SCHOOL’S IN

Hong Kong now has its own degree in Manufacturing Engineering. Professor K V Patri, from the island’s City Polytechnic, explains what awaits prospective students.

The introduction of the new BEng (Hons) course in Manufacturing Engineering had the advantage that it could be developed with no prior commitments or preconceived ideas. We were a new department in a new academic institution with good financial support.

The course’s graduates were expected to join Hong Kong’s active manufacturing industry and so the first lesson was all about finding out what that industry wanted. We analysed over 7500 job advertisements, appearing in a local paper over a year, and also interviewed many entrepreneurs and senior executives.

It soon became clear that the prime need was for broad-based engineers capable of leading the small and medium industries into the 21st Century. They needed to be able to think about manufacturing in a systems way rather than just be high-quality expert technologists. Interpersonal and application skills were seen as extremely important. The engineers needed to be familiar, not only with the traditional ‘mechanical’ elements of manufacturing (the M-theme) but also with manufacturing management and systems (S-theme) and the industrial use of electronics and computers (E-theme).

These three themes became the base of our course, which was designed to provide a balance of the themes in the first two years with the final year concentrating on consolidating them to form the integrated engineer required. Modest inputs of supporting studies in applied mathematics and communications are provided early on in the programme.

Student Centred Activities

Nearly 2500 years ago Confucius said:
“Tell me and I will forget,
Show me and I will remember.
Let me do it and I will understand”

This philosophy lies at the base of what we are trying to do in this course.

In many ways up to now Hong Kong education has been even more traditional than many Western countries, with the emphasis heavily on telling rather than doing. As a result, students come out with flying colours in examinations, but there is a question about their ability to apply their knowledge to solve real open-ended problems. The knowledge explosion in engineering means that it is impossible to ‘tell and show’ everything that needs to be known. They have to ‘learn to learn’. The emphasis then is to get the students learning the basic science and how to apply this in a variety of situations.

Our belief is that we have to move from the traditional Teacher Centred Teaching to Student Centred Activity (SCA), where the students are challenged outside the lecture room with open-ended tasks related to the subject area being studied. The teacher acts only as a technical consultant.

Traditionally, each subject had a series of practicals to supplement lectures, but these tended to be isolated exercises designed to develop practical and experimental skills in a narrow area. Thus, system-level application and integration tended not to be developed. Our approach is that each of seven major topics in the curriculum (Introduction to Manufacturing Engineering Analysis of Systems: Work Design; Engineering Analysis & Design: Materials; Manufacturing Technology: Control Engineering) have a SCA as a major part of their laboratory and tutorial work.

The first SCA comes very early on in Introduction to Manufacturing Engineering, where each student group is asked to develop a broad process plan and production system for a locally-made product. This is done well before they have studied manufacturing systems in any depth and forces the students to seek information for themselves, thus developing creative approaches from the start. The excellent polytechnic library is essential for this. Likewise, the SCA in Engineering Analysis and Design is devoted to analysis of the kinematics, mechanics, and design of a production assembly with moving parts. In addition, this SCA is linked with the one for Engineering Materials.

System-level Application and Integration Laboratories

One of the problems of conventional laboratory sessions is their lack of integration and relation to overall systems typical of modern manufacturing. Many of the problems of a manufacturing system concern material and information flow. In principle, these flows can be achieved by manual means, but in today’s environment it is better to think in electronic terms, so the idea of building a major computer-based manufacturing facility within the polytechnic was conceived. In fact two of these are being developed. The first SAIL, for mould and die-making, consists of a range of industrial CNC machines interconnected through a suitable network. This shop floor network is, in turn, connected to the Central CAD facility, which can be used to develop and store the parts library, parts geometry and NC parts programmes. The other SAIL for flexible assembly will consist of both manual and flexible automated assembly cells, computer controlled, networked and connected to the central CAD database. Specific tasks will be carried out by the students on these SAILs and in addition major development tasks will be contracted to student project groups in their final year.

Course Design and Structure

With the emphasis on student centred learning, we find that the students put in very much more effort than implied by timetabled hours, so these are not too meaningful. However, the following gives some indication:

S theme (Manufacturing Management) - 350 hours
M theme (Mechanical) - 550 hours
E theme (Electronic & Computing) - 450 hours

Supporting Studies - 120 hours
Integrated Studies - 240 hours

In addition to the above, the students undertake three distinct projects. In the Manufacturing Project, the students work in groups to plan and make a complex electro-mechanical product, probably linked to a hardware requirement for a SAIL. Each student does an individual project which is related to a problem in local industry (or perhaps an aspect of a SAIL). The aim is to combine the student’s intellectual and application skills. Finally, in the Comprehensive Project, the students again work in groups to meet a system-level challenge related to industry, or the SAILs, such as ‘develop strategies for reducing in-process inventory in the system by 15%’.

Conclusion

With the high standard of students entering this course and the innovative nature of the learning we are sure that we will be producing some of the best manufacturing engineers in the world.