Course Description: Decision Theory

1- Basic Information:

Course Name	Decision Theory
Course ID	BQM603
Contact Hours (Registered Sessions)	24
Contact Hours (Synchronized Sessions)	24
Mid Term Exam	-
Exam	75 min
Registered Sessions Work Load	48
Synchronized Session Work Load	24
Credit Hours	5
Course Level	6

2- Pre-Requisites:

Course	ID
Operations Research	BQM502
Economic and Administrative Mathematics	GMA403

3- Course General Objectives:

This course aims to enhance students' ability to:

1. Being able to define the principles of decision theory in daily life as well as studying and applying decisions in situations of risk and uncertainty.
2. Improving the ability to extract and analyze the elements that define the decision environment at the individual, group and organizational level, including the characteristics and strategies of decision-making at each level.

3. *Understand methodologies and decision-making mechanisms systematically, use decision-analysis techniques and group processes, and integrate values into decision-making, so that the student gains self-confidence in decision-making and decision-making.*
4. *Developing principles of critical thinking, and understanding the process of analysis, decision-making.*
5. *Developing knowledge and skills to solve problems of individual and group decisions.*
6. *Identify and manage constraints, conflicts and uncertainties within the risk framework to define system requirements and interactivity.*
7. *Distinguish decision-making methodologies in new contexts or new problems, to explore, test, analyze and synthesize complex ideas, theories or concepts.*
8. *Apply theoretical and conceptual tools, programs, physical tools and advanced knowledge to research and evaluate the future performance of complex systems.*

4- Intended Learning Outcomes (ILO): After completing the course, students will be able to:

Code	Intended Learning Outcomes
ILO	**Intended Learning Objectives/Outcomes**
ILO1	*Understand the basic principles of classic decision theory, group choice, utility theory, game theory, and multi-criteria decision theory.*
ILO2	*Demonstrate an evolving awareness of management behavior during the decision-making and decision-making process.*
ILO3	*Analyze problems and demonstrates management opportunities using rational decision modeling.*
ILO4	*Systematically structure real-world business problems and explains the steps of decision-making, and extracts different types of decision-making environments.*
ILO5	*Distinguish between different work problems and the use of appropriate modeling techniques, and he is able to compare theoretical solutions to solve decision-making problems.*
ILO6	*Discuses and explains the special difficulties that many people face when facing administrative decision-making.*

ILO7	*Systematically devise the structure and framing of a decision problem (for example: decision tables, matrices, benefit tables, weighted decision tables, etc.).*
ILO8	*Explain human decision-making (or behaviors) in light of decision theory (for example, probability theory, theory of avoiding remorse, etc.) and the ability to describe the practical implications of its use.*
ILO9	*List and defines decision-making characteristics (for example: information and alternatives, criteria, nature states, outcomes, goals, value, preference, quality, acceptance).*
ILO10	*Explain the paradoxes in decision-making in light of risk and uncertainty.*
ILO11	*Show the difference between making decisions under uncertainty when the probability values are unknown, and making decisions at risk when the probability values are known.*
ILO12	*Able to judge and distinguish between the nature of decision-making and is able to explain the crucial importance of personal values and social norms in the decision-making process.*
ILO13	*Identify and derives decision-making strategies at the organizational level (for example: optimization decision, satisfactory decision, maxi-max standard, maxi-min standard, Laplace standard, Hurwicz standard, etc.).*
ILO14	*Design and develop suitable and useful decision trees. It uses revision of probability estimates using Bayes' theorem.*
ILO15	*Apply utility functions to solve the expected benefit and expected value problems (such as probability calculation, probability returns, expected value calculations, etc.).*
ILO16	*Uses and applies game theory that outlines the conflict strategies used by decision makers.*
ILO17	*Distinguish between single-standard decisions and appropriate solution strategies, multiple-standard, and sometimes contradictory decisions, and methods for solving them.*
ILO18	*Discusses and argues the advantages and disadvantages of individual and group decision-making, and is able to manage decisions effectively.*
ILO19	*Demonstrates the correct knowledge of critical thinking in relation to strategic decision management.*

5- ***Course Syllabus*** *(**24** hours of total Recorded Sessions, **24** hours of total synchronized sessions)*

