Alpha Institute of Technology

Engineering Graduate School of CAEDMI

AIT GRADUATE CATALOG
2024-2026

Course Listing for Mechatronics and Robotics

(Rev. 2.4)

CAEDMI
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Office of the AIT Academic Affairs

Recommended Courses per semester: A minimum of **120 credits** is required for graduation.

Semester	Course (credit)	Comment
1st	**General core courses (13)** GP 5001 – Pedagogy and Psychology for Engineers GL 5005 – Technical Writing Essentials for Engineers GM 5030 – Engineering Mathematics **Core courses (10)** MeRo 5020 – Embedded Control Systems MeRo 5011 - Linear Control Systems for Mechatronics ***Core elective courses (5): Choose one course** MeRo 5010 – Simulation Techniques for Dynamic systems MeRo 6031 – System Dynamics and Modeling **Practice (2)** MeRo 7001 – Research	*Elective courses will be offered contingent upon the availability of instructors.
2nd	**General elective courses (5): Choose one course** GL 5010 – Thesis Writing in English GL 5006 – Korean Language and Culture (*conditional) **Core courses (8)** MeRo 5050 – Power Electronics ****Core elective courses (7): Choose one course** MeRo 5040 – Mechatronic Systems: Sensors, Actuators and Applications MeRo 5045 – Introduction to Robotic Systems and Control **Practice (10)** MeRo 7002 – Internship MeRo 7001 – Research	* GL5006: Students must get approval from the Academic Dean. **Elective courses will be offered contingent upon the availability of instructors.
3rd	**General core courses (3)** GM 7000 - Research and Development (R&D) Methods for Engineers **Core courses (5)** MeRo 5051 – Energy conversion systems and control ***Core elective courses (10): Choose one course from a and b** (a1) MeRo PRC6010 – Thermodynamic Principles with Electro-mechanical Systems (a2) MeRo 6012 – Advanced Control of Mechatronics Systems (b1) MeRo 6020 – Mathematical Methods for Data Analytics (b2) MeRo 6050 – Power converter modeling and control **Practice (12)** Prc 7003 – Pedagogical Practice MeRo 7001 – Research	*Elective courses will be offered contingent upon the availability of instructors.
4th	**Practice (15)** Prc 7003 – Teaching Practice **Graduation work (15)** MeRo 7010 – Dissertation MeRo 8000 – State Examination	

General Courses (All credits required)

GP 5001 – Pedagogy and Psychology for Engineers
This course is designed to s to equip engineering students with the psychological knowledge and skills needed to create technologies that are safe, efficient, and user-friendly. Also, students will study the physiological basis of behavior, including how engineers understand humans in designing systems that align with human physical and cognitive capabilities.
Credit Hour(s): 3
Lecture Hour(s): 3 hours (6 weeks) including practice hours
Semester: 1ST Semester (Fall)
Instruction Type(s): Lecture, Online Lecture, practice
Prerequisite(s):

GL 5005 – Technical Writing Essentials for Engineers
This course is designed to equip engineering students with the skills to produce clear, accurate, and informative technical documents, including research methods and proper documentation practices, research reports, project proposals, and feasibility studies. Students are introduced to ethical considerations and legal issues related to technical documentation, such as intellectual property, confidentiality, and plagiarism.
Credit Hour(s): 5
Lecture Hours(s) : 3 hours
Semester: 1ST Semester (Fall)
Instruction Type(s): Lecture, Online Lecture, practice
Prerequisite(s): Upper-Intermediate level of spoken and written English

GM 5030 – Engineering Mathematics
This course covers a diverse range of mathematical topics that are essential for early graduate engineering courses. It includes subjects such as linear algebra, systems of ordinary differential equations, Laplace transforms, Fourier series and transforms, and partial differential equations, among others.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 1ST Semester (Fall)
Instruction Type(s): Lecture, Online Lecture, laboratory
Prerequisite(s): Basics of Calculus and some familiarity with differential equations.

