**City University of Hong Kong**
**Course Syllabus**

**offered by**
**Department of Mechanical Engineering**
**with effect from Semester B 2019 / 2020**

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**Part I Course Overview**

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|---|---|
| **Course Title:** | CAD/CAM/CAE Integration |
| **Course Code**: | MNE8112 |
| **Course Duration:** | 1 semester |
| **Credit Units**: | 3 credits |
| **Level**: | R8 |
| **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)* | MBE6001/MNE6001 CAD/CAM Integration |
| **Exclusive Courses**: *(Course Code and Title)* | Nil |

## Part II Course Details

### 1. Abstract

The aim of this course is to develop a comprehensive understanding of technology underlying Computer Aided Design and Manufacture and Computer Aided Engineering solutions. Students will learn how to apply CAD/CAM/CAE technology to solve integrated design/analysis/manufacturing problems with a significant geometric component.

### 2. Course Intended Learning Outcomes (CILOs)

| No. | CILOs[#] | Weighting* (if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) | | |
|---|---|---|---|---|---|
| | | | *A1* | *A2* | *A3* |
| 1. | **describe** the mathematical basis for the representation of geometric entities including parametric curves and free-form surfaces. | | ✓ | ✓ | |
| 2. | **describe** the basic theories and algorithms for solid modelling and other advanced representation schemes. | | ✓ | ✓ | |
| 3. | **elaborate** the general methodology for integrated CAD/CAE solutions and **apply** the method for typical applications. | | ✓ | ✓ | |
| 4. | **describe** the techniques in CNC toolpath computation for 3-axis and multi-axis machining with selected topics in advanced CAD/CAM applications. | | ✓ | ✓ | |
| 5. | **interpret** a design/analysis/manufacturing problem with a significant geometric component, **translate** it into an algorithmic problem, and **apply** relevant techniques to solve it. | | | ✓ | ✓ |
| ** If weighting is assigned to CILOs, they should add up to 100%.* | | N.A. | | | |

*[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.*

*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)

| TLA | Brief Description | CILO No. | | | | | Hours/week (if applicable) |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| Lecture | Lectures covering four major areas on CAD modelling, integrated CAD/CAE solutions, CAM processing, and 3D printing. | ✓ | ✓ | ✓ | ✓ | ✓ | 2 hrs/week |
| Tutorial | Tutorials on CAD modelling, including spline-based modelling, subdivision-based modelling and solid modelling. | ✓ | ✓ | | | ✓ | 1 hr/week for 8 weeks |
| Mini-project | Mini-projects covering various topics on integrated CAD/CAE solutions, CAM, 3D printing and other closely related topics. | | | ✓ | ✓ | ✓ | 1 hr/week for 5 weeks |

## 4. Assessment Tasks/Activities (ATs)

| Assessment Tasks/Activities | CILO No. | | | | | Weighting* | Remarks |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| Continuous Assessment: 40% | | | | | | | |
| Assignment / Test | ✓ | ✓ | | | ✓ | 15% | |
| Mini-project | | | ✓ | ✓ | ✓ | 25% | |
| Examination: 60% (duration: 2 hours) | | | | | | | |
| Examination | ✓ | ✓ | ✓ | ✓ | ✓ | 60% | |
| **The weightings should add up to 100%.* | | | | | | 100% | |

**For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.**

## 5. Assessment Rubrics

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B, B-) | Fair (C+, C, C-) | Marginal (D) | Failure (F) |
|---|---|---|---|---|---|---|
| 1. Examination | Through examination, the students will be evaluated on the knowledge in the fields of CAD/CAM/CAE integration. | High | Significant | Moderate | Basic | Not even reaching marginal levels |
| 2. Assignment/ Test | Tutorials mainly covering various topics of lectures on CAD modelling and processing. | High | Significant | Moderate | Basic | Not even reaching marginal levels |
| 3. Mini-project | Mini-projects mainly covering topics on integrated CAD/CAE solutions, CAM processing, 3D printing, and other closely related topics. | High | Significant | Moderate | Basic | Not even reaching marginal levels |

## Part III Other Information

### 1. Keyword Syllabus

CAD/CAM systems, Bezier, B-spline and NURBS for curve and surface modelling, subdivision-based modelling, CSG and B-Rep for solid modelling, algorithms for curve/curve intersection, curve/surface intersection and surface/surface intersection, isogeometric analysis for integrated CAD/CAE solutions with typical applications in computational mechanics and thermal analysis, algorithms for 3-axis and multi-axis toolpath extraction, data processing for 3D printing.

### 2. Reading List

### 2.1 Compulsory Readings

None

### 2.2 Additional Readings


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|---|---|
| 1. | Les Piegl and Wayne Tiller, "The NURBS Book", Springer-Verlag Berlin, Heidelberg, 1997. |
| 2. | David F. Rogers, “An Introduction to NURBS : with Historical Perspectives”, Academic Press, San Francisco, 2001. |
| 3. | I. Zeid, “Mastering CAD/CAM with Engineering Subscription Card”, McGraw-Hill, 2004. |
| 4. | J. Austin Cottrell, Thomas J. R. Hughes, Yuri Bazilevs, "Isogeometric Analysis: Toward Integration of CAD and FEA", John Wiley & Sons, 2009. |
| 5. | Christopher G. Provatidis, “Precursors of Isogeometric Analysis: Finite Elements, Boundary Elements, and Collocation Methods”, Springer, 2019. |
| 6. | I. Gibson, D. Rosen and B. Stucker, "Additive Manufacturing Technologies - 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer-Verlag New York, 2015. |
| 7. | Computer Methods in Applied Mechanics and Engineering, Elsevier Science. |
| 8. | Computer-Aided Design Journal, Elsevier Science. |