture problem solving	Written tests
	5	**4**	B&C	**rth differential of function**	Lecture and discussion	Written tests
	6	**4**	B&C	**Taylor's method**	Lecture and discussion	Observation
	7	**4**	B&C	**Steepest descent method**	Lecture and discussion	Observation
	8	**4**	B&C	**Conjugate gradient method (FR)**	Lecture and discussion	Observation
	9	**4**	A&B	**Conjugate gradient method (HS)**	Lecture and problem solving	Observation
	10	**4**	B&C	**Conjugate gradient method (PR)**	Lecture and discussion	(H.W)
	11	**4**	B	**Newton's method**	Lecture and project	Observation
	12	**4**	D	**Marquardt method**	Lecture and discussion	(H.W)
	13	**4**	A&B	**Quasi newton method**	Lecture and problem solving	Observation
	14	**4**	A&C	**Davidon-Fletcher-Powell method**	Lecture and discussion	Observation
	15	**4**	A&C	**Broyden-Fletcher-Goldfarb-shanno method**	Lecture and interrogation	TEST

Course Evaluation
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)
Learning and Teaching Resources
Required textbooks (curricular books, if any) Operation Resea (2011) gupta

Main references (sources) Engineering optimization theory a practice (2009) Rao	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	www.gametheory.net

Course Description Form

. Course Name: Decision Theory
. Course Code: CMOR23-F3271
.
. Semester / Year: 3nd
. Description Preparation Date:10/04/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total) 3/2
. Course administrator's name (mention all, if more than one name)
Name: dr.Zahraa Abed Al-Aziz Al-nuaimi Email: zahraaalnuaimi2017@uomosul.edu.iq Name: Neam Hazim Ahmed Email: neam.alfahady@uomosul.edu.iq
. Course Objectives

Course Objectives	**1- Identify decision theory and its uses in real life** **2- Identify the criteria used to determine the optimal decision** **3- The student learns how to distinguish between the best criteria for decision-making** **4- The student learns about the concept of investment portfolios and what they mean**

. Teaching and Learning Strategies

Strategy	A: Knowledge and understanding 1a- The student learns to distinguish between the best criteria for makin decision 2a- The student learns to distinguish between different standards after try more than one standard

	3a- The student learns that he must take more than one criterion and then ma he decision that gives the same results in two or more criteria 4a- The student learns about the criteria that are preferable to use in the case profit as well as in the case of loss and determines the optimal decision 3- Subject-specific skills 1b- The student learns about the concept of expected value and how to ben from this concept in decision making 2 The student learns to make use of definite integration in finding the expec expected value and thus determining the optimal decision 3b-The student will be able to deal with different issues in terms determining the optimal decision for each case C- Thinking skills 1c- The student learns to apply the standards he has learned to a realistic iss 2c-The student solves this problem and determines the optimal decision D - General and transferable skills (other skills related to employability and personal development). D1- That the student implements the standards D2- Choose the best standard D3- Analyze the results D4- Giving the final decision

Course Structure					
Week	**Hours**	**Required Learning Outcomes**	**Unit or subject name**	**Learning method**	**Evaluation method**
1	3	A	Basic elements in decision making	Lecture a discussion	Lecture and discussion
2	3	A	States of nature	Lecture a discussion	Lecture and discussion
3	3	A&B	Decision or parts, val function and utility function table and uti table	Lecture a discussion	Lecture and discussion
4	3	A&B	The function of remo or regret and the table remorse and regret	Lecture and probl solving	Lecture and problem solving
5	3	**B&A**	Returns table	Lecture and probl solving	Lecture and problem solving
6	3	**A & C**	Characteristics of decision-making situations	Lecture a discussion	Lecture and discussion
7	3	**B & C**	Decision making criteria in case of uncertainty	Lecture a discussion	Lecture and discussion
8	3	**A& C**	Optimistic criterion, pessimistic criterion, Laplace criterion	Lecture a discussion	Lecture and discussion
9	3	**B & C**	Missed opportunitie regret standard, Hrouz standard	Lecture and problem solving	Presentation (power point)
10	3	B	Decision making criteria	Lecture a discussion	Assignments and Observation (H.W)
11	3	D	Mid-Course exam		
12	3	**A&B**	Standard expected value and variance	Lecture and Project	Project(Report)
13	3	A &C	Most likely probability criterion	**Lecture and probl solving**	Assignments and Observation (H.W)
14	3	**A& C**	Complete information standard	Lecture a discussion	Assignments and Observation (H.W)
15	3	C&D	Investment portfolio	**Lecture a nterrogation**	TEST
. Course Evaluation					