General Courses (All credits required)

GM 7000 - Research and Development (R&D) Methods for Engineers
This course aims to provide engineering graduate students with the skills and knowledge necessary to conduct thorough and impactful research in their field. It offers an overview of the research process, including formulating hypotheses and research objectives in engineering. Additionally, students are introduced to various research designs and methodologies that contribute to the final outcomes of their research. Engineers also need to be aware of ethical issues and integrity, including plagiarism, text reuse, and data falsification.
Credit Hour(s): 3
Lecture Hour(s): 1.5 or 3 hours (6 or 12 weeks) including practice hours
Semester: 3RD Semester (Fall)
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): GL 5005: Technical Writing Essentials for Engineers

Electives 1: General Courses (5 Credits required)

GL 5010 – Thesis Writing in English
This course provides thesis writing skills and knowledge needed to complete their M.S. Thesis successfully. Students learn the following components in the classroom: Introduction to thesis writing, literature review, research methodology, thesis proposal development, formatting and submission, and ethical considerations, oral defense preparation.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 2ND Semester (Spring)
Instruction Type(s): Lecture, Online Lecture, practice
Prerequisite(s): GL 5005: Technical Writing Essentials for Engineers

GL 5006 – Korean Language and Culture
This course This course is designed for students with little to no prior knowledge of the Korean language and culture. It provides a comprehensive introduction to the basics of Korean language, including reading, writing, speaking, and listening skills. Additionally, the course offers insights into Korean culture, history, and social customs.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 2ND Semester (Spring)
Instruction Type(s): Lecture, Online Lecture, practice
Prerequisite(s): GL5005: Technical Writing Essentials for Engineers or GL5010

Major Courses (All credits required)

MeRo 5011 - Linear Control Systems for Mechatronics
This course offers a comprehensive introduction to the principles of linear systems, including an in-depth exploration of transfer functions and Laplace transforms. It delves into the concept of stability and feedback, providing essential design tools for specifying transient response. Furthermore, the course encompasses frequency-domain techniques, offering a thorough understanding of their application.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 1st Semester (Fall)
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): Familiarity with linear system model, calculus
Corequisite(s):

MeRo 5020 – Embedded Control Systems
This graduate-level course provides a comprehensive introduction to embedded control systems for first-year students, including the fundamentals of embedded control systems. It focuses on technology relevant to mechatronics and robotics control systems, using single-board micro-computers, such as Raspberry Pi- and/or Arduino-based control systems.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 1st Semester (Fall)
Instruction Type(s): Lecture, Online Lecture, laboratory
Prerequisite(s): Electrical circuit and electronics, understanding of hardware and programming language
Corequisite(s):

MeRo 5050 – Power Electronics
This course covers advanced analysis, design, and control of power electronic systems, providing graduate students with the knowledge and skills to engineer efficient and robust power conversion circuits for various applications in areas like renewable energy systems, motor drives, electric vehicles, and power supplies.
Credit Hour(s): 8
Lecture Hour(s): 3 (Lab hours included)
Semester: 2ND Semester (Spring)
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): Strong foundation in electrical engineering fundamentals, including circuit analysis, control theory, and MeRo 5010ge: Simulation technique of dynamic systems.

Major Courses (All credits required)

MeRo 5051 – Energy conversion systems and control
All-electric actuators and drives are being vigorously developed and applied to transportation, robot, aircraft, and naval applications, to name a few, to enhance reliability and efficiency. This course will meet such emerging needs with the science and engineering aspects involved in the modeling, analysis, design, and control of such systems. Furthermore, as a part of the coursework, students will learn and utilize an online motor design tool (EasiMotor) to design AC motors, expecting to have a practical learning experience. I would like to express my gratitude to *EasiTech company* for providing online software that is accessible to students.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 3RD Semester (Fall)
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MeRo 5011 Power Electronics, Mero 5050 Linear control systems

Electives 1: Major Courses (5 Credits required)

