MSc Future Power Networks

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is intended as a reference point for prospective students, current students, external examiners and academic and support staff involved in delivering the programme and enabling student development and achievement.

Programme Information		
Programme Title	Future Power Networks	
Award(s)	MSc	
Programme Code	H6U7	
Awarding Institution	Imperial College London	
Teaching Institution	Imperial College London	
Faculty	Faculty of Engineering	
Department	Department of Electrical and Electronic Engineering	
Associateship	City and Guilds of London Institute (ACGI)	
Main Location of Study	South Kensington Campus	
Mode and Period of Study	1 academic year full-time	
Cohort Entry Points	Annually in October	
Relevant QAA Benchmark Statement(s) and/or other external reference points	Master's Degree in Engineering	
Total Credits	ECTS: 90	CATS: 180
FHEQ Level	Level 7	
EHEA Level	2nd cycle	
External Accreditor(s)	N/A	
Specification Details		
Student cohorts covered by specification	2019-20 entry	
Person responsible for the specification	Dr Balarko Chaudhuri, Course Director	
Date of introduction of programme	October 2015	

Date of programme specification/revision	February 2019

Programme Overview

This course will develop skills in planning, designing and operating power networks that are needed by engineers working in the 21st century electricity industry which is driven by clean and low carbon energy sources.

Worldwide electricity usage has been growing at an unprecedented rate with energy consumption predicted to grow by 56% in the next 25 years. There is a growing need for more trained power engineers, and you will be equipped to pursue careers that involve design, modelling, analysis and control, and the business aspects of bulk electric power supply systems.

The course content draws on our last 15 years of research expertise in the areas of power system control, economics and power electronics.

From studying this degree students will gain:

- an understanding of operating practice, design standard and regulatory policies in the electricity supply industry
- knowledge of power transmission and distribution grid operation code
- competency in the advanced modelling, optimisation and analysis of a large system
- competency in advanced signal and data analysis
- operating knowledge of commonly adopted power system simulation tools (DigSilent, EMTDC-PSCAD, Matlab, PSSE and Power System Toolbox)

Graduates will be equipped to pursue careers that involve research, design, modelling, analysis and control, system optimisation and the business aspects of bulk electric power supply systems.

Learning Outcomes

The Imperial Graduate Attributes are a set of core competencies which we expect students to achieve through completion of any Imperial College degree programme. The Graduate Attributes are available at: www.imperial.ac.uk/students/academic-support/graduate-attributes

Knowledge and Understanding of:

1. Advanced power system and component modelling and economic value analysis in the context of smart grid and state of the art in smart grid technology deployment;
2. State of the art of High voltage direct current transmission (HVDC) system, Flexible AC Transmission Systems (FACTS) and power electronic components in distribution networks;
3. Contemporary analytical methods of power system stability analysis, state estimation and power system control design;
4. Linear and nonlinear optimization methods from engineering system theory perspectives;
5. Integrated energy systems and operation under low system inertia
6. Research methods, including literature search, report writing, presentation skills;
7. Project management and communication skills including problem definition, project design, execution, and reporting.

Intellectual (thinking) skills - able to:

1. (Analysis) model power systems mathematically and apply relevant control and optimisation theory to study their properties and performance;
2. (Synthesis) design of network and component for successful operation of smart grid technologies and their roles in decarbonisation of the electricity sector;
3. (Computing) apply computational principles and techniques to control future power system design operation and control problems;
4. (Evaluative) plan, conduct and report on a programme of original research.

Practical skills – able to:

1. Write programs using at least one common language (Matlab);
2. Understand the literature so personal knowledge and skills can be kept up-to-date; 3. Define problems and design /manage associated projects;
4. Write effective technical reports.

Transferable skills – able to:

1. Thinking, using presentations, webpages and written reports;
2. Apply knowledge to new power system problems (management skills) formulate problem definitions;
3. Design and evaluate projects using objective criteria (under intelligent (thinking) skills - above);
4. Transfer techniques and solutions from one discipline to another;
5. Figure out how techniques and solutions from one research discipline could be transferred to another research discipline;
6. Use ICT;
7. Manage resources and time;
8. Learn independently with open-mindedness and critical enquiry;
9. Learn effectively for the purpose of continuing professional development.

Entry Requirements	
Academic Requirement	Normally high first class (1st) (75%+) UK Bachelor's Degree with Honours in Electrical Engineering or a related subject (or a comparable qualification recognised by the College).
Non-academic Requirements	N/A
Candidates (International) may be required to attend an interview.	
English Language Requirement	Higher requirement • Pass the Imperial Professional English Programme (applicants for postgraduate taught or research admission only) • Take an English language proficiency test

	• Provide evidence of a previous qualification that you have taken that confirms your English level • Provide evidence that you meet one of our English language exemptions IELTS 7.0 with a minimum of 6.5 in each element or equivalent.
The programme's competency standards document can be found at: http://www.imperial.ac.uk/electrical-engineering/study/undergraduate/applicants-with-disabilities/	
Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	• Lectures • Video archive from Blackboard
E-learning & Blended Learning Methods	• Simulation exercise in some courses • Matlab or other tolls for course work • Software simulation and hardware laboratory for laboratory component of the course
Project Learning Methods	• Individual projects
Assessment Strategy	
Assessment Methods	• Written examinations • Coursework software or hardware deliverable • Oral and poster presentations • Reports
Academic Feedback Policy	
Mechanisms for providing prompt feedback to students on their performance in course work and examinations and processes for monitoring that these named processes are effective: • All coursework is promptly marked • Meeting of individual students with course directors to discuss exams, research project and career aims • General remarks are communicated by broadcast emails to all Course students • More details given to representatives in the Staff – Student Committee Course questionnaire evaluation of taught components Feedback to all submitted coursework is expected within two weeks	
Re-sit Policy	
The College's Policy on Re-sits is available at: http://www.imperial.ac.uk/student-records-anddata/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-andregulations/	
Mitigating Circumstances Policy	

