

**City University of Hong Kong  
Course Syllabus**

**offered by Department of Physics  
with effect from Semester B 2017/18**

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**Part I Course Overview**

**Course Title:** **Nanotechnology for Biological and Medical Applications**

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**Course Code:** **AP6179**

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**Course Duration:** **One semester**

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**Credit Units:** **3**

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**Level:** **P6**

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**Medium of Instruction:** **English**

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**Medium of Assessment:** **English**

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**Prerequisites:** **Nil**  
*(Course Code and Title)*

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**Precursors:** **Nil**  
*(Course Code and Title)*

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**Equivalent Courses:** **Nil**  
*(Course Code and Title)*

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**Exclusive Courses:** **AP8179 Nanotechnology for Biological and Medical Applications**  
*(Course Code and Title)*

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## Part II Course Details

### 1. Abstract

The course presents the knowledge of the application of nanomaterials in biology and medicine. Upon successful completion of the course, the students are expected to gain a broad view of using nanomaterials for various applications and improve the ability of applying nanomaterials to address some of the problems/limitations of the current technologies and therapies in biology and medicine.

### 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<br>(if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) |    |    |
|-----|--|------------------------------|---|----|----|
|     |  |                              | A1  | A2 | A3 |
| 1.  | Identify and describe the concept, synthesis and characterisation of nanomaterials.  |                              |   | √  |    |
| 2.  | Identify and evaluate the risks of nanomaterials.  |                              |   | √  |    |
| 3.  | Design the application of nanomaterials in biology and medicine and explain the working principles. Identify the state-of-the-art developments in this area.                                     |                              |   | √  |    |
| 4.  | Apply the knowledge and encourage discovery, innovation and creativity activities to address some of the problems/limitations of the current technologies and therapies in biology and medicine. |                              | √   |    | √  |
|     |  | 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 |                            |
| Large Class Activities  | Introduce the concept of different classes of nanomaterials and their utilities in biology and medicine.   | √        | √ | √ | √ | 2.5 hrs/week               |
| Small Class Activities  | Ask the students to survey a specific class of nanomaterials used in biology and medicine. The students are also required to provide their opinions on the nanomaterials in the context of bioapplications.  |          |   | √ | √ | 0.5 hr/week                |
| Literature Study Report | Ask the student to comment on an assigned literature. They are recommended to answer the following questions:<br>What have you learnt from the reading?<br>What inspiration do you get?<br>What are the advantages of the described technologies?<br>Do the described technologies still have shortcomings? If yes, how to improve them in your opinion? |          |   | √ | √ | 0.5 hr/week                |

### 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 |           |         |
| Continuous Assessment: 50%           |          |   |   |   |           |         |
| Assignment                           |          |   | √ | √ | 30%       |         |
| Mid-term test                        | √        | √ | √ | √ | 20%       |         |
| Examination: 50% (duration: 2 hours) |          |   |   |   |           |         |
|                                      |          |   |   |   | 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<br>(A+, A, A-) | Good<br>(B+, B, B-) | Fair<br>(C+, C, C-) | Marginal<br>(D) | Failure<br>(F)                    |
|------------------|--|--------------------------|---------------------|---------------------|-----------------|-----------------------------------|
| 1. Examination   | Ability to describe and explain the scientific principles and to solve biological and medical problems | High                     | Significant         | Moderate            | Basic           | Not even reaching marginal levels |
| 2. Mid-term test | Ability to explain the working mechanisms and to solve related problems                                | High                     | Significant         | Moderate            | Basic           | Not even reaching marginal levels |
| 3. Assignment    | Ability to sum up, to assess, and to comment on the work of their peers                                | High                     | Significant         | Moderate            | Basic           | Not even reaching marginal levels |

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

**1. Keyword Syllabus**

- Introduction of nanomaterials (Focused on nanomaterials having potential applications in biology and medicine: mainly colloidal nanoparticles, but will include nanowires, nanorods, nanotubes, nanofilms, etc.)
- Biological and medical driven strategies for synthesizing nanomaterials (including phase transfer between aqueous and organic solvents)
- Characterization of nanomaterials
- The application and working principle of nanomaterials in biology and medicine

Nanoparticles for controlled/targeted drug delivery. Gene therapy using nanoparticles. Cancer therapy using nanoparticles. Nanoparticles in immunology. Nanoparticles in cell biology and therapy. Bactericidal applications of nanoparticles. Quantum dots as fluorescent probes. Nanoparticles in diagnosis. Magnetic nanoparticles for medical applications. Biomedical applications of other nanomaterials (e.g., nanotubes, nanowires, nanofilms). Nanorobotics. Nanomaterials for implants.

- Nanomaterial safety (opportunities and risks)

**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.)*

Nil

**2.2 Additional Readings**

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

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| 1. | Nano-biotechnology for biomedical and diagnostic research, Eran Zahavy, Arie Ordentlich, Shmuel Yitzhaki, Avigdor Shafferman (Editors), 2012, Springer                                     |
| 2. | Nanofabrication towards biomedical applications: techniques, tools, applications, and impact, Challa SSR Kumar, Josef Hormes, Carola Leuschner (Editors), 2005, Wiley-VCH                  |
| 3. | Journals:<br>Nature<br>Science<br>Nature Nanotechnology<br>Nature Biotechnology<br>Nature Medicine<br>Biomaterials<br>Nanomedicine: Nanotechnology, Biology and Medicine<br>Nanotoxicology |