PROPOSAL OF A NEW GRAPHICS COURSE IN THE FACULTY OF ENGINEERING

BACKGROUND

Within the framework of the NSERC Design Engineering Chair, the Faculty of Engineering (FoE) is committed to providing a renewed emphasis on the teaching of design in its curricula. In reviewing the design and design-related courses offered in the FoE, mostly in the Department of Mechanical Engineering (DME), the DME Design Committee found that the teaching of graphics, on which the design courses hinge, requires an in-depth revision. Indeed, the DME offers two graphics courses, one for its own programs, MECH 291 Graphics, and one service course, MECH 290 Graphics 2, taken by Civil Engineering and Mining Engineering students. The courses having a common objective, with minor differences in scope, they have developed each on its own, thereby leading to two different syllabi with very little common ground. Moreover, MECH 291 is not perceived by the students as highly relevant to their overall curriculum or to their career goals. It is therefore one aim of this proposal to offer one single course that would cater to all FoE students, including those in the School of Architecture (SoA), while exploiting modern tools allowing students to solve more realistic engineering and architecture problems than possible with classic tools.

OUTLINE

The proposal offers the features below:

a) One single course for all FoE students;
b) a modular organization;
c) a project-based mode of operation; and
d) catering to all needs of the individual units.

Feature a) means an even distribution of resources. This feature attends the needs of Mechanical Engineering, Civil Engineering, Mining Engineering and SoA students, while attempting to attract, eventually, students from all other FoE programs. In this vein, the course is planned for offering throughout the whole calendar year, in the fall, winter and summer terms.

The modular organization contemplates lecturers and teaching assistants from all units involved, under the coordination of one full-time professor, Dr. Damiano Pasini, DME. The three modules are i) free-hand sketching; ii) fundamentals of geometry construction; and iii) technology of object representation. The new course, moreover, is worth three credits, i.e., the same number as the current ones.

The project-based operation recognizes that design graphics is an activity best learned by doing. In this vein, the assignments, midterm and final examinations of the current courses are replaced by two midterm projects and one final project. The final project is tailored according with the specific needs of each program.

Catering to all needs of the programs involved means active participation of professors from all participating units in the assignment of the final project. Each unit involved is thus expected to appoint one full-time professor to liaise with the Course Coordinator. Given the project-based nature of the proposed course, it is expected that the course will be supported by a number of TA-hours larger than what is currently the case. All units involved are expected to contribute resources to support this pool of TAs.

Tentatively, the course is proposed as **MECH 289 Design Graphics**, the name indicating that the course is an integral part of the design education of the FoE students.

MECH 289 Design Graphics (3) (3,3,3)

Aim: to provide students with the ability to communicate graphically during the design process from the preliminary concepts to the final working drawings.

Learning goals:

- To develop skills to sketch free-hand pictorials in various projection views.
- To develop competence for the understanding, construction and manipulation of geometric objects and their relations.
- To acquire proficiency of modern cad instruments and rules for the representation of architecture and engineering objects.

Course topics (gathered mostly in three modules)

M0) Context of design graphics: the role of graphics as a medium of communication in the design stages (1.5 hrs).

M1) Free-hand sketching: *Sketching techniques* for shape description and guidelines for good sketching. *2D pictorials*: orthographic projections and auxiliary views. *3D Pictorials*: oblique projections (cavalier, cabinet, general); axonometric projections (isometric, diametric, trimetric); perspective projections (one, two and three vanishing points). (9 hrs)

M2) Fundamentals of geometry construction: *2D objects*, including points, lines, polygons, conics and higher-order curves. *3D objects*, including surfaces such as planes, quadrics and higher-order surfaces, sculpted surfaces, and objects created by extrusion, revolution, twist and combinations thereof. *Geometric relations* comprising intersection, parallelism and perpendicularity. *Geometric affine transformations* including translations, rotations, reflections, scaling and stretching. Methods based on both geometric reasoning and software tools are emphasized. (14 hrs).

M3) Technology of object representation: *Rules and conventions* for sectioning, involving symbols and partial views; dimensioning; tolerances; welding representation; working drawings including scales and units. *Rule applications* to represent engineering works relevant to architecture, civil engineering, mechanical engineering and mining engineering. Training in the use of software tools is stressed (14.5 hrs).

Coursework: three projects are assigned. The first focuses on free-hand sketching, the others contemplate the use of modern instruments (CAD hardware and software) to produce engineering drawings. The final project is customized for each participating program. The theme of this project is proposed by a professor representing each program. The product of the final project is a poster comprising drawings realized according to the design stages: preliminary sketches, 2D and 3D CAD models. Students are required additionally to compile a portfolio of all coursework.

Tutorials: support hours are given to students for learning and practicing with the representation tools

Evaluation scheme: the final marking is based on the quality of: 1) the portfolio; 2) the poster; and 3) the poster oral presentation (5-10 minutes).

Bibliography:

Earle, J. H., 2004, eleventh edition, Engineering Design Graphics, Prentice Hall.
Perez-Gomez, A. and Pelletier, L., 2000, Architectural Representation and the Perspective Hinge, The MIT Press, Cambridge, Massachusetts.
User's guides for AutoCAD and Pro/Engineer.