

MNE4125: PRINCIPLES AND TRANSPORT PROCESS FUNDAMENTALS OF SEMICONDUCTOR MANUFACTURING

Effective Term

Semester A 2026/27

Part I Course Overview

Course Title

Principles and Transport Process Fundamentals of Semiconductor Manufacturing

Subject Code

MNE - Mechanical Engineering

Course Number

4125

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

Nil

Precursors

Nil

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

Microchips are made in a series of precise manufacturing processes involving hundreds or thousands of repeated operations to fabricate interconnected multi-layer electronic components on the same wafer at the designed specification. The engineers who wish to develop their careers in the semiconductor fabrication plants should have the basic knowledge of the principles of semiconductor manufacturing and the capability to solve problems encountered in their future careers with the transport processes in the manufacturing.

This course aims to provide students with a solid understanding of the principles of semiconductor manufacturing, particularly on the fundamentals of involved transport processes. Lectures will be given with illustrative examples for enhancing the students' knowledge comprehension. Homework assignments will assist students in developing their skills to analyze the transport process problems in the manufacturing. In addition to the examination, students are required to learn through individual project sessions to improve their understanding of strategic thinking, problem-solving, and interactions between the fields of knowledge they have learned in this and the other courses.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if DEC-A1 DEC-A2 DEC-A3 app.)			
1	Describe the principles and the transport process fundamentals in semiconductor manufacturing and their impacts on the process performance.		x		
2	Solve a problem of semiconductor manufacturing which involves modeling and simulation of transport process.			x	
3	Select relevant skills to obtain the solutions for the manufacturing problems.			x	
4	Present analyses and results of projects in a proper format of a written report such that a technically-qualified person can follow and obtain similar findings.		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	This includes typical lectures on different topics of transport processes and applications in semiconductor manufacturing accompanied by in-class activities.	1, 2, 3	3 hrs/week
2	Project Work	Students should do independently on the assigned project works for designing their fabrication process for an electronic device using knowledge learned in the class.	1, 2, 3, 4	Project information will be provided in class time. Assessment will be based on reports submitted.

Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?	
1	Quizzes and test	1, 2, 3	20	Quizzes in individual lectures. One mid-term test on week 7.	No
2	Project Reports	1, 2, 3, 4	20	Two reports to be submitted	Yes

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

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. Quizzes and test

Criterion

Ability to apply the concepts of semiconductor manufacturing to solve assigned problems.

Excellent (A+, A, A-)

80%-100%

Good (B+, B, B-)

60%-80%

Fair (C+, C, C-)

45%-59%

Marginal (D)

40%-44%

Failure (F)

<40%

Assessment Task

2. Project Reports

Criterion

Ability to use the learned knowledge to design the fabrication steps to electronic components, analyse the processes involved in the proposed fabrication steps, and discuss the project outputs.

Excellent (A+, A, A-)

Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge of the lectured materials concerned.

Good (B+, B, B-)

Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with lectured materials.

Fair (C+, C, C-)

Student who is profiting from the project class; understanding of the subject; ability to develop solutions to concerning the project.

Marginal (D)

Sufficient familiarity with the project content to enable the student to move onto other project materials.

Failure (F)

Little evidence of familiarity with the project class materials; weakness in critical and analytic skills; limited, or irrelevant use of data.

Assessment Task

3. Examination

Criterion

Capability to apply the fundamental concepts of semiconductor manufacturing processes to solve the manufacturing problems.

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 principle of semiconductor manufacturing; 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 semiconductor manufacturing.

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

This course will cover the principles and transport processes fundamentals in the following operations:

- wafer manufacturing,
- chemical mechanical planarization,
- photolithography,
- epitaxy,
- oxidation,
- vapor deposition,
- wafer washing,
- ion diffusion,
- etching,
- ion implant,
- rapid thermal processing.

Reading List

Compulsory Readings

Title	
1	There is no compulsory reading suitable for the current syllabus.

Additional Readings

Title	
1	H Xiao, Introduction to Semiconductor Manufacturing Technology, 2nd Edn, 2012
2	G.S. May and C.J. Spanos, Fundamentals of semiconductor manufacturing and process control, John Wiley & Sons, 2006