

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	ME22003
Subject Title	Visualization and Communication in Design Engineering
Credit Value	3
Level	2
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	<ol style="list-style-type: none"> 1. To enhance the students' three-dimensional visualization skills and equip them with range of visual communication tools; and 2. To provide students with fundamental understanding of the engineering design process.
Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <ol style="list-style-type: none"> a. Appreciate the qualities of a well-designed product and have awareness of the need of specific disciplinary knowledge to develop functional products that meet customer's and manufacturer's need; b. Communicate engineering design details with confidence using range of visualization and communication tools including hand-sketching, CAD geometric models, mechanism simulations, engineering drawings and physical prototypes; c. Work in a team to modify or improve an existing consumer product; and d. Apply project management techniques in meeting planned schedule.
Subject Synopsis/ Indicative Syllabus	<p><i>Appreciation of Design Engineering</i> – Characteristics of good design, customer's perspective, manufacturer's perspective, role of materials, investigation of manufacturing methods, skills of a design engineer, examples of successful design.</p> <p><i>Creativity and Design process</i> – What is design? Basic introduction to engineering design process, creativity in design, Visual thinking (brainstorming, concept mapping) and its relationship with design innovation, applications of computer in design.</p> <p><i>Visualization and Communication techniques for Design Engineering</i> – hand-sketching, 3-D solid modelling, assembly modeling and simulation, engineering drawings, prototyping (virtual prototypes, 3-D printing, physical prototypes).</p> <p><i>Working in a Team Environment</i> – Multi-disciplinary project team: its importance in modern industry/community. Functions of design project team: team roles, design logbook, project scheduling, review and assessment of design stages, project outcome communication including interim report, oral presentation, final report and prototype presentation.</p>
Teaching/ Learning Methodology	This introductory course aims at arousing students' interest in design engineering and related skills important for engineering design. It also aims at developing interest and curiosity in all relevant subsequent subjects. Students are learnt to

appreciate the qualities of well-designed products through direct interaction with the products. The importance of design visualization and communication will be experienced with in-class group/individual activities. Design communication tools including hand- sketching, CAD geometric modeling, mechanism simulation, engineering drawings, and 3D printing will be introduced with the use of real product examples. The focus of software introduction is not mere training but education in fundamentals to equip the students with sound skills for lifelong career.

The intended learning outcomes of the subject are mainly achieved through a group design improvement project. Students will work in groups of 4-5 members. All the learning activities, including CAD skill development are centered around a product given to each student group. Students begin the learning by studying the function, design features, materials, manufacturing methods, technology, etc. of the product. They then develop visualization techniques by sketching the product. The product is then dissected to learn about the internal mechanisms, take part measurements and develop CAD geometric models. The geometric model is used for assembly and mechanism visualization, basic design analysis and use creativity techniques to make a simple design improvement to improve the product function/cost reduction/improve its aesthetic qualities, etc. The details of the final design are then presented using different visualization and communication techniques such as photo rendering, 3-D printed physical models, hand crafted models, and 2-D engineering drawings. Final outcome will be presented orally and through a written technical report.

Following is the suggested study plan:

Week 1	Introduction of the subject and the mini team-project
Week 2	Appreciation of design engineering; Introduction to solid modelling: Part modelling
Week 3	Creativity and design process; Introduction to solid modelling: Assembly modelling and 2-D Engineering documentation
Week 4	Practice and consultation: (for weeks 1, 2 & 3 including planning of the mini team-project)
Week 5	Solid Modelling with mechanism
Week 6	Surface Modelling and sheet metal modelling
Week 7	Practice and consultation: (for weeks 5 & 6 including checking milestones of the mini team-project)
Week 8	Basic simulation of mechanism motion
Week 9	Basic Structural/static analysis
Week 10	3-D printing and Solid Modelling with photo rendering
Week 11-13	Practice and consultation: (to complete and present the mini team-project)

Assessment Methods in Alignment with Intended Learning Outcomes	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
			a	b	c	d
	1. Individual assignments	30%	√	√		
	2. Group assignments	20%	√	√	√	
	3. Oral communication: Group oral presentation	20%	√	√	√	
	4. Written communication: Group technical report (with peer evaluation)	30%	√	√	√	√
Total	100 %					
<p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</p> <p>Overall Assessment: 1.0 x Continuous Assessment</p> <p>Written examination is not suitable for this course since a specific set of knowledge is not the intended learning outcome. Focus is more on the skill development, critical thinking and creativity improvement. Individual assessment of students can be achieved through individual assignments, oral presentation and peer evaluation. Project assessment consists of an oral presentation and a written report. The assessment is performed by a panel of assessors that includes guest assessors from the industry. Project assessment is mainly based on the performance of the whole project group to encourage team spirit. Intra-group peer evaluation is performed to elicit the individual contribution for project activities.</p>						
Student Study Effort Expected	Class contact:				Time	
	▪ Lectures				15 Hrs.	
	▪ Small group activities/Workshops/Consultations				24 Hrs.	
	Other student study effort:				Time	
	▪ CAD and sketching skills development				40 Hrs.	
	▪ Independent study and homework				20 Hrs.	
	▪ Project				20 Hrs.	
	Total student study effort				119 Hrs.	

Reading List and References	<ol style="list-style-type: none">1. D.K. Lieu and S. Sorby, Visualization, Modeling, and Graphics for engineering Design, CENGAGE Learning, Latest Edition.2. M.N. Horenstein, Design Concepts for Engineers, Prentice Hall, latest edition.3. T. Taura, Creative design engineering : introduction to an interdisciplinary approach, Academic Press, Latest Edition.
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