**Course Outline Fall II 2018-2019**

**10661437 – Growth Aspects of Semiconductors**

**Instructor:** Dr. Iyad SAADDDIN

**Office:** physics department (Room # 142460)

**Expected Course outcome (Objectives):** The student expected to have a clear overview of the microelectronic fabrication process. Also the student will be able to Understand the physics of each key step in the process. In addition, the student will be able to understand new technologies by self-learning in the future.

**Grading:** First Exam 25% : Sunday 03/03/2019 (12:00-13:00)

Second Exam 25% : Sunday 14/04/2019 (12:00-13:00)

Final Exam 50% :

**Primary text:**

 "Introduction to Microelectronic Fabrication, 2nd ed", Richard C. Jaeger, Prentice Hall 2002

**Other references**:

 "Microelectronic Processing", W.S. Ruska, McGraw-Hill

 "The Science and Engineering of Microelectronic Fabrication", Stephen Campbell, 2nd ed, Oxford Univ. Press.

**Prerequisite:**

 Students need understanding of basic transistor & diode operation.

**Intended topics to be covered:**

**1: Clean Room Technology & Silicon Wafer Production**

 Basic outline of fabrication process: with to real structures.

 Theory behind clean room operations:

 History of semiconductor devices: diodes, transistors, Germanium/Silicon transition, monolithic integrated circuits

 Basic operation of Transistors, diodes

 Projected trends in Fabrication

 Theory and operations for contamination elimination, and safety issues.

 Silicon wafers; Crystallography, Production and Defects:

 Basic silicon wafer parameters, solid solubility of dopants in silicon, defects, and basic economics of operations.

**2: Thermal Oxidation**

 Basic theory of the silicon oxidation, practical operations and measurement of films (thickness and quality).

**3: Lithography**

 Basic operation of photolithography, chemical basis of photoresist, exposure equipment, exposure/development theory, and problems.

**4: Advanced Lithography**

 Dealing with defects and exposure effects

 Advanced Lithography, Deep UV, Extreme UV, X-ray

**5: Etching**

 Theory and operations of etching in general;

 Wet (chemical) etching of oxides

**6: Etching II**

 Wet etching of silicon and metals

**7: Diffusion Processes & Ion Implantation**

 Diffusion theory (constant, limited source, multisource).

 Theory and operation of Ion implantation doping techniques.

**8: Thin Film Deposition: Evaporation and Sputtering**

 Theoretical and experimental operation of vacuum systems.

 Theory and operation of evaporation and sputtering systems

**9: Thin Film Deposition: Chemical Vapor Deposition**

 Theory and operation of Chemical Vapor Deposition (CVD), Plasma Enhanced CVD

 Film thickness measurement and film problems

**10: Expitaxy CVD and Dry Etching Processes**

 Expitaxy (deposition with same crystal structure) & laser CVD

 Dry etching processes (Plasma, Sputtering and Reactive Ion)

**11: Packaging, Yields, Processing Silicon Foundries**

 Testing, dicing of wafers, packaging, bonding, yield theory and measurements.

 Measurement techniques: Optical microscope, Scanning Electron Microscope, energy dispersive analysis of

X-rays, Augue analysis, Secondary Ion Mass Spectroscopy (SIMS), Laser Ion Mass Spectroscopy (LIMS),

Rutherford Backscatter Spectroscopy (RBS), X-ray diffraction.

 Silicon Foundries

**12: CMOS and Bipolar Process Integration in practice**

 Layer by layer process of sample CMOS and Bipolar

 Yield Analysis

 Using mask design tools

**13: Future of the processing**

 Problems in submicron technology and Micromachining/sensors as a new fabrication area.

 Summary of main course points.