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)

. Learning and Teaching Resources	
Required textbooks (curricular books, if any	Theoretical دار الكتب للطباعة والنشر. جامعه الموصل 1994 د.قيس سعيد عبد الفتاح. ة القرار
Main references (sources)	محاضرات في مادة اتخاذ القرار د. دلفوف سفيان . كلية العلوم الاقتصادية والتجارية وعلوم التيسير . قسم العلوم الاقتصادية . الجزائر . 2022/2021
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	http://www.aspu.edu.sy/laravel . Pdf.

Course Description Form

. Course Name: Regression Analysis (2)	
. Course Code: **CMOR23-F3261**	
. Semester / Year: Second Course	
. Description Preparation Date: 1/4/2024	
Available Attendance Forms: In presence	
Number of Credit Hours (Total) / Number of Units (Total): 2	
. Course administrator's name (mention all, if more than one name)	
Name: Salih Mooaed Shaker Email: salih.mooaed@uomosul.edu.iq	
. Course Objectives	
Course Objectives	**1-Define the multiple linear regression model** **2- Estimating regression parameters for multiple model** **3-Additional sum of squares control** **4-Methods for choosing the best regress equation**

. Teaching and Learning Strategies	
Strategy	1- Define the linear model 2- Parameter estimation, properties of estimators 3- Create a variance analysis table 4- Identify the multiple partial correlation coefficient and the standard par regression coefficient 5- Find the additional sum of squares 6- Methods for choosing the best regression equation 7- Significant or expressive variables 8- The case of a qualitative independent variable 9- Other multivariate methods 10- Path analysis

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3	1	**Matrices, linear model**	Lecture and discussi	watching
2	3	2	**Parameter estimation, properties of estimators**	Lecture and discussi	watching
3	3	3	**Analysis of variance tabl**	Lecture and exercise	watching
4	3	4	**Partial multiple correlati coefficient And the standard partial regressi coefficient**	Lecture and exercise	watching
5	3	5	**Additional sum of squares And the coefficient of partial determination**	Lecture and exercise	Oral exams
6	3	6	**Choose the best equation Regression using several criteria**	Lecture and exercise	watching
7	3	6	**Backword deletion meth**	Lecture and exercise	watching
8	3	6	**Forward deletion method**	Lecture and exercise	watching
9	3	6	**Stepwise regression meth**	Lecture and exercise	watching
10	3	3	**Significant or expressive variables**	Lecture and exercise	Written tests
11	3		**Mid Exame**		
12	3	7	**The general concept of function variables, in Th**	Lecture and exercise	watching

			condition of having one qualitative independent variable In the regression equati		
13	3	9	**Some other methods are multiple Variables, principal components analysis**	Lecture and exercis	watching
14	3	10	**Path analysis**	Lecture and exercis	watching

. Course Evaluation	
Written tests the report Assignments and Observation (H.W)	
. Learning and Teaching Resources	
Required textbooks (curricular books, if any)	Al-Rawi, Khashi Mahmoud, 1987, Introduction Regression Analysis, University of Mosul, Iraq.
Main references (sources)	1-Draper, N. R. and Smith H. 1981. Applied Regress Analysis, 2nd.ED.
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	https://www.Coursera.org/learn/predictive-modeling-model-fitting-regression-analysis

Course Description Form

Course Name: Fazzy logic
Course Code: **CMOR22-F3231**
Semester 2/ Year:3nd
Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
Course administrator's name (mention all, if more than one name)
Name: dr.neaam alfahady Email: neam.alfahady@uomosul.edu.iq
Course Objectives

Course Objectives:

This Course deals with the basic concept of the properties of fuzzy lo and the fuzzy number

- Enable the student to recognize and use the mysterious number.
- Have a basic idea about using the fuzzy number in real life.
- Identify the types of ambiguous rules in MATLAB, how to use them, a make the appropriate decision

- **Finding optir strategies**
- **How to build competitive model**
- **Market competitic rules**

Teaching and Learning Strategies

A- Knowledge and understanding

A.1. Identify the properties of fuzzy sets
A.2. Convex fuzzy logic test
A.3. Learn about the concept of fuzzy numbers
A.4. Knowledge of mysterious period processes
A.5. Know the properties of arithmetic operations in closed periods

B - Subject-specific skills

B 1. Testing the interval of a truncated fuzzy number in the form α.
B.2. Knowledge of fuzzy number operations
B.3. Programming fuzzy numbers in MATLAB

C- Thinking skills

C.1. Know the use of rounding mysterious triangle numbers
C.2. Recognizing fuzzy and classical rules
C.3. To apply the rules of fuzzy logic
C.4 Using a fuzzy inference system

D - General and transferable skills (other skills related to employability and personal development).

