# Course Syllabus

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| **1** | **Course title** | System Modelling and Vibrations | |
| **2** | **Course number** | 0908381 | |
| **3** | **Credit hours** | 3 | Obligatory Course |
| | **Contact hours (theory, practical)** | 3 Theoretical Hours | |
| **4** | **Prerequisites/corequisites** | 0301202<br>0903211<br>0904222 | |
| **5** | **Program title** | B.Sc. in Mechatronics Engineering | |
| **6** | **Program code** | 08 | |
| **7** | **Awarding institution** | The University of Jordan | |
| **8** | **School** | Engineering | |
| **9** | **Department** | Mechatronics | |
| **10** | **Course level** | 3 | |
| **11** | **Year of study and semester (s)** | 1st Semester 2023/2024 | |
| **12** | **Other department (s) involved in teaching the course** | | |
| **13** | **Main teaching language** | English | |
| **14** | **Delivery method** | ✓ Face to face learning ☐Blended ☐Fully online | |
| **15** | **Online platforms(s)** | ✓ Moodle ✓ Microsoft Teams ☐Skype ☐Zoom<br>☐Others………… | |
| **16** | **Issuing/Revision Date** | 1/10/2023 | |

**17 Course Coordinator:**

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|---|---|
| **Name:** Dr. Adham Alsharkawi | **Contact Hours:** Sunday-Thursday from 12:00 – 13:00 |
| **Office:** Mechatronics Eng. Dep. | **Phone Number:** 5355000 Ext. 23030 |
| **e-mail:** a.sharkawi@ju.edu.jo | |

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**18 Other instructors:**

**19 Course Description:**

Introduction to system dynamics, nonlinearities and linearization, Laplace transform, solution of linear differential equations using Laplace transform, transfer function of linear systems, dominant poles, block diagram and signal-flow graph, state diagrams, state-space representation of linear systems, time response analysis of first-order and second-order, mathematical modelling of electrical networks, translational mechanical systems, and electromechanical systems, undamped one-degree of freedom vibration of a rigid body using the equation of motion and energy methods, analysis of undamped force vibration and viscous damped forced vibration.

**20 Course aims and outcomes:**

**A. Aims:**

The primary objective of this course is to interpret and analyze the dynamic behavior of physical systems. To reinforce students' understanding, we will utilize tools such as MATLAB, Simulink, and Python.

**B. Student Learning Outcomes (SLOs):**

Upon successful completion of this course, students will be able to:

| SLO(s) / SO(s) | SO (1) | SO (2) | SO (3) | SO (4) | SO (5) | SO (6) | SO (7) |
|---|---|---|---|---|---|---|---|
| Understand the concept of a dynamic system | | | | | | | |
| Solve LTI differential equations using the Laplace Transform method | | | | | | | |
| Apply the block diagram representation to a dynamic system | | | | | | | |
| Apply Mason’s rule to determine the transfer function of a dynamic system | | | | | | | |
| Construct state diagrams from differential equations | | | | | | | |
| Formulate the state-space representation of a dynamic system | | | | | | | |
| Formulate mathematical models for physical systems | | | | | | | |
| Demonstrate understanding of basic vibration theory | | | | | | | |
| Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions | | | | | | ✓ | |

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## 21. Topic Outline and Schedule:

