UNIVERSITY OF LEADING THE WAY WESTMINSTER

PROGRAMME SPECIFICATION

Course record information

Name and level of final award:	MSc Electrical Engineering for Modern Sustainable Transport Systems The MSc Electrical Engineering for Modern Sustainable Transport Systems is a degree that is Bologna FQ-EHEA second cycle degree or diploma compatible.
Name and level of intermediate awards:	Postgraduate Diploma Electrical Engineering Postgraduate Certificate Electrical Engineering
Awarding body/institution:	University of Westminster
Teaching Institution:	University of Westminster
Status of awarding body/institution:	Recognised Body
Location of delivery:	Cavendish
Language of delivery and assessment:	English
Mode, length of study and normal starting month:	Full-Time (one year); Part-Time (Two years); taught in blocks
QAA subject benchmarking group(s):	
Professional statutory or regulatory body:	IET accreditation pending (newly validated course)
Date of course validation/review:	2016
Date of programme specification approval:	2016
Valid for cohorts:	From January 2017
Course Leader:	Dr Anush Yardim
Course URL: Westminster Course Code: JACS code: UKPASS code:	westminster.ac.uk/courses/postgraduate H600

Admissions requirements

There are standard minimum entry requirements for all postgraduate courses. Students are advised to check the standard requirements for the most up-to-date information. For most courses a decision will be made on the basis of your application form alone. However, for some courses the selection process may include an interview to demonstrate your strengths in addition to any formal entry requirements. More information can be found here: https://www.westminster.ac.uk/courses/postgraduate/how-to-apply.

Aims of the course

The overall aim of Conversion MSc course Electrical Engineering for Modern Sustainable Transport Systems is to provide an enriching learning experience, enhancing the knowledge and skill base of the participating students in the area of intelligent and efficient transport systems design. In particular, the course will develop advanced practical skills to enable the student to determine system requirements, select and deploy a suitable design process and use the latest specialist tool chains to test and/or prototype a device or algorithm. Modern electrical, electronic and communication systems for intelligent transport today are a combination of skills and solutions that require engineers with cross-disciplinary abilities to implement them. The course covers a broad range of disciplines that will enable a successful graduate to enter into a career that requires a cross-disciplinary approach with a practical skillset. The course is intended both for engineers in current practice and for fresh honours graduates to facilitate their professional development, mobility and employability.

More specifically, the generic aims of the course are to:

- G1. Encourage a lively investigative spirit that will sustain a commitment to independent future study.
- G2. Provide communication skills associated with oral and written presentations of technical work and develop interpersonal and organisational skills associated with project planning, execution and appraisal.
- G3. Provide individualised experience of a significant individual project which exploits and applies disparate modules of knowledge.
- G4. Foster a spirit of independent student-centred study with effective management of time and development of research methods.
- G5. Provide a broad coverage of engineering topics that includes not only technical design issues but also a wider set of considerations including social and economic issues, ethical issues and environmental issues.
- G6. Develop team work skills by providing a frame work of team activities

In addition, the MSc in Electrical Engineering for Modern Sustainable Transport Systems aims to produce postgraduates with a strong practical skill base that will enable them to model, analyse, design electric motors with the appropriate drives and control, as well as sensors and communication subsystems for intelligent and efficient transport systems. Furthermore, the design and prototype of either power conversion circuits, or digital control sub-systems, or sensor system including data acquisition and processing systems will be pursued. Specialist knowledge and practical skillsets will be taught, extensively developed and practiced in the areas of electric motor and drives, power conversion circuits, control systems, sensors and communication. The analysis, categorisation and design strategies of rail and road vehicle systems that meet the increasingly stringent requirements for a sustainable and intelligent transport system will be addressed.

The knowledge and skillsets taught within the course are extensively used, as an example, in the design of electrical and electronic systems in modern electric vehicles and self-driving cars. They are also the key enabling skillsets used to implement devices, circuits and systems for applications such traffic monitoring and control, network rail condition control, and other possible services for future intelligent and efficient transport systems exploiting the availability of collaborative and cloud technologies.
Broader considerations such as the social and economic impact of modern and sustainable transport systems, health and safety and existing and forthcoming legislative issues will be examined. It is intended that the course will re-focus and enhance existing knowledge in the areas of electrical engineering, power electronics, sensor and communication systems to enable the student to participate in the fast expanding and exciting sector of intelligent road vehicle and rail transport systems.

