University of Mosul

B.Sc. - Operations Research and Intelligent Technologies

Table of Contents

1. Overview

This catalogue is about the courses (modules) given by the program of Operations Research and Intelligence Technologies to gain the Bachelor of Science degree. The program delivers (48) Modules with (6000 total student workload hours and 240 total ECTS. The module delivery is based on the Bologna Process.

2. Undergraduate Courses 2024-2025

Module 1

Code	Course/Module Title	ECTS	Semester
OR101	operations research (1)	6	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			

Operations Research (OR) is a field in which people use mathematical and engineering methods to study optimization problems in Business and Management, Economics, Computer Science, Civil Engineering, Industrial Engineering, etc. This course introduces frameworks and ideas about various types of optimization problems in the business world. In particular, we focus on how to formulate real business problems into mathematical models that can be solved by computers.

1-1 Fundamentals of operations research and development
1-2 Scientific methods in operations research
1-3 Operations research and its relationship to decision-making
1-4 Linear programming of the general form
1-5 Building linear programming models
1-6 The canonical and standard form of linear programming

2-1 Simplex method
3-1 Special cases in linear programming
4-1 Big M method
5-1 Corresponding(dual) model
6-1 The relationship between the normal and the corresponding model
7-1 The corresponding(dual) optimal solution
8-1 The corresponding(dual) simplex method

Module 2

Code	Course/Module Title	ECTS	Semester
OR102	Calculus (1)	6	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
Sets–set representation–general review on real numbers–intervals and their types – linear and nonlinear inequalities – functions – types of functions – algebraic operations on functions – composition of functions– inverse of functions – definition of limit – computing limits – the concept of continuity – theorems in continuity–continuity at a point– continuity on an interval– properties of continuous functions – derivatives-derivative rules– higher order derivatives– implicit functions and their derivatives– L'Hôpital's first and second rule– Rolle's theorem–Mean value theorem–critical points – extremes values – increasing and decreasing functions – first derivative test – second derivative test – concavity – inflection points – drawing curves – applications to extreme values– integration– integration rules– definite integral– the Fundamental Theorem of Calculus– applications of definite integral in finding the area.			

Module 3

Code	Course/Module Title	ECTS	Semester
OR103	Programming (1)	5	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	4	93	107
Description			
MATLAB is a high-level programming language and integrated development environment (IDE) used in scientific computing. MATLAB is characterized by its capabilities and ability to handle numerical data, making it suitable for the analysis and design of digital electronics, statistical systems, operational analysis, and machine learning. MATLAB includes many specialized tools and functions, such as plotting, factor analysis, and window reporting. MATLAB also supports both programming and functional programming. MATLAB is used in many scientific fields, such as mathematics, physics, chemistry, engineering, and computer science. It is widely used in scientific research, industry, medicine, and other technical fields. Programs in MATLAB can be written using the Editor window, where users can add collaborators. The program can be run in its entirety or step-by-step using debug mode. MATLAB terminology is easy to use and contains a comprehensive and detailed explanation,			

including numerous examples and explanations.

Module 4

Code	Course/Module Title	ECTS	Semester
OR104	Linear algebra	6	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
Matrices Basic concepts and definitions of matrices and their types - Arithmetic operations on matrices (addition, subtraction, multiplication) and the properties of those operations - The effect of the matrix and its applications in arithmetic operations - Complex numbers and arithmetic operations on them and their properties - Complex numbers and arithmetic operations on them and their properties - Complex numbers and arithmetic operations on them and their properties - Finding the determinants of large matrices - Properties of determinants - Inverse of matrices (using elementary transformations and Gaussian elimination) - Properties of inverse matrices - Methods for solving systems of non-homogeneous linear equations using the Gauss, Gauss-Jordan, and Cramer methods when the determinant of the matrix is non-zero - Equivalent matrices and types of solutions to linear equations - Finding the rank of matrices using equivalence - The morphological or suppression formula - Definition of the nth Euclidean space and some of its related theorems - Definition of the linear combination, the Euclidean length, and the Euclidean distance between two vectors in the nth Euclidean space - Finding the characteristic roots and characteristic vectors			

Module 5

Code	Course/Module Title	ECTS	Semester
UOM1040	Democracy & Human Rights	2	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	33	17
Description			
Human rights are described as both legal in their general context and legal in their specific context. They combine the essence of the rights that individuals should enjoy, including civil and fundamental rights such as the right to life, food, clothing, and shelter; social rights related to the right to social life, the right to freedom of expression, the right to belief, the right to religion and belief; political rights such as the right to vote and to run for office; and other rights that evolve with the development of life, such as the right to happiness and to live in a clean environment; the right to protect these rights from violation; and the guarantees for granting and preserving these rights. The purpose of teaching this			

subject is to enlighten cognitive and academic thought about the harmony of these rights with the demands of life at all levels.

