***Course Specifications of***

# CSE 417 Computer-based Control Systems

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| **Course title:** | Computer-based Control Systems | | | | |
| **Course code:** | CSE 417 | | | | |
| **Academic year**: | | | 4th Year (5th Level) | | |
| **Program including the course:** | | | Electronics and Communications Engineering | | |
| **Department offering the program:** | | | Electronics and Communications Engineering | | |
| **Department offering the course:** | | | Computers and Systems Engineering | | |
| **Lecture:** 3 | | **Tutorial:** 1 | **Lab.:** 0 | **Total:** 4 |  |
| **Lecturer:** | | Dr. Ahmed Alenany | |  | |

1. **Course Objectives:**

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| By the end of the course the students will be able to:   * Describe the components of a digital control system. * Use the z-transform to analyze discrete-time control systems. * Analyze the stability of discrete time control systems. * Design digital control systems using several approaches. * Recognize the implementation issues of discrete control systems. * Identify dynamic systems using least squares method. * Use MATLAB to simulate and design digital control systems. |

**2- Intended learning outcomes of course (ILOs)**

**a- Knowledge and understanding:**

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| a1. | State the components of a digital control system. |
| a2. | Identify the basic properties of z-transform used in the analysis of discrete systems. |
| a3. | Explain how the stability and performance of control systems are affected by the pole locations in z-plane. |
| a4. | List some stability tests of discrete systems. |
| a5. | Recognize the basic methods of digital control system design. |
| a6. | List the steps of identifying dynamic systems using least squares method. |

**b- Intellectual Skills:**

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| b1. | Develop discrete-time models from continuous-time models. |
| b2. | Test the stability of discrete control system. |
| b3. | Design deadbeat, Dahlin, discrete PID, and pole placement controllers using given specifications. |
| b4. | Calculate the parameters of dynamic systems using least squares method. |

**c- Professional and practical skills:**

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| c1. | Use MATLAB for the design and simulation of control systems. |
| c2. | Apply digital control concepts to a case study. |

**d- General and transferable skills:**

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| d1. | Write assignments, discuss results and defend ideas. |

**3- Course Contents**

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| Week No. | Topic |
| 1 | Introduction to digital control systems |
| 2 | Sampled-data systems and the z-transform |
| 3 | Properties and inverse of z-transform |
| 4 | Manipulation of block diagrams in open-loop and closed-loop discrete systems |
| 5 | Comparing discrete to continuous systems - Performance indices of control system and its relationship to pole locations in s and z-plane |
| 6 | Stability of discrete-time systems |
| 7 | Design of deadbeat and Dahlin controllers |
| 9 | Design of discrete controllers using pole placement approach |
| 10 |
| 11 | Discrete PID controller |
| 12 | Controller realization |
| 13 | Introduction to system identification |
| 14 | Case study: control system using microcontroller |

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| **4- Teaching and Learning Methods**  4.1- Lecture.  4.2- Tutorial. |
| **5- Student Assessment**     |  |  |  |  |  | | --- | --- | --- | --- | --- | | Category | Description | No. | Schedule (Week No.) | Mark | | Semester work | Quizzes | 4 | 3, 5, 9, 11 | 5 | | Assignment | 2 | 6, 12 | 5 | | Written exams | Mid-Term Exam | 1 | 8 | 15 | | Final Exam | 1 | 15 | 50 | |  | | | **Total** | **75** | |

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| **6- List of References** |
| **6.1- Course Notes**  **---------------** |
| **6.2- Recommended reference books:**  Microcontroller-based applied digital control, Dogan Ibrahim, Elsevier, 2006. |
| **6.3- Periodicals, Web Sites, etc.**  **---------------** |
| **7- Facilities Required for Teaching and Learning**   * Data show. * Computer software (MATLAB). |
| **Course Coordinator:** Dr. Ahmed Alenany  **Head of Department:** Assoc. Prof. Dr. Nesreen Ibrahim Ziedan  Signature:  Date: |
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**Course Content/ILO Matrix**

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| Course content | a1 | a2 | a3 | a4 | a5 | a6 | b1 | b2 | b3 | b4 | c1 | c2 | d1 |
| Introduction to digital control systems | **•** |  |  |  |  |  |  |  |  |  |  |  |  |
| Sampled-data systems and the z-transform |  | **•** |  |  |  |  |  |  |  |  |  |  |  |
| Properties and inverse of z-transform |  | **•** | **•** | **•** |  |  | **•** |  |  |  |  |  |  |
| Manipulation of block diagrams in open-loop and closed-loop discrete systems | **•** |  |  |  | **•** |  | **•** | **•** | **•** |  | **•** |  |  |
| Comparing discrete to continuous systems - Performance indices of control system and its relationship to pole locations in s and z-plane |  |  | **•** | **•** |  |  |  | **•** |  |  | **•** |  |  |
| Stability of discrete-time systems |  |  | **•** | **•** |  |  |  | **•** |  |  | **•** |  |  |
| Design of deadbeat and Dahlin controllers |  |  |  |  | **•** |  |  |  | **•** |  | **•** |  | **•** |
| Design of discrete controllers using pole placement approach |  |  |  |  | **•** |  |  |  | **•** |  | **•** |  | **•** |
| Discrete PID controller |  |  |  |  | **•** |  |  |  | **•** |  | **•** |  | **•** |
| Controller realization |  |  |  |  | **•** |  |  |  | **•** |  | **•** |  |  |
| Introduction to system identification |  |  |  |  |  | **•** |  |  |  | **•** |  | **•** |  |
| Case study: control system using microcontroller |  |  |  |  | **•** |  |  |  | **•** |  |  | **•** | **•** |

**Learning Method /ILO Matrix**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Learning method | a1 | a2 | a3 | a4 | a5 | a6 | b1 | b2 | b3 | b4 | c1 | c2 | d1 |
| Lecture | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |
| Tutorial | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |

**Assessment Methods /ILO Matrix**

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| Assessment | a1 | a2 | a3 | a4 | a5 | a6 | b1 | b2 | b3 | b4 | c1 | c2 | d1 |
| Quizzes | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |  |  |  |
| Assignment |  |  |  |  |  |  | **•** | **•** | **•** | **•** | **•** | **•** | **•** |
| Mid-Term Exam | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |  |  |  |
| Final Exam | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |  |  |  |