In particular, the course aims to:

ERC1. Teach advanced system level design, documentation and implementation approaches and provide practical experience in the development and prototyping of electrical and electronic systems in the context of intelligent transport systems using innovative product design methodologies, platforms and tools.

ERC2. Explore broader issues concerning the development and adoption of an intelligent and efficient transport system including legislation for road vehicle and rail transport, sustainability and safety considerations and product life cycle.

ERC3. Teach and deploy mathematical and software based tools to analyse, model and describe the motion and behaviour of an electric machines with techniques that allow its usage as both motor and generator.

ERC4. Teach the theoretical background and develop practical skills to analyse, design, test and prototype power conversion and control sub-systems for electric motors and generators.

ERC5. Develop skills in the deployment and programming of real-time embedded microcontroller platforms for data acquisition and processing, providing first-hand experience in prototyping a sensor system.

ERC6. Teach analytical tools and methodologies to analyse, model and design communication systems including data transmission and security and frequency bands allocation.

ERC7. Deploy software tools and formalization techniques to design algorithms for smart transport applications, developing image analysis techniques for features recognition in the automotive domain, and devising formal descriptions of complex systems and infrastructures, such as railway networks.

Employment and further study opportunities

Today's organisations need graduates with both good degrees and skills relevant to the workplace, i.e. employability skills. The University of Westminster is committed to developing employable graduates by ensuring that:

- Career development skills are embedded in all courses;
- Opportunities for part-time work, placements and work-related learning activities are widely available to students;
- Staff continue to widen and strengthen the University's links with employers in all sectors, involving them in curriculum design and encouraging their participation in other aspects of the University's career education and guidance provision;
- Staff are provided with up-to-date data on labour market trends and employers' requirements, which will inform the service delivered to students.

The subject areas covered within the MSc course offer students an excellent launch pad which will enable the successful graduate to enter into this ever expanding, fast growing and dominant area within the electrical engineering sector, and particularly in the area of intelligent and efficient transport systems. With ever increasing demands from consumers such as efficient, sustainable and safe transport systems, reduced pollution, increased battery lifetime and advanced electronic assisted driving features combined with reductions in cost, modern electrical, electronic and communication systems are finding ever more application areas. As an example, recent advances in embedded system devices has led to a leap forward in electric motor design and utilization. Real time modelling and simulation are now incorporated as standard into many motor drives, thus allowing them to achieve very high level of dynamic performance and efficiency.
Industry and users have fed the explosion in demand for advancements in electrical, electronic and communication systems for transport. In particular, demands for higher efficiency and sustainability, driving assistance, position and traffic control for smart transport planning, demands to reduce transportation time and cost have become common place. This has led to expanding opportunities within the modern electrical, electronic and communication engineering sector. In particular, there is a need for engineers that can solve problems requiring a multi-disciplined approach covering skills from electrical engineering, control engineering, power electronic systems engineering, communication engineering, digital electronic systems engineering, analogue electronic engineering, and mechanics amongst others.

The MSc degree offered will provide the foundations required to re-focus existing knowledge and enter the world of multi-disciplined jobs. Possible job titles that a successful graduate with the relevant background education and experience may inspire to include:

- Electrical systems design engineer
- Control systems engineer
- Transport systems engineer
- Plant control engineer
- Electronic systems design engineer
- Communication systems design engineer
- Sensor systems engineer
- Computer systems engineer

In various industries such as:

- Transport industries
- Automobile industry
- Aviation industry
- Electrical systems industry
- Electronic systems industry
- Assembly line manufacturers
- Robotics and home help industries
- Toy industry
- Communication systems industry
- Logistics and distribution industries
- Consumer industry
- Life-style industry
- Security and surveillance industry
- Petro-chemical industry

The lists above are not prescriptive or exhaustive. There are many companies that require a workforce that have good engineering skills combined with a high level of knowledge in electrical and electronic technologies and transport systems. Despite the high demand for engineers that are competent in electrical systems as well as in control, electronic and communication disciplines, currently the supply of good systems engineers, that can fulfil all the requirements of these sectors, is too small. This has led to increased demand as companies scramble to get the best candidates that they can.