Module 6

Code	Course/Module Title	ECTS	Semester
UOM1021	English Language 1	2	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	33	17
Description			
The general methodological principles adopted for this course are based on integrating all four skills (reading, writing, speaking and listening) into highly motivational activities. Meaningful learning is brought to be through activities are based on the students' interests with the aim of fostering motivation. Another key methodological concept is that of the autonomous learner. Recently, due to the effects of changes in language teaching strategies, great importance has been given to the need for teachers to promote and motivate self study, through continuous evaluation. The student will have constant feedback on his/her progress with the aim of modifying, when necessary, his/her learning. Therefore, course contents will be made up of activities that consolidate the linguistic abilities of students, in such a way that they not only learning theoretical knowledge, but create for students the necessary tools for students to continue their language learning through self study techniques studied along the course.			

Module 7

Code	Course/Module Title	ECTS	Semester
OR107	operations research (2)	6	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
The course deals with the use of mathematical models for planning of corporate and governmental activities. Most of the planning problems will consist of an economic objective which we want to maximize under scarce resources. Operations Research consists of: - limiting and defining the current problem, - formulating a mathematical model of the problem, - calculating an optimal solution of the model, -and finally interpreting and implementing the found solution. 1-1 Dual Model 1-2 Definition of the Dual Problem 1-3 Solution of the Dual Problem 1-4 Relationship Between Primal and Dual Objective Values			

1-5 Dual Simplex Method

1-6 Economic interpretation of the corresponding model

2-1 Interpreting the Simplex Tableau: Sensitivity Analysis

2-2 Post optimal or Sensitivity Analysis

2-2-1 Changes Affecting Optimality

2-2-2 Changes Affecting Feasibility

2-2-3 Changes Affecting Optimality and Feasibility

2-3 Parametric Linear Programming

2-3-1 Changes in C

2-3-2 Changes in B

2-3-3 Changes in Pj

2-3-4 Simultaneous Changes in C and b

3-1 Mathematical Foundations

2-1-1 Standard LP Model in Matrix Form

2-1-2 Basic Solution and Bases

2-1-3 The Simplex Tableau in Matrix Form

3-2 Revised (Primal) Simplex Method

2-2-1 Product Form of the Inverse

2-2-2 Steps of the Primal Revised Simplex Method

Module 8

Code	Course/Module Title	ECTS	Semester
OR108	Calculus (2)	6	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			

In this course, the following will be studied:

Trigonometric functions: differentiation of trigonometric functions, integral of trigonometric functions, inverse trigonometric functions, derivatives of inverse trigonometric functions, integrals resulting in inverse trigonometric functions.
Exponential functions: derivatives of exponential functions, integration of exponential functions.
Logarithmic functions: basic properties of logarithms, derivatives of logarithmic functions.
Hyperbolic trigonometric functions: derivatives of hyperbolic trigonometric functions, integration of hyperbolic trigonometric functions.
Integration methods: integration by parts, integration by partial fractions, integrals of powers of trigonometric functions, trigonometric substitutions, integrals of quadratic formulas, integration by substitution, other substitutions.
Multivariable functions: functions in two variables, finding domain and range.

Partial Derivatives: The partial derivative of functions in two variables.
Double integration: applications of double integration (calculate volume, area, mass, centers of mass, and …)
Polar coordinates: polar coordinates, relationship between polar and cartesian coordinates, curves in polar coordinates, calculating areas using polar coordinates.

Module 9

Code	Course/Module Title	ECTS	Semester
OR109	Programming (2)	8	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	4	93	107
Description			

MATLAB is a high-level programming language and integrated development environment (IDE) used in scientific and engineering computing. MATLAB is characterized by its superior capabilities in processing numerical data, and can be used for the analysis and design of dynamic systems, as well as for statistical operations, factor analysis, and machine learning.

MATLAB includes many specialized tools and functions, such as graphing, factor analysis, statistics, signal processing, and control. In addition, MATLAB supports object-oriented and functional programming.

MATLAB is used in many scientific and engineering fields, such as mathematics, physics, chemistry, engineering, and computer science. It is widely used in scientific research, manufacturing, medicine, and other technical fields.

Programs in MATLAB can be written using the Editor window, where the user can add and execute commands. The program can also be run in its entirety or step-by-step using Debugging mode. MATLAB is easy to use and contains comprehensive and detailed documentation that includes numerous examples and explanations.

Module 10

Code	Course/Module Title	ECTS	Semester
OR110	Principles of Statistics	5	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	47
Description			

In this course, students learn the basic concepts of Principles of Statistics, which include the concept of statistics and its application in real life and scientific research, as well as methods for collecting and tabulating data, samples and their types. Students also learn about data and their types. Students also learn about statistical concepts such as the arithmetic, geometric, harmonic, and quadratic means, the relationship between these means, their advantages and disadvantages, the weighted arithmetic

mean and how to extract them for ungrouped and grouped data, as well as the variance, standard deviation, median, and mode for ungrouped and grouped data. Students also learn how to represent data using histograms, frequency polygons, and pie charts. Students learn about the concepts of symmetry and skewness in frequency distributions. They also learn about permutations and combinations and the relationship between them, which forms an introduction to the subject of probability, which students will explore in the second stage.