- ***RS:*** *Recorded Sessions;* ***SS:*** *Synchronized Sessions;*

ILO	Course Syllabus	RS	SS	Type	Additional Notes
ILO1 ILO2	**CH 1: Basic concepts of decision theory** 1.1. Decision Theory: A Formal Philosophical Introduction 1.2. The concept of decision theory 1.3. The three schools of decision-making 1.3.1. Normative theory: expected utility theory 1.3.2. Descriptive theory: 1.3.2.1. Prospect theory 1.3.2.2. Social judgment theory 1.3.2.3. Naturalistic theory 1.3.3. Prescriptive theory 1.3.3.1. Analytic Hierarchy Process 1.3.3.2. Stanford Economic-Systems 1.3.3.3. Value Focused Thinking 1.3.3.4. Real options 1.4. The concept of decision 1.5. Types of decisions 1.6. Decision making steps 1.7. Factors influencing decision-making 1.8. Decision situations	2	2	☒ Exercises ☒ Assignments ☒ Seminars ☒ Projects ☒ Practices ☒ Others	Historical background: the evolution of decision science in management thought. Read additional articles, before session.
ILO3 ILO5	**CH 2: Business problems, solution alternatives and evaluation criteria** 2.1. The concept of the problem 2.1.1. Problem life cycle 2.1.2. Types of business problems 2.1.3. Find solutions to business problems 2.1.4. Modeling the problem 2.1.5. Appropriateness and development of the model	2	2	☒ Exercises ☒ Assignments ☒ Seminars ☒ Projects ☒ Practices ☒ Others	Read additional articles, practical cases applied to real-world companies before session.

	2.2. Decision alternative *2.2.1. Decision alternative sets* *2.2.2. The characteristics of good alternatives* *2.2.3. Generating alternatives from objectives and criteria* *2.2.4. Screening* *2.2.5. Developing strategies alternatives* *2.2.6. Alternatives refining* *2.3. decision criteria* *2.3.1. Types of criteria (quantitative &Non-quantitative criteria, Static & Variable criteria, Simple & Complex criteria, Financial or non-financial criteria)* *2.3.2. The concept of the relative importance of criteria* *2.3.3. Methods of setting the relative importance of criteria* *2.3.4. Explain decision modeling* *2.3.5. Describe and create decision tables* *2.3.6. Describe and create decision models reflecting uncertainty*				
ILO3 ***ILO4*** ***ILO19***	***<u>CH 3: Rational Choice Theory</u>*** *3.1. Basic Assumptions about Choice Determination* *3.2. Brief Description of the Rational Choice Method (Theory Revision, Preference Specification)* *3.3. Describe the attributes of a bounded rational decision maker and the attributes*	*2*	*2*	☒ *Exercises* ☒ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices* ☒ *Others*	*Read additional articles, practical cases applied to real-world companies before session.*

	3.4. Why is the Rational Choice Approach so Popular? *3.5. Issues in Rational Choice Theory* *3.6. Critiques of Rational Choice Theory* *3.7. Several Brief Examples*				
ILO9 ***ILO12***	**<u>CH 4: From choices to preferences</u>** *4.1. Incomplete preferences;* *4.2. Dynamics – preferences* *4.3. Comparisons using attributes* *4.4. Cardinal Utility Model* *4.5. Ordinal Utility Model* *4.6. Random Utility Model* *4.7. Cardinal vs. Ordinal Utility* *4.8. Time and risk; Attitudes towards risk; risk aversion and utility* *4.9. Revisit the concept of Preferences and its connection to Utility.*	*2*	*2*	☒ *Exercises* ☒ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices* ☒ *Others*	*Read additional articles, practical cases applied to real-world companies before session.*
ILO5 ***ILO6*** ***ILO7***	***<u>CH 5: Decision Making Under Certainty</u>*** *5.1. Input / Output Analysis* *5.2. Breakeven Analysis* *5.3. Goal Programming* *5.4. Transportation and Assignment* *5.5. Inventory Models*	*2*	*2*	☒ *Exercises* ☐ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices* ☒ *Others*	*Read additional articles.* *Read & solved exercises before session.*
ILO8 ***ILO11***	***<u>CH 6: Risk-based decision-making</u>*** *6.1. Principles of Risk Management* *6.2. A Risk Assessment Process,* *6.3. Determination of risk event Likelihood/Probability (qualitative/quantitative) and Consequence,* *6.4. Risk Characteristics and Factors such as Onset and Duration,*	*2*	*2*	☒ *Exercises* ☐ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices* ☒ *Others*	*Read additional articles.* *Read & solved exercises before session.*

