MODULE DESCRIPTION FORM

Module Information					
Module Title	Optimization / Operations Research			Module Delivery	
Module Type	C			☑ Theory ☑ Lecture ☐ Lab ☑ Tutorial ☐ Practical ☐ Seminar	
Module Code	AIE323				
ECTS Credits	3				
SWL (hr/sem)	75 H/Sem.				
Module Level	3		Semester of Delivery	6	
Administering Department	Artificial Intelligence Eng.		College	College of Engineering	
Module Leader	Amjed Baqer Jumaah		e-mail	Amjed.baqer@alayen.edu.iq	
Module Leader's Acad. Title	Asst. Lec.		Module Leader's Qualification	MSc	
Module Tutor	Amjed Baqer Jumaah		e-mail	Amjed.baqer@alayen.edu.iq	
Peer Reviewer Name			e-mail		
Scientific Committee Approval Date			Version Number	1.0	

Relation with other Modules			
Prerequisite module		Semester	
Co-requisites module		Semester	

Module Aims, Learning Outcomes and Indicative Contents	
Module Objectives	Fundamental concepts of Optimization and Operations Research - real engineering problems as mathematical optimization models - Linear Programming problems using graphical and simplex methods - duality theory and sensitivity analysis - integer programming techniques.- network models including spanning trees, shortest path, and assignment problems - project management tools such as CPM and PERT - game theory and scheduling techniques for decision-making problems.

وزارة التعليم العالي والبحث العلمي
جامعة العين العراقية
كلية الهندسة
قسم الذكاء الاصطناعي

ا.م.د سرمد كاظم ذياب

<table>
<tr><td>Module Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Knowledge</td><td>A1</td><td>A1.1 Define the fundamental concepts of Optimization and the role of mathematical modeling in real-world decision-making problems.
A1.2 Explain different types of optimization problems (linear, nonlinear, integer) and their importance in improving system performance and efficiency.
A1.3 Describe the structure of Linear Programming (LP) models and their relevance in resource allocation and planning.
A1.4 Illustrate solution techniques such as the Simplex Method and their application in solving optimization problems.
A1.5 Explain methods for duality and sensitivity analysis and their use in interpreting optimal solutions.
A1.6 Differentiate between deterministic and stochastic optimization models and their applications in uncertain environments.
A1.7 Apply optimization techniques to practical scenarios such as transportation, assignment, and scheduling problems.</td></tr>
<tr><td>Skills</td><td>B1</td><td>B1.1: Solve structured engineering optimization problems individually.
B1.2: Work effectively within teams to analyze decision-making scenarios</td></tr>
<tr><td></td><td>B2</td><td>B.2.1 Communicate effectively – graphically with a range of audiences using contemporary tools.
B.2.2 Communicate verbally and in writing with a range of audiences using contemporary tools</td></tr>
<tr><td>Ethics</td><td>C3</td><td>C.3.1 Utilize contemporary technologies
C.3.2 Make use of codes of practice and standards, quality guidelines.</td></tr>
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<tr><td>Indicative Contents</td><td>Indicative content includes the following.

Unit 1: Introduction to Operations Research & Linear Programming (8 hours)

• Definition and scope of OR
• Mathematical modeling
• Linear Programming formulation
• Graphical solution method

Unit 2: Simplex Method (10 hours)

• Standard form
• Slack and surplus variables
• Simplex algorithm
• Artificial variables (Big M / Two-Phase method)</td></tr>
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	Unit 3: Duality and Dual Simplex (8 hours) • Formulation of dual problem • Economic interpretation • Complementary slackness • Dual simplex method **Unit 4: Integer Programming (6 hours)** • Integer and binary decision variables • Branch and Bound method • Applications **Unit 5: Network Models (8 hours)** • Network representation (nodes and arcs) • Minimum spanning tree • Shortest path • Assignment problem and Hungarian method **Unit 6: Project Management (CPM & PERT) (6 hours)** • Critical Path Method (CPM) • Slack time calculation • PERT probabilistic model **Unit 7: Scheduling and Game Theory (6 hours)** • Sequencing problems • Scheduling techniques • Introduction to Game Theory • Pure and mixed strategies
Learning and Teaching Strategies	
Strategies	• Presentation • Interactive learning • Discussions • Brainstorming • Group Solving Problems • Problem-Based Learning • Self-learning

Student Workload (SWL)			
Structured SWL (h/sem)	48	Structured SWL (h/w)	3.4
Unstructured SWL (h/sem)	27	Unstructured SWL (h/w)	1.9
Total SWL (h/sem)	75		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري		
	Material Covered	**LOs**
Week 1	Introduction to OR and modeling concepts	A1.1, B1.1, B1.2, B3.1, B3.2, C3.1, C3.2
Week 2	Linear Programming formulation	A1.2, A1.3, B1.1, B1.2, B3.1, B3.2, C3.1, C3.2
Week 3	Graphical method	A1.3, A3.1, B1.1, B1.2, B3.1, B3.2, C3.1, C3.2
Week 4	Simplex Method – basics	A1.4, B1.1, B1.2, B3.1, B3.2, C3.1, C3.2
Week 5	Simplex – advanced problems	A1.5, A4.4, B1.1, B1.2, B3.1, B3.2, C3.1, C3.2
Week 6	Artificial variables (Big M / Two Phase)	A1.6, B1.1, B1.2, B3.1, B3.2, C3.1, C3.2
Week 7	Midterm Exam	A1.6, B1.1, B1.2, B3.1, B3.2, C3.1
Week 8	Duality theory	A1.7, B1.1, B1.2, B3.1, B3.2, C3.1
Week 9	Dual Simplex	A1.7, B1.1, B1.2, B3.1, B3.2, C3.1
Week 10	Integer Programming	A1.5 , A1.7
Week 11	Assignment & Hungarian Method	A1.6, B1.1, B1.2, B3.1, B3.2, C3.1
Week 12	Network Models & Spanning Tree	A،B1.1, B1.2, B3.1, B3.2, C3.1
Week 13	CPM & PERT	A1.7, B1.1, B1.2, B3.1, B3.2, C3.1
Week 14	Scheduling & Game Theory	A
Week 15	Review & Applications	All

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر		
	Material Covered	Los
Week 1		
Week 2		
Week 3		
Week 4		
Week 5		
Week 6		
Week 7		
Week 8		
Week 9		
Week 10		
Week 11		
Week 12		
Week 13		
Week14		
Week15		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	A1
	Assignments	2	10% (10)	2, 4,6,8,10,12	A1
	Projects	1	10% (10)		
	Report	1	10% (10)	13	A1, B1, B2
Summative assessment	Midterm Exam	1	10 % (10)	8	A1
	Final Exam	3	50% (50)	16	A1
Total assessment			100% (100 Marks)		

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	1. Introduction to Operations Research – Frederick S. Hillier & Gerald J. Lieberman. 2. Operations Research: An Introduction – Hamdy A. Taha.	Yes
Recommended Texts	1. Linear Programming and Network Flows – Bazaraa, Jarvis & Sherali.	NO
Websites	https://eng.alayen.edu.iq//colleges/e/42	

Grading Scheme مخطط الدرجات				
Group	**Grade**	التقدير	**Marks (%)**	**Definition**
Success Group (50 - 100)	**A** - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX** – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.