Learning outcomes

General Learning Outcomes Knowledge and understanding
Graduates will satisfy the following criteria:

G1: they will be able to demonstrate their knowledge and understanding of essential facts, concepts, theories and principles pertaining to their area of engineering, and its underpinning science and mathematics. They will appreciate the social, environmental, ethical, economic and commercial considerations affecting the exercise of their engineering judgement.

Specific skills
G2: they will be able to apply appropriate quantitative science and engineering tools to the analysis of problems. They will be able to demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs. They will be able to comprehend the broad picture and thus work with an appropriate level of detail.

G3: they will possess practical engineering skills acquired through, for example, work carried out in laboratories; in project work; in design work; and in the use of computer software in design and analysis.

Key transferable skills

G4: they will have developed transferable skills that will be of value in a wide range of situations. These skills include:

- The ability to exercise initiative and personal responsibility whilst working with others.
- The ability to plan self-learning and improve performance, as the foundation for lifelong learning

- The ability to communicate effectively through written reports and presentations and the ability to handle competently technical questioning.
- The ability to use effectively general IT and information retrieval facilities.
- The ability to develop, monitor and update a plan, to reflect a changing operating environment.
- The ability to monitor and adjust a personal programme of work on an on-going basis, and to learn independently;
- The ability to learn new theories, concepts, methods, etc and apply these to solve problems in unfamiliar situations.

Specific Learning Outcomes

1. Science and Mathematics

Graduates will be able to demonstrate:

SM1fl a comprehensive understanding of the scientific principles and underlying mathematics used to describe, model and evaluate the operation of electric motors and the underlying control, sensing and communication sub-systems that are used to realise an intelligent and efficient transport system;

SM2fl an awareness of the characteristics and limitations of current practices, technologies and state-of-the-art techniques used in modern and sustainable transport systems and their electro-mechanical, control, sensing and communication sub-systems, and how these characteristics and limitations influence the adoption of a specific motor and its control, and data acquisition, data processing and communication sub- systems in various transport systems;

SM3fl know-how in the analysis, modelling, deployment and underlying principles of electric motor and drives, power conversion, control systems, sensors and communication standard used in road vehicles and rail transport systems together with a broader understanding of legislation, safety and legislative requirements, environmental concerns, regulatory processes and certification requirements, in both individual coursework's and a final complex engineering project.

2. Engineering Analysis

Graduates will be able to demonstrate:

EA1fl in-depth know-how in the analysis and modelling of various complex sub-systems of intelligent and efficient transport systems to facilitate optimal planning and management, efficiency and sustainability, performance, robustness of control and stability together with an understanding of the limits of the models and analysis tools used;

EA2fl the ability to evaluate and review the research and/or industry issues in the area of intelligent and efficient transport systems and their control, sensing and communication sub-systems within a project domain given fundamental knowledge of the analysis and design tools used for road vehicles and rail transport systems design and where appropriate investigate and appraise new emerging technologies;

EA3fl the ability to use effectively appropriate methods of gathering and analysing information including research data to formulate a proposal that presents and/or defends research and current practice in the area of transport systems and then apply the appropriate innovative techniques, adaptation of an existing engineering analytic method or use of appropriate analysis techniques and tools to solve a complex real problem.

