ES97A-15 Operation and Control of Power Systems

24/25

Department
School of Engineering
Level
Taught Postgraduate Level
Module leader
Li Ran
Credit value
15
Module duration
10 weeks
Assessment
30% coursework, 70% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES97A-15 Operation and Control of Power Systems

Module web page

Module aims

This module aims to present the current (advanced) technologies and trends in development that will shape future electrical power systems to achieve the low carbon objectives. The students will gain a comprehensive knowledge and understanding of the construction, operation and control principles of power systems. They will learn advanced analytical skills for examining different modes of operation in complex systems. The students will be introduced (through assignment) to ETAP which is a package widely used in industry for power system analysis and design. The content includes the following main elements:

- Generation, Transmission and Distribution of Electrical Power
- Load Flow Analysis
- Stability Analyses and Control of Power Systems
- Fault Analysis and Power System Protection Concept and Techniques

- Adequacy and Security of Power Systems
- Effects and Management of Distributed Generation
- Flexible AC Transmission Systems (FACTS) and High Voltage DC (HVDC) Transmission Technologies
- Power System Frequency and Voltage Control
- Power Quality Monitoring and Management
- Renewable Penetration and Grid Code Requirements
- The Role of Energy Storage and the Development of Relevant Technologies
- Smart Grids: Communications and standards, demand side response, wide area measurements, privacy and cyber security.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Fundamentals of 3-Phase AC Power Systems
- Planning and Expansion of Power Systems
- Power Flow Calculation and Security Analysis of Network Operation
- Fault Calculation and Power System Protection
- Power System Stability Calculation and Control
- Wind Turbine/Farm Characteristics
- Challenges of Wind Power Integration in Power Systems
- Shunt Reactive Power Compensation Technologies
- Controllable Series Compensators in Transmission Networks
- HVDC Transmission – LCC Technology
- VSC (voltage source converters) – HVDC
- Flexible AC Transmission Systems (FACTS)
- Integration of Large Scale PV Generation
- Marine Renewable Generation
- Control of Power System Frequency and Voltage
- Handling of Power Quality Issues in Power Systems
- Fault Level Management
- Combined Heat and Power
- Smart Grids: Communications and standards, demand side response, privacy and cyber security

Learning outcomes

By the end of the module, students should be able to:

- Critically assess the effects of future renewable penetration and distributed generation, and possible solutions based on modern technologies to manage such effects. [M2, M4, M5]
- Solve complex operation and control problems in modern power systems to accommodate evolving power generation landscapes, with load flow, stability and faults/protection, as well as frequency constraints. [M1, M4, M6]
- Demonstrate an advanced understanding of power quality monitoring and control. [M4, M5]

- Based on socioeconomic requirements, develop insight into the designs of smart grid technologies and justify their applications in different scenarios. [M4, M5]
- Conduct experimental investigation of complex power system components. [M12]

Indicative reading list

1. Seifi H. and Sepasian M.S., Electric Power System Planning - Issues, Algorithms and Solutions, Springer 2011
2. Wildi T., Electricl Machines, Drives, and Power Systems, Pearson Prentice Hall, 2014
3. Weedy B.M., Cory B.J., Jenkins N., Ekanayake J.B. and Strbac G. Electric Power Systems (5th Ed), John Wiley & Sons, 2012
4. Kundur P., Power System Stability and Control, McGraw-Hill, 1994
5. Horowitz S.H. and Phadke A.G., Power System Relaying (4th Ed), John Wiley & Sons, 2014
6. Freris L. and Infield D., Renewable Energy in Power Systems, John Wiley & Sons, 2020
7. Nasar S., Electric Power Systems, Schaum's Outlines, McGraw-Hill, 1990

Research element

Research element is included in the assessed assignment, about medium voltage distribution networks with embedded low carbon generation.

Subject specific skills

Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality

Transferable skills

Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions
Apply problem solving skills, information retrieval, and the effective use of general IT facilities
Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
Exercise initiative and personal responsibility, including time management, which may be as a team member or leader

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Study

Study time

Type	Required
Lectures	26 sessions of 1 hour (17%)
Tutorials	2 sessions of 1 hour (1%)
Total	150 hours

Type	Required
Practical classes	2 sessions of 2 hours (3%)
External visits	1 session of 2 hours (1%)
Other activity	2 hours (1%)
Private study	114 hours (76%)
Total	150 hours

Private study description

Guided Independent Learning 114 hours

Other activity description

2x1 hour Revision Class

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group D6

	Weighting	Study time
Assignment Assignment report (8 pages).	30%	
QMP Examination 2 hr QMP ~Platforms - AEP,QMP	70%	

- Online examination: No Answerbook required
- Students may use a calculator
- Engineering Data Book 8th Edition
- Graph paper

Feedback on assessment

The students will obtain feedback through contact with lecturer during office hours. Exercises will

be given after every lecture and solutions will be provided in the next week. The students will also obtain written feedback on the laboratory and simulation report. There will also be cohort level feedback on examinations.

Past exam papers for ES97A

Availability

Courses

This module is Core for:

- Year 1 of RESA-H6P9 Postgraduate Research Wide Bandgap Power Electronics
- Year 1 of TESA-H643 Postgraduate Taught Electrical Power Engineering
- Year 1 of TESA-H642 Postgraduate Taught Energy and Power Engineering
- Year 4 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng
- Year 5 of UESA-H607 Undergraduate Electrical and Electronic Engineering with Intercalated Year

This module is Optional for:

- Year 4 of UESA-H116 MEng Engineering with Exchange Year
- Year 5 of UESA-H115 MEng Engineering with Intercalated Year
- Year 2 of TESA-H1A0 Postgraduate Taught Sustainable Energy Technologies

This module is Option list A for:

- Year 4 of UESA-H114 MEng Engineering

This module is Option list B for:

- Year 1 of TESA-H644 Postgraduate Taught Electrical and Electronic Engineering