Module 11

Code	Course/Module Title	ECTS	Semester
UOM1011	Arabic language 1	2	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	32	18
Description			
The aim of this course is to introduce students to the parts of speech, including nouns, verbs, and particles, as well as to familiarize them with the Arabic sentence and its parts, including nominal and verbal sentences. It also aims to teach them linguistic, grammatical, and expressive issues so that they can learn how to write a solid academic research paper.			

Module 12

Code	Course/Module Title	ECTS	Semester
UOM1031	Computer 1	3	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	2	48	27
Description			
This course provides a comprehensive introduction to computer science, covering the fundamental principles of hardware and software and how their components interact to perform computing tasks. The course discusses the basic structure of computers, digital data representation, algorithms, operating systems, networks, cybersecurity, and programming fundamentals. It also offers an overview of modern trends in information technology, such as artificial intelligence and cloud computing.			

Module 13

Code	Course/Module Title	ECTS	Semester
OR201	Integer & Dynamic Programming	5	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	63	62
Description			
This course aims to introduce students to how to solve integer and dynamic programming models, through different methods of solving and how to deal with time in dynamic models, An integer programming problem, is an linear programming problem where in Some of all of the decision Variables are restricted to be integer valued pure integer programming, A pure Integer programing is one in which all the Variables are restricted to be integers. Mixed integer programming, A mixed Integer programming restricts Some of the variables to be integers while others can assume Continuous (fractional values). Methods of Integer programming problem 1-Branch and Bound method. 2- Cutting Plane method (Gomory's cutting plane) D Approximation Implicit enumeration method Methods of Integer programming problem 1- approximation method 2-Branch and Bound method. 3- Cutting Plane method (Gomory's cutting plane). 4-implicit enumeration method Dynamic Programming: Dynamic programming is a mathematical technique dealing with the optimization of multistage decision problems. The technique was originated in 1952 by Richard Bellman Dynamic programming problem (DPP) is a decision making problem in i variables, the problem being Subdivided into n sub problems.			

Module 14

Code	Course/Module Title	ECTS	Semester
OR202	Probability Theory (1)	6	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
This module covers the fundamental concepts of set theory, including subsets, complements, unions, intersections, and set partitioning. Exploring theorems and proofs deepens understanding. It extends to sequences, and limits, and introduces De Morgan's theory with compelling proofs. Combinatorics involves counting and tree diagrams, with the fundamental principle of counting and methods like arrangements, permutations, and combinations. Multinomial expansion enhances counting techniques. Probability topics include binomial theorems, connections to random experiments, and definitions of sample space and events. The Classical and Axiomatic approaches define probability, utilizing tools like dice and playing cards for independent events. Conditional probability, axioms, and practical calculation methods are covered. The introduction of Bayes' theory provides valuable tools for providing a firm basis for advanced work on probability and its applications.			

Module 15

Code	Course/Module Title	ECTS	Semester
OR203	**numerical analysis (1)**	**6**	**3**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	**3**	**78**	**72**
Description			
In this course, a curriculum has been developed to enable the student to understand the topic of numerical analysis and its uses. And to clarify the types of numerical errors And to facilitate the solution of linear differential equations in different ways And solve nonlinear equations by numerical methods. And also to compare the analytical solution with the numerical solution of differential equations And to learn how to apply programming using numerical methods. In the beginning, we got to know the types of errors and how to derive them. And the use of simple methods in the numerical solution, such as drawing. Also, the use of the method of changing the sign in solving the differential equation. Newton Raphson's simple method for solving. And Newton Raphson's method for solving nonlinear equations. and find the value of the root. And find the reciprocal of the number using Newton Raphson's method.			

Module 16

Code	Course/Module Title	ECTS	Semester
OR204	**مسائل تتابعية**	4	**3**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	48	5**2**
Description			
This course covers the scheduling problem, its types, and scheduling criteria, as well as prominent topics in operations management and control, typically in situations where scarce resources must be allocated to activities over time. It focuses on deterministic scheduling models. Major topics include complexity results and some important optimization and scheduling algorithms used in operations research and computing for single-machine problems, parallel machines, multiprocessor tasks, open-shops, flowcharts, workshops, resource-constrained project scheduling for sequential processing, and real-world scheduling applications.			

Module 17

Code	Course/Module Title	ECTS	Semester
OR205	**معادلات تفاضلية**	**5**	**3**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	**2**	**63**	**62**
Description			
In this course, we introduce many of the basic concepts and definitions that are encountered in a typical differential equations course. We will also take a look at direction fields and how they can be used to determine some of the behavior of solutions to differential equations. In this section some of the common definitions and concepts in a differential equations course are introduced including order, linear vs. nonlinear, initial conditions, initial value problem and interval of validity. In this section we discuss direction fields and how to sketch them. We also investigate how direction fields can be used to determine some information about the solution to a differential equation without actually having the solution. In this section we give a couple of final thoughts on what we will be looking at throughout this course. we will look at several of the standard solution methods for first order differential equations including linear, separable, exact and Bernoulli differential equations. We also take a look at intervals of validity, equilibrium solutions and Euler's Method. In addition we model some physical situations with first order differential equations.			

