MNE4125: PRINCIPLES AND TRANSPORT PROCESS FUNDAMENTALS OF SEMICONDUCTOR MANUFACTURING

Effective Term
Semester B 2022/23

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 collaborative project sessions to improve their understanding of strategic thinking, problem-solving, team working, the relationships, and interactions between the fields of knowledge they have learned in this and other courses.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
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.

Teaching and Learning Activities (TLAs)

	TLAs	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 for 13 weeks
2	Project Work	Students should team up on assigned project work for designing their fabrication process for an electronic device using knowledge learned in the class and summarize and discuss the results obtained from the design.	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 (e.g. Parameter for GenAI use)
1	Tests and Assignments	1, 2, 3	20	One mid-term test
2	Project Reports	1, 2, 3, 4	20	2 reports to be submitted

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. Tests and Assignments

Criterion

Apply the concepts of semiconductor manufacturing to solve problems.

Excellent (A+, A, A-)

75%-100%

Good (B+, B, B-)

60%-74%

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
Describe the fundamental concepts of semiconductor manufacturing processes 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 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	D.A. Neamen, Semidconductor Physics and Devices. McGraw Hill, 2003
2	G.S. May and C.J. Spanos, Fundamentals of semiconductor manufacturing and process control, John Wiley & Sons, 2006