3. Design

Graduates will be able to demonstrate:

Graduates will be able to demonstrate:

D1fl the ability of using knowledge gained to determine the initial requirements of a given road vehicle or rail transport system and/or control or sensing and communication problem with an incomplete or uncertain description by analysing, modelling and solving the motor electrical behaviour and/or control signal dynamics or communication bandwidth constraints of an intelligent and efficient transport system; the ability to determine an initial specification for the solution based on the requirements identified; the ability to implement a prototype test bench by writing real-time software for the solution on a given development platform and through experimentation quantify the effects of various configuration and parameter choices in respect of functionality, performance, efficiency, robustness and stability to produce the final design and solution;

D2fl the ability to undertake a complex project in the area of intelligent and efficient transport systems that is unfamiliar; the ability to select a suitable design process and methodology and apply them; the ability to communicate the objective defence of the chosen design process against other possible selections taking into account the nature of the technical solution and a broader range of engineering issues including professional codes of practice, commercial risk, sustainability, social and environmental impact, legislation, regulatory practice, safety and risk analysis;

D3fl the ability to independently work on and solve complex real problems in the area of intelligent and efficient transport systems from specification to final build and test, by applying, modifying where appropriate, and deploying advanced engineering techniques and tools to solve new design problems; the ability to critically evaluate their own work knowing current solutions and practices, identifying limitations of their work and assessing contributions of their work with respect to the existing knowledge base.

4. Economic, Legal, Social, Ethical and Environmental Context

Graduates will be able to demonstrate:

ET1fl the ability to fully articulate the importance of high levels of professional and ethical conduct given knowledge and understanding of development costs and the social and environmental impacts caused by the use of modern road vehicles and rail transport systems; the ability of the student to write technical reports to prescribed standards and formats, to work to deadlines and to critically evaluate their work and give a critical reflection of the planning and management of their professional development;

ET2fl the ability to communicate an objective defence of the chosen design process taking into account commercial risk, codes of practice, ethical requirements, safety requirements and the environmental impact of intelligent and efficient transport systems;

ET3fl the ability to communicate an objective defence of the chosen business arguments taking into account commercial risk, regulatory practices and certification requirements, safety requirements and the environmental impact of modern and sustainable transport systems;

ET4fl the ability to identify required resources and defend and deploy methodologies, business arguments and design processes that will ensure sustainable development;

ET5fl the ability to communicate an objective defence of the design process, design methodology and/or business arguments chosen given the regulatory requirements in the area of modern and sustainable transport systems;

ET6fl the ability of the student to evaluate risks related to the environment, health and safety and where appropriate commercial risk of modern and sustainable transport systems.

5. Engineering Practice

Graduates will be able to demonstrate:

EP1fl an advanced level of knowledge and understanding of the principles, limitations and electro-mechanical characteristics of electric motors, timing characteristics, design and/or implementation, deployment and application of power drives and control systems, communication standard and interfaces, and instrumentation such as sensors and actuators in the context of intelligent and efficient road vehicles and rail transport systems;

EP2fl the ability to use effectively methods of gathering and analysing information and develop a thorough understanding and critical evaluation of current practices used in modern transport systems; the ability to identify and critically evaluate possible future trends in intelligent and efficient transport systems;

EP3fl the ability to select, report and apply a suitable design process and design methodology given commercial and industrial constraints for a complex road vehicle and rail transport system problem.

EP4fl understanding of different roles within an engineering team and exercise initiative and personal responsibility within their role.

Learning, teaching and assessment methods

Learning and Teaching

The taught portion of the courses is delivered in three highly concentrated 40 credit modules which we call learning modules. The teaching within these modules is delivered in the format of an industrial short course. This delivery style allows students to rapidly gain a full overview of the horizons of the subject matter and furthermore enables the student to achieve a state of relevant functionality without a great deal of elapsed time. This can be especially advantageous if the student is attending on an occasional basis, or has urgent needs of immediate skill in a given topic area at his/her place of work.

Within the taught portion of each module there is adequate time given to "hands-on" practice of concepts and tools taught. The student usually experiences practical in-place application of the knowledge being dispensed during the taught portion of the module on most days. Any assignments and exercises carried out within the taught portion of a module are meant to develop basic capability and, as such, serve as a useful vehicle for sharpening the skills baseline required for undertaking the portfolio of work described within the Independent Learning Package (ILP).

The ILP consists of a collection of short answer, long answer and open ended project based assignments and tasks that must be solved independently by the student. The project based task within the ILP will require the student to exercise and use principles, concepts and technologies within the specialism of the module to design, implement and verify the operation of a complex real system. In some modules the project component may be in the form of a group project whilst in other modules the project component may be in the form of an individual project.

