National Centre for Maritime Engineering & Hydrodynamics
Australian Maritime College

JEE362
MARINE ELECTRICAL POWERING AND SYSTEMS

Semester 2, 2020

Unit Outline

Dr Mark Symes
# CONTACT DETAILS

## Unit coordinator

<table>
<thead>
<tr>
<th>Unit coordinator/Lecturer:</th>
<th>Dr Mark Symes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus:</td>
<td>Newnham</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:mark.symes@utas.edu.au">mark.symes@utas.edu.au</a></td>
</tr>
<tr>
<td>Phone:</td>
<td>03-6324-9349</td>
</tr>
<tr>
<td>Room location and number:</td>
<td>Swanson Building, G91</td>
</tr>
<tr>
<td>Consultation hours:</td>
<td>via appointment</td>
</tr>
</tbody>
</table>
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WHAT IS THE UNIT ABOUT?

Unit description

The purpose of this unit is to develop engineering ability for system level design and commissioning of electrical powering and systems within marine and offshore sectors. The unit focuses on estimation of plant power electrical loads, design and analysis of marine electrical machines, power electronics and powering systems.

Intended Learning Outcomes

On completion of this unit, you will be able to:

1. Estimate plant electrical loads and the required power supply capacity using single-line diagrams, schematic drawings of electrical wiring, distribution and protection systems;
2. Explain operating principles of electric machines and solid state semiconductors used in power electronics and marine and offshore industries;
3. Perform basic calculations and analysis of DC, AC power systems and power electronic systems;
4. Design marine electrical powering and systems in compliance with statutory and classification society regulations and rules; and
5. Perform analysis and inspection of marine electrical machines and powering systems.
Graduate Statement

Successful completion of this unit supports your development of course learning outcomes, which describe what a graduate of a course knows, understands and is able to do. Course learning outcomes are published in the Bachelor of Engineering (Specialisation) with Honours Course Rules. This document is available at http://www.amc.edu.au/ncmeh-course-information.

Course learning outcomes are developed with reference to national discipline standards, Australian Qualifications Framework (AQF), any professional accreditation requirements and the University of Tasmania’s Graduate Statement.

The University of Tasmania experience unlocks the potential of individuals. Our graduates are equipped and inspired to shape and respond to the opportunities and challenges of the future as accomplished communicators, highly regarded professionals and culturally competent citizens in local, national, and global society. University of Tasmania graduates acquire subject and multidisciplinary knowledge and skills, and develop critical and creative literacies and numeracies and skills of inquiry. They demonstrate the ability to apply this knowledge in changing circumstances. Our graduates recognise and critically evaluate issues of social responsibility, ethical conduct and sustainability, are entrepreneurial and creative, and are mindful of their own wellbeing and that of the community. Through respect for diversity and by working in collaborative ways, our graduates reflect the values of the University of Tasmania.

Alterations to the unit as a result of student feedback

No major alterations have been made. However, additional class activities have been added to support students' learning needs.

Prior knowledge &/or skills

- JEE344 Maritime Automation is a prerequisite for this unit
- Knowledge and skills of engineering mathematics;
- Knowledge of electrical engineering; and
- Knowledge and skills of MATLAB/Simulink programming
HOW WILL I BE ASSESSED?

Assessment schedule

<table>
<thead>
<tr>
<th>Assessment task</th>
<th>Date due</th>
<th>Percent weighting</th>
<th>Links to Intended Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Assignment 1</td>
<td>Week 6, 12 and 13</td>
<td>40%</td>
<td>All</td>
</tr>
<tr>
<td>Design Assignment 2</td>
<td>Week 13</td>
<td>25%</td>
<td>2, 3, 4</td>
</tr>
<tr>
<td>Lab Report</td>
<td>Week 10</td>
<td>25%</td>
<td>1, 2, 3, 5</td>
</tr>
<tr>
<td>Tutorials</td>
<td>Week 7, 13</td>
<td>10%</td>
<td>1, 2, 3, 4</td>
</tr>
</tbody>
</table>

IMPORTANT NOTE: due to the ongoing changes in restrictions brought about by COVID-19, please be aware that the assessment tasks and requirements for this unit may change. Students will be notified in writing at the earliest opportunity should changes be necessary; please check your emails and/or the MyLO site regularly.