Module 18

Code	Course/Module Title	ECTS	Semester
UOM2050	جرائم نظام البعث في العراق	2	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	32	18
Description			
This course aims to introduce students to the crimes of the Ba'ath regime in Iraq and their disastrous effects on society and the state, with a focus on the difference between democratic and dictatorial regimes. The course covers mass grave crimes, torture and persecution, environmental crimes such as burning oil wells and draining marshes, as well as the Iraqi Criminal Court's rulings against figures of the former regime. It also highlights crimes committed in secret prisons, analyzing the legal and humanitarian impact of these crimes. The course provides students with a deep understanding of transitional justice and its role in holding criminals accountable and ensuring that such violations are not repeated in the future.			

Module 19

Code	Course/Module Title	ECTS	Semester
UOM2022	English Language 2	2	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	33	17
Description			
This is a course for students have a solid foundation in the language. They may have recently completed an elementary course or they may be returning to language learning after a break and need to revise key language before being able to progress further. New language is introduced systematically, allowing students to extend and consolidate their knowledge of the language. New vocabulary is introduced regularly and this is followed by controlled practice activities, allowing students to immediately activate the language in a supported way. There are also freer practice activities where students can focus on their fluency, so that students feel able to actively participate in conversations and discussions. The course also aims at helping learners to achieve an overall English language proficiency leading to professing at language, and it also helps developing conversational skills, expressing ideas, and helping learners deal with problems and situations successfully.			

Module 20

Code	Course/Module Title	ECTS	Semester
OR207	Probability Theory (2)	6	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
This module covers the concept of random variables, including discrete and continuous ones, along with their associated probability functions and distribution functions. We learn how to obtain the probability mass function (p.m.f.) for discrete random variables and the probability density function (p.d.f.) for continuous random variables. Various examples of discrete distributions, such as the uniform, Bernoulli, binomial, Poisson, geometric, hypergeometric, and negative binomial distributions, are explored. Additionally, continuous distributions like the uniform continuous, exponential, normal, gamma, and beta distributions are discussed. The module also covers mathematical expectations, including definitions, properties, and calculations for both discrete and continuous distributions. Lastly, we explore moments, central moments, and their applications using the moment-generating function (MGF).			

Module 21

Code	Course/Module Title	ECTS	Semester
OR208	Numerical Analysis (2)	**6**	**4**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	**3**	**78**	**72**
Description			
In this course, the student will increase and develop information on the topic of numerical analysis and its uses. And to facilitate the solution of a system of linear and nonlinear differential equations in different ways. Learn about improved methods in numerical analysis. And how to apply programming on numerical methods. And on how to improve the numerical methods to improve the output and reduce the number of iterations. And finding differential equations by giving data values and function values at the given points and using inclusion, interpolation and Lagrange formulas. And the use of trigonometric analysis by using matrices to solve. And the use of general and special methods to find the solution to the system of linear equations. And the use of matrices in special methods of solution, such as Jacobi's special method and Kaus Seidel's special method.			

Module 22

Code	Course/Module Title	ECTS	Semester
OR209	Assignment Problems	**4**	**4**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	**2**	**63**	**37**
Description			
Learn about transportation problems, their types, methods for finding initial solutions, optimality testing, allocation problems, and different methods for solving them. Learn about special cases in allocation problems, how to formulate an allocation matrix, types of allocation problems, and the traveling salesman problem.			

Module 23

Code	Course/Module Title	ECTS	Semester
OR210	Reliability theory	4	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	37
Description			
Describes the system's ability to complete the task for which it is responsible in a given time. It is the one that helps to improve the work of systems and reduce the chances of their failure, and these systems include aircraft, linear accelerators, health systems and any other product. It has been developed using probability and statistics. It was used in the nineteenth century in the field of marine navigation and the field of life insurance in exchange for sums of money from its customers. Even today, the failure rate and risk rate are still verbal. Similarly, this theory is used in cases of failure of mechanical devices such as ships, trains, and automobiles. Statistical models suitable for any of these topics are called "time-to-event" models, and failure or death cases are called the even			

Module 24

Code	Course/Module Title	ECTS	Semester
OR211	Game Theory	5	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	62
Description			
This course aims to introduce students to how to solve cooperative and non-cooperative game models, especially when time, cost, and quality are important elements in the solution. The types of games are addressed for both cooperative (competitive) and non-cooperative (also called non-competitive) games. There are different solution methods, including the computational method when the game is competitive and the size of the payout matrix is $2*2$. If the game is cooperative and non-competitive and the size of the payout matrix is $2*2$, the cooperative probability method is used. If it is a competitive game and one of the players has two strategies and the other has more than two strategies, the drawing method is used. If it is cooperative and of the same size, we use the elimination method to make the matrix square. Thus, if it is square and the size of the payout matrix is $3*3$ and the game is competitive, the linear programming method is used. In contrast to the cooperative non-competitive game, the Nash-Egan equilibrium method is used, and so on for the rest .of the methods			

Module 25

Code	Course/Module Title	ECTS	Semester
UOM2012	Arabic 2	2	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	33	17
Description			
In this course, you will learn about the relationship between language and society, its importance in our lives, knowledge of languages and dialects, the difference between them, and how to distinguish between a speaker's style and intent.			