MeRo 5010 – Simulation Techniques for Dynamic systems
This course is designed to provide an introduction to the use of software tools for dynamic system modeling, control system analysis, and design. The course will focus on practical applications in real-world dynamic systems, placing particular emphasis on the development of models, validation processes, parameter identification techniques, effective control algorithms, and presentation of results. Students will gain hands-on experience with various software tools and learn how to apply them to solve complex dynamic system problems.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 1st Semester (Fall)
Instruction Type(s): Lecture, Online Lecture, laboratory
Prerequisite(s): Familiarity with electrical circuit and linear system control
Corequisite(s):

MeRo 6031 – System Dynamics and Modeling
This course provides an exploration of modeling multi-domain engineering systems, focusing on a level of detail appropriate for design and control system implementation. Key topics covered include network representation, state-space models, multiport energy storage and dissipation, nonlinear mechanics, transformation theory, Lagrangian and Hamiltonian forms, and control-relevant properties. Practical application examples encompass a wide range of systems, such as electro-mechanical transducers, mechanisms, electronics, fluid and thermal systems, compressible flow, chemical processes, diffusion, and wave transmission.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 1st Semester (Fall)
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MeRo 5030 Engineering Math, Some familiarity with physical system modelling
Reference: Brown, Forbes T. *Engineering System Dynamics*. New York, NY: CRC, 2001. ISBN: 9780824706166.

Electives 2: Major Courses (5 Credits required)

MeRo 5040 – Mechatronic Systems: Sensors, Actuators and Applications
This course provides a comprehensive introduction to the fundamentals of mechatronic systems. It is designed to expose students to the theoretical knowledge and practical skills necessary to design, analyze, and implement advanced mechatronic systems. The course covers a wide range of topics, including sensors and actuators, control systems, microcontrollers, and the integration of mechanical, electrical, and computer engineering principles.
Credit Hour(s): 7
Lecture Hour(s): 3 (Lab hours included)
Semester: 2ND Semester (Spring)
Instruction Type(s): Lecture, Online Lecture, seminars
Prerequisite(s): Basic knowledge of electrical circuit, electronics, linear control systems

MeRo 5045 – Introduction to Robotic Systems and Control
This course provides a comprehensive introduction to the field of robotics, focusing on the mechanics and control of robotic systems. Students will explore the fundamental principles and techniques used in the design, analysis, and control of robots.
Credit Hour(s): 7
Lecture Hour(s): 3 (Lab hours included)
Semester: 2ND Semester (Spring)
Instruction Type(s): Lecture, Online Lecture, seminars
Prerequisite(s): Basic knowledge of electrical circuit, electronics, linear control systems

Electives 3: Major Courses (5 Credits required)

MeRo PRC6010 – Thermodynamic Principles with Electro-mechanical Systems
This course provides graduate students with the skills and knowledge needed to effectively use Computer-Aided Design (CAD) software for designing and developing complex electro-mechanical systems. It offers an in-depth exploration of thermodynamic principles and their applications within these systems. Students will learn fundamental concepts of thermodynamics, including the laws of thermodynamics, energy conversion, and the behavior of gases and liquids. The course emphasizes the integration of thermodynamic principles with electro-mechanical systems, highlighting their real-world applications in engineering.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 3RD Semester (Fall)
Instruction Type(s): Lecture, Online Lecture, Laboratory
Prerequisite(s): Understanding of mechanical systems, MeRo 6031 System Dynamics and Modeling

MeRo 6012 – Advanced Control of Mechatronics Systems
This course focuses on advanced techniques for controlling mechatronic systems. Key topics include digital signal processing, system inversion-based control algorithms, robustness properties, Youla parameterization, optimal feedforward compensators, repetitive and learning control, adaptive control, and real-time control applications. The course combines theoretical lectures with practical laboratory sessions to provide a comprehensive understanding of these advanced control methods.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 3RD Semester (TBD)
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MeRo 5011 Linear Control Systems; MeRo 5041 – Mechatronics and Robotic Systems, and Applications

Electives 4: Major Courses (5 Credits required)