	6.5. A Risk Representation mechanism (Risk Matrix or Heat Map), 6.6. Risk Decisions (Prioritization, mitigation/treatment). 6.7. Decision Making Under Risk 6.8. Expected Monitory Value (EMV) 6.9. Expected Opportunity Loss (EOL) 6.10. Expected Value of Perfect Information (EVPI) 6.11. Expected Value with Perfect Information (EVWPI)				
ILO8 **ILO10** **ILO11** **ILO14**	***CH 7: Decision tree and conditional probabilities*** 7.1. What is a Decision Tree? 7.2. Structure of a Decision Tree 7.3. Construction of Decision Tree 7.4. Decision Tree Uses 7.5. Tips for Creating a Decision Tree 7.6. Decision Tree Representation 7.7. Strengths and Weakness of Decision Tree approach 7.8. The disadvantages of decision trees 7.9. What are conditional probabilities 7.10. Conditional Probability and Bayes Theory. 7.11. Introducing Bayes Theory 7.12. Simple Bayesian model 7.13. Monetary value of complete additional information 7.14. Composite Bayesian model 7.15. Preview and expected monetary value of sample information 7.16. practical application	2	2	☒ Exercises ☐ Assignments ☒ Seminars ☒ Projects ☒ Practices ☒ Others	Read additional articles, practical cases applied to real-world companies. Read the case before session.

ILO12 ILO15 ILO16	***CH 8: Utility theory*** *8.1. St. Petersburg paradox* *8.2. Expected utility theory and the theory of means* *8.3. Utility and means* *8.4. Associative means* *8.5. Functional means* *8.6. The expected utility principle* *8.7. The von Neumann–Morgenstern representation theorem* *8.8. Representation of preferences via expected utility* *8.9. Utility of money* *8.10. Risk aversion* *8.11. A measure of risk aversion* *8.12. Difficulties in assessing utility* *8.13. Exercises*	*2*	*2*	☒ *Exercises* ☒ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices* ☒ *Others*	*Read additional articles,* *Read the application before session.*
ILO7 ILO8 ILO9	***CH 9: Decision-making under complete uncertainty and simple models in decision-making*** *9.1. Wald's Maximin criterion* *9.2. Hurwicz's criterion* *9.3. Maximax criterion* *9.4. Savage's minimax regret criterion* *9.5. Laplace's insufficient reason criterion* *9.6. Pros and Cons Analysis.* *9.7. Lexicographic Model.* *9.8. Conjunctive and Disjunctive Models.*	*2*	*2*	☒ *Exercises* ☒ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices* ☒ *Others*	*Read additional articles, practical cases applied to real-world companies before session.*
ILO15 ILO16	***CH 10: Games theory and decisions*** *10.1. Overview: Basic framework:, uses of game theory,*	*2*	*2*	☒ *Exercises* ☒ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices*	*Read the application before session.*

	10.2. Formal definitions of: the normal form, payoffs, pure strategy, dominant strategies, Nash equilibrium, *10.3. Zero-sum games: secure strategy, mini-max theorem, value of a game* *10.4. Normal form games: dominance, iterated dominance, Nash equilibrium* *10.5. Extensive form games: sub-game perfection, sequential equilibrium* *10.6. Repeated games: Folk theorem and repeated prisoner's dilemma* *10.7. Some applications and examples*			☒ *Others*	
ILO17 **ILO18** **ILO19**	***CH 11: Multi-criteria decision-making theory*** *11.1. Why a Multi-criteria Approach is Necessary?* *11.2. Taking into Account as Many Criteria as Necessary* *11.3. Why Not Opting for Criteria Weighted Average?* *11.4. The concept of multi-criteria decision-making* *11.5. Some methods of Multi-criteria decision-making MCDM* *1. Criteria for choosing a method*	*2*	*2*	☒ *Exercises* ☒ *Assignments* ☒ *Seminars* ☒ *Projects* ☒ *Practices* ☒ *Others*	*Read the application before session.*
ILO17 **ILO18** **ILO19**	***CH 12: Applications of multi-criteria decision-making methods*** *12.1. ELECTRE Methodology*	*2*	*2*	☒ *Exercises* ☒ *Assignments* ☒ *Seminars* ☒ *Projects*	

