High-Tech Facility Design

Purpose: The purpose of this course is to provide basic design knowledge needed for fabrication facilities that supplement high-tech manufacturing and R&D. High-Tech includes, not limited to, the advanced technologies applied in the fields of micro-electronics, optoelectronics, precision equipment, telecommunication, nanotech, pharmaceutics, biotech, medical devices, animal experiment, and Aerospace. The processes undertaken in high-tech manufacturing plants and R&D labs require cleanrooms with extremely stringent environmental control.

The environmental control includes temperature and humidity level, air/water quality, purity of chemicals and gases, noise and vibration degree, electromagnetic and radio frequency interference, electrostatic discharge, materials out-gassing, safe grounding, assurance of personnel health, safety and security and prevention of biohazard.

The focus of this course is on designing cleanroom and engineering its associated facilities. Students will gain skills needed to meet ever-changing challenge of delivering an ultra pure clean room and ultra pure utilities. Moreover, this course will strengthen students' understanding and background in constructing high-tech manufacturing fab/plant and research lab. Many advanced topics will be introduced, such as 450mm/18" fab, 10 nm manufacturing, IoT (Internet of Things), Green Fab, FinFET (Fin Field-Effect Transistor), LiFi (Light Fidelity), Intelligent Sensing, AMHS (Automated Material Handling System)...etc.

Outstanding full-time students will be recommended for summer internship from high-tech companies and get exposure to high-tech facility design and/or construction in summer.

Scope: This course is intended to offer to **undergraduate Juniors and Seniors, MS, EMBA & PhD students**. Students in engineering, science, pharmacy, and life sciense will be exposed to fundamental theories and their applications in the design/build/certify of the high tech manufacturing plants and research labs. Academic faculty will teach basic theories and principles. Professional industrial experts will be invited to address the application of theories and principles in the real world practices. The contents will include lectures, pop quizzes, home works, a semester team project with an oral presentation and a written report, and/or a final examination. Field trips to visit high-tech plants and research labs, and cleanrooms will be arranged. Moreover, laboratory experiments will be provided to enable students to have hands-on experiences to measure the cleanroom where is the heart of high-tech M&R&D.

High-Tech Facility Design– Fall

WEEK	SUBJECT
1	Moon Festival (holiday)
2	Course Introduction, High-tech Facilities Overview (Green Manufacturing and Fab Economics)
3	Fundamentals of Integrated Circuit Manufacturing Processes, (3D IC Design, Immersion, EUV, ArF-dry, Imprint, and Double Patterning)
4	Airborne Molecular Contamination and EMI Mitigation
5	5D Design Tool (BIM) and Term Project Kickoff
6	Plan, Design and Construction of a Fab Environmental Impact Assessment
7	Fundamentals of Vibration, Architecture and Structure Design
8	Fab Layout and Automated Material Handling System
9	No Midterm Exam, Mandatory Field Trip on 12/10. Visit TSMC Construction Sites in Taichung
10	30% Design Review
11	UPW, Gases and Chemical System Design
12	Cleanroom and Mechanical System
13	Electrical and Facility Management & Control System No Midterm Exam, Mandatory Field Trip on 12/10. Visit TSMC Construction Sites in Taichung
Field Trip	Visit TSMC Construction Sites in Taichung
14	60% Design Review Meeting and Concurrent Engineering
15	Code Compliance for Semiconductor Facilities
16	Air abatement, Wastewater treatment and Waste Management
17	Group Term Project Presentation (Final 100% Design Review)
18	Final Exam

1. The above course outline may be adjusted to suit for students' interests and learning progress.
2. Other guest instructors may be invited to reinforce students understanding of applying theories into real world practice.
3. The course will be taught in Mandarin. Most hand-outs, homework arrangements and final exam will be in English.
4. Students are welcome to use English in the class and answer the homework, and final Exam.
5. To get 10% grade for class participation, students have to take all the field trips except emergency.

GROUP PROJECT:

There is one (1) group term project. The group term project tests the student's understanding of the principal concepts covered in the course within the context of a comprehensive "real-world" problem. It also provides an opportunity to develop skills for working in a project team context and communication skills. The group report should conform to good engineering practices and should include, as a minimum, a title page, abstract, table of contents, introduction, theories, real-world practice, comparison between theory and practice, conclusion and references. A good quality report contains **well-indicated reference pages and balanced arguments with solid evidences**. Individual student's contribution to the report should be clearly indicated.

The following deadlines must be observed:

1. Joining a Group, and Selection of Focus Design Area,
2. Table of Contents and Abstract
3. 30% Design Complete
4. Design Complete
5. E-mail in the Group Presentation Slides.
6. Oral Presentation, Only PowerPoint slides are suitable for the presentation. The oral presentation should be 15 minutes in length which includes time for questions and discussion. However, groups will be penalized if more than 20 minutes are required to present their group's study.
7. Turn in two paper final reports, one CD contains final report and presentation slides.

Any group misses the above deadline will be penalized 5% off the semester term project grade.

Grading Scale of the Course:

1. Measurement -10%
2. Homework -5%
3. Final Exam-15%
4. Group Project-60%
5. Attendance-10%