Module 26

Code	Course/Module Title	ECTS	Semester
UOM2032	Computer 2	3	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	2	48	27
Description			

This course is designed to provide students with a comprehensive understanding of fundamental computing tasks and their practical applications. Topics covered include:

1. **Utilization of Computers for Fundamental Tasks:** Students will gain proficiency in performing basic computing functions such as file management, operating system navigation, and utilizing essential software tools to complete everyday tasks efficiently.
2. **Identification and Discussion of Hardware Components:** This section focuses on familiarizing students with the key hardware components of a computer system, including the central processing unit (CPU), memory units, storage devices, input/output peripherals, and network interfaces, alongside their respective functions and interactions within the system.
3. **Document Creation and Presentation Development:** Students will develop skills in creating, formatting, and editing documents using a word processor, as well as designing effective presentations using presentation software. Emphasis will be placed on both technical proficiency and effective communication through these mediums.
4. **Conducting Internet-Based Research:** Students will be introduced to advanced research techniques using the internet, including the use of academic databases, search engines, and online resources. Critical evaluation of information sources will also be emphasized to ensure quality and reliability in research findings.
5. **Introduction to Artificial Intelligence:** An introductory overview of artificial intelligence (AI) concepts will be presented. Topics will include the fundamentals of machine learning, natural language processing, and problem-solving techniques, with a focus on the potential applications and ethical considerations surrounding AI technologies.

Module 27

Code	Course/Module Title	ECTS	Semester
OR301	Unconstrained optimization (1)	6	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72

Description

Basic concepts:

Optimization, Statement of an optimization problem, One variable unconstrained optimization problem, Definition: local minimum value, local maximum value , global minimum value , global maximum value, Concave and convex functions of a one variable, Necessary and sufficient conditions of a one variable functions , Taylor' s series expansions . Methods of One variable unconstrained optimization problem. Dichotomous method, introduction , Algorithm, examples. Interval halving method , introduction , Algorithm, examples. Fibonacci method, introduction , Algorithm, examples. Golden section method , introduction , Algorithm, examples. Quadratic interpolation method , introduction , Algorithm, examples. Cubic interpolation method , introduction , Algorithm, examples. Newton method , introduction , Algorithm, examples. Quasi newton method , introduction , Algorithm, examples. Secant method , introduction , Algorithm, examples.

Module 28

Code	Course/Module Title	ECTS	Semester
OR302	Inventory Models(1)	6	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
The main purpose of studying inventory models is to determine the rules and foundations through which the management can use them to minimum total costs of inventory that result from the storage process to cover customer demands, and the presence of an amount of inventory that protects the management from any unexpected decrease in the volume of production, as it remains able to respond to customer requests By addressing Definition of Inventory and Model, Objective of Inventory System ,Concepts and characteristic of inventory system and type of storage Knowing the meaning of demand in inventory models and its classifications ,Identify all costs related to inventory systems: A:unit cost, B:setup cost, C:holding cost, D:shortage cost, E:order quantity , F:reorder point G:safety stock, H:lead time, I:demand, J:constraints ,K:maximum level of shortage and inventory control hypotheses and Classification of inventory model and definition of Deterministic inventory model included Model(1) purchase model without shortage, Model(2) purchase model with shortage ,Model(3) production model without shortage ,Model (4) production model with shortage, and static order deterministic of one item.			

Module 29

Code	Course/Module Title	ECTS	Semester
OR303	تقنيات ذكائية (1)	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	63	62
Description			
Introduction to the term artificial intelligence, its basic concepts, components, and various applications for solving numerous problems in operations research and optimization. Introduction to concepts such as knowledge representation using logic. This course also covers search methods and search algorithms (or computer programs) that mimic human mental abilities or other behavioral patterns to give the computer the ability to learn and			

infer situations that the machine has not learned. Use of metaheuristic algorithms to find the optimal solution to operations research and optimization problems.

Module 30

Code	Course/Module Title	ECTS	Semester
OR304	Fuzzy logic (1)	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	63	62
Description			
In this Course we study the generalize traditional two-value logic, to infer in uncertain circumstances. And an easy way to describe and represent the human experience through one of the mysterious theories and techniques through which systems can be built, which are expert systems or artificial intelligence, and they are used as a better way to process data in programming systems and deal with inaccurate human-like information, in a way that reflects people's thinking as a model for our sense of words that we trade and use, enabling us to decide and give a closer picture of how these things are represented in computer software. It is how the degree of affiliation is determined. It also offers practical solutions to realistic problems, as effective and reasonable solutions, compared to other solutions that provide other technologies.			

