

4/1/4. Course Specification:

## **COURSE SPECIFICATIONS**

### Form

Course Title: Optimization Methods

Course Code: 14016166-3

Date: 2018 –10 – 21.

Institution: Umm Al-Qura University

College: College of Computer and Information Systems Department: Department of Computer Science

### A. Course Identification and General Information

1. Course title and code: Optimization Methods 14016166-3

2. Credit hours: 3

3. Program(s) in which the course is offered. Master of Computer Science (Artificial Intelligence)  
(If general elective available in many programs indicate this rather than list programs)

4. Name of faculty member responsible for the course Dr. Muhammad Arif

5. Level/year at which this course is offered: 2/3

6. Pre-requisites for this course (if any):

7. Co-requisites for this course (if any):

8. Location if not on main campus:

9. Mode of Instruction (mark all that apply):

- |                                     |                      |             |                                  |
|-------------------------------------|----------------------|-------------|----------------------------------|
| a. Traditional classroom            | <input type="text"/> | percentage? | <input type="text" value="100"/> |
| b. Blended (traditional and online) | <input type="text"/> | percentage? | <input type="text"/>             |
| c. E-learning                       | <input type="text"/> | percentage? | <input type="text"/>             |
| d. Correspondence                   | <input type="text"/> | percentage? | <input type="text"/>             |
| f. Other                            | <input type="text"/> | percentage? | <input type="text"/>             |

Comments:

## B Objectives

1. The main objective of this course

This course covers the main concepts of optimization

2. Describe briefly any plans for developing and improving the course that are being implemented. (e.g. increased use of the IT or online reference material, changes in content as a result of new research in the field)

The contents will be prepared from globally recognized text books, web-based reference materials and latest research in the field. Practical home works and a term project related to latest tools and techniques will also be designed. At the end of the course, a seminar day can be announced in which students can present their course projects and literature review.

## C. Course Description (Note: General description in the form used in the program's bulletin or handbook)

### Course Description:

Several problems in many areas such as machine learning, computer vision, data analysis, scheduling, etc. require optimization. This course will teach students computational methods for linear, nonlinear, network, and integer optimization.

1. Topics to be Covered		
List of Topics	No. of Weeks	Contact hours
Introduction to the need of optimization in AI	1	3
Unconstrained optimization methods – Gradient methods	1	3
Unconstrained optimization methods – Newton-like methods	1	3
Unconstrained optimization methods – Conjugate direction methods	1	3
Unconstrained optimization methods – Restricted step methods	1	3
Sum of squares and Nonlinear equations	1	3
Constrained optimization – Linear programming	1	3
Constrained optimization – Quadratic programming	1	3
Constrained optimization – Nonlinear programming	2	6
Optimization using meta-heuristics methods, e.g., Particle Swarm Optimization (PSO)	2	6
Discrete optimization	2	6

### 2. Course components (total contact and credit hours per semester):

	Lecture	Tutorial	Laboratory/ Studio	Practical	Other	Total

Contact Hours	Planned	42					42
	Actual	42					42
Credit	Planned	3					3
	Actual	3					3

**3. Individual study/learning hours expected for students per week.**

9-12

#### 4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategies

On the table below are the five NQF Learning Domains, numbered in the left column.

**First**, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table). **Second**, insert supporting teaching strategies that fit and align with the assessment methods and targeted learning outcomes. **Third**, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy should fit in together with the rest to form an integrated learning and teaching process. (Courses are not required to include learning outcomes from each domain.)

##### Curriculum Map

Code #	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
<b>1.0</b>	<b>Knowledge</b>		
1.1	Understand basics of mathematics and statistics required for optimization	Lectures	Exam, Quizzes
1.2	Understand unconstrained and constrained optimization algorithms	Lectures	Exams, Homework, Quizzes
1.3	Understand different meta-heuristic optimization methods	Lectures	Exam, Homework, Quizzes
1.4	Understand discrete optimization methods	Lectures	Exam, Homework, Quizzes
<b>2.0</b>	<b>Cognitive Skills</b>		
2.1	Design, implement and evaluate constrained and unconstrained optimization methods	Lecture, Case studies	Exams, Quizzes, Homework, Reports,
2.2	Design, implement and evaluate heuristic methods-based optimization	Lecture, Case studies,	Exams, Reports
2.3	Design, implement and evaluate discrete optimization methods	Group discussion, Project	Project Report, Project presentation
<b>3.0</b>	<b>Interpersonal Skills &amp; Responsibility</b>		
3.1	Work in a group to accomplish an application of optimization methods	Group discussion, Project	Project Report, Project presentation