Assessment details

Design Assignment 1 (40%)

| Task description | The purpose of this assessment task is to develop and demonstrate students’ skills in designing and estimating plant and ship electrical power systems. In this task, the students are required to work in groups (3 members per group) to design and estimate electrical power system for an offshore platform or shipboard power system. 

This task include:

Part A: Proposal (Pass/Fail)

- Select a type of vessel, including underwater vehicle, and classification society requirements
- Write a proposal. The proposal should include:
  - The list of the group members
  - The type of the selected system (shipboard/offshore plant)
  - General information of the selected shipboard/offshore plant such as the name of the ship/platform, location, year of operation, picture, dimensions, deadweight tonnage, propulsion type etc.

Part B: Full report (30%)

- Estimate plant electrical power loads and draw diagrams/schematics. This includes load tables, single line diagram of your system and any associated tables/diagrams.
- Select types of electrical machines (generators and motors)
- Select proper electrical protection devices and power electronic devices
- Perform necessary calculations based on relevant theories
- Produce documents by referring to classification society rules and regulations

Part C: Oral presentation (10%)

- Orally present your design of the selected system
- Appeal your strong point in your design


### Design Assignment 2 (25%)

**Task description**
The purpose of this assessment task is to develop and demonstrate students' skills in designing power electronics devices for various applications. The assessment task includes:
- Design a single phase/three phase full wave-controlled rectifier to drive a dc/ac motor
- Investigate the working principle of power electronic devices
- Perform necessary calculations based on relevant theories
- Select suitable dc and ac motor drives
- This is an individual assessment task. Each student works independently
- Submit a report

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Measures Intended Learning Outcome:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion 1</td>
<td>Design approaches used to design a rectifier, selection of power electronics devices and identification of appropriate parameters from datasheet of switching device for analysis</td>
</tr>
<tr>
<td>Criterion 2</td>
<td>Solve problems in the design and analysis of power electronic system</td>
</tr>
<tr>
<td>Criterion 3</td>
<td>Apply theoretical knowledge of electrical engineering and power electronics and related engineering principles to design power electronics device</td>
</tr>
</tbody>
</table>

### Task length
- **Report:** Maximum of 8 pages (excluding appendices and cover page) using the NCMEH assignment template and software program

### Due date
- **Report submission due by Friday 16/10/2020, 4 pm** (Submission via MyLo)
Lab Practical (25%)

Task description
The practicals in the control engineering lab require preparation, participation, and individual or group reporting. Reports are scheduled in one week after the commencement of experiments. The format for the reports will be discussed prior to the submission of the lab report. Practical reports, teamwork and written and graphical communication skills will be emphasised and assessed. This task includes:
- Attending the labs and performing experiments
- Submitting a lab report
- Students are required to work in groups

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Measures Intended Learning Outcome:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion 1</td>
<td>Demonstrate and apply theoretical and practical knowledge of electrical engineering and power electronics and related engineering principles to explanation of electrical and electronic systems and components in laboratories</td>
</tr>
<tr>
<td>Criterion 2</td>
<td>Solve problems in the design and analysis of power electronic system</td>
</tr>
<tr>
<td>Criterion 3</td>
<td>Evaluate the performance of the electrical systems through relevant calculations, results and experimental data analysis</td>
</tr>
</tbody>
</table>

Task length
- Lab attendance and performance: three hours lab session
- Lab report (group lab report): Maximum of 20 pages

Due date
- Lab practical in Week 10
- Lab report submission due by Thursday 24/09/2020, 4pm (Submission via MyLo)

Tutorials (10%)

Task description
In this assessment task, students are required to submit their answers of tutorial 1,2,3,4,5,6,7 and 8. This is an individual assessment task. The submission of tutorials is divided into two submissions
- First submission: tutorials 1 to 4
- Second submission: tutorials 5 to 8

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Measures Intended Learning Outcome:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion 1</td>
<td>Demonstrate and apply theoretical knowledge of electrical engineering and power electronics and related engineering principles to calculate and analyse of electrical circuits and systems</td>
</tr>
<tr>
<td>Criterion 2</td>
<td>Solve problems in the design and analysis of power electronic system</td>
</tr>
<tr>
<td>Criterion 3</td>
<td>Evaluate the performance of the electrical systems through relevant calculations</td>
</tr>
</tbody>
</table>

Task length
Sufficient to describe solutions using NCMEH lab template

Due date
- Tutorials 1 to 4: Tuesday 25/08/2020 (hand-in)
- Tutorials 5 to 8: Tuesday 22/09/2020 (hand-in)
How your final result is determined

Your final result in this unit is determined according to Academic Senate Rule 6 – Admission, Assessment and Student Progress and the College of Sciences and Engineering Procedure for Processing of Results.