Each taught module is allocated 400 hours of study time. Out of this time 70 hours or 10 working days are allocated to the delivery of the taught portion of the module, 16 hours are allocated to additional tutorial sessions and the remaining 314 hours are allocated to the student to work on and complete the ILP. To enable the student to further practise and solidify their understanding of material taught and their abilities in using the relevant tool sets additional tutorials outside of the taught portion of the module are provided. These tutorials provide just in time practice sessions during the ILP period of the module. The ILP is where the remaining learning takes place, where abundant 'soak-time' to solve the portfolio of work described within the ILP package document is given. The performance of work carried out for the ILP can take place at the university, within the students' place of work or at their home.

Assessment

Assessment of Learning Modules

The assessment for the learning modules is formed by setting a portfolio of work known as an Independent Learning Package (ILP) that the student must complete. The ILP typically consists of short answer, long answer and open ended project based assignments and small tasks. The student must submit their completed ILP work in the form of an ILP report that will contain a critical, reflective and detailed description of the independent work carried out by the student and the results achieved by the student.

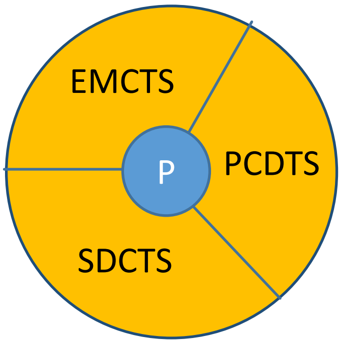
Unlike the assignments given in the ILP exercises carried out in the taught portion of a learning module are not assessed, these exercises are meant to develop basic capability and, as such, serve as a useful vehicle for sharpening the skills baseline for undertaking the associated Independent Learning Package (ILP) – often through keen competition within the class. In summary, the taught portion of a module is not explicitly subject to assessment, whereas ILPs are.

Assessment is carried out when the student presents himself/herself for examination. This process has two phases: submission of all supporting written evidence (worked problems, design and simulation results, software programs, written reports and the like) in the form of an ILP report, followed by attendance for an oral defence of the work detailed in the ILP report. An ILP Review Panel, consisting of at least two members of staff, will be empowered to determine the level of achievement of the student by giving a 'Pass with Distinction', 'Pass with Merit', 'Pass' or 'Fail' judgement after thorough scrutiny of the written evidence and hearing the oral defence and to make a recommendation to the Assessment Board.

Course structure

This section shows the core modules of the course and their credit value. Full-time Postgraduate students study 180 credits per year.

The course consists of three taught modules (40 credits each) plus an individual project (60 credits). All four modules (taught modules and the project) are core modules for the course (there are no option modules).



Credit Level 7				
Module code	**Module title**	**Status**	**UK credit**	**ECTS**
EMCTS	Electric Motors and Control for Transport Systems	Core	40	20
PCDTS	Power Conversion and Drives for Transport Systems	Core	40	20
SDCTS	Sensor, Data Acquisition and Communication for Transport Systems	Core	40	20
7ELEN016W	Project	Core	60	30

The inner layer represents the project module P (7ELEN016W), which is composed of two parts, denoted by Part I and Part II; students will need to have completed all the taught modules before undertaking Part II of the project module.

The outer layer represents the three taught core modules, which characterize the degree.

Each taught module consists of:

- A ten-day short course run Wednesday to Tuesday to provide two weekend breaks;
- An Independent Learning Package (ILP), which has the aim of assessing and reinforcing the learning outcomes developed through the taught material in the short course.

The ten-day short course structure of each of the taught modules within the MSc allows employees from Industry to undertake the course, wherever they are geographically based, by being released by their employer for this short period. Therefore, it provides a feasible route for them to completing the educational requirements for CEng while in employment.

The ILP allows students to tackle real life industry relevant engineering problem or challenge over eight weeks for full-time mode and sixteen weeks for part time mode.

Academic regulations
The current Handbook of Academic Regulations is available at westminster.ac.uk/academic-regulations

How will you be supported in your studies?

