**4/1/4. Course Specification:**

# COURSE SPECIFICATIONS

## Form

Course Title: Computer Vision

Course Code: 14016487-3

| | |
|---|---|
| **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: Computer Vision 14016487-3
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. Khaled Termisi
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 | | percentage? | 100 |
| b. Blended (traditional and online) | | percentage? | |
| c. E-learning | | percentage? | |
| d. Correspondence | | percentage? | |
| f. Other | | percentage? | |

Comments:

## B Objectives

1. The main objective of this course

The course provides a theoretical and practical understanding of computer vision and video processing.

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:**

In this course students will gain knowledge of theory and practice in Computer Vision, and by the end will have demonstrable ability to implement a working solution for real-world problems in image and video analysis. Students will get hands-on experience in deriving the mathematical underpinnings as well as the programmatic implementation of classical vision problems such as image classification, object detection and tracking, pose estimation, Structure-from-Motion, localization and mapping and more. Students will additionally learn how to train a deep neural network, write a GPU-optimized algorithm, evaluate their implementations on standard vision datasets, and compare their results to the state-of-the-art work of computer vision laboratories worldwide.

**1. Topics to be Covered**

| List of Topics | No. of Weeks | Contact hours |
|---|---|---|
| Introduction to Computer Vision | 1 | 3 |
| Optics, Light, Color, Human Vision, Cameras | 1 | 3 |
| 2D low-level: Convolutions, Filters, Edges | 1 | 3 |
| 2D mid-level: Interest points, Features, Descriptors | 1 | 3 |
| 2D high-level: Shapes, Models, Matching | 1 | 3 |
| Stitching: Image Registration, Homography, Blending | 2 | 6 |
| Object detection: Introduction | 1 | 3 |
| Object detection: Eigenfaces, Viola-Jones, BoVW | 1 | 3 |
| Tracking: Mean-shift, Kalman Filters | 1 | 3 |
| Segmentation: Clustering, Region Growing, Superpixels, Graph methods, graph cuts, CRF/MRF | 1 | 3 |
| Multi-view 1: MVG intro, Epipolar Geometry, Disparity, MV camera calibration, Stereo, Structured Light | 1 | 3 |

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|---|---|---|
| Multi-view 2: Structure-from-Motion, Visual odometry, SLAM 1, SLAM 2 | 1 | 3 |
| GPU: Parallelizing vision tasks, Practicalities, CUDA, OpenCL | 1 | 3 |

**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 |
|---|---|---|---|
| **1.0** | **Knowledge** | | |
| 1.1 | Recognize the essential of design and implementation of Computer Vision based systems. | Lecture, Small group discussion, research activities. | Exams, Homework, Quizzes, Reports, presentations |
| 1.2 | An ability to recognize the use of Computer Vision in solving real life problems. | Lecture, Small group discussion, research activities | Exams, Quizzes, Reports, Research paper, presentations |
| **2.0** | **Cognitive Skills** | | |
| 2.1 | Design, implement and evaluate an Computer Vision based system, process, component, or program to meet desired needs. | Lecture, Homework, discussion, research activities, case studies, Projects | Exams, Quizzes, Reports, Research paper, Group presentations |

| | | | |
|---|---|---|---|
| 2.2 | Investigate real world problems in the context of Computer Vision and design innovative solutions | Lecture, Homework, discussion, research activities, case studies, Projects | Exams, Quizzes, Reports, Research paper, presentations |
| 2.3 | Design, implement and evaluate an Computer Vision based system, process, component, or program to meet desired needs. | Lecture, Homework, discussion, research activities, case studies, Projects | Exams, Quizzes, Reports, Research paper, presentations |
| **3.0** | **Interpersonal Skills & Responsibility** | | |
| 3.1 | Demonstrate own learning and professional development | Group discussion, Project | Project Report, Project presentation |
| **4.0** | **Communication, Information Technology, Numerical** | | |
| 4.1 | Use of latest information technologies | Project | Project Report, Project presentation |
| **5.0** | **Psychomotor (if any)** | | |
| 5.1 | Ability to operate and construct necessary tools of computer vision systems | Research activities, Projects | Reports, Research paper, Group presentations |

**5. Assessment Task Schedule for Students During the Semester**

| | Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | Quiz 1 | 3 | 5% |
| 2 | Homework 1 | 2 | 5% |
| 3 | Quiz 2 | 7 | 5% |
| 4 | Homework 2 | 6 | 5% |
| 5 | Midterm Exam | 8 | 20% |
| 6 | Project | 13 | 30% |
| 7 | Final Exam | 15 | 30% |

## D. Student Academic Counseling and Support

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| 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)<br>i. Office Hours for student counseling and support – Three hours/week<br>ii. Availability of teaching Staff on e-learning resources like uqu20/Piazza |

## E Learning Resources

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| 1. List Required Textbooks<br>i. Prince, Simon JD. Computer vision: models, learning, and inference. Cambridge University Press, latest edition.<br>ii. Forsyth, David, and Jean Ponce. Computer vision: a modern approach. Upper Saddle River, NJ; London: Prentice Hall, latest edition.<br>iii. Szeliski, Richard. Computer vision: algorithms and applications. Springer Science & Business Media, latest edition. |
| 2. List Essential References Materials (Journals, Reports, etc.)<br>i. Recent Papers in Computer Vision related journals |
| 3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.<br>i. |
| 4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.<br>i. MATLAB, Python or similar software |

## F. Facilities Required

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| 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.) |
| 1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)<br>i. One classroom (25 seats)<br>ii. One lab (25 PCs) |
| 2. Technology resources (AV, data show, Smart Board, software, etc.)<br>i. Whiteboard<br>ii. Internet connection<br>iii. Anti-plagiarism software |
| 3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) |

## G Course Evaluation and Improvement Procedures

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| 1. Strategies for Obtaining Student's Feedback on Effectiveness of Teaching |

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| 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. |
| 2. Other Strategies for Evaluation of Teaching by the Instructor or the Department<br>i. Course file of the course will be maintained and evaluated by some senior faculty member.<br>ii. Instructor evaluation is performed for every semester |
| 3. Procedures for Teaching Development<br>i. Constant reading of new books and research papers, attending related conferences and workshops, participation in the research groups and blogs etc. |
| 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)<br>i. A random sample from the marked papers may be evaluated by an independent senior faculty member.<br>ii. Departmental quality assurance committee can review the students grades and course files to make sure that high standard of teaching is maintained. |
| 5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for developing it.<br>i. Department has curriculum committee that periodically review courses.<br>ii. Faculty council review offer program as per need. |

**Name of Course Instructor:** Dr. Khaled Termisi

**Signature:** *Khaled Termisi* **Date Completed:** Oct. 22, 2018

**Program Coordinator:** _____

**Signature:** _____ **Date Received:** _____