D.1. Using fuzzy logic rules in MATLAB to program chapter topics in MATLAB
D.2. Fuzzy logic programming in MATLAB

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	
1	3	A	Properties of fuzzy sets	Lecture and discussion	As
2	3	A	Convex fuzzy logic	Lecture and discussion	ar
3	3	A&B	Fuzzy number concept	Lecture and discussion	As
4	3	A&B	Play time lapse	Lecture and problem solving	W

	5	**3**	**B&A**	Exam	Lecture and problem solving		Written tests
	6	**3**	**A & C**	Characteristics of arithmetic operations in closed periods	Lecture and discussion		Assignments and Observation (H.W)
	7	**3**	**B & C**	α-cut interval fuzzy number	Lecture and discussion		Assignments and Observation (H.W)
	8	**3**	**A& C**	Play fuzzy number	Lecture and discussion		Assignments and Observation (H.W)
	9	**3**	**B & C**	Fuzzy triple number	Lecture and problem solving		Presentation (power point)
	10	**3**	B	Playing fuzzy ternary number	Lecture and discussion		Assignments and Observation (H.W)
	11	**3**	D	Approximation of a fuzzy triangular number	Lecture and Project		Project(Report)
	12	**3**	**A&B**	Classic and fuzzy rules	**exam**		**exam**
	13	**3**	A &C	Fuzzy logical reasoning	**Lecture and problem solving**		Assignments and Observation (H.W)
	14	**3**	**A& C**	Fuzzy logic rules in matlab	Lecture and discussion		Assignments and Observation (H.W)
	15	**3**	C&D	Exam	**Lecture and interrogation**		TEST

Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources)	Operation Resea (2011) gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	www.gametheory.n

Stage 4 Course 1

Number of units	Number of hours				Course Type	Course Code	Name		ت
	total	discussion	Practical	Theoretical					
3	4	1	—	3	Required section	CMOR23-F4111	Constrained Optimization (1)	امثلية مقيدة (1)	1
3	4	1	—	3	Required section	CMOR23-F4121	Queuing Theory (1)	Theoretical الطوبير(1)	2
3	4	1	—	3	Required section	CMOR23-F4131	Neural Networks (1)	شبكات عصبية(1)	3
3	4	—	2	2	Required section	CMOR23-F4141	Modeling	نمذجة	4
2	3	1	—	2	Department Elective	CMOR23-F4151	Pattern Recognition	تمييز الانماط	5
2	3	1	—	2	Department Elective	CMOR23-F4161	Reliability Theory	Theoretical المعولية	6
2	2	—	—	2	Faculty Mandatory Course	CMOR23-F4171	Scientific Search Method	منهج البحث العلمي	
18	24	5	2	17	total				

Course Description Form

. Course Name: Modeling
. Course Code: **CMOR23-F4141**
. Semester / Year:1nd
. Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total)4 / Number of Units (Total)3
. Course administrator's name (mention all, if more than one name)
Name: asmaa abdulmunem abdullah Email: asmaa.abd@uomosul.edu.iq
. Course Objectives

Course Objectives	Finding optir strategies How to build competitive model Market competitio rules

. Teaching and Learning Strategies

A- Knowledge and understanding
A1- To enable the student to understand the subject of modeling
A2- The goal of the modeling Course is to introduce the student to mathematic
modeling and how to build the model using differential and differential
equations
and practical applications on them.

