ADSE4006: SEMICONDUCTOR MANUFACTURING AND PROCESS CONTROL

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Semiconductor Manufacturing and Process Control

Subject Code
ADSE - Advanced Design and System Engineering
Course Number
4006

Academic Unit
Systems Engineering (SYE)

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
ADSE3003 Design and Analysis of Manufacturing Processes and Systems

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The aim of this course is to provide students with a basic understanding of the approaches and techniques for semiconductor manufacturing and process control. The course will provide an overview of the critical unit processes in semiconductor manufacturing and the integration of these unit processes into sequences for fabricating and packaging ICs. The course will introduce various sensor metrology and methods of monitoring IC fabrication processes, and various statistical modelling techniques including the most recent artificial intelligence (AI) methods. Advanced process control will be introduced including univariate and multivariate run-by-run control, and intelligent supervisory control.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand manufacturing concept and goal, beware of basic knowledge of modern semiconductor manufacturing, and acquire fundamental knowledge of statistical control and AI methods.	15	x		
2	Beware of major steps of unit process: oxidation, photolithography, etching, ion implantation, and metallization; Beware of process integration into sequences for fabricating and packaging integrated circuits.	20		x	
3	Beware of various sensor metrology and methods of monitoring IC fabrication processes. Understand wafer state measurement and equipment state measurement.	15		x	
4	Beware of basic modelling technologies, such as, regression, principal component analysis, and the most recent AI approaches. Design linear model, nonlinear model, and multivariable model for the given problem.	20		x	x
5	Beware of difference between real-time engineering control and statistical process control; Design run-by-run control with various methods; Design supervisory control with model and AI methods.	30		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 self-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	Large Class Activities	Take place in classroom setting and consist of lecturing and student activities in between. Students will be grouped in the large classroom to work on mini-tasks.	1, 2, 3, 4, 5	3 hours/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks
1	Course work	1, 2, 3, 4, 5	40	

Continuous Assessment (%)
40

Examination (%)
60

Examination Duration (Hours)
2

Additional Information for ATs
For a student to pass the course, at least 30% of the maximum mark for the examination should be obtained.

Assessment Rubrics (AR)

Assessment Task
Course work

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Excellent (A+, A, A-)
High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Additional Information for AR
Examination and course work will be numerically marked and grades awarded accordingly. Overall, the course work weights about 40% and examination weights about 60% of the total mark. The course work includes two assignments and one test.

Part III Other Information

Keyword Syllabus

- Manufacturing introduction
- Statistical fundamentals
  - statistical process control
  - experimental design
- Manufacturing technologies
  - Unit processes
  - Process integration
- Process monitoring
- Process modeling
  - Regression modeling
  - Intelligent modeling
- Advanced process control
  - Run-by-run control
  - Supervisory control

Reading List

Compulsory Readings

	Title
1	Gary S. May & Costas J. Spanos, Fundamentals of Semiconductor Manufacturing and Process Control, John Wiley & Sons Inc, 2006

Additional Readings

	Title
1	Nil