

Chapter 3

Linking Materials Science and Engineering Curriculum to Design and Manufacturing Challenges of the Automotive Industry

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ABSTRACT

Materials engineering applications are becoming more widespread, varied and sophisticated due to advances in science and increasing interdisciplinary cooperation. To be able to impart engineering graduates with the required technical background, educators need to update the course syllabus and the program curriculum continuously. Most importantly, in a world of constant change, educators need to develop the right graduate capabilities in engineering students. This calls for new, innovative teaching approaches to materials education. This chapter demonstrates the authors' teaching approach through the design and development of an Automotive Materials course at postgraduate level in an 'International Automotive Engineering' program at RMIT University in Melbourne, Australia. To elucidate this teaching approach to materials education, the authors discuss in detail the need to impart an up-to-date understanding of new, alternative materials, the development of graduate capabilities, interdisciplinary systems thinking towards materials education, and the environmental sustainability of engineering materials.

INTRODUCTION

Materials Engineering courses in postgraduate engineering programs are an integral part of engineering programs around the world. Postgraduate level Materials Engineering courses

fulfill a special need to link the fundamentals of materials science learned at undergraduate level to engineering practices relevant to a particular engineering discipline at the postgraduate level.

The *Automotive Materials* course, which was first introduced in 2008 as part of the post-

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graduate Automotive Engineering curriculum at RMIT University in Melbourne, Australia, is a typical example, where the Materials Engineering understandings are imparted to a particular group of professional engineers, i.e. automotive engineers. Tailoring the course content and the delivery methods towards the specific needs of this group has the potential to enhance the relevance of postgraduate engineering education.

Understanding of Materials Engineering is integral to mechanical design and product engineering, which constitutes the core of Automotive Engineering practice. Conventional teaching of materials begins with their physics and chemistry, progressing from the atomic structure through the microstructure to the macroscopic behaviour, such as stress and strain. This approach, whilst scientifically correct, tends to present materials in isolation from the engineering science (e.g. mechanics of materials). As a result, this approach fails to engage many engineering students, who cannot see the relevance of microstructure, chemistry etc. (Ashby & Cebon, 2003).

Design and development of Automotive Materials in postgraduate Automotive Engineering programs must aim to overcome the inherent weakness of the traditional teaching methods by enabling students to make the connection between the underlying physical science of a material and its performance in real-life engineering applications. To be relevant to the current engineering practices and up-to-date with recent advances in science and technology, Automotive Materials course content should focus on niche (and interesting) areas of component design based activities with a concomitant interest in alternative materials. Also, the understanding of Materials Engineering needs to be facilitated by means of experiential teaching and learning approaches where the properties of materials are discussed in the context of particular applications relevant to Automotive Engineering.

In this chapter, several key issues facing educators in designing engineering curricula are

identified: development of graduate attributes, a systems thinking approach to materials education, the importance of sustainability of engineering materials, and the necessity of ongoing development of course syllabi. The chapter discusses the design and development of a postgraduate Automotive Materials course at RMIT University (Australia) by providing:

1. The course content, including an example module and a relevant case study;
2. A student group project on Materials and Process Selection; and
3. Assessment methods and student evaluation of the course. It aims to present educators with a pedagogical framework in designing engineering curricula in a rapidly changing world.

BACKGROUND

The Automotive Materials course was designed and developed as part of the International Automotive Engineering postgraduate program curriculum at RMIT University in Melbourne, Australia. The course aims to impart an understanding of materials to the automotive engineering postgraduate students. The International Automotive Engineering program recognises the need to increase Australia's international position as a provider of high quality engineering education, in particular in the Asia-Pacific region where a rapidly developing automotive industry is emerging.

Extensive consultation with research organisations, local and global automotive industries shaped the curriculum development of the postgraduate degree program. Global relevance, work integrated learning, and development of graduate capabilities were identified as required features of the curriculum. Design and development of a core course *Automotive Materials* for the program complies with program initiatives and responds

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