B - Subject-specific skills
B1 - The student applies the model to a real situation

B2 - The student should be able to solve the model mathematically

C- Thinking skills
C1- The student takes a problem from reality
C2- The student should compare the methods of solving
differential equations and differential equations for the same problem
C3- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employability and personal development).
D1- The student should improve the method used in the solution
D2- The student should improve the method used in the solution
D3- To verify the method

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	4	A	An introductory introduction to models, types of models – scientific modeling,	Lecture and discussion	Assignments and Observation (H.W)

				components of the model – types of models,		
	2	4	A	mathematical modeling – classification of mathematical models	Lecture and discussion	Assignments and Observation (H.W)
	3	4	A&B	Stages of building a mathematical model, using differential equations in building population models	Lecture and discussion	Assignments and Observation (H.W)
	4	4	A&B	Modeling change using difference equations, sequences	Lecture and problem solving	Written tests
	5	4	B&A	An easy model for modeling change – various examples, difference equations	Lecture and problem solving	Written tests
	6	4	A & C	Solving difference equations – examples, case studies in deterministic modeling of change	Lecture and discussion	Assignments and Observation (H.W)
	7	4	B & C	Modeling Newton's law of cooling,	Lecture and discussion	Assignments and Observation (H.W)

	8	**4**	**A& C**	**modeling savings certificates**	Lecture and discussion	Assignments and Observation (H.W)
	9	**4**	**B & C**	**Modeling the decay of radium and its half–life**	Lecture and problem solving	Presentation (power point)
	10	**4**	B	**, modeling digoxin in the blood**	Lecture and discussion	Assignments and Observation (H.W)
	11	**4**	D	**Exam**	Lecture and Project	Project(Report)
	12	**4**	**A&B**	**Logistic model with applications, growth in a cetacean community,**		
	13	**4**	A &C	**modeling the relationship between two animal communities**	**Lecture and problem solving**	Assignments and Observation (H.W)
	14	**4**	**A& C**	**modeling the relationship between two animal communities**	Lecture and discussion	Assignments and Observation (H.W)
	15	**4**	C&D	**Exam**	**Lecture and interrogation**	TEST

. Course Evaluation

Written tests
Project(Report)
Presentation (power point)
Assignments and Observation (H.W)

. Learning and Teaching Resources

Required textbooks (curricular books, if any) **خل الى النمذجة الرياضية** **الجزء الاول)matlbبأستخدام ال (** **الجزء الثاني)matlbمدخل الى النمذجة الرياضية بأستخدام ال (** **تأليف : الاستاذ الدكتور باسل يونس ذنون**	
Main references (sources): Modeling and simulation	Operation Resea (2011) gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websit https://www.arageek.com/l/%d8%a7%d9%84%d9%86%d9%85% d8%b0%d8%ac%d8%a9- %d9%88%d8%a7%d9%84%d9%85%d8%ad%d8%a7%d9%83%d8%a %d8	www.gametheory.ne

Course Description Form

. Course Name: Pattern Recognition
. Course Code: CMOR23-F4151
. Semester / Year: 4nd
. Description Preparation Date:10/04/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total) 3/2
. Course administrator's name (mention all, if more than one name)
Name: dr.Zahraa Abed Al-Aziz Al-nuaimi Email: zahraaalnuaimi2017@uomosul.edu.iq Name: Neam Hazim Ahmed Email: neam.alfahady@uomosul.edu.iq
. Course Objectives

Course Objectives	Recognizing the topic of pattern recognition. dentifying the areas in which the topic of pattern ecognition applies.

	The student learns to link between probability theory and calculus, and recognizing patterns. The student becomes familiar with the concept of distance and its use in pattern recognition. The student becomes familiar with the concept of classification and its types. The student becomes familiar with the topic of clustering and its methods. The student becomes familiar with decision trees and their divisions. Finding the ranks for the tree.
. Teaching and Learning Strategies	
Strategy	A: Knowledge and understanding 1A- The student learns how to use probability theory, differentiation, and integration to find the expected value. 2A- And the student learns to find the variance and covariance matrix and the relationship between them. 3A- The student learns how to use matrices in pattern recognition. 4A-The student becomes acquainted with the concept of classification and its types. B- Subject-specific skills 1B- The student becomes familiar with the concept of eigenvectors, eigenvalues, and the quadratic form. 2B- The student learns about distances and their types, and how to utilize them in pattern recognition. 3B- The student learns to use Bayesian theory in classification as well as the Fisher technique used in classification. 4B- The student becomes acquainted with decision trees, their types, and their uses in pattern recognition. C- Thinking skills 1CThe student learns how to determine the optimal method for classification. 2C- The student applies classification methods to real-world problems. 3C- The student learns clustering, its methods, and how to use it in classification.

	4C- The student learns decision trees, their divisions, and how to find the best tree D - General and transferable skills (other skills related to employability and personal development). 1D- The student executes various classification methods. 2D- The student executes clustering methods. 3D- The student writes a computer program to calculate distances and clustering. D4- Providing the final classification.

Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3	A	Formulating pattern recognition problems:	Lecture a discussion	Lecture and discussion
2	3	A	Main categories of pattern recognition problems: Decision recognition problems Automatic pattern recognition systems	Lecture a discussion	Lecture and discussion
3	3	A&B	Random vectors and th distributions, quadratic formulas,	Lecture a discussion	Lecture and discussion
4	3	A&B	multivariate normal distribution,	Lecture and probl solving	Lecture and problem solving
5	3	**B&A**	linear transformation.	Lecture and probl solving	Lecture and problem solving
6	3	**A & C**	Properties of eigenvalues and eigenvectors,.	Lecture a discussion	Lecture and discussion
7	3	**B & C**	Bayes classifier, Fisher classifier	Lecture a discussion	Lecture and discussion
8	3	**A& C**	Parametric classifiers, non-parametric classifiers.	Lecture a discussion	Lecture and discussion

9	3	**B & C**	Dissimilarity measure, hierarchical methods.	Lecture and problem solving	Presentation (power point)
10	3	B	Single-linkage Complete linkage	Lecture a discussion	Assignments and Observation (H.W)
11	3	D	Mid-Course exam		
12	3	**A&B**	Decision tree algorithm types of decision trees	Lecture and Project	Project(Report)
13	3	A ,C&D	split criterion, secondary splits categorical variables	**Lecture and probl solving**	Assignments and Observation (H.W)
14	3	**A& C**	recording splits continuous response variable	Lecture a discussion	Assignments and Observation (H.W)
15	3	C&D	determining the best decision tree, determining the best classification method.	**Lecture a nterrogation**	TEST

. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

Written tests
Project(Report)
Presentation (power point)
Assignments and Observation (H.W)

. Learning and Teaching Resources

Required textbooks (curricular books, if any)	
Main references (sources)	1-Andrew R Webb," Statistical Pattern recognition" second edition, John Wiley and Sons, LTD 2002 2- J.P.Marques de sa, "Pattern Recognition" Concepts, Methods and Applications, 2001 3- Keinosuke Fukunaga "Introduction to Statistical Pattern Recognition" Second Edition Academic Press, New York, 1999 4-Richard O.Duda, Peter E.Hart and David G.Strok,"Pattern Classification" Second Edition WWW.edition , 2007 5- Pattern Recognition and Classification. An Introduction . Geoff Doughety .Springer.2013 6- Essential of Pattern Recognition. Jianxin Nanjing University. China 2020

Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	http://www.pattern recobnition . Pdf.

Course Description Form

. Course Name: Queuing theory (1)
. Course Code: **CMOR23-F4121**
. Semester 1 / 2024
. Description Preparation Date:1/4/2024
Available Attendance Forms: In presence
Number of Credit Hours (4) / Number of Units (3)
. Course administrator's name (mention all, if more than one name)
Name: Asst. Prof. Dr. Ghazwan Hani Mahmood Em ghazwan.alsoufi@uomosul.edu.iq Name: Dr. Oday Abdulrahman Jarjies Email: odayjarjies@uomosul.edu
. Course Objectives
Introduce the queuing theory. **To recognize the properties of queuing models.** **To understand the efficiency metrics of queuing models.** **To recognize the types of queuing models and Kendall's notation.** **To realize pure birth and death process.** **This Course deals with two different models of queuing theory.** **This is the basic subject for all types of queuing models.** **To develop problem solving skills and an understanding of queuing theory through applying formulas to solve some examples.** **• Finding optin strategies** **• How to build competitive model** **• Market competition rules**
. Teaching and Learning Strategies
A- Knowledge and understanding A1- The student should mention the previous laws A2- The student should write some terms A3- The student should describe the model A4- The student should distinguish between the models A5- The student explains the mathematical formula A6- The student summarizes the steps to solve the mathematical formula **B - Subject-specific skills** B1 - The student applies the model to a real situation B2 - The student must reveal the error in the form. B3 - The student tabulates the results

