

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information				
معلومات المادة الدراسية				
Module Title	Optimization Algorithms		Module Delivery	
Module Type	Elective		☒ Theory ☐ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☒ Seminar	
Module Code	CET4208			
ECTS Credits	5			
SWL (hr/sem)	150			
Module Level	4	Semester of Delivery		8
Administering Department	CET	College	EETC	
Module Leader	Ammar Hussein Mutlag		e-mail	ammar_alqiesy@mtu.edu.iq
Module Leader's Acad. Title	Professor	Module Leader's Qualification	PhD	
Module Tutor	Asst. Prof. Siraj Qays Mahdi		e-mail	Siraj_qays@mtu.edu.iq
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Scientific Committee Approval Date	13/06/2023	Version Number	1.0	

Relation with other Modules			
العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	Semester	
Co-requisites module	None	Semester	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims أهداف المادة الدراسية	1- Provides students with an introduction to optimization techniques and genetic algorithms. 2- Students will learn about various optimization problems, including linear and nonlinear optimization. 3- Explore the principles and applications of genetic algorithms. 4- Cover the fundamental concepts, algorithmic implementations, and practical considerations for solving optimization problems using genetic algorithms. 5- Students will gain hands-on experience through programming assignments and project work.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Understand the fundamental concepts and principles of optimization techniques. 2- Explain the different types of optimization problems, including linear programming, nonlinear programming, and combinatorial optimization. 3- Evolutionary Algorithms, Swarm Intelligence Algorithms. 4- Understand the principles and workings of genetic algorithms. 5- Advantages and disadvantages of Genetic algorithms. 6- Population, selection, crossover, and mutation algorithms 7- Design and implement genetic algorithms to solve optimization problems. 8- Analyze and compare the performance of different optimization algorithms. 9- Evaluate and select suitable optimization algorithms for specific problem domains. 10- Implement optimization algorithms using programming languages and libraries commonly used in the field. 11- Analyze and interpret the results obtained from optimization algorithms. 12- Apply optimization techniques to real-world applications in various domains.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. 1- Introduction to Optimization [5 hrs] Optimization problems and their classifications; Linear programming and integer programming; Nonlinear Optimization. 2- Evolutionary Computation [5 hrs] Introduction to evolutionary computation; Swarm Intelligence Algorithms; Principles of genetic algorithms, advantages, and disadvantages. 3- Genetic Algorithm Components [5 hrs] Representation and encoding of solutions; Selection, crossover, and mutation operators. 4- Genetic Algorithm Operators and Strategies [25 hrs] Tournament selection, roulette wheel selection, and rank-based selection; Single-point crossover, uniform crossover, and arithmetic crossover; Mutation techniques and their impact on exploration and exploitation

	5- Genetic Algorithm Variants and Extensions [10 hrs] Elitism and population size selection; Adaptive and dynamic parameter settings 6- Applications of Optimization and Genetic Algorithms [10 hrs] Optimization in engineering, operations research, and finance; Applications in scheduling, routing, and resource allocation; Real-world case studies and examples
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials, and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	74	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعياً	5.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	76	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعياً	5.4
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5, 14	LO #1-3 and 4-9
	Projects / Lab.	1	10% (10)	Continuous	All
	Seminar	1	10% (10)	12	LO # 4-11
Summative assessment	Midterm Exam	2 hr	20% (20)	8	LO # 1-7
	Final Exam	4hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to optimization algorithms
Week 2,3	Nature-inspired Optimization Techniques
Week 4,5	Evolutionary Algorithms, Swarm Intelligence Algorithms
Week 6	Introduction to Genetic Algorithm
Week 7	Mid Term Exam
Week 8	Advantages and disadvantages of Genetic algorithms
Week 9	Type of operators, population, selection, crossover, crossover rate, mutation, mutation rate
Week 10,11	Population, selection, crossover, and mutation algorithms
Week 12,13	Applications of genetic algorithms
Week 14,15	Introduction to Particle swarm optimization (PSO)
Week 16	A preparatory week before the Final Exam

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي المختبر

	Material Covered
Week 1	Introduction to MATLAB: m file
Week 2	Benchmark functions
Week 3	The initial population of the genetic algorithm
Week 4	candidate solutions based on dimension and population
Week 5	Population Movement
Week 6	Genetic algorithm implementation
Week 7	The real application of the genetic algorithm

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	"Introduction to Genetic Algorithms" by Melanie Mitchell.	No
Recommended Texts	"Introduction to the Theory of Optimization" by J.E. Dennis Jr. and Robert B. Schnabel.	No
Websites	https://www.coursera.org	

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.