MSc Curriculum Development and Requirements

Prepared by

Professor M. Shafik, University of Derby

Professor M. E. Farrag, Glasgow Caledonian University

MSc programme with a focus on Engineering and Technology based on first year is a teaching year and second year is for programme dissertation and industrial placement.

This is a draft of the possible potential 2-year postgraduate engineering and technology programme with a focus on Electric Vehicle Systems. The programme has a selection of modules that split over 2 years. Each module specifications will play a vital development of the student knowledge and skills to meet the existing and future industrial market needs and revolution. The titles of the modules are reflecting the possible contents that can be included. It could also be used to reveals the learning outcomes to achieve in each module and the programme. This can also be used for knowledge and skills mapping for accreditation purpose.

Two programme structures are proposed right here, one based on scholarship and industrial placement modules, and one based on dual degree programme between Brunel University and Saudi Institutions.

The aims of the proposed programme are:

- provide a boarder and flexible learning opportunities informed by industrial applied research in the field of advanced engineering and technology with a focus on electric vehicle systems.
- provide and prepare graduates with the potential knowledge, and skills in engineering and technology with a focus on electric vehicle systems.
- prepare graduates with the ability of products, systems, and services development from concept to realisation, close to commercialisation.
- prepare graduates with the critical thinking skills, and ability of problem solving.
- an enhanced treatment of business and management that aids progression to a position of responsibility.
- greater confidence to manage and to take on leadership in major engineering projects with a focus on electric vehicle systems.

(2 Year MSc programme based on first year is a teaching year and second year is for programme dissertation and industrial placement)

Y_1	Automotive Systems Engineering and Technology	Industrial Electronics for EV Systems	Advanced Programming Engineering and Technology (Solid Sate)	Advanced Mechatronics Systems (Drive and Steer by Wire)	Heat transfer and cooling in EV systems	Professional Development (Project Management for Engineers & Research Methodology)	Modern Control Systems	Advanced Vehicle Dynamics, Materials and Manufacturing
Y_2	Project Scholarship/Dissertation – 60 Credits				Industrial Placement			

Year_1: Modules List and Learning Outcomes:

Academic Year	Module Title	Credits	Learning Outcomes
Y_1	Automotive Systems Engineering and Technology	15	On successful completion of the module, student will be able to: ○ Develop knowledge, skills, and ability to critically assess all major operations of manufacture, and improvement of next

			generation of EV engineering and technology. ○ Identify, and describe the roles of mechatronics systems in a modern motor vehicle technology. ○ Develop knowledge on data collection using sensor and Sensorless technology, and the use of signal conditioning and information technology relevant to automotive systems. ○ Develop an understanding of all the major automotive mechanical and electrical components including chassis, powertrain, suspension, … etc.
	Industrial Electronics for EV Systems	15	On successful completion of the module, student will be able to: ○ Critically analyse the latest developments in industrial electronics and their applications in EV systems, critically evaluating technical, commercial and sustainability implications. ○ Analyse, design, simulate, and build an industrial control system using appropriate electronics, critically evaluating the outcome for EV systems. ○ Identify, select, and evaluate the necessary electrical, electronic and control units to build a specific EV industrial application system.
	Advanced Programming Engineering and Technology	15	On successful completion of the module, student will be able to: ○ Design and development the hardware of a solid-state microcontroller-based system, including interface, and critically evaluate its performance. ○ Design, implement and critically evaluate the programming code for solid-state embedded system, selecting an appropriate programming language, tools, and development environment, and analysing close to real-time requirements. ○ Define and critically evaluate a current area of advance distributed networking in embedded design for EV applications considering safety critical factors and high reliability systems.
	Advanced Mechatronics Systems (Drive and Steer by Wire)	15	On successful completion of the module, student will be able to: ○ Critically analyse and evaluate Advanced Mechatronic Systems, and its implementation in EV applications including drive and steer by wire. ○ Analyse, design, simulate, and build an EV application using Programmable Logic Controller Embedded Mechatronic Controller. ○ Identify, select, and evaluate the necessary programming, digital electronics, and controlled systems in the

