***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 EngineeringPh.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.
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**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**

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| 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).
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| **Course Coordinator:** Dr. Ahmed Alenany**Head of Department:** Assoc. Prof. Dr. Nesreen Ibrahim ZiedanSignature: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 | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** | **•** |  |  |