

# MODULAR MSc AND CPD COURSES IN ELECTRICAL POWER ENGINEERING ICEE 2002 CONFERENCE

*N.Jenkins<sup>1</sup>*

**Abstract**  $\frac{3}{4}$  The paper starts by describing the UMIST experience (over more than 15 years) of a modular MSc course in electrical power engineering that is open to industrial CPD delegates. The course consists of a series of week-long modules taught intensively. All teaching, including laboratory sessions, is delivered within one week. Each year the course is presented to some 15-20 full-time MSc students, up to 10 part-time MSc students and some 50 CPD delegates, who attend only individual module(s).

The objectives of the programme will be considered and, in particular the tension between the training needs/desires of the CPD delegates and the educational requirements of a rigorous MSc course.

**Index Terms**  $\frac{3}{4}$  modular, MSc, electrical power engineering, CPD.

## INTRODUCTION

UMIST has been providing post-graduate courses in electrical power engineering since the 1960's. Originally these were to support the electrical manufacturing industry in Manchester but rapidly developed into taught Masters courses attracting students from all over the world. Some 15 years ago a decision was made to structure the delivery of the MSc course in Electrical Power Engineering into a modular programme.

The programme consists of two Semesters of taught material and a Masters level project. Semester 1 consists of fundamental material and techniques that all electrical power engineers should be capable of handling in a competent and reliable manner. In Semester 2 a number of optional courses are offered to the students who can select a course of study to match their particular interests.

The mode of delivery is in week-long intensive modules and so the course is accessible to part-time MSc students (who may take up to 5 years to complete the course) as well as Continuing Professional Development (CPD) delegates who attend only those modules in which they are interested. In general, part-time MSc students are employed by UK industry, although there have been students based as far afield as Canada and the Middle East. The programme is continually updated to reflect industrial developments and so there has been increasing emphasis in recent years on Power System Economics and Distributed Generation.

## THE MSc PROGRAMME IN ELECTRICAL POWER ENGINEERING

The educational aims of the programme may be summarised as to "provide an advanced education in electrical power engineering. The programme intends to give graduates the education, knowledge and skills they need to make sound decisions in a rapidly changing electricity supply industry". More specifically, the programme provides opportunities for students to develop and demonstrate knowledge and understanding in the following:

- Structure of power systems and function of the various components
- Steady state and dynamic analysis of power systems
- Operation of power systems under normal and abnormal conditions
- Design of power system plant
- Management of power engineering projects
- Power system reliability and power quality
- Distribution system operation with distributed generation
- Economics of power systems in a competitive environment
- Insulation co-ordination
- Environmental impacts of electricity supply
- Distributed generation technologies
- Renewable energy systems.

The program also gives students the opportunity to develop skills in the following areas:

- Computer aided analysis of power systems
- High voltage measurements and techniques
- Development of renewable energy projects
- Software development applied to power engineering applications
- Written and oral communication
- Planning and conducting research projects.

Up until 2001/2 the course led only to an MSc or Diploma in Electrical Power Engineering. Semester 1 comprised the following compulsory modules:

- Overview of power systems [c]
- Power system modelling
- Steady state power systems analysis [c]

<sup>1</sup> N Jenkins, UMIST, Manchester, UK. n.jenkins@umist.ac.uk

Transmission and distribution plant  
Analysis of faulted power systems  
Dynamics and optimisation  
Power engineering project management. [c]

Those modules marked [c] were assessed by coursework only while all other modules were assessed by a 2-hour examination with a 10% contribution from coursework.

In Semester 2 students were required to pass the examination (again with a 10% coursework component) in 4 modules selected from

Embedded generation  
Power system dynamics  
Power system protection  
Reliability and power quality  
Insulation co-ordination and HV testing  
Power system operations  
Power system economics

Each module is self-contained, and taught within a week. When a full time student is not attending a module he/she is expected to undertake private study, as each module requires around 100 hours of study. Part-time MSc students undertake this private study in their own time. As all the Semester 1 modules are compulsory there is no requirement for a system of pre-requisites. The Semester 2 modules can be selected by the student freely according to his/her interests. The examinations are held in the main university examination periods at the end of each Semester.

### **BACKGROUND OF THE STUDENTS**

The students come from a wide variety of backgrounds and countries and generalisations are difficult. Of the full-time MSc students perhaps 10% are from the UK with a further 20-30% from elsewhere in the European Union. The remainder of the students are from a very wide range of countries with no particular concentration from any geographical area. Only a minority of the full time students have significant industrial experience although some overseas students may have worked as practising engineers for up to 15 years. The normal entry requirement is a 2.2 honours degree in electrical engineering or in another engineering discipline (e.g. electronic or mechanical engineering) with a significant component of electrical science.

In contrast the part-time MSc students are all in employment in the electrical power engineering sector and the great majority are from the UK. Again the normal entry requirement is a 2:2 honours degree although some of these students may have had a less traditional education. Applications are considered on a case-by-case basis by the UMIST Graduate School. A part-time student may take up

to 5 years to complete the MSc with up to 3 years for the taught modules and 2 years for the project.