			design of advanced mechatronic systems for EV applications. ○ Develop innovative solutions to automation problems that arise in advanced manufacturing for EV applications.
	Heat Transfer and Cooling in EV Systems	15	On successful completion of the module, student will be able to: ○ Develop knowledge and skills in mathematical analysis on heat exchange and experimental data for EV industrial applications. ○ Identify, select, and evaluate the principles of heat transfer, power generation, and cooling systems to include regenerative techniques. ○ Critically analyse and assess the environmental sustainability of power generation and its use in the EV applications. ○ Describe, select, and evaluate cost drivers, reliability, critical risks, health, and safety in power generation.
	Professional Development (Project Management for Engineers & Research Methodology)	15	On successful completion of the module, student will be able to: ○ Demonstrate ability to deal with complex issues creatively and make the right judgements that show your ability of problem-solving skills in EV industry. ○ Develop ability to analysis and convey complicated ideas, concepts and industrial challenges in EV engineering and Technology to automotive professional and non-professional audiences. ○ Develop the ability to choose and implement modern Computer Aided Design tools, right research methods, and general Information Communication Technology infrastructure. ○ Develop the knowledge and skills in project management in EV engineering and technology industry to work in your own or as a member of a team, learn independently, use critical thinking, and demonstrate independence in resource and time management.
	Modern Control Systems	15	On successful completion of the module, student will be able to: ○ Design and critically analyse the performance of modern control systems for EV applications using appropriate analytical control techniques, programming, experimental and computer aided design simulation tools. ○ Critically analyse, describe, and validate theoretically and virtually the performance of commonly used modern control design

			for EV applications, including modern digital, optimal and robust control techniques. ○ Critically evaluate the role of advanced control techniques for EV applications using state space, digital, optimal, and robust in industrial control systems. ○ Demonstrate a clear understanding of existing and future modern control system techniques using AI for EV applications.
	Advanced Vehicle Dynamics, Materials and Manufacturing	15	On successful completion of the module, student will be able to: ○ Critically analyse and implement complex mathematical methods, CAD tools to evaluate vibrational problems in the environment of automotive chassis dynamics specially for EV Engineering and Technology. ○ Identify, select, and integrate the necessary mechatronics tools to support the study of EV dynamics. ○ Critically assess and evaluate the performance of advanced automotive chassis systems including materials, components, and systems through the use of analytical, quantitative and qualitative processes and CAD modelling methods. ○ Analyse, design, simulate, and manufacture a real industrial case study of EV chassis systems and carry out the necessary validation and verifications.

Year_2: Modules List and Learning Outcomes:

Academic Year	Module Title	Credits	Learning Outcomes
Y_2	MSc Project Scholarship/Dissertation	60	On successful completion of the Independent Studies module, student will be able to: ○ Originate and manage a major piece of engineering and technology research programme, demonstrating creativity, innovation, application of research methods, and advanced engineering practice. ○ Work on your own initiative, and or as a member of a team to developing and applying techniques of scientific investigation, project management, data analysis, engineering experimentation, research and problem solving. ○ Develop in depth reflection upon the research and project development, place the results in context in relation to theories and practices and the specification developed for the study. ○ Ability to engage in professional discussion to communicate findings, including critical issues, major impact on direction of system development, and key design specifications.

	Industrial Placement	60	In this Industrial Placement module student requires to take on a substantial period (i.e., 3 up to 6 months) of supervised work experience in automotive manufacturing environment (preferred EV environment) and on successful completion of the module, student will be able to: ○ Create, implement, and evaluate a plan for professional development in automotive manufacturing environment. ○ Critically examine industry requirements via UK-SPEC for Engineers, in relation to your own professional development ○ Discuss and critically appraise relevant literature about the impact of engineering in society. ○ Reflect on the importance of people and behaviours in the engineering process, based on your learning and development in the workplace.