	12.1.1. Why Opting for the ELECTRE Methods? *12.1.2. ELECTRE III Methods* *12.1.3. Indexes for Building the Outranking Relation* *12.1.4. Concordance Index, Discordance Index* *12.1.5. Combining the Concordance and Discordance Indexes: the Outranking Matrix* *12.1.6. Discrimination Threshold, Outranking Relation and Qualification* *12.1.7. Distillation: the Heart of the ELECTRE III's Ranking Procedure* *12.1.8. Practical Example* *12.2. AHP Methodology* *12.2.1. Analytic hierarchy process AHP: An overview* *12.2.2. The three basic functions of Analytic hierarchy process AHP* *12.2.3. Methodology of hierarchical analysis of decisions* *12.2.4. Advantages of the decision hierarchy* *12.2.5. Practical Example.*			☒ *Practices* ☒ *Others*	*Read the application before session.*

6- Assessment Criteria (Related to ILOs)

ISC	Interactive Synchronized Collaboration		Ex	Exams		Rpt	Reports
PF2F	Presentations and Face-to-Face		PW	Practice Work			

	Assessments			

ILO Code	ILO	Intended Results	Assessment Type				
			ISC	PW	Ex	PF2F	Rpt
ILO1	Understand the basic principles of classic decision theory, group choice, utility theory, game theory, and multi-criteria decision theory.	The student's ability to understand problems and visualize the entrance to the solution	x	x		x	x
ILO2	Demonstrate an evolving awareness of management behavior during the decision-making and decision-making process.	The student's ability to understand and create models	x	x		x	x
ILO3	Analyze problems and demonstrates management opportunities using rational decision modeling.	The student's ability to understand and explain the decision-making mechanism and its components	x	x		x	x
ILO4	Systematically structure real-world business problems and explains the steps of decision-making, and extracts different types of decision-making environments.	The student was able to systematically formulate the problem and its structure	x	x		x	x
ILO5	Distinguish between different work problems and the use of appropriate modeling techniques, and he is able to compare theoretical solutions to solve decision-making	The student was able to understand the concepts of decision theory	x	x		x	

	problems.						
ILO6	*Discuses and explains the special difficulties that many people face when facing administrative decision-making.*	*The student's ability to explain the mechanism of his preferences when comparing alternatives*	*x*	*x*		*x*	
ILO7	*Systematically devise the structure and framing of a decision problem (for example: decision tables, matrices, benefit tables, weighted decision tables, etc.).*	*Enabling the student to systematically formulate the decision problem*	*x*	*x*	*x*	*x*	
ILO8	*Explain human decision-making (or behaviors) in light of decision theory (for example, probability theory, theory of avoiding remorse, etc.) and the ability to describe the practical implications of its use.*	*The student's ability to explain the decision-making process*	*x*	*x*	*x*	*x*	
ILO9	*List and defines decision-making characteristics (for example: information and alternatives, criteria, nature states, outcomes, goals, value, preference, quality, acceptance).*	*Enabling the student to define decision-making characteristics*	*x*	*x*	*x*	*x*	
ILO10	*Explain the paradoxes in decision-making in light of risk and uncertainty.*	*The student's ability to understand decision-making discrepancies*	*x*	*x*	*x*	*x*	