C- Thinking skills
C1- The student poses a problem based on reality
C2- The student should compare the solution methods
C3- To rearrange the solution method
C4- To plan how to use the appropriate method in the solution
D - General and transferable skills (other skills related to employability and personal development).
D1- That the student implements the method used by the proof
D2- That the student improves the method used in the solution
D3- Verify the method
D4- Enabling the student to solve the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	4	A	The properties of queuing models.	Lecture and discussion	Assignments and Observation (H.W)
2	4	A	The efficiency metrics of queuing models.	Lecture and discussion	Assignments and Observation (H.W)
3	4	A&B	Types of queuing models and Kendall's notation.	Lecture and discussion	Assignments and Observation (H.W)
4	4	A&B	Arrival process.	Lecture and problem solving	Written tests
5	4	B&A	Departure process.	Lecture and problem solving	Written tests
6	4	A & C	Differential-Difference equations of (M/M/1) :(GD/∞ / ∞) Model.	Lecture and discussion	Assignments and Observation (H.W)
7	4	B & C	Probability distribution of Pn.	Lecture and discussion	Assignments and Observation (H.W)
8	4	A& C	Expected number of units in queue and system.	Lecture and discussion	Assignments and Observation (H.W)

	9	**4**	**B & C**	**Expected waiting time in queue and system.**	**Lecture and problem solving**	**Presentation (power point)**
	10	**4**	**B**	**Numerical examples.**	**Lecture and discussion**	**Assignments and Observation (H.W)**
	11	**4**	**D**	**Differential-Difference equations of (M/M/1) :(GD/N/ ∞) Model.**	**Lecture and Project**	**Project(Report)**
	12	**4**	**A&B**	**Probability distribution of Pn.**		
	13	**4**	**A &C**	**Expected number of units in queue and system.**	**Lecture and problem solving**	**Assignments and Observation (H.W)**
	14	**4**	**A& C**	**Waiting time distribution in queue and system.**	**Lecture and discussion**	**Assignments and Observation (H.W)**
	15	**4**	**C&D**	**Numerical examples.**	**Lecture and interrogation**	**TEST**

. Course Evaluation

Written tests
Project(Report)
Presentation (power point)
Assignments and Observation (H.W)

. Learning and Teaching Resources

Required textbooks (curricular books, if an		
Main references (sources)	- جزاع، عبد ذياب. (1986). بحوث الPracticalات. وزارة التعليم العالي، جامعة بغداد. الطبعة الثانية. 2- الشمرتي، حامد سعد نور. والزبيدي، خليل. (2007). مدخل الى بح الPracticalات. المملكة الاردنية الهاشم دار مجدلاوي للنشر والتوز	Operation Research (20 gupta
Recommended books and references (scientific journals, reports…)	1- Adan, I., & Resing, J. (2002). Queueing theory. 2- Sztrik, János, (2012). Basic queueing theory. *University of Debrecen, Faculty of Informatics*	

Electronic References, Websites	https://samehar.files.wordpress.com/2022/03/queueing-theory-1.pdf	www.gamethec net

Stage 4 Course 2

Numbers of Units	Numbers of Hours				Course Type	Course Code	Name		ت
	total	discussion	Practical	Theoretical					
3	4	1	—	3	Required section	CMOR23-F4111	Constrained Optimization (2)	امثلية مقيدة (2)	1
3	4	1	—	3	Required section	CMOR23-F4121	Queuing Theory (2)	Theoretical ةالطوبير(2)	2
3	4	1	—	3	Required section	CMOR23-F4131	Neural Networks (2)	شبكات عصبية(2)	3
3	4	—	2	2	Required section	CMOR23-F4141	Modeling	محاكاة	4
2	2	__	__	2		CMOR23-F4151	Pattern Recognition	لغة انكليزية (4)	5
2	4	__	4	__	Department Elective	CMOR23-F4161	Search Project	مشروع التخرج	6
16	22	3	6	31	total				

Course Description Form

. Course Name: simulation
. Course Code: **CMOR23-F4241**
. Semester / Year:2nd
. Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) 4 / Number of Units (Total) 3
. Course administrator's name (mention all, if more than one name)
Name: asmaa abdulmunem abdullah Email: asmaa.abd@uomosul.edu.iq
. Course Objectives

Course Objectives:--to enable the student to understand the subj **of simulation and its applications** **Public life matters** **- How to build a simulation model and generate random numbers**	**Finding optir** **strategies** **How to build** **competitive model**

	Market competitio ules

. Teaching and Learning Strategies

A- Knowledge and understanding
A1- How to generate random numbers in different ways
A2- Facilitating the development of models for any problem,
its solution, and creating simulations for it.and practical applications on them.
A3-- To learn how to apply and use programming in modeling and simulation
B - Subject-specific skills
B1 - The student applies the simulation model to a real situation

B2 - The student should be able to perform manual simulation

C- Thinking skills
C1- The student takes a problem from reality
C2- The student will compare between manual and computer simulation methods
C3- To plan how to use the appropriate method in the solution