To achieve a full pass in this unit, you must meet all the following:

1. Attain all the Intended Learning Outcomes.
2. Achieve an overall mark of 50%.
3. Your mark for your Design Assignment 1 must be at or above 40%.

You will Fail (NN) the unit if your overall mark is less than 45%.

If you do not meet the threshold criteria outlined in the assessment task, your final result will be recorded as Absent Deemed Fail (AN) with no mark recorded.

Submission of assignments

All assignments, reports, etc. must be completed using the template provided on the AMC website, unless otherwise specified by the lecturer. All coursework must have the AMC Assignment Cover Sheet attached.

All assignments and reports must be typed and completed using Word, Excel, approved Engineering drawing software and include the relevant theory, illustrations, results, analysis, and conclusion.

Group reports must be signed by all participants.

Assignments and reports must be submitted via MyLO.

Please remember that you are responsible for lodging your coursework on or before the due date. We strongly recommend that you keep a copy. Even in the most ‘perfect’ of systems, items sometimes go astray.

Requests for extensions

Extensions will only be granted on medical or compassionate grounds. Requests for extensions should be made via email to the lecturer prior to the due date. Medical certificates or other evidence must be included (electronically or the hard copy mailed) and must contain information which justifies the extension sought.
Penalties

Late assignments which have not been granted an extension will, at the lecturer’s discretion, be penalised by deducting ten per cent of total marks for each day overdue. Assignments submitted more than five days late will normally not be accepted by the lecturer.

Failure to adhere with the WH&S standards whilst taking part in any assessed activity that involves field trips and/or that requires the use of UTAS or AMC facilities will result in the following penalties:

- **first offense** - 5% penalty (applicable to the whole team in team projects);
- **second offense by student (or another member of the same team in team projects)** - 20% penalty (applicable to the whole team in team projects); and
- **third offense** - a fail grade in the assessment.

Review of results and appeals

If you have questions about, or problems with, your assessment you should discuss this with the following people:

1. The person who marked the assessment.
2. Unit Coordinator.
3. Course Coordinator.
4. Director, NCMEH.

If this does not resolve the issue, you may file a formal review of assessment. The procedure is given at: [http://www.utas.edu.au/exams/results](http://www.utas.edu.au/exams/results)

Academic integrity

What is academic integrity?

The University community is committed to upholding the Statement on Academic Integrity. A breach of academic integrity is defined as being when a student:

a) fails to meet the expectations of academic integrity; or
b) seeks to gain, for themselves or for any other person, any academic advantage or advancement to which they or that other person is not entitled; or

c) improperly disadvantages any other member of the University community.

Breaches of academic integrity such as plagiarism, contract cheating, collusion and so on are counter to the fundamental values of the University and can result in a range of penalties. These penalties are outlined in [Ordinance 9: Student Academic Integrity](http://www.utas.edu.au/exams/results).

More information is available from [the Academic Integrity for Students webpage](http://www.utas.edu.au/exams/results).

The University and any persons authorised by the University may submit your assessable works to a text matching service, to obtain a report on possible instances of plagiarism or contract cheating.
**Academic Integrity Training Module**

As part of the University's educative approach to academic integrity, there is a short Academic Integrity Training Module that all students are required to complete.

Completion of the module allows you to demonstrate your understanding of what constitutes academic misconduct.

The Academic Integrity Training Module is available for all students through MyLO.

**If you do not complete this module your final unit results will be withheld.**

You should aim to complete the module within the first few weeks of commencing study at the University.

**Academic referencing**

In your written work you will need to support your ideas by referring to scholarly literature, works of art and/or inventions. It is important that you understand how to correctly refer to the work of others and maintain academic integrity.

Failure to appropriately acknowledge the ideas of others constitutes a breach of academic integrity, a matter considered by the University of Tasmania as a serious offence.

The appropriate referencing style for this unit is APA

The University library provides information on presentation of assignments, including referencing styles and should be referred to when completing tasks in this unit.

For further information, see the Academic Integrity for Students webpage.
WHAT LEARNING OPPORTUNITIES ARE THERE?