Module 31

Code	Course/Module Title	ECTS	Semester
OR305	English Language	2	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	32	18
Description			
Reading, writing, speaking, and listening are all integrated into highly motivating exercises as part of the overall methodological ideas used for this course. Activities that are centered on the interests of the students are used to provide meaningful learning with the intention of increasing motivation. The independent learner is yet another crucial methodological idea. Due to the effects of recent developments in language teaching methodologies, educators now place a high priority on the necessity of encouraging and motivating self-study through ongoing evaluation. The student will have constant feedback on his/her progress with the aim of modifying, when necessary, his/her learning. Therefore, course contents will be made up of activities that consolidate the linguistic abilities of students, in such a way that they not only learning theoretical knowledge, but create for students the necessary tools for students to continue their language learning through self study techniques studied along the course.			

This course aims at accomplishing its goal in a full academic module through developing students' all language skills. SLO (Students Learning Outcomes) achievement is also aimed within this course. So the students learning outcomes (what students will know and be able to do with the language at the end of the instruction) are listed in detail on a skill base.

Module 32

Code	Course/Module Title	ECTS	Semester
OR306	Modeling and simulation	6	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
In this course, the student will be able to understand the topic of modeling and simulation and its applications in public life matters. The aim of the modeling and simulation course is to introduce students to mathematical modeling and how to build a model using differential and differential equations and practical applications on it. And how to generate random numbers in different ways Facilitating the development of models for any problem, its solution and simulation. To learn how to apply and use programming on modeling and simulation.			

Module 33

Code	Course/Module Title	ECTS	Semester
OR307	Unconstrained optimization (2)	6	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
Basic concepts: Unconstrained optimization , Multi variable unconstrained optimization , Hessian matrix , Test the matrix is positive , negative definite or indefinite, Concave and convex functions of multi variable functions , Necessary and sufficient conditions of a multi variable functions. Definition: rth differential of function , Taylor's method . Methods of Multi variables unconstrained optimization problem. Steepest descent (Cauchy) method. Conjugate gradient methods. Hestenes – Stiefel method (HS). Fletcher – Reeves method (FR). Polak – Ribiere method (PR). Newton's method. Marquardt method. Quasi newton			

method. Davidon – Fletcher – Powell method (DFP). Broyden – Fletcher – Goldfarb – Shanno method (BFGS)

Module 34

Code	Course/Module Title	ECTS	Semester
OR308	Inventory Models (2)	6	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			

Definition of Inventory Models ,Objective of Inventory System ,Concepts and characteristic of inventory system Knowing the meaning of demand in inventory ABC distribution ABC Analysis classifies inventory items into three categories based on their value and importance to the business: A (high-value items), B (medium-value items), and C (low-value items). The A items typically the most expensive and most important should be managed with extra care and attention. ,Planning and management of spare parts, General goals for planning and management of spare parts, Scientific method to control of stock ABC distribution and find economic order quantity in Break price model,

Probabilistic model ,Review inventory (A continuous model) and single period model,Uniform demand setup cost equal to zero and examples ,Constraints storage and represented The Constraints for investment capital, the Constraints for storage space, the Constraints for the number of orders,an addition to other restrictions represented in the holding cost, the cost of preparing the order, and the cost of one unit, whether it is the cost of consumption or production ,Multiple unit inventory system, Multiple item static model with shortage limitation and form Special case when we have only one constraint .

Module 35

Code	Course/Module Title	ECTS	Semester
OR309	AI	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	63	62
Description			
This course provides an overview of evolutionary algorithms, including genetic algorithms, their concepts, components, and applications, as well as swarm intelligence (SI), including behavioral swarm intelligence and SI applications. Students will learn various swarm intelligence algorithms inspired by natural systems such as bird flocks and will implement these algorithms and apply them to solve real-world problems in operations research and optimization.			

Module 36

Code	Course/Module Title	ECTS	Semester
OR310	Fuzzy logic(2)	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	63	62
Description			
In this Course we study the generalize traditional two-value logic, to infer in uncertain circumstances. And an easy way to describe and represent the human experience through one of the mysterious theories and techniques through which systems can be built, which are expert systems or artificial intelligence, and they are used as a better way to process data in programming systems and deal with inaccurate human-like information, in a way that reflects people's thinking as a model for our sense of words that we trade and use, enabling us to decide and give a closer picture of how these things are represented in computer software. It is how the degree of affiliation is determined. It also offers practical solutions to realistic problems, as effective and reasonable solutions, compared to other .solutions that provide other technologies			

Module 37

Code	Course/Module Title	ECTS	Semester
OR311	Neural Network	4	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	48	52
Description			

Artificial neural networks are a very important topic and a method of intelligent technology that can be used as a research tool to describe, analyze, and train networks to achieve the goal specified by the student or researcher. Their solution uses programming methods that accelerate the achievement of the desired results.
Artificial neural networks generally include three stages for their solution: the input layer (the data under study), the hidden layer (the equations used), and the output layer (which represents the results obtained from training the network).
Neural networks can also be solved with or without supervision. If there is a specific goal sought by the researcher or student, then they are called supervised-trained networks. If the network lacks any goal, then it is called an unsupervised neural network.
Neural networks include several types, including single-layer networks, multi-layer networks, back-directional networks, and forward propagation networks.
We will discuss each of the above in detail during the specified semester.