D - General and transferable skills (other skills related to employability and personal development).
D1- That the student implements the methods used in solving the simulation
D2- The student should improve the method used in the solution
D3- To verify the method

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	4	A	Knowing simulation, simulation using computer – –	Lecture and discussion	Assignments and Observation (H.W)
2	4	A	objectives of simulation, – advantages of simulation	Lecture and discussion	Assignments and Observation (H.W)
3	4	A&B	disadvantages of simulation models,	Lecture and discussion	Assignments and Observation (H.W)

	4	**4**	A&B	**The Monte Carlo method, , ,.**	Lecture and problem solving	Written tests
	5	**4**	**B&A**	**methods for generating random numbers**	Lecture and problem solving	Written tests
	6	**4**	**A & C**	**the mean method of multiplication**	Lecture and discussion	Assignments and Observation (H.W)
	7	**4**	**B & C**	**he mean square method**	Lecture and discussion	Assignments and Observation (H.W)
	8	**4**	**A& C**	**, the inverse method**	Lecture and discussion	Assignments and Observation (H.W)
	9	**4**	**B & C**	**Decision simulation, manual simulation – applied examples**	Lecture and problem solving	Presentation (power point)
	10	**4**	B	**Simulation method**	Lecture and discussion	Assignments and Observation (H.W)
	11	**4**	D	**Exam**	Lecture and Project	Project(Report)
	12	**4**	**A&B**	**Simulation method for inventory control, Monte Carlo integration simulation**		
	13	**4**	A &C	**One–dimensional Monte Carlo integration, acceptance and rejection method**	**Lecture and problem solving**	Assignments and Observation (H.W)
	14	**4**	**A& C**	**Multidimensional Monte Carlo integration**	Lecture and discussion	Assignments and Observation (H.W)

	15	**4**	C&D	**Exam**	**Lecture and interrogation**	TEST

. Course Evaluation	
Written tests Project(Report) Presentation (power point) Assignments and Observation (H.W)	
. Learning and Teaching Resources	
Required textbooks (curricular books, if any) **خل الى النمذجة الرياضية بأستخدام الmatlb(الجزء الاول)** **مدخل الى النمذجة الرياضية بأستخدام الmatlb(الجزء الثاني)** **تأليف : الاستاذ الدكتور باسل يونس ذنون**	
Main references (sources): Modeling and simulation	Operation Resea (2011) gupta
Recommended books and references (scientific journals, reports…)	
Electronic References, Websit https://www.arageek.com/l/%d8%a7%d9%84%d9%86%d9%85%d8%b0%d8%ac%d8%a9-%d9%88%d8%a7%d9%84%d9%85%d8%ad%d8%a7%d9%83%d8%a%d8	www.gametheory.ne

Course Description Form

. Course Name: Reliability theory
. Course Code: CMOR23-F4251
. Semester / Year:4th
. Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)

. Course administrator's name (mention all, if more than one name)

Name: Lec. Ahmed N. Alkhateeb
Email: ahmed.alkhateeb@uomosul.edu.iq

. Course Objectives

Course Objectives	• Finding optimal strategi • How to build a competitive model • Market competition rule

. Teaching and Learning Strategies

A- Knowledge and understanding
A1- The student should mention the previous laws
A2- The student should write some terms
A3- The student should describe the model
A4- The student should distinguish between the models
A5- The student explains the mathematical formula
A6- The student summarizes the steps to solve the mathematical formula
B - Subject-specific skills
B1 - The student applies the model to a real situation
B2 - The student must reveal the error in the form.
B3 - The student tabulates the results

C- Thinking skills
C1- The student poses a problem based on reality
C2- The student should compare the solution methods
C3- To rearrange the solution method
C4- To plan how to use the appropriate method in the solution
D - General and transferable skills (other skills related to employabilit and personal development).
D1- That the student implements the method used by the proof
D2- That the student improves the method used in the solution
D3- Verify the method
D4- Enabling the student to solve the results

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	3	A	Concept of Reliability	Lecture and discussion	Assignments and Observation (H.W)
2	3	A	Elements of reliability	Lecture and discussion	Assignments and Observation (H.W)

