***Course Specifications of***

# CSE 631 System Identification

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| **Course title:** | System identification | | | | |
| **Course code:** | CSE 631 | | | | |
| **Program including the course:** | | | M.Sc. in Computers and Systems Engineering  Ph.D. in Computers and Systems Engineering | | |
| **Department offering the program:** | | | Computers and Systems Engineering | | |
| **Department offering the course:** | | | Computers and Systems Engineering | | |
| **Lecture:** 3 | |  | | |  |
| **Lecturer:** | | Dr. Ahmed Alenany | |  | |

**1 – Course objectives**

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| By the end of the course the students will be able to:   * Use correlation analysis and sine wave test to identify nonparametric model. * Identify parametric dynamic systems using least squares method. * Evaluate the quality of estimated model. * Identify dynamic systems using recursive least squares (RLS) method. * Implement and analyze the algorithms studied using MATLAB. |

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

**a- Knowledge and understanding:**

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| a1. | Explain the meaning of several statistical concepts frequently used in identification such as mean, bias, variance, covariance, and correlation. |
| a2. | Describe the identification of nonparametric models using correlation analysis and sine wave methods. |
| a3. | Explain the least squares method applied for parametric system identification. |
| a4. | List three approaches for evaluating the quality of estimated models. |
| a5. | Recognize several model structures used in identification. |
| a6. | Illustrate the recursive least squares (RLS) method. |

**b- Intellectual Skills:**

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| b1. | Deduce the least squares algorithm. |
| b2. | Calculate the parameters of dynamic systems using least squares method. |
| b3. | Calculate and judge confidence intervals for the estimated parameter. |
| b4. | Deduce the RLS algorithm step by step. |

**c- Professional and practical skills:**

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| c1. | Implement identification algorithms using MATLAB. |

**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 system identification |
| 2 | Review of statistical concepts: mean, bias, variance, covariance, and correlation |
| 3 |
| 4 | Identification of impulse response parameters from general input-output data |
| 5 | Identification of impulse response parameters using correlation analysis |
| 6 |
| 7 | Identification of transfer function using sine wave testing |
| 8 | The least squares method: derivation, geometric meaning |
| 9 |
| 10 | The least squares method: quality of the estimate |
| 11 |
| 12 | Model structures used in identification. |
| 13 | Recursive least squares: derivation and simulation |
| 14 |

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| **4- Teaching and Learning Methods**  4.1- Lectures. |

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| **5- Student Assessment**     |  |  |  |  |  | | --- | --- | --- | --- | --- | | Category | Description | No. | Schedule (Week No.) | Mark | | Semester work | Assignment | 3 | 3, 6, 9 | 30 | | Written exams | Final Exam | 1 | 16 | 70 | |  | | | **Total** | **100** | |

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| **6- List of References** |
| **6.1- Course Notes**  **---------------** |
| **6.2- Recommended reference books:**  System identification an introduction, K. J. Keesman, Springer-Verlag London, 2011. |
| **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 | d1 |
| Introduction to system identification | **•** |  |  |  |  |  |  |  |  |  |  |  |
| Review of statistical concepts: mean, bias, variance, covariance, and correlation | **•** |  |  |  |  |  |  |  |  |  |  | **•** |
| Identification of impulse response parameters from general input-output data |  | **•** |  |  |  |  |  |  |  |  | **•** | **•** |
| Identification of impulse response parameters using correlation analysis |  | **•** |  |  |  |  |  |  |  |  | **•** | **•** |
| Identification of transfer function using sine wave testing |  | **•** |  |  |  |  |  |  |  |  | **•** | **•** |
| The least squares method: derivation, geometric meaning |  |  | **•** |  |  |  | **•** | **•** |  |  | **•** | **•** |
| The least squares method: quality of the estimate |  |  |  | **•** |  |  |  |  | **•** |  | **•** | **•** |
| Model structures used in identification. |  |  |  |  | **•** |  |  |  |  |  | **•** |  |
| Recursive least squares: derivation and simulation |  |  |  |  |  | **•** |  |  |  | **•** | **•** | **•** |

**Learning Method /ILO Matrix**

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

**Assessment Methods /ILO Matrix**

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| Assessment | a1 | a2 | a3 | a4 | a5 | a6 | b1 | b2 | b3 | b4 | c1 | d1 |
| Assignment | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |
| Final Exam | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |  |  |