<b>4.0</b>	<b>Communication, Information Technology, Numerical</b>		
4.1	Ability to communicate clearly in oral and written form with range of audiences	Project	Project Report, Project presentation
4.2	Demonstrate the ability to use mathematical and statistical techniques in the design and analysis of optimization methods	Lecture, Case studies	Exams
<b>5.0</b>	<b>Psychomotor (if any)</b>		
5.1			

<b>5. Assessment Task Schedule for Students During the Semester</b>			
	<b>Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)</b>	<b>Week Due</b>	<b>Proportion of Total Assessment</b>
1	Quiz 1	2	3.3%
2	Homework 1	3	3.3%
3	Quiz 2	4	3.3%
4	Homework 2	5	3.3%
5	Midterm Exam	7	20%
6	Quiz 3	8	3.3%
7	Homework 3	9	3.3%
8	<b>Project Report</b>	<b>11</b>	<b>30%</b>
9	Final Exam	14	30%

## D. Student Academic Counseling and Support

- |  |
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| <p>1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic counseling. (include the time teaching staff are expected to be available per week)</p> <ul style="list-style-type: none"><li>i. Office Hours for student counseling and support – Three hours/week</li><li>ii. Availability of teaching Staff on e-learning resources like uqu20/Piazza</li></ul> |
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## E Learning Resources

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|---|
| <p>1. List Required Textbooks</p> <ul style="list-style-type: none"><li>i. Rardin, Optimization in Operations Research, latest edition.</li><li>ii. Fletcher, Roger. Practical methods of optimization. John Wiley &amp; Sons, latest edition.</li><li>iii. Chong, Edwin KP, and Stanislaw H. Zak. An introduction to optimization. Vol. 76. John Wiley &amp; Sons, latest edition.</li></ul> |
| <p>2. List Essential References Materials (Journals, Reports, etc.)</p> <ul style="list-style-type: none"><li>i. Recent Papers in Optimization related journals</li></ul>   |
| <p>3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.</p> <ul style="list-style-type: none"><li>i.</li></ul>  |
| <p>4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.</p> <ul style="list-style-type: none"><li>i. MATLAB, Python or similar software</li></ul>   |

## F. Facilities Required

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|---|
| <p>Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access, etc.)</p>                                |
| <p>1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)</p> <ul style="list-style-type: none"><li>i. One classroom (25 seats)</li><li>ii. One lab (25 PCs)</li></ul>                     |
| <p>2. Technology resources (AV, data show, Smart Board, software, etc.)</p> <ul style="list-style-type: none"><li>i. Whiteboard</li><li>ii. Internet connection</li><li>iii. Anti-plagiarism software</li></ul> |
| <p>3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list)</p>  |

## G Course Evaluation and Improvement Procedures

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| <p>1. Strategies for Obtaining Student's Feedback on Effectiveness of Teaching</p> <ul style="list-style-type: none"><li>i. At the end of semester, course evaluation forms will be filled by the students electronically or on paper. The evaluation forms will be anonymous.</li></ul> |
| <p>2. Other Strategies for Evaluation of Teaching by the Instructor or the Department</p>  |

<ul style="list-style-type: none"> <li>i. Course file of the course will be maintained and evaluated by some senior faculty member.</li> <li>ii. Instructor evaluation is performed for every semester</li> </ul>
<p>3. Procedures for Teaching Development</p> <ul style="list-style-type: none"> <li>i. Constant reading of new books and research papers, attending related conferences and workshops, participation in the research groups and blogs etc.</li> </ul>
<p>4. Procedures for Verifying Standards of Student's Achievement (e.g. check marking by an independent member teaching staff of a sample of student's work, periodic exchange and remarking of tests or a sample of assignments with staff members at another institution)</p> <ul style="list-style-type: none"> <li>i. A random sample from the marked papers may be evaluated by an independent senior faculty member.</li> <li>ii. Departmental quality assurance committee can review the students grades and course files to make sure that high standard of teaching is maintained.</li> </ul>
<p>5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for developing it.</p> <ul style="list-style-type: none"> <li>i. Department has curriculum committee that periodically review courses.</li> <li>ii. Faculty council review offer program as per need.</li> </ul>

**Name of Course Instructor:** Dr. Muhammad Arif

**Signature:** Muhammad Arif **Date Completed:** Oct. 22, 2018

**Program Coordinator:** \_\_\_\_\_

**Signature:** \_\_\_\_\_ **Date Received:** \_\_\_\_\_