	3	**3**	A&B	**Continuous distribution**	Lecture and discussion	Assignments and Observation (H.W)
	4	**3**	A&B	**Reliability function**	Lecture and problem solving	Written tests
	5	**3**	**B&A**	**Mean time to failure**	Lecture and problem solving	Written tests
	6	**3**	**A & C**	**Hazard funciotn**	Lecture and discussion	Assignments and Observation (H.W)
	7	**3**	**B & C**	**Cumulative function and failure rate**	Lecture and discussion	Assignments and Observation (H.W)
	8	**3**	**A& C**	**Reliability condition**	Lecture and discussion	Assignments and Observation (H.W)
	9	**3**	**B & C**	**Constant failure rate**	Lecture and problem solving	Presentation (power point)
	10	**3**	B	**Failure model**	Lecture and discussion	Assignments and Observation (H.W)
	11	**3**	D	**Half exam**	Lecture and Project	Project(Report)
	12	**3**	**A&B**	**Exponentail Distribution**		
	13	**3**	A &C	**Weibull Distribution**	**Lecture and problem solving**	Assignments and Observation (H.W)
	14	**3**	**A& C**	**Types of systems**	Lecture and discussion	Assignments and Observation (H.W)
	15	**3**	C&D	**Systems diagram**	**Lecture and interrogation**	TEST

. Course Evaluation

Written tests
Assignments and Observation (H.W)

. Learning and Teaching Resources

Required textbooks (curricular books, if any)	

Main references (sources): An introduction to reliability maintainability engineering by	Operation Research (2011) gupta
Recommended books and references (scientific journals, reports…): Introduction to Reliability Analysis Probability Models and Statistical Method	
Electronic References, Websites	www.gametheory.net

Course Description Form

Course Name: English Language
. Course Code: CMOR23-F4261
. Semester / Year:2nd
. Description Preparation Date:2023/2024
Available Attendance Forms: In presence
Number of Credit Hours (Total) / Number of Units (Total)
. Course administrator's name (mention all, if more than one name)
Name: Zainab Qusay AL-Oraibi Email: Zainab.q@uomosul.edu.iq
. Course Objectives
Course Objectives To think in English and then speak. To be able to talk in English. To be able to compose freely and independently in speech and writing. To be able to read books with understanding.
. Teaching and Learning Strategies
. Speaking skill A1- He must have the ability to think and speak in English A2- The ability to speak English fluently A3- The ability to formulate sentences correctly **B - Reading skill** B1 - The ability to read sentences correctly B2 - Correct pronunciation of words. **C- Writing skill** C1- The ability to write sentences in English correctly The ability to express ideas through writing **D - Listening skills.** D1- Developing the student's listening skill

D2-The ability to distinguish words while listening

Course Structure

Week	Hours	Required learning outcome	Unit or subject name	Learning method	Evaluation method
1	**3**	D	Introduction: about the study materials.	Lecture and discussion	Assignments and Observation
2	**3**	A	Grammar: Verbs and nouns. Passive and active voices, and practices.	Lecture and discussion	Assignments and Observation
3	**3**	A&B	Second conditional, practices, questions, and short answers.	Lecture and discussion	Assignments and Observation
4	**3**	A&B	Grammar: might, If I were you.	Lecture and problem-solving	Observation
5	**3**	**B&C**	Vocabulary: phrasal verbs.	Lecture and problem-solving	Observation
6	**3**	**A& B& D**	social expressions, practices.	Lecture and discussion	Observation
7	**3**		Mid-term Exam		
8	**3**	**B& D**	Grammar: Present perfect continuous, practices.	Lecture and discussion	Assignments and Observation
9	**3**	**A& B& D**	Grammar: Words formation, adverbs, reading.	Lecture and problem-solving	Observation
10	**3**	**A& B& D**	Social expressions: Everyday English (telephoning), practices.	Lecture and discussion	Assignments and Observation
11	**3**	**A& B& D**	Tenses: Past perfect practices,	Lecture and discussion	Observation

			grammar, and pronunciation.		
12	**3**	**A&B**	Report statement, practices.	Lecture and discussion	Observation
13	**3**	A &C	Hot verbs (bring, take, come, go).	**Lecture and problem–solving**	Assignments and Observation
14	**3**	**A& C**	Social expressions about (saying goodbye), practices.	Lecture and discussion	Assignments and Observation
15	**3**	C&D	Study the material review	Lecture	Observation

. Course Evaluation

Written tests
Participate
Assignments and Observation

. Learning and Teaching Resources

Required textbooks (Headway pre-intermediate plus student's book (John and Lize Soars))

Main references (Headway pre-intermediate plus work's book)

Recommended books and references (scientific journals, reports…)

Websites https://7esl.com/