MyLO

MyLO is the online learning environment at the University of Tasmania. This is the system that will host the online learning materials and activities for this unit.

Lecture notes, tutorials, online quizzes, assessments, past exam papers, selected solutions and lecture recordings can be downloaded via MyLO. News and announcements may be posted to MyLO News and students are expected to be aware of the content of such posts within 48 hours of them being posted.

Getting help with MyLO

It is important that you are able to access and use MyLO as part of your study in this unit. To find out more about the features and functions of MyLO, and to practice using them, visit Getting Started in MyLO.

For access to information about MyLO and a range of step-by-step guides in pdf, word and video format, visit the MyLO Student Support page on the University website.

If something is not working as it should, contact the Service Desk (Service.Desk@utas.edu.au, phone 6226 1818), or Request IT Help Online.

Resources

Required readings

You will need the following materials:

- Lecture notes and handouts distributed by lecturer

Recommended readings


Equipment, materials, software, accounts

Materials to be provided by the student

- A non-programmable scientific calculator (Casio fx-82AU PLUS II) is required at all times.
**Computer hardware & software**
- MATLAB/Simulink

## Activities

### Learning expectations

The University is committed to high standards of professional conduct in all activities, and holds its commitment and responsibilities to its students as being of paramount importance. Likewise, it holds expectations about the responsibilities students have as they pursue their studies within the special environment the University offers.

**Students are expected to participate actively and positively in the teaching/learning environment. They must attend classes when and as required, strive to maintain steady progress within the subject or unit framework, comply with workload expectations, and submit required work on time.**

### Details of teaching arrangements

<table>
<thead>
<tr>
<th>Class</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture and consultation</td>
<td>Tuesday</td>
<td>13:00-16:00</td>
<td>Online</td>
<td>All</td>
</tr>
<tr>
<td>Tutorial</td>
<td>Thursday</td>
<td>09:00-10:00</td>
<td>Online</td>
<td>All</td>
</tr>
<tr>
<td>Lab</td>
<td>TBA</td>
<td>TBA</td>
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<td>TBA</td>
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</tbody>
</table>

*Check tutorial groups and lab timetable/groups to identify your designated time and day.*
<table>
<thead>
<tr>
<th>Week</th>
<th>Date beginning</th>
<th>Topic/ Module/ Focus Area</th>
<th>Activities</th>
<th>Readings/ Further Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13 July</td>
<td>Introduction: Fundamentals of Electricity, magnetism and circuit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>20 July</td>
<td>AC power system fundamentals</td>
<td>• Tutorial 1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>27 July</td>
<td>Three-phase circuits</td>
<td>• Tutorial 2 • Release design assignment 1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 August</td>
<td>Estimate of plant power</td>
<td>• Tutorial 3 • Submit group members list of design assignment 1 and practicals</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10 August</td>
<td>Three-phase Induction Machines</td>
<td>• Tutorial 4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>17 August</td>
<td>DC generators</td>
<td>• Tutorial 5 • Submission of tutorials 1 to 4 • Submit design assignment 1 – Part A (design proposal)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>24 August</td>
<td>DC motors</td>
<td>• Tutorial 6</td>
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<tr>
<td><strong>Semester Break (31 August – 6 September)</strong></td>
<td></td>
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<tr>
<td>8</td>
<td>7 September</td>
<td>Fundamentals of power electronics</td>
<td>• Tutorial 7 • Release design assignment 2</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>14 September</td>
<td>Fundamentals of power electronics (cont.)</td>
<td>• Tutorial 8</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>21 September</td>
<td>Fundamentals of power electronics (cont.)</td>
<td>• Submission of tutorials 5 to 8 • Lab practical • Lab report submission</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>28 October</td>
<td>Safety, earthing, distribution and protection systems: Safety and earthing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>5 October</td>
<td>Safety, earthing, distribution and protection systems (cont.): Electrical distribution, AVR</td>
<td>• Submission of design assignment 1 – Part B (Full report)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>12 October</td>
<td>Safety, earthing, distribution and protection systems (cont.): Harmonics</td>
<td>• Presentation of design assignment 1 • Submission of design assignment 2</td>
<td></td>
</tr>
</tbody>
</table>
Topics covered

1. Theory

*Estimation of Plant Electrical Load*
Determination of power supply capacity, standby capacity of plain cable feeders and transformer feeders, rating of motors in relation to their prime movers, rating of generators in relation to their prime movers.

