Railway Systems Engineering and Integration modules

LMR20: Mathematics as an Engineering Tool (not credit bearing)

This module was introduced to allow students from backgrounds that do not include an engineering or physical sciences degree to acquire the main mathematical tools needed to complete the taught postgraduate programmes offered by BCRRE. The module includes a brief introduction to standard A-level mathematics, it addresses the generation of differential equations from the physical characteristics of systems and the use of engineering software tools like MATLAB. It also introduces 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 employed in graduate level jobs but not holding a first degree in a science or engineering subject. An additional fee is payable for this course.

RSIW: Induction Weekend (not credit bearing)

This weekend course prepares the new cohorts of students of the postgraduate programmes offered by BCRRE for the challenges ahead. It consists of a brief introduction to railway systems engineering and railway complexity, a lecture on the history of railways and an exercise to get the members of the cohort to interact. This is followed by an in-depth analysis of the structure of the British railway industry, as well as an introduction to freight railway operations. 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 full-day visit to a railway test site and maintenance depot.

SMRO: Strategic Management of Railway Operations (10 credits)

This module covers the full spectrum of railway management and operations activities, from demand based and operationally based railway planning through to inter-modal freight transport operations. Areas addressed include business continuity, train service and timetable modelling, marketing, the management of freight and passenger train services, human factors, human resources development and scheduling, the legislative and financial background of the European railway industry and environmental affecting the rail industry. The module is led by the School of Civil Engineering and supported by industry speakers. The week includes a visit to a mainline railway depot.
Module Leader: Prof Felix Schmid, University of Birmingham

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RRSD: 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 with respect to rolling contact fatigue or gauge corner cracking. The module includes lectures on rail vehicle dynamics, aerodynamics, body-shell design and crashworthiness issues, the choice of materials, the behaviour of active suspension and tilting systems as well as an introduction to the main features of freight vehicles, rolling stock maintenance and use. The course is led by a member of staff of The University of Birmingham and includes lectures by guest speakers from industry who provide the most up to date information on rolling stock systems design and manufacture.
Module Leader: Dr Charles Watson, University of Birmingham

RTSD: Railway Traction Systems Design (10 credits)

The traction systems module is conceptually and technically 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 and EMI issues. The module includes a visit to a railway traction manufacturer and is run by the University of Birmingham's School of Electronic, Electrical and Systems Engineering, with guest speakers from the rail industry.
Module Leader: Dr Stuart Hillmansen, University of Birmingham

Rolling Stock and Traction Systems Laboratory Days (not credit bearing)

One day each is allocated to laboratory activities associated with the Railway Rolling Stock Systems Design module and the Railway Traction Systems Design module. The mechanical aspects are covered by an introduction to dynamic modelling and include practical work with advanced modelling tools. Power electronic and electrical aspects are covered by two practical experiments covering DC and AC machines and traction drives respectively.

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SEID: Systems Engineering and Integration for Dependability (10 credits)

Dependability is defined as the combination of a required level of availability, reliability, on-time performance and safety, often measured as service performance. The module on dependability is designed to cover two broad areas, namely formal systems engineering approaches and management of the engineering process, including project risk, risk control and reliability engineering. Lectures cover both hard and soft systems methodologies, systems engineering tools, case studies and safety case theory and practice. Human factors, organisational systems and the management of risks in organisations are also addressed in the lectures. The module is run by the School of Electronic, Electrical and Systems Engineering with additional input from the railway industry.
Module Leader: Prof Clive Roberts, University of Birmingham

RITS: Railway Infrastructure & Track Systems (10 credits)

The infrastructure module is designed to teach participants all aspects of the railway infrastructure, from earthworks, structures and tunnels through to conventional ballasted track and slab track systems. Railway alignment design issues are discussed in detail, as are issues relating to the rolling contact behaviour of the wheel-rail interface, acoustics, station and tunnel systems. Industry-based speakers address the topics of station design, station systems and tunnel services. The lecturers on the module also address issues such as environmental impact assessment, structure gauging and track maintenance. The module is offered by the School of Civil Engineering at the University of Birmingham with considerable contributions from the railway industry.
Module Leader: Dr Charles Watson, University of Birmingham

RCSE: Railway Control Systems Engineering (10 credits)

The module starts with a discussion of the basic principles required to design railway control systems and railway signalling installations, including issues such as braking distance, block operation, route setting, failsafe principles and the mathematical theories of safe software design etc. Interlocking design, automatic train control (ATP and ATO) and moving block systems are also covered. It then covers the European Rail Traffic Management System (ERTMS) and its ATP component, the European Train Control System (ETCS). The speakers also cover the practical implementation of signalling principles, as well as signalling maintenance and EMC issues. Modelling of signalling systems and the simulation of simple railway networks are introduced through lectures and practical activities. The module is managed by the School of Civil Engineering of the University of Birmingham but features many lecturers from the railway signalling industry.
Module Leader: Prof Felix Schmid, University of Birmingham

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RETM: Railway Economics and Technology Management (10 credits)

The module team introduces students to a range of business management aspects of running a railway company or organisation. This includes an introduction to key economic principles, finance, accounting, marketing, and the management of people, projects, technology and assets. The strategic development of railways is also covered, as are various railway specific topics, such as railway funding and franchising. The core economics content includes the issues of supply and demand, macro- and micro-economics and how these relate to the railway industry. Project financing and investment are also discussed, as are the use of KPIs and benchmarking for business improvement. A brief introduction to business process controls is also included. The majority of the module is taught by means of lectures, supplemented by case studies and a franchising-based team exercise.

Module Leaders: Stephen Kent and Prof Felix Schmid, University of Birmingham

EHFR: Ergonomics and Human Factors for Railways (10 credits)

This is a very practice oriented module, taking a holistic approach to human interaction with technology, with the content ranging from anthropometry to ergonomics based risk assessment. Attention is given to the needs of both customers of railways and of staff associated with their operations. Classical ergonomics, such as the 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 reasonable number of lectures but much of the learning is through a practical group project where participants apply the concept of triangulation to real-life situations. 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, Ergonomics Specialist

LMR50 / LMR51 / LMR52: Research Modules (20 credits each)

The research modules, each worth 20 credits at Masters level, allow students to explore in more depth the most significant concepts taught in the modules LMR31 to LMR38. The modules involve the production of four Major Assignments, each of which requires about 50 hours of background research and writing effort.

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LMR21: European Study Tour (not credit bearing)

The European study tour is included in the programme to allow delegates to experience at first hand some of the most advanced railway systems and subsystems available in Europe, before setting out on their dissertation project. It is an opportunity for benchmarking one's earlier experience. The tour both stimulates thought and prevents the participants from re-inventing the wheel, encouraging individuals to learn from a wide range of approaches to railway operations and engineering. Destinations to date have included Austria, Belgium, Czech Republic, Denmark, France, Germany, Holland, Italy, Norway, Poland, Portugal, Spain, Sweden and Switzerland.
Module Leaders: Dr Charles Watson and Prof Felix Schmid, University of Birmingham

LMR09: 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 activities allows the student to learn more about finding a topic, coming up with a hypothesis and about carrying out the necessary research.

Most of the taught modules of the MSc programme in Railway Systems Engineering and Integration last one week and consist of lectures, tutorials and practical activities. Team exercise workshops allow participants to reinforce their understanding of the major issues presented in lectures and to learn from the experience of their team members. Contributors include lecturers from several universities and experts from the railway industry. The modules are intended for graduates who want to enter the railway industry, practising railway engineers and professionals from the industry who wish to develop their skills and knowledge.

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