# MNE3046: AUTOMATION TECHNOLOGY

**Effective Term**
Semester A 2024/25

## Part I Course Overview

**Course Title**
Automation Technology

**Subject Code**
MNE - Mechanical Engineering
**Course Number**
3046

**Academic Unit**
Mechanical Engineering (MNE)

**College/School**
College of Engineering (EG)

**Course Duration**
One Semester

**Credit Units**
3

**Level**
B1, B2, B3, B4 - Bachelor's Degree

**Medium of Instruction**
English

**Medium of Assessment**
English

**Prerequisites**
ADSE2011/SYE2011 Fundamental Engineering Analysis and Design for Manufacturing Engineers II OR
EE2005 Electronic Devices and Circuits OR
BME2029/MNE2029 Electrical and Electronic Principles I or equivalent
OR
MNE3049 Control Principles

**Precursors**
Nil

**Equivalent Courses**
Nil

**Exclusive Courses**
Nil

# Part II Course Details

**Abstract**

The aim of this course is to introduce concepts of fixed, programmable and flexible automation/mechatronics, their design, implementation, application and cost-effects. The emphasis will be placed on

- the utilization of mechanization devices and material handling systems;
- the "design-for-assembly" principles;
- the most common part and motion sensing devices (excluding machine vision);
- programmable motion controllers, with an emphasis on how to build two-state on/off, combinational, and sequential automation systems – by relying on case studies, appreciate the maturity, versatility and effectiveness, as well as limitations, of the technology involved;
- the construction, performance, programming and application of non-servo (limited sequence) robots and expected cost effects;
- the development, anticipation, selection and supervision of the implementation of flexible assembly systems in manufacturing;
- the design and development of a mini-project to demonstrate automatic control capability through the techniques and tools learned in the course.

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | Identify technology options for automating a production facility or process after simplifying the operations (by design-for-assembly and similar considerations). | | x | | |
| 2 | Generate for this task solutions that may form the fixed, programmable or flexible automation systems and then hypothesise cost-effects of implementing it in order to assess possible alternatives. | | | x | |
| 3 | Analyse possible partitioning of the adopted automation- concept into functional modules, then into individual devices, while either identifying standard engineering components that are commercially available for such devices or compiling the performance specification for non-standard engineering components that must be custom built. | | | x | |
| 4 | Integrate part and motion sensing devices, with material handling, testing, robotic or other subsystems, into a microprocessor-controlled system with programmable controllers and simple electronic-signal interfacing requiring aspects of digital electronics. | | x | x | x |

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

**Learning and Teaching Activities (LTAs)**

| | LTAs | Brief Description | CILO No. | Hours/week (if applicable) |
|---|---|---|---|---|
| 1 | Lecture | Traditional lecture with case studies. | 1, 2, 3, 4 | 3 hrs/week |
| 2 | Laboratory Work | Hands-on experience. | 1, 2, 3, 4 | 3 hrs/week for 3 weeks |

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Laboratory Reports | 2, 3, 4 | 20 | 3 reports to be submitted |
| 2 | Mini-project (group) with presentations | 1, 2, 3, 4 | 20 | 1 Report to be submitted with presentations. The presentation will be marked independently by a panel composed by 2-3 members (Teaching staff and assistants). A peer assessment form will also be collected from each member of a group. |

**Continuous Assessment (%)**

40

**Examination (%)**

60

**Examination Duration (Hours)**

2.5

**Additional Information for ATs**

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained

**Assessment Rubrics (AR)**

**Assessment Task**

1. Laboratory Reports

**Criterion**

Application of control principles. Explain differences between theory and practice.

**Excellent (A+, A, A-)**

Strong evidence of original thinking; excellent capacity to analyse and synthesize experimental data and systems; superior grasp of hand-on skills; clear evidence of extensive knowledge base in data interpretation, system integration, analysis skills, and/or technical trends.

**Good (B+, B, B-)**

Evidence of grasp of subject topics, and some evidence of critical capacity and analytic ability in control systems; reasonable understanding of basic control theory and methods; evidence of familiarity with the literature of control engineering.

**Fair (C+, C, C-)**

Student who is profiting from the university experience; understanding of the main control topics; ability to develop solutions to simple problems in control system integration.

**Marginal (D)**

Sufficient familiarity with the subject matter in control system integration to enable the student to progress without repeating the course.

**Failure (F)**

Little evidence of familiarity with the control essential methods; weakness in critical and analytic skills in using control methods; limited or irrelevant use of taught control theory or methods in experiments.

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**Assessment Task**

2. Mini-project (group) with presentations

**Criterion**

Application of control principles. Explain differences between theory and practice.

**Excellent (A+, A, A-)**

Strong evidence of original thinking; excellent capacity to analyse and synthesize experimental data and systems; superior grasp of hand-on skills; clear evidence of extensive knowledge base in data interpretation, system integration, analysis skills, and/or technical trends.

**Good (B+, B, B-)**

Evidence of grasp of subject topics, and some evidence of critical capacity and analytic ability in control systems; reasonable understanding of basic control theory and methods; evidence of familiarity with the literature of control engineering.

**Fair (C+, C, C-)**

Student who is profiting from the university experience; understanding of the main control topics; ability to develop solutions to simple problems in control system integration.

**Marginal (D)**

Sufficient familiarity with the subject matter in control system integration to enable the student to progress without repeating the course.

**Failure (F)**

Little evidence of familiarity with the control essential methods; weakness in critical and analytic skills in using control methods; limited or irrelevant use of taught control theory or methods in experiments.

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**Assessment Task**

3. Examination

**Criterion**

Describe the fundamental concepts of engineering mechanics and apply them to solve the problems that involve loading and motion.

**Excellent (A+, A, A-)**

Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

**Good (B+, B, B-)**

Significant evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with course matter.

**Fair (C+, C, C-)**

Student is profiting from the university experience; understanding of the mechanics; ability to develop solutions to simple problems in the course.

**Marginal (D)**

Basic familiarity with the subject matter to enable the student to progress without repeating the course.

**Failure (F)**

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; very limited demonstration of correct use knowledge in mechanics.

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**Additional Information for AR**

**Note: For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.**

# Part III Other Information

**Keyword Syllabus**

Overview of Automation. Design for Assembly and/or mechatronics. Part and motion sensing devices (excluding machine vision). System integration, material handling, testing, and/or other subsystems. Automated cells. Programmable controller design, analysis and ladder diagram. Basic electronic interface circuits for device integration. Boolean logic, logic gates and simple designs. Design and control of non-servo robots from standard components.

**Reading List**

**Compulsory Readings**

| | Title |
|---|---|
| 1 | Frank Lamb, Industrial Automation: Hands-On, McGraw-Hill, 2013. |
| 2 | Siciliano, Bruno, and Oussama Khatib, eds., Springer Handbook of Robotics, Springer Science & Business Media, 2008. |

**Additional Readings**

| | Title |
|---|---|
| 1 | S. B. Morriss, Automated Manufacturing Systems, McGraw-Hill Int. Editions. |
| 2 | Bishop, Christopher M., Pattern Recognition and Machine Learning, Springer, 2006. |
| 3 | N. P. Mahalik, Mechatronics, McGraw-Hill. |