Module 38

Code	Course/Module Title	ECTS	Semester
OR312	Decision theory	4	6
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	37
Description			
This course aims to provide students with an understanding of decision theory and its real-life applications. It trains them to make optimal decisions using various criteria, such as the optimism and pessimism criteria, the Laplace criterion, expected value, regret criterion, and missed opportunities. The expected value of missed opportunities is determined after reviewing information related to a given problem, such as how to determine the optimal decision in a profit-and-loss situation. In other words, the student learns how to make the decision that results in the least loss and the decision that results in the highest profit when the problem is a profit-making one. The student also learns how to determine the risk ratio that is predicted based on the available information for each given problem. This course also introduces students to investment portfolios, their nature, and how they are used in real life. It also teaches students how to combine the mathematical and statistical information they learned in the second stage, such as definite integrals, which they learned about in calculus, as well as rate, variance, and expected value, which they learned about in the second stage in probability theory.			

Module 39

Code	Course/Module Title	ECTS	Semester
OR401	Constrained Optimization (1)	6	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	3	78	72
Description			
This course is concerned with studying how to find the optimal solution for nonlinear problems .Using optimization to find the lowest cost and ffinding the optimal solution for non-linear problems by using algorithms and flowcharts to solve them .Solving nonlinear problems using optimization and programming also using matlab language and the ideal solution for non-linear problems for all direct and indirect methods .The general formula, the solution method, and the algorithm for the Lagrangian inequality function. The general formula, solution method and algorithm for the Lagrangian equality function. Solving nonlinear problems using optimization and using numerical programming			

Module 40

Code	Course/Module Title	ECTS	Semester
OR402	Queueing theory (1)	6	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
This module shows the properties of queueing models and the efficiency metrics. Types of queueing models and Kendall's notation introduce to the students. Arrival and departure processes are explained and derived. Differential-Difference equations of (M/M/1):(GD/∞/∞) Model is derived and then the probability distribution of Pn is introduced. The expected number of units and waiting time distribution in queue and system are presented and discussed. Numerical examples for (M/M/1) :(GD/ ∞/∞) are solving to illustrate the efficiency metrics. Differential-Difference equations of (M/M/1) :(GD/N/∞) Model is derived and then the probability distribution of Pn is introduced. The expected number of units and waiting time distribution in queue and system are presented and discussed. Numerical examples for (M/M/1):(GD/ N/∞) are solving to illustrate the efficiency metrics.			

Module 41

Code	Course/Module Title	ECTS	Semester
OR403	Stochastic Process (1)	6	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	3	78	72
Description			
The theory of stochastic processes deals with systems which develop in time or space in accordance with probabilistic laws. The stochastic processes has many applications in diverse fields such as statistical physics, management science (operations research), communication and control theory, and time series analysis. And other applications in astronomy, biology, industry and medicine.			

Module 42

Code	**Course/Module Title**	**ECTS**	**Semester**
OR404	Regression Analysis (1)	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	63	62
Description			
This course covers the basic concepts of regression analysis through definition of regression analysis, uses of regression analysis, causal relationship, types of regression, general model, assumptions of analysis, estimation of regression parameters, Least Square. In addition, the characteristics of the regression line equation will be entered, and what is related to errors, unbiasedness, estimation of community variance, estimation of regression coefficient variances, estimation of variance of the average response and covariance. Analysis of variance, Confidence intervals, Regression through the origin, Coefficient of Determination, Correlation coefficient, Hypothesis testing will also be discussed. The irregularities or imbalances in the analysis Assumptions will also be understood, A test of lack of fit, Test of homogeneity of error variance, Test of autocorrelation between errors with application.			

Module 43

Code	Course/Module Title	ECTS	Semester
OR405	Pattern Recognition	5	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	62
Description			
In this course, the student will familiarize himself with the scientific concepts related to pattern recognition like how to specify fingerprints, handwriting, human face and the DNA chain. It is also concerned with studying and distinguishing patterns, studying random vectors and the quadratic formula for vectors, finding eigenvalues for functions, and using Bayes classification in classification for data taken from real life. These data may be medical or industrial. As well as the use of Fisher's classification to classify the data and use Bayesian threshold in the classification, and study clustering And methods of clustering to find the cluster such as single –link method, complete-link method ward method and learn the student how to use matlab program in clustering and distances like Euclidean distance, maximum distance, etc.			