Course Management
This course is managed by staff from the Department of Engineering in the Faculty of Science and Technology. The Course Team consists of lecturers on individual modules, the Head of Department and technical support staff. The day-to-day running of each course is the responsibility of the Course Leader, while the strategic direction of the courses and the allocation of staff is the responsibility of the Head of the Department. The Dean of the Faculty of Science and Technology takes overall responsibility for all departments within it.

Academic Support
Upon arrival, an induction programme will introduce you to the staff responsible for the course, the campus on which you will be studying, the Library and IT facilities, additional support available and to your Faculty Registry Office. You will be provided with the Course Handbook, which provides detailed information about the course. Each course has a course leader or Director of Studies. All students enrolled on a full-time course and part time students registered for more than 60 credits a year have a personal tutor, who provides advice and guidance on academic matters. The University uses a Virtual Learning Environment called Blackboard where students access their course materials, and can communicate and collaborate with staff and other students

Learning Support
The Academic Learning Development Centre supports students in developing the skills required for higher education. As well as online resources in Blackboard, students have the opportunity to attend Study Skills workshops and one to one appointments.

Learning support includes four libraries, each holding a collection of resources related to the subjects taught at that site. Students[1] can search the entire library collection online through the Library Search service to find and reserve printed books, and access electronic resources (databases, e-journals, e-books). Students can choose to study in the libraries, which have areas for silent and group study, desktop computers, laptops for loan, photocopying and printing services. They can also choose from several computer rooms at each campus where desktop computers are available with the general and specialist software that supports the courses taught at their Faculty. Students can also securely connect their own laptops and mobile devices to the University wireless network.

Support Services
The University of Westminster Student Affairs department provide advice and guidance on accommodation, financial and legal matters, personal counselling, health and disability issues, careers, specialist advice for international students and the chaplaincy providing multi-faith guidance. The University of Westminster Students' Union also provides a range of facilities to support students during their time at the University.

How do we ensure the quality of our courses and continuous improvement?

[1] Students enrolled at Collaborative partners may have differing access due to licence agreements.

The course was initially approved by a University Validation Panel in 20XX. The panel included internal peers from the University, academic(s) from another university and a representative from industry. This helps to ensure the comparability of the course to those offered in other universities and the relevance to employers.

The course is also monitored each year by the Faculty to ensure it is running effectively and that issues which might affect the student experience have been appropriately addressed. Staff will consider evidence about the course, including the outcomes from Course Committees, evidence of student progression and achievement and the reports from external examiners, to evaluate the effectiveness of the course. Each Faculty puts in to place an action plan. This may for example include making changes on the way the module is taught, assessed or even how the course is structured in order to improve the course, in such cases an approval process is in place.

A Course review takes place periodically to ensure that the curriculum is up-to-date and that the skills gained on the course continue to be relevant to employers. Students meet with review panels to provide feedback on their experiences. Student feedback from previous years e.g. from Course Committees is also part of the evidence used to assess how the course has been running.

How do we act on student feedback?
Student feedback is important to the University and student views are taken seriously. Student feedback is gathered in a variety of ways.

- Through Course Committees students have the opportunity to express their voice in the running of their course. Student representatives are elected to Committee to expressly represent the views of their peer. The University and the Students' Union work together to provide a full induction to the role of the student representatives.

- Each Faculty also has its own Faculty Student Forum with student representatives; this enables wider discussions across the Faculty. Student representatives are also represented on key Faculty and university committees.

- All students are invited to complete a questionnaire before the end of each module. The feedback from this will inform the module leader on the effectiveness of the module and highlight areas that could be enhanced.

- The University also has an annual Postgraduate Taught Experience Survey or PTES which helps us compare how we are doing with other institutions, to make changes that will improve what we do in future and to keep doing the things that you value.

Please note: This programme specification provides a concise summary of the main features of the course and the learning outcomes that a student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided. This specification should be read in conjunction with the Course Handbook provided to students and Module Handbooks, which provide more detailed information on the specific learning outcomes, content, teaching, learning and assessment methods for each module.