| Week | Lecture | Topic | SLO | Platform | Synchronous / Asynchronous Lecturing | Evaluation Methods | Resources |
|---|---|---|---|---|---|---|---|
| 1 | 1.1 | Introduction to System Modelling and Vibrations (SMV) | | | | | |
| | 1.2 | The Laplace Transform (I) | | | | | |
| 2 | 2.1 | The Laplace Transform (II) | | | | | |
| | 2.2 | The Laplace Transform (III) | | | | | |
| 3 | 3.1 | The Laplace Transform (IV) | | | | | |
| | 3.2 | Transfer Function Approach to Modelling Dynamic Systems | | | | | |
| 4 | 4.1 | Simplifying Complex Block Diagram - Block Diagram Reduction (I) | | | | | |
| | 4.2 | Simplifying Complex Block Diagram - Block Diagram Reduction (II) | | | | | |
| 5 | 5.1 | Mason's Rule and the Signal-Flow Graph (I) | | | | | |
| | 5.2 | Mason's Rule and the Signal-Flow Graph (II) | | | | | |
| 6 | 6.1 | Obtaining a Transfer Function from a State-Space Representation | | | | | |
| | 6.2 | Signal-Flow Graph of State Equations | | | | | |
| 7 | 7.1 | Time Response Analysis (I) | | | | | |
| | 7.2 | Time Response Analysis (II) | | | | | |
| 8 | 8.1 | Time Response Analysis (III) | | | | | |

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|---|---|---|---|---|---|---|---|
| | 8.2 | Time Response Analysis (IV) | | | | | |
| 9 | 9.1 | Time Response Analysis (V) | | | | | |
| | 9.2 | Time Response Analysis (VI) | | | | | |
| 10 | 10.1 | System Response with Additional Poles and Zeros | | | | | |
| | 10.2 | Mathematical Modelling of Electrical Systems (I) | | | | | |
| 11 | 11.1 | Mathematical Modelling of Electrical Systems (II) | | | | | |
| | 11.2 | Mathematical Modelling of Mechanical Systems (I) | | | | | |
| 12 | 12.1 | Mathematical Modelling of Mechanical Systems (II) | | | | | |
| | 12.2 | Electromechanical systems | | | | | |
| 13 | 13.1 | Electromechanical systems | | | | | |
| | 13.2 | Free vibrations (I) | | | | | |
| 14 | 14.1 | Free vibrations (II) | | | | | |
| | 14.2 | Forced vibrations (I) | | | | | |
| 15 | 15.1 | Forced vibrations (II) | | | | | |
| | 15.2 | Linearization | | | | | |

## 22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLO(s) are provided through the following assessment methods and requirements:

| Evaluation Activity | Mark | Topic(s) | SLO(s) | Period (Week) | Platform |
|---|---|---|---|---|---|
| Midterm Exam | 30 | Topics Covered in the First 10 Weeks | | 10th Week | On Campus |
| Quiz | 10 | Mathematical Modelling (Electrical, Mechanical, Electromechanical) | | 13th Week | On Campus |
| MATLAB | 10 | MATLAB for SMV | | 15th Week | On Campus |
| Final Exam | 50 | All Topics | | | |

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**23 Course Requirements**

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| **(e.g: students should have a computer, internet connection, webcam, account on a specific software/platform…etc):**<br>Every student is required to have a computer equipped with MATLAB and a reliable internet connection. |

**24 Course Policies:**

- **Attendance:**

Students are expected to attend EVERY class session. They are responsible for all materials, announcements, schedule changes, and other pertinent information discussed in class.

- **Make-up Examinations**

Make-up exams will not be offered for any scheduled exams throughout the course. Exceptions are limited to:

  - The passing of immediate family members (father, mother, sister, or brother).
  - Hospitalization (as an inpatient) at the time of the scheduled examination.

Any other circumstances will result in a score of zero for the respective exam.

**25 References:**

**Required book:**

- System Dynamics by Katsuhiko Ogata. 4th Edition, Prentice Hall.

**Recommended books:**

- Control Systems Engineering, by Norman S. Nise, 6th Edition, Johm Wiley.
- Modern Control Systems. Richard Dorf and Robert Bishop, 12th Edition, Prentice Hall.
- Modern Control Engineering, Katsuhiko Ogata, 5th Edition n, Prentice Hall.

**26 Additional information:**

| | Name | Signature | Date |
|---|---|---|---|
| **Course Coordinator:** | Dr. Adham Alsharkawi | | |
| **Head of Curriculum Committee/Department:** | | | |
| **Head of Department:** | | | |
| **Head of Curriculum Committee/Faculty:** | | | |
| **Dean:** | | | |