Module 44

Code	Course/Module Title	ECTS	Semester
OR406	Scientific Research Method	2	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
1	1	32	18
Description			
An understanding of the nature and importance of scientific knowledge. Knowing the different types of scientific research. Learn how to identify and define the research problem. Developing skills in evaluating research problems. Learning how to choose an appropriate research methodology for a particular study. Developing skills in collecting and organizing research data			

Module 45

Code	Course/Module Title	ECTS	Semester
OR407	Constrain Optimization (2)	6	8
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	3	78	72
Description			
This course is contained Definitions and basic principles of the penalty function and the barrier together.The necessary and sufficient condition, the penalty and the barrier function together Basic theories of the penalty and barrier function together.The general formula, the solution method, and the algorithm is the inequality barrier function . The general formula, the solution method, and the algorithm, the penalty function for equality constraints .G.P.P and S.P.P, Q.P.P. General formula, method of solution and algorithm Applications using MATLAB for Inequality Constraints Applications using MATLAB for Constraints			

Module 46

Code	Course/Module Title	ECTS	Semester
OR408	Queueing theory (2)	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
In this course, Differential-Difference equations and probability distribution of Pn for (M/M/C):(GD/∞/∞) are derived. Expected number of units and waiting time in queue and system are presented. Numerical examples are solved. Differential-Difference equations and probability distribution of Pn for (M/M/C) :(GD/N/∞) are derived. Expected number of units and waiting time in queue and system are presented. Numerical examples are solved. Differential-Difference equations and probability distribution of Pn for (M/M/1):(GD/N/∞) are derived. Expected number of units and waiting time in queue and system are presented. Numerical examples are solved. Differential-Difference equations and probability distribution of Pn for (M/M/C):(GD/N/N) are derived. Expected number of units and waiting time in queue and system are presented. Numerical examples are solved. Differential-Difference equations and probability distribution of Pn for (M/M/∞):(GD/∞/∞) are derived. Expected number of units and waiting time in queue and system are presented. Numerical examples are solved.			

Module 47

Code	Course/Module Title	ECTS	Semester
OR409	Stochastic process (2)	6	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	78	72
Description			
This section is dealing with Poisson Process .Poisson Process is defined as stochastic process and it used in many subjects like customers services and Queues analysis Student learns how to use Poisson process in the life			

Module 48

Code	Course/Module Title	ECTS	Semester
OR410	Regression Analysis (2)	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	63	62
Description			
This course includes the basic concepts of multiple linear regression, Teach the student all the skills of multiple regression analysis, as there will be several independent variables in the regression model, The student will be taught data description, graphical representation, mathematical model, understanding of analysis assumptions of multiple linear regression, parameter estimation using the least squares method, understanding the properties of least squares estimators, analysis of variance table, explanation of the multiple correlation coefficient, partial correlation coefficient, Standard partial regression coefficient, estimation of a confidence interval for a linear function, simple for several partial coefficients, estimation of a confidence interval for the average response, Additional sum of squares, selection of the best regression equation using several criteria, reverse elimination method, forward elimination method, gradient regression method, principal component analysis Path analysis.			

Module 49

Code	Course/Module Title	ECTS	Semester
OR411	English Language	2	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	1	32	18
Description			
This material study helps students to have a base in the language should. This course helps the student who need to review important vocabulary before moving on. The methodical introduction of new language enables students to expand and solidify their language skills. Regular vocabulary introductions are followed by supervised practice exercises that let students use the new words in a supportive way right away. In order to feel comfortable taking part in conversations and discussions, there are also more liberated practice sessions where students can concentrate on improving their fluency. The student will have constant feedback on his/her progress with the aim of modifying, when necessary, his/her learning. Therefore, course contents will be made up of activities that consolidate the linguistic abilities of students, in such a way that they not only learning theoretical knowledge, but create for students the necessary tools for students to continue their language learning along the course. Meaningful learning is brought to be through activities are based on the students' interests with the aim of fostering motivation. Another key methodological concept is that of the autonomous learner.			

Module 50

Code	Course/Module Title	ECTS	Semester
OR412	Project مشروع بحث	5	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
0	3	48	77
Description			
The idea behind scientific research work is to systematically explore and investigate specific topics or questions using rigorous methods. It involves formulating hypotheses, conducting experiments, analyzing data, and drawing meaningful conclusions. Scientific research aims to expand knowledge, address gaps in existing understanding, and contribute to the body of scientific literature. It often involves collaboration, peer review, and replication to ensure reliability. The ultimate goal is to provide evidence-based insights that can inform further studies and practical applications. Scientific research fosters innovation, advances disciplines, and plays a vital role in solving complex problems and improving the quality of life for individuals and societies. The ideas of scientific research for the projects of graduate students in our department revolve around the topics of operations research, in addition to the intelligent techniques and how to use them in these topics. The aim of the graduation project is to train the student to understand the steps of the mechanism of scientific research in order to prepare him for future postgraduate studies.			

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