The CPD delegates also tend to be from UK industry although a small minority come from overseas. The CPD delegates are informed that the modules are taught at MSc level and they would normally be expected to be graduates. However there is no formal entry requirements for attending a module as a CDP delegate.

In a typical year there are 15-20 full-time students following the MSc (or in some cases the post-graduate Diploma), 5-10 part-time MSc students and up to 50 CPD delegates attending one or more week-long modules

### **BENEFITS AND TENSIONS OF A COMBINED MSC AND CPD COURSE**

It is widely acknowledged in the UK that there is a serious shortage of well-educated young electrical power engineers. This is mainly due to a lack of suitable students rather than shortage of educational courses but a sustained shortage of students will lead inevitably to closure of courses and reduction in provision for educating power engineers.

Hence an important benefit of a combined MSc/CPD course is that instruction in advanced topics can be offered to a wide audience and specialist topics can be taught to a reasonable class size. Although some of the modules attract up to fifteen CPD delegates, the more specialist topics (e.g. insulation co-ordination) may attract only around five CPD delegates. It would be very difficult to justify an external CPD course for such a small number of delegates and yet these topics are important for specialist engineers and quite difficult to master by private reading alone. It is also beneficial for the full-time MSc students, particularly those without industrial experience, to interact in the classroom with practicing engineers and to begin to understand some of the practical implications of the material being taught.

There are however, tensions. Firstly the combined programme requires that the modules are taught in intensive week-long blocks with up to 7 hours student/teacher contact per day. It is only by delivering the course in this manner that the part-time MSc students and the CPD delegates can obtain time off from their employment. However, this method of delivery can be fatiguing both for the class and the lecturers and needs careful management. This is achieved by sharing the teaching of a module among 2-3 lecturers and by scheduling example classes and computer exercises to break up the lecturing periods.

Secondly, the aspirations of the CPD delegates and the MSc students can differ. The MSc course is a broad education in electrical power engineering and has a significant mathematical/analytical content. Hence fundamental concepts are explored and there is considerable

emphasis on the basic techniques used in power systems analysis. In addition, some students can be very focussed on passing the examination and become anxious with the uncertainty in data and engineering judgement required for many real-life investigations. In contrast many CPD delegates do not use mathematics intensively in their day-to-day employment and have a tendency to rely on computer packages, whose scientific basis they may not fully understand, and past experience. In addition, of course, they have a much greater knowledge of practical power engineering. Although the CPD courses are marketed as being part of an MSc, on occasions delegates will be sent by their company in response to a very specific industrial need. The teaching staff try to respond, but such an expectation by the company illustrates a misunderstanding of what a week-long educational module can provide in terms of immediate commercial advantage.

### FUTURE DEVELOPMENTS

From 2002/3, in addition to the main course in Electrical Power Engineering, two new specialisations will be introduced in Power System Engineering and Economics and Sustainable Electricity Systems. Although the basic structure of the course remains, the introduction of these new specialisations will extend the coverage of the course and provide clearer focus on power system economics or issues of sustainable electricity supply for those students interested in these areas. An MSc may be awarded in either Electrical Power Engineering or one of the two specialisations on satisfactory performance with 180 credits of work while a post-graduate Diploma requires 120 credits and a post-graduate Certificate 60 credits.

In order to accommodate these two new specialisations, and also as part of the continuous updating of the programme the modules have been modified. In Semester 1 students will study 5 of the following modules, depending on the specialisation.

- Introduction to power systems
- Power system modelling
- Power system analysis
- Economic operation of power systems
- Power system plant
- Sustainable electricity supply
- Power Engineering project management

In Semester 2 students will study 4 of the following modules

- Power system dynamics
- Insulation co-ordination and HV testing
- Reliability and power quality
- Generation for sustainable energy systems
- Integration of distributed generation
- Economics of power systems

From 2003/4 an introductory module "Introduction to Electrical Engineering" will also be offered, before the start of the main programme. This is intended to provide a route into the programme for those students (e.g. graduates in mechanical or civil engineering) who have not studied electrical engineering at 2<sup>nd</sup> and 3<sup>rd</sup> year undergraduate level.

### CONCLUSIONS

A combined MSc/CPD programme in electrical power engineering has been delivered successfully at UMIST for more than 15 years. Its advantages are that it allows specialist teaching to be provided to reasonable class sizes and specialist topics to be offered on a regular basis to both fulltime students and industrial delegates. It also provides an opportunity for full-time MSc students, part-time MSc students and CPD delegates to study together and to benefit from each others experience and insights. The intensive method of delivery (up to 7 hours per day) is potentially fatiguing for both staff and students. Hence careful planning of the daily timetable of the modules is essential. Finally the educational requirements of an MSc must be balanced against the needs of practicing engineers who may attend only one module of the programme

### ACKNOWLEDGEMENT

Many UMIST colleagues have contributed to the development and delivery of the MSc in Electrical Power Engineering over some 40 years. Their commitment to the course and students together with their contribution to the material presented in this paper is gratefully acknowledged.