ILO11	*Show the difference between making decisions under uncertainty when the probability values are unknown, and making decisions at risk when the probability values are known.*	*The student's ability to distinguish between decisions under uncertainty and decisions is at risk*	*x*	*x*	*x*	*x*	
ILO12	*Able to judge and distinguish between the nature of decision-making and is able to explain the crucial importance of personal values and social norms in the decision-making process.*	*The student's ability to explain the importance of personal values and social norms in the decision*	*x*	*x*	*x*	*x*	
ILO13	*Identify and derives decision-making strategies at the organizational level (for example: optimization decision, satisfactory decision, maxi-max standard, maxi-min standard, Laplace standard, Hurwicz standard, etc.).*	*The student is able to apply techniques when making decisions in the event of complete uncertainty*	*x*	*x*	*x*	*x*	
ILO14	*Design and develop suitable and useful decision trees. It uses revision of probability estimates using Bayes' theorem.*	*The student's ability to develop a decision tree to express a problem that requires a decision in multiple stages in the event of a risk*	*x*	*x*	*x*	*x*	
ILO15	*Apply utility functions to solve the expected benefit and expected value problems (such as probability*	*The request was able to build the dependency utility*	*x*	*x*	*x*	*x*	

	calculation, probability returns, expected value calculations, etc.).						
ILO16	*Uses and applies game theory that outlines the conflict strategies used by decision makers.*	*The student's ability to understand the game and implement the mechanism of the solution*	x	x	x	x	
ILO17	*Distinguish between single-standard decisions and appropriate solution strategies, multiple-standard, and sometimes contradictory decisions, and methods for solving them.*	*The student was able to distinguish between a single-standard decision and a multi-standard decision*	x	x	x	x	
ILO18	*Discusses and argues the advantages and disadvantages of individual and group decision-making, and is able to manage decisions effectively.*	*The student's ability to distinguish between the advantages and disadvantages of individual and group decision*	x	x	x	x	
ILO19	*Demonstrates the correct knowledge of critical thinking in relation to strategic decision management.*	*Enabling the student to the mechanism of critical thinking*	x	x	x	x	

7- Practice Tools:

Tool Name	***Description***
WinQSB	*One of the well-known operations research programs is called Quantitative Systems for Business (WinQSB), a program that contains approximately 19 small programs representing operations research models. The program depends on the Windows driver.*

Electre III & IV	*An MCDA support program developed to group decision-makers' preferences into a single result. Elimination Et Choix Traidusaint la REalite (Electre) works on the results of compatibility and incompatibility tests for specific input preferences. (Electre IV) without setting weights.*
Expert Choice	*One of the multi-criteria decision support programs (MCDA), developed to derive the weights of standards from even comparisons. Applying the method of hierarchical analysis process (AHP: Analytic Hierarchy Process), which is one of the methods of multi-criteria decision-making.*

8- Main References

1- ***Martin Peterson (2017). An Introduction to Decision Theory. Cambridge University Press.***
2- ***Richard Bradley (2017). Decision Theory with a Human Face. Hardcover. 351 pages.***
3- ***Parmigiani, G., Inoue, L. Y. T., & Lopes, H. F. (2010). Decision Theory: Principles and Approaches. Wiley Blackwell.***
4- **طلال عبود، (٢٠١٧). نظرية القرارات، منشورات المعهد العالي لإدارة الأعمال، ط١، دمشق-سورية.**

9- Additional References

1- ***Gilboa, Itzhak. 2009. Theory of decision under uncertainty. Cambridge University Press.***
2- ***Weirich, Paul. 2004. Realistic decision theory: Rules for nonideal agents in nonideal circumstances. Oxford University Press.***
3- ***Kaplan, Mark. 1998. Decision theory as philosophy. Cambridge University Press.***
4- ***JP Branset et Marshal, aide multicritère a la décision, le cerveau du décideur, publication de l'université libre de Bruxelles ,2001***
5- ***Hausman, Daniel M. 2011b. Preference, value, choice, and welfare. Cambridge University Press.***

6- *Roy B. (1996). Multicriteria Methodology for Decision Aiding. Kluwer Academic Publishers. The Netherlands.*
7- *Sen, Amartya. (1990). "Rational Behavior," in Eatwell, John, Milgate, Murray, and Newman Peter, Utility and Probability (New York: W. W. Norton & Company), pp. 1998-216.*
8- *Simon, Herbert A. 1990. Bounded rationality. Pages 15-18 of: Utility and probability. Springer.*
9- *Tversky, Amos, and Kahneman, Daniel. (1986, October). "Rational Choice and the Framing of Decisions." Journal of Business 59(4, part 2), S251-S278.*
10- *Other Articles for each chapter.*