City University of Hong Kong
Course Syllabus

offered by Department of Physics
with effect from Semester B 2017 / 2018

Part I Course Overview

Course Title:	**Emerging Semiconductor Devices in 21st Century**
Course Code:	**AP6265**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**P6**
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**Nil**
Precursors: *(Course Code and Title)*	**Nil**
Equivalent Courses: *(Course Code and Title)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**AP5265 Semiconductor Physics and Devices** **AP8265 Emerging Semiconductor Devices in 21st Century**

Part II Course Details

1. Abstract

Nowadays electronic devices have tremendous impact on our society and daily life. This is driven by the development of semiconductor technology during the last century. Several Nobel prizes and prestigious awards have been given to physicists, engineers, and chemists who contributed to the breakthrough understanding and development of the science and technology of semiconductors. However, existing Silicon based technology is reaching a bottle-neck, and new materials and device concept are developing for the next generation devices that required supper high-efficiency and low-power consumption.

This course will provide the students an overview of the development of semiconductor devices. Several important semiconductor physics and prototypical devices will be introduced. It is followed by the discussions of the limitations of existing technology. Emphasis will be put on the discussions of the state-of-the-art materials and device concept for the next generation semiconductor devices.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Understand the major physics and working principles of semiconductor devices.	20%		√	
2.	Develop connections between applications and different functionalities of semiconductor devices.	20%		√	
3.	Understand the limitations of existing technology on such fast-growing and high-demanding society.	10%		√	
4	Innovatively project the future development of semiconductor devices with emerging technology with nano and novel semiconducting materials.	30%			√
5	Develop insight on future development of electronic devices and applications.	20%	√		
		100%			

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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5		
1	Lectures	√	√	√	√	√		26 hrs / 13 wks
2	Tutorials	√	√	√				4 hrs / 4 wks
3	Group project and presentation				√	√		6 hrs / 6 wks

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5			
Continuous Assessment: 100%								
Assignment	√	√	√	√	√		20%	performance assessment purpose
Midterm	√	√	√				30%	performance assessment purpose
Presentation		√	√	√	√		20%	Research project
Report		√	√	√	√		30%	Research project
Examination: 0%								
							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	Understand the principle concepts and able to master certain design rules in semiconductor devices.	High	Significant	Moderate	Basic	Not reaching marginal level
2. Midterm	Individual ability of problem solving; able to apply knowledge on differentiating different requirements and judging various technical issues of semiconductor devices.	High	Significant	Moderate	Basic	Not reaching marginal level
3. Presentation	Having an in depth understanding on the selected semiconductor devices; The working principle, limitations, and future development**.**	High	Significant	Moderate	Basic	Not reaching marginal level
4. Report	Having an in depth understanding on the selected semiconductor devices; The working principle, limitations, and future development**.**	High	Significant	Moderate	Basic	Not reaching marginal level

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

- A review of classical semiconductor physics and devices (e.g. pn junction, energy band, diode, MOSFET etc.).
- An introduction of classical optoelectronic devices (e.g. LED, laser, photodetectors and solar cells etc.). The working principles and applications.
- Advanced semiconductor devices will be discussed in details (e.g. tunnel diode, TFT, JFET, MESFET). Semiconductor devices for special applications.
- New device physics will be introduced (e.g. heterojunction, quantum well, Coulumb blockade effect, ballistic transport etc.). New physics for the next generation semiconductor devices.
- Emerging semiconductor devices (e.g. single electron transistor, ballistic transistor, 2-D materials, nano-devices etc.). New concept and promising performance of devices are developing in research.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	S. M. Sze and Kwok K. Ng, "Physics of Semiconductor Physics (3rd)", Wiley, 2007

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Supriyo Datta, "Quantum Transport Atom to Transistor", Cambridge University Press, 2005