New
Model
in Technology
& Engineering

Liberal Engineering

Raison D'être & Philosophy

NMiTE's Accelerated Integrated Masters Liberal Engineering Degree (AIMLED) has resulted from disruptive interventions in the development of a new innovative approach to engineering course curriculum design.

AIMLED draws its inspiration from a number of worldwide developments that seek to provide a more appropriate 21st century approach to engineering higher education than that which is typically found across the world's universities.

Traditional engineering courses build upon bedrock of science and mathematics, which is viewed as part of a 'continuum' leading into subsequent engineering topics. Indeed engineering degree courses are often presented as 'applied science' - or as a subject that 'turns science and maths into reality'. This is far from the reality of the relationship.

Science is about achieving an understanding of our world – producing and evaluating models of observed behaviour which are then used to predict behaviours of other possibly more complex phenomena (the 'Scientific Method'). Mathematics has an important role in this modelling activity. Differential equations, for example, play an important part in the modelling of dynamic systems that are found throughout engineering disciplines.

Whilst Science is about Analysis, Engineering, on the other hand, is about Synthesis. It is about creating things - products that in some way address and solve the problems, challenges or needs of our society. Seldom do these products arise from new scientific and mathematical developments (although there are exceptions); on the contrary, many scientific and mathematical developments follow engineering creativity. Thus, the Science of Thermodynamics came *after* the creation of the early steam engines; the Science of Aerodynamics *followed* the Wright brother's early work on flying machines.

The continuum, such as it is, between Science and Maths to Engineering is in fact in the reverse direction - it is engineering creativity that often gives rise to developments in science and mathematics. There are some who work at the boundaries of these subjects.

Despite this, many traditional engineering courses are arranged around a 'linear curriculum' that first teaches science and mathematics and then moves to engineering. Analysis dominates in this approach, usually at the expense of one most important example of the essence of engineering - Creativity.

Sir Ken Robinson has defined creativity as 'having ideas of value', resulting from 'applied imagination'. Checking out those ideas to be sure that they are feasible, viable and even

desirable is a step often described as 'proof of concept', and can lead to a patentable invention. But bringing the idea to market, to reality, is referred to as Innovation.

Innovation is a process that calls upon a wide variety of subjects beyond science and mathematics. This includes finance, economics, management, quality, IT, languages, rhetoric, marketing, sociology, ethics, art, facilities, human resources – and in particular, design.

All these subjects (and more) contribute to Innovation, a truly eclectic mix. The AIMLED course will make all these subjects more visible than conventional approaches, and in doing so appeal to students with a wider range of backgrounds and experiences. The course will therefore be, at the same time, a '*Liberal Engineering* Course' and also a course '*liberated'* from the strictures and narrow confines of science and mathematics.

Of particular significance is Design. Design has been defined by Sir George Cox, (past Chairman of the Design council) in his 2006 report as follows: "*Design is what links Creativity and Innovation. It shapes ideas to become practical and attractive propositions for users or customers. Design may be described as creativity deployed to a specific end."*

Design goes way beyond the 'look' of something (its 'form'). In the context of engineering, Design covers Design for form, for function, for manufacture, for operation, for reliability, for maintenance, and for disposal. As someone said, Design is not 'Applied Art', but is a rigorous discipline with its own defined approaches to achieving specific outcomes.

So here we have the blessed trinity - Creativity, Design and Innovation – the distilled quintessence of Engineering. Yet few engineering courses in higher education recognise this, instead concentrating on what has been described in the US as *'the mind-numbing math-science death march that casts aside thousands of capable young people who might otherwise have made effective engineers'*.

NMiTE's AIMLED course aims to correct this through a new approach to curriculum structure and delivery.

The flagship 'exemplifying' qualification for the Engineering Council's UK-SPEC (United Kingdom Standard for Professional Engineering Competence) is the MEng. This degree provides the 'educational base' required in the formation of Chartered Engineers (CEng). The MEng is an integrated undergraduate Masters level engineering qualification – integrated in the sense that it subsumes a Bachelors level qualification, yet remains undergraduate in status to permit access to student loans.

Under the QAA (Quality Assurance Agency) Course Credit scheme, an MEng carries 480 credits, where a credit is taken to be the learning derived from 10 hours of study; thus the MEng represents 4,800 hours of study time. Conventional MEng delivery presents these hours over four academic years, each comprising thirty weeks of 40 hours of study. The AIMLED course presents the degree over three years of 1,600 study hours each, requiring forty 40-hour weeks per year. With inter-block breaks (qv) this will require the commitment of students for 46 weeks, the remainder of the year being taken as vacation. This

accelerated approach brings a number of advantages. First, for the student, it means entry into employment after graduation one year early, and accommodation arrangements will be simplified and costs reduced. For academic staff, more, longer periods are available for block teaching (qv) and industrial experience, and, without long vacations, educational momentum can be maintained. In addition, a 46 week year would help to remove the 'town-gown' feel of a city based University and provide the students with a more 'fulfilled' experience. Students would be able to fully immerse themselves in the city, their University and most importantly engineering, for the duration of the course.

Course delivery

Course material will be typically presented in 3-week Blocks, which will concentrate on a particular technical or liberal course topic or area (or a combination). This implies 12 (UK) Credits and some 120 hours of study, but other Block sizes are possible, as appropriate.

Each Block might contain:

- One or two key concepts as a basis
- A project or problem (which might run across several Blocks)
- Knowledge acquisition via on-line provision, taught seminars, or self-study
- Contextual liberal study
- Development of a specified competence
- Hooks to other Blocks
- An assessed outcome, collected as a portfolio.

Students will work in teams of 6-8 in a problem-based or project-based learning format, with team members selected to give a balanced background of experience and interests. Each team will report to a member of academic staff.

Prof Kel Fidler CEng HonFIET FREng
Curriculum Development Group (Herefordshire Tertiary Education Trust)
March 2016

Professor Kel Fidler is an academic engineer. He graduated with a BSc from King's College, Durham University, and a PhD from Newcastle University, both in Electrical Engineering. Since then he worked as a Senior Research Associate at Newcastle; Lecturer, Senior Lecturer, Reader and Chairman of the Department of Electrical Engineering Science at Essex University; Professor and Head of the Electronics Discipline at the Open University; Professor and Head of the Department of Electronics and also Pro-Vice-Chancellor and Deputy Vice-Chancellor at the University of York; and Vice-Chancellor and Chief Executive of Northumbria University.
In something of a parallel existence, Kel has also worked extensively with the Engineering Profession. He is an Honorary Fellow of the Institution of Engineering & Technology; a Chartered Engineer registered with the Engineering Council; and a Fellow of the Royal Academy of Engineering. He has Honorary Degrees recognising his work with the Engineering Profession from The University of Huddersfield, the University of York, and Northumbria University. He has served on numerous bodies involved with engineering. In particular he was Chairman of the Engineering Council, the national body that regulates the engineering profession and sets and applies the standards required for recognition as a professional engineer. He led the groups that developed the Engineering Council UK-SPEC standards and chaired the QAA Engineering Benchmark Subject review group.