هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

# Course Specification
## (Bachelor)

| | |
|---|---|
| **Course Title:** | **Robotics** |
| **Course Code:** | **CENX 459** |
| **Program:** | **B.S. in Computer Engineering** |
| **Department:** | **Department of Computer Engineering** |
| **College:** | **College of Computer and Information Sciences** |
| **Institution:** | **King Saud University** |
| **Version:** | *Course Specification Version Number* |
| **Last Revision Date:** | *Pick Revision Date.* |

## Table of Contents

## A. General information about the course:

### 1. Course Identification

| 1. Credit hours: ( 1 hours ) | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **2. Course type** | | | | | |
| **A.** | ☐University | ☐College | ☒ Department | ☐Track | ☐Others |
| **B.** | ☐ Required | | ☒ Elective | | |
| **3. Level/year at which this course is offered: ( Level 9 and 10)** | | | | | |
| **4. Course general Description:** | | | | | |
| **Historical development of robotics, robot arm kinematics, inverse kinematics, trajectory planning, resolved motion control, MATLAB simulation of control algorithms. Introduction to autonomous mobile robots. Kinematic model of a wheeled mobile robot, sensors for localization and perception. Mapping, and navigation. Control of a mobile robot. Algorithms implementation on Q-bot mobile robot. Internet and Web Robotics.** | | | | | |
| **5. Pre-requirements for this course** (if any)**:** | | | | | |
| **CEN453-Digital control and robotics** | | | | | |
| **6. Co-requirements for this course** (if any)**:** | | | | | |
| | | | | | |
| **7. Course Main Objective(s):** | | | | | |
| **This course provides students with basic knowledge in robotics as well as algorithms for control, localization, and navigation.** | | | | | |

### 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 4 hours per week | 100% |
| 2 | E-learning | | |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4 | Distance learning | | |

## 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | 45 |
| 2. | **Laboratory/Studio** | |
| 3. | **Field** | |
| 4. | **Tutorial** | 15 |
| 5. | **Others (specify)** | |
| **Total** | | 60 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |
| 1.1 | Apply knowledge of mathematics to kinematics model (forward and inverse kinematics) for an arm manipulator and mobile robot. | **1** | | |
| 1.2 | Explain different approaches used in trajectory planning and obstacle avoidance. | **1** | | |
| **2.0** | **Skills** | | | |
| 2.1 | Design and implement appropriate methods to control an arm manipulator | **1** | | |
| 2.2 | Design and implement different controllers of a mobile robot with obstacles avoidance (Application to Q-bot mobile robot) | **1** | | |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | Simulate an algorithm for autonomous navigation of a mobile | **6** | | |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | manipulator in an unknown environment. | | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | Robot arm forward kinematics and inverse kinematics. | 12 |
| 2. | Control and trajectory planning for arm manipulators. | 8 |
| 3. | Mobile robot (Kinematic, and control) | 12 |
| 4. | Localization, mapping and navigation | 12 |
| 5. | Simulation and implementation of algorithms | 12 |
| 6. | Internet and Web Robotics | 4 |
| Total | | 60 |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | Midterm Examination (1) | 8 | 20% |
| 2. | Midterm Examination (2) | 12 | 20% |
| 3. | Assignments and Quizzes | Weekly | 20% |
| 4. | Final Exam | End | 40% |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| Essential References | Robot Modeling and control by Mark. W. Spong, Seth Hutchinson and M. Vidyasagar, John Willy & Sons, Dec. 2005. |
| Supportive References | Robotics, Vision and control: Fundamental algorithms in MATLAB by Peter Corke, Springer, 2nd ed. 2017. |
| Electronic Materials | https://lms.ksu.edu.sa |
| Other Learning Materials | https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/ |

### 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Lecture room with number of seats enough to accommodate enrolled students. |
| **Technology equipment**<br>(projector, smart board, software) | Overhead projector with required software to facilitate presentations on smart board. MATLAB software for simulation of different algorithms. |
| **Other equipment**<br>(depending on the nature of the specialty) | Q-bot mobile robot for real-time implementation as a demo. |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | Department Council | Course reports are evaluated by the Department Council. |
| Effectiveness of Students assessment | Faculty-Peer Review | Final examination is moderated. |
| Quality of learning resources | Students | Indirect – Edu-gate survey. |
| The extent to which CLOs have been achieved | Students | Attainment level of every CLO is measured directly. |
| Other | | |

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

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|---|---|
| **COUNCIL /COMMITTEE** | |
| **REFERENCE NO.** | |
| **DATE** | |