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Programme Structure

Full-time	Term One	Term Two	Term Three
Core Modules	3	1	0
Elective Modules	6	7	0
Projects	0	0	1

Assessment Dates & Deadlines

Written Examinations	May
Coursework Assessments	Continuous
Project Deadlines	Mid-March and Early-September
Practical Assessments	Continuous

Assessment Structure

Marking Scheme

The Pass Mark for all **postgraduate** taught course modules is 50%. Students must pass all elements in order to be awarded a degree.

Final Degree Classifications

An MSc degree will be awarded to students obtaining:

- at least 40% for each of the 8 modules counted for the computation of the examinations average
- at least 50% for the laboratory work average
- at least 50% for both the project and examinations average

MSc degree with **merit** will be awarded to students obtaining

- at least 40% for each of the 8 modules counted for the computation of the examinations average
- at least 50% for the laboratory work average
- at least 60% for both the project and examinations average

MSc degree with **distinction** will be awarded to students obtaining

- at least 40% for each of the 8 modules counted for the computation of the examinations average

- at least 50% for the laboratory work average
- at least 70% for the project and 70% for examinations average

Module Weightings	
Module	% Module Weighting
HVDC Technology and Control	N/A
Laboratory	N/A
Selected Topics in Power Systems	N/A
Power System Dynamics, Stability and Control	N/A
Role and Value of Smart Grid Technologies	N/A
4 x Elective Modules	N/A
Individual Research Project	N/A

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Coursework	% Practical	FHEQ Level	ECTS
EE9-FPN1-01	Role and Value of Smart Grid Technologies	CORE	20	105	0	125	100%	0%	0%	7	5
EE9-FPN1-02	HVDC Technology and Control	CORE	20	105	0	125	80%	20%	0%	7	5
EE9-FPN1-03	Power System Dynamics, Stability and Control	CORE	20	105	0	125	100%	0%	0%	7	5
	Selected Topics in Power Systems	CORE	20	105	0	125	80%	20%	0%	7	5
EE9-FPN1-04	Optimization	ELECTIVE	20	105	0	125	100%	0%	0%	7	5
EE9-CS7-1	Topics in Control Systems	ELECTIVE	20	105	0	125	0%	100%	0%	7	5
EE9-FPN2-01	Traffic Theory and Queuing systems	ELECTIVE	20	105	0	125	100%	0%	0%	7	5
EE9-FPN2-02	Probability and Stochastic Processes	ELECTIVE	20	105	0	125	85%	15%	0%	7	5
EE9-FPN2-03	Digital Signal Processing and Digital Filters	ELECTIVE	20	105	0	125	100%	0%	0%	7	5
EE9-FPN2-04	Adaptive Signal Processing and Machine Intelligence	ELECTIVE	20	105	0	125	0%	100%	0%	7	5
EE9-FPN2-05	Stability and Control of Non-linear Systems	ELECTIVE	20	105	0	125	75%	25%	0%	7	5
EE9-FPN2-06	Design of Linear Multivariable Control Systems	ELECTIVE	20	105	0	125	100%	0%	0%	7	5
EE9-FPN2-07	Estimation and Fault Detection	ELECTIVE	20	105	0	125	100%	0%	0%	7	5
EE9-FPN2-08	Systems Identification	ELECTIVE	20	105	0	125	100%	0%	0%	7	5
EE9-FPN2-09	Wavelets and Applications	ELECTIVE	20	105	0	125	75%	25%	0%	7	5

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Coursework	% Practical	FHEQ Level	ECTS
EE9-FPN2-10	Sustainable Electrical Systems	ELECTIVE	20	105	0	125	80%	20%	0%	7	5
EE9-FPN2-11	Power System Economics	ELECTIVE	20	105	0	125	80%	20%	0%	7	5
EE9-QLAB	Laboratory	CORE	30	220	0	250	0%	0%	100%	7	10
EE9-QPRJ	Individual Research Project	CORE	0	1000	0	1000	0%	100%	0%	7	40

Supporting Information
The Programme Handbook is available at: http://www.imperial.ac.uk/electricalengineering/study/current-students-course-handbook/#m
The Module Handbook is available at: http://intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/crslistpg.asp?c=Q1
The College's entry requirements for postgraduate programmes can be found at: www.imperial.ac.uk/study/pg/apply/requirements
The College's Quality & Enhancement Framework is available at: www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance
The College's Academic and Examination Regulations can be found at: https://www.imperial.ac.uk/about/governance/academic-governance/regulations
Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine". http://www.imperial.ac.uk/admin-services/secretariat/college-governance/charters/charter-andstatutes/
Imperial College London is regulated by the Office for Students (OfS) https://www.officeforstudents.org.uk/