MeRo 6020 – Mathematical Methods for Data Analytics
This course is designed for engineering students as well as data science aspirants. It provides a comprehensive understanding of advanced mathematical and statistical methods essential for data analytics. Students will explore key concepts in probability, statistics, linear algebra, and mathematical optimization, with a focus on their applications in data analytics and machine learning. The course emphasizes practical implementation of mathematical and statistical algorithms using programming tools.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 3RD Semester (TBD)
Instruction Type(s): Online Lecture
Prerequisite(s): MeRo 5030 Engineering Math, MeRo 5020, and programming languages like Python or other relevant languages
Reference: Wolfgang Ertel (translated by Nathanael Black), *Introduction to Artificial Intelligence 2ND edition*, Springer, 2017.

MeRo 6050 – Power converter modeling and control
This course is an advanced course of power electronics, covering the nonlinear modeling of power conversion circuits of DC-DC converter and DC-AC inverter in theories and simulations. During the course, practical applications and case studies will be presented as well.
Credit Hour(s): 5
Lecture Hour(s): 3
Semester: 3RD Semester (TBD)
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): MeRo 5030 Engineering Math, MeRo 5050 Power Electronics, MeRo 5011 Linear Control Systems for Mechatronics

Research / Thesis Criteria (All credits required)

MeRo 7001 – Research
Research work for projects and thesis as a degree requirement.
Credit Hour(s): up to 30
Lecture Hour(s): N/A
Semester: 1st, 2nd, 3rd, 4th semester
Instruction Type(s): Independent research work, project related research, Thesis preparation
Prerequisite(s):
Corequisite(s):

MeRo 7002 – Internship
Internship at a company to gain hands-on experiences as a degree requirement.
Credit Hour(s): 6
Lecture Hour(s): N/A
Semester: 2ND Semester (Spring)
Instruction Type(s): Research, Online research, laboratory
Prerequisite(s):
Corequisite(s):

Prc 7003 – Pedagogical Practice
Educational and pedagogical practice for graduation requirements.
Credit Hour(s): 3
Lecture Hour(s): N/A
Semester: 3RD Semester (Fall)
Instruction Type(s): research, Online research
Prerequisite(s):
Corequisite(s):

MeRo 7010 – Dissertation
Master's dissertation work as a degree requirement.
Credit Hour(s): 12
Lecture Hour(s):
Semester: 4TH Semester (Spring)
Instruction Type(s): research, Online research
Prerequisite(s):
Corequisite(s):

MeRo 8000 – State Examination
State examination as a degree requirement.
Credit Hour(s): 3
Lecture Hour(s):
Semester: 4TH Semester (Spring)
Instruction Type(s):
Prerequisite(s):
Corequisite(s):

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Revision History

Date: Oct. 03, 2024
Rev.1.2 : MeRo 5041 Description and course semester changed.
Date: Jan. 09, 2025
Rev.2.0 : Major Changes
- G 5010 → Moved to General Elective courses from General Required courses
- MeRo 5030→ G 5030 (General Courses)
- MeRo 7000 → G7000 (General Courses); Credits: 5 → 3
- MeRo 5010, 6031 → Moved to Major Elective courses from General Electives
- MeRo 5040 + MeRo 5041 → MeRo 5040:
  a) Combined two courses and moved to Elective course
  b) Credits: 5 → 7
- MeRo PRC 6010 → Moved to Elective course
- Credits in the Research/Thesis Criteria are changed.

Date: Feb. 06, 2025
Rev.2.1 : Year (2025-27 → 2024 -26) changed
Date: Feb. 07, 2025
Rev.2.2 : MeRo 6011 (Robotic Systems and Control) Removed
Date: Feb. 28, 2025
Rev.2.3 :
- Course titles were revised according to the curriculum (Year 2024-26)
- MeRo PRC 6010, MeRo 6020 : Course titles are changed. They are more detailed.

Date: Mar. 3, 2025
Rev.2.4 : Added the table of courses per semester with credits