

Module Information for the MSc programme in Railway Systems Engineering & Integration

Mathematics as an Engineering Tool

This module was introduced to allow students without a first degree to cover the main mathematical tools needed to undertake the MSc programme in railway systems engineering. The module includes a limited introduction to standard A-level mathematics, the generation of differential equations from the physical characteristics of systems, the use of engineering software tools like MATLAB and the application of standard software tools (Excel etc.) to engineering tasks. The module is optional for students with a first degree in a numerate subject. The industrial advisory group to the programme suggested the establishment of the module because they are conscious of the large number of staff in the railway industry who are employed in graduate level jobs but who do not have a first degree. An additional fee is payable for this course.

Induction Days

This weekend course prepares the new cohorts of students for the challenges ahead. It consists of a brief introduction to railway systems engineering, a team exercise to get the group to interact, a lecture on the history of railways, a lecture on the legislative and financial background of the European railway industry and an in-depth analysis of the structure of the British railway industry as well as an introduction to freight railway operations and to human factors. The course also includes a substantial element of skills development, in particular, the students are given a thorough grounding in academic writing. The course includes a visit to a railway maintenance depot.

Strategic Management of Railway Operations (10 credits)

This module covers the range of railway management and operations activities, from demand based railway planning through to inter-modal freight transport operations, all based on an interpretation of the special characteristics of the rail mode of transport which was developed for the MSc Programme. Areas addressed include asset maintenance and management, marketing, safety cases and rolling stock acceptance issues, freight and passenger train services, human resource management, the British railway industry structure and environmental issues, as well as operations management for the rail industry. Normally, the module also includes a short seminar on a topic of current importance for the industry. The module is supported by the industry with speakers and includes a visit to a track systems plant.

Module Leader: Associate Professor Felix Schmid, University of Birmingham
f.schmid@bham.ac.uk

Railway Rolling Stock Systems Design (10 credits)

The starting point for this module is the wheel rail interface which is discussed in some detail, particularly in the light of the recent problems of gauge corner cracking. The module includes lectures on rail vehicle dynamics, aerodynamics, body-shell design and crashworthiness issues, choice of materials, active suspension and tilting systems as well as an introduction to the economic issues in rail vehicle construction, maintenance and use. A visit to a rolling stock manufacturing plant forms part of the module.

Module Leader: Charles Watson, Kingston University C.Watson@kingston.ac.uk

This module is also run by staff from Manchester Metropolitan University, with guest

speakers from industry and input from the University of Birmingham.

Laboratory Week

Three and two days respectively are allocated to laboratory work associated with modules LMR02 and LMR03. The mechanical aspects are covered by laboratory experiments on the dynamics of mechanical systems, an introduction to CAD and FE work and an overview of dynamic modelling tools such as Vampire and Adams Rail. The electrical aspects are covered by two practical experiments covering DC and AC machines and traction drives respectively.

Railway Traction Systems Design (10 credits)

The traction systems module is conceptually the most difficult course for most of the students since it covers all aspects of traction power from diesel engines through to modern pulse width converter systems. Individual lectures deal with the basic physics of railway traction, autonomous and diesel traction, friction and electric braking systems, DC and AC motor design, power converters from rectifiers to PWM converters, AC and DC supply systems, train detection and EMI issues. The module includes a visit to a railway traction manufacturer and is run by the University of Birmingham in association with guest speakers from industry.

Module Leader: Associate Professor Felix Schmid, University of Birmingham
f.schmid@bham.ac.uk

Systems Engineering for Dependability (10 credits)

Dependability is defined as the combination of an acceptable level of regularity, reliability, punctuality and safety. The module on dependability is designed to cover three broad areas: systems engineering and management of the engineering process, management of engineering and project risk, and reliability engineering. Lectures cover both hard and soft systems approaches, systems engineering tools, case studies and an in depth review of safety case theory and practice. Human factors, organisational systems and the management of risks in organisations are also addressed in the lectures. The module includes a visit to a systems house specialising railway maintenance and track inspection. The module is run by the University of Birmingham with a high level of input from the railway industry.

Module Leader: Dr Clive Roberts, Department of Electronic and Electrical Engineering, University of Birmingham c.roberts20@bham.ac.uk

Railway Infrastructure & Track Systems (10 credits)

The infrastructure module is designed to teach students about all aspects of the railway infrastructure, from structures and tunnels through to conventional track and slab track. Track forms and metallurgical issues of the wheel rail interface are included as well as power supply infrastructure and station and tunnel systems. The lecturers on the module also address issues such as environmental impact assessment, structure gauging and track maintenance. The module is currently managed by the Department of Civil Engineering at the University of Birmingham. Most of the contributors are from industry.

Module Leader: Professor Chris Baker, University of Birmingham

Train Control Systems Engineering (10 credits)

The module starts with a description of the basic principles underlying railway control systems and signalling, including issues such as braking distance, block operation, route setting, failsafe principles and the mathematical theories of safe software design etc. It

then covers the European Train Control System (ERTMS) and practical implementations of signalling principles, as well as signalling maintenance and EMC issues. The module is managed by the Department of Civil Engineering of the University of Birmingham but features many lecturers from the railway signalling industry and a researcher from the University of New Orleans.

Module Leader: Associate Professor Felix Schmid, University of Birmingham
f.schmid@bham.ac.uk

Railway Economics and Technology Management (10 credits)

The module has two primary objectives, namely, to introduce the students to the fundamental principles of economics and to develop their understanding of technology strategy issues. Economics is covered at a basic level and includes the issues of supply and demand, macro- and micro-economics and marginal costing as well as some elements of balance sheet analysis and project financing. More than 50% of the module is devoted to the railway paradigm, the strategic cycle and the understanding of supply chains and logistics. KPIs and benchmarking are also covered in this part of the module. Both economics and technology strategy are taught by means of lectures and case studies.

Module Leaders: Robin Hirsch, Railway Technology Strategy Centre, Imperial College, and Associate Professor Felix Schmid, University of Birmingham f.schmid@bham.ac.uk

Ergonomics and Human Factors for Railways (10 credits)

This is a very practically oriented module, taking a holistic approach to human interaction, with content ranging from anthropometry to ergonomics based risk assessment. Attention is given to the needs of both customers of railways and for staff associated with their operations. Classical ergonomics (design of work places, vehicle interiors and other railway related environments) are covered as well as more philosophical issues, such as the concepts of fitness for purpose, usability and acceptance. The module includes a number of lectures but is centred around a practical group project where participants can apply and extend the taught elements. Typically, this project involves user requirements analysis, simulation of ageing and disability and the preparation and trialling of design mock-ups.

Module Leader: David Hitchcock

Research Modules (10 credits each)

There will also be four research modules, each one worth 10 credits. Each module involves the production of two Major Assignments relating to the above taught disciplines.

European Study Tour

The European study tour is included in the programme to allow the students to experience at first hand some of the most advanced railway systems and elements available in Europe before setting out on their dissertation project. It is an opportunity for benchmarking one's earlier experience. It both stimulates thought and prevents the participants from re-inventing the wheel. Destinations have included France, Belgium, Holland, Germany Denmark, Sweden and Switzerland.

MSc Individual Investigative Research (60 credits)

The main focus of the dissertation project is on systems integration. Most postgraduates undertake the dissertation while working for a sponsor. Project titles are agreed between the student, the University and the sponsor, whether or not the student is a permanent

employee. A project workshop held before the main project activity allows the student to learn more about finding a topic, coming up with a hypothesis and about carrying out the necessary research.

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