MSc Curriculum Development and Requirements

MSc programme with a focus on Engineering and Technology based on first year at KSA and the second year at Brunel – Dual degree.

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Two programme structures are proposed right here, one based on scholarship and industrial placement modules, and one based on dual degree programme between Brunel University and Saudi Institutions.

(2 Year MSc programme based on first year at KSA and the second year at Brunel – Dual degree)

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Y_2	Advanced Vehicular Systems Technology	Advanced Embedded Systems Engineering	Power Electronics and Drives	Artificial Intelligence & Autonomous Electric Vehicle Technology	Project Scholarship/Dissertation – 60 Credits			

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Year_2: Modules List and Learning Outcomes:

Academic Year	Module Title	Credits	Learning Outcomes
Y_2	Advanced Vehicular Systems Technology	15	On successful completion of the module, student will be able to develop: ○ Comprehensive knowledge and the ability to apply concepts from electrical and electronic engineering in complex problems in electric vehicle systems and a critical awareness of new developments and the wider context of engineering. ○ Ability to formulate and critically evaluate complex problems involving uncertain or incomplete data using data analytics in electric vehicle systems design. ○ Ability to select and apply modelling techniques and technologies for complex problems in electric vehicle systems and discussing the limitations of the techniques employed. ○ Select and critically evaluate literature about current and future vehicular technology with respect to current engineering practices; as well as social, legal, ethical, and professional issues. ○ Communicate effectively on complex electric vehicle systems matters with

			technical and non-technical audiences and the ability to evaluate the effectiveness of the methods used.
	Advanced Embedded Systems Engineering	15	On successful completion of the module, student will be able to: o Apply a comprehensive knowledge of the structure and the operating principles of embedded systems and reconfigurable devices, such as FPGAs. o Analyse/evaluate complex embedded system problems and reach substantiated solutions using computation/measurement principles. o Design solutions for complex embedded system problems by considering the various engineering, societal, scientific, and economic factors and trade-offs influencing eventual implementation that supports equality, diversity and inclusion. o Apply a Hardware Description Language approach, based on VHDL, for the solution of hardware/circuit design problems. o Use and evaluate practical laboratory skills to investigate complex embedded system problems.
	Power Electronics and Drives	15	On successful completion of the module, student will be able to develop: o Comprehensive knowledge and the ability to apply concepts from electronic engineering in complex problems in power electronics and drives and awareness of new developments and the wider context of engineering. o Ability to formulate and critically evaluate complex problems involving uncertain or incomplete data using data analytics in power electronic circuits design. o Ability to select and apply simulation and modelling techniques and technologies for complex problems in power electronics and drive circuits and to discuss the limitations of any techniques used. o Ability to select and critically evaluate literature about current and future power electronics and drive circuits with respect to current engineering practices as well as social, legal, ethical, and professional issues.
	Artificial Intelligence & Autonomous Electric Vehicle Technology	15	On successful completion of the module, student will be able to develop: o clear understanding of computational intelligence and computer systems with focus on Artificial Intelligence, including machine, deep and cognitive learning principles, and its applications in Autonomous EV. o knowledge and understanding the inspiration for designing intelligent machines, their impacts and related

			rational issues, including intelligence, learning, deep and cognitive learning. ○ Ability to distinguish between major forms of machine learning operation challenges, such as supervised, unsupervised and reinforcement learning and implement the fundamental ideas of algorithms for solving these identified industrial challenges. ○ knowledge, skills, and ability to critically assess all major operations of manufacture, and improvement of next generation of Autonomous EV engineering and technology using Applied Artificial Intelligence. ○ Identify, and describe the roles of mechatronics systems and AI in a modern motor vehicle technology. ○ Develop knowledge on big data and machine learning including data collection using sensor and Sensorless technology, and the use of signal conditioning and information technology relevant to automotive systems. ○ Develop an understanding of all the major automotive mechanical and electrical components including chassis, powertrain, suspension, … etc.
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