*AC power system fundamentals*
Three phase circuits with balanced and unbalanced loads. Technical specifications and per-unit quantities. Real power; reactive power, apparent power, power factor and power factor correction.

*DC Motors*

*Three Phase AC Motors*

*Three Phase AC Generators*
Construction and principle of operation, salient and cylindrical pole types. Shaft generators, excitation methods, automatic voltage regulators, synchronising, parallel operation and load sharing. Gas turbine and Diesel Gen-sets characteristics. PTO/PTI systems (shaft alternators that can be used as propulsion)

*Earthed and Insulated Neutral Distribution Systems*

*Safety*
Applicable Safety standards. Safe voltages. Safe operation and maintenance. Requirements for electrical equipment in hazardous areas on vessels and oil rigs.

*Introduction to Maritime Electrical Systems Analysis*
Typical systems and wiring diagrams for Ships, boats and oil rigs. Harmonics and filtering, EM disturbances and counter measures, surge protection.

*Power Electronics*
Elements of power electronics, devices (Thyristers, MOSFETs). Rectifiers, inverters / frequency controllers, and converters. PWM. Soft starters.

2. Practicals/Labs/Site Visits

*Lab*
Power Electronics Lab (electrical machines, inverters and frequency control of motors and generators in Power Electronics Lab)
Specific attendance/performance requirements
Attendance at all assigned class times is expected. You are responsible for all information (both academic and administrative) presented during class times. Should you miss a class for whatever reason it is your responsibility to obtain information and content that was missed. Attendance at all tutorials, laboratory and practical sessions (including any project work) is compulsory.

In this unit, your active engagement will be monitored in the following way:

1. Attendance at lecture and tutorial classes
2. Find a group for design assignment 1 and submit the group members list by week 4

If you do not demonstrate evidence of having engaged actively with this unit by completing these two activities by Week 4 of semester, your enrolment may be cancelled or you may be withdrawn from the unit.

Teaching and learning strategies
Unit materials will be provided in MyLO. It is expected that students read ahead the uploaded unit materials before each lecture and tutorial class.

This unit consists of four assessment tasks. The purpose of having several assessment tasks is to enforce students understanding of subject area and increase their engagement in the unit. In addition, ungraded activates and exercises will be used in each lecture class to foster students’ engagement in the unit. Lecture class activates, in addition to tutorial sessions, provide the opportunity for the students to use and develop their skills in problem solving of electrical power systems and improve their understandings of electrical machines and power electronics devices. These learning activities will support the students to complete the assessment tasks.

Students’ attendance to classes and participation in class activities are recommended. These learning opportunities will help students to develop all intended learning outcomes that will improve their academic performance.

Work Health and Safety (WHS)
The University is committed to providing a safe and secure teaching and learning environment. In addition to specific requirements of this unit you should refer to the University's Safety and Wellbeing webpage and policy.

Students must wear lab coats and safety boots when doing activities in Control Lab. In addition, white card should be presented in the lab.

Communication
News and announcements may be posted to MyLO News, and students will be expected to be aware of the content of such posts within 48 hours of them being posted.

Students are also expected to check their UTAS email very regularly (once a day) for important announcements.
Concerns and complaints

The University is committed to providing an environment in which any concerns and complaints will be treated seriously, impartially and resolved as quickly as possible. We are also committed to ensuring that a student may lodge a complaint without fear of disadvantage. If you have a concern, information about who to contact for assistance is available on the ‘How to resolve a student complaint’ page.

Learning support

The University provides a range of face-to-face and online services to help equip students with the academic and literacy skills that they need to undertake their study. These services are in addition to the support you receive in each unit from unit coordinators, lecturers and tutors. For details of these additional services such as workshops, individual consultation for learning advice, and peer assisted learning opportunities, please visit https://www.utas.edu.au/students/learning.

The University also provides free access to Studiozity, 24/7 online study help for all UTAS students, enabling them to get feedback on written work within 24 hours or chat live with a subject specialist anywhere and anytime.

All direct assessment-based feedback is provided only from the staff teaching you the unit.

Further information and assistance

More information with regard to content, assessments, grading, GPA etc. is found in the Course Rules Document, available on the AMC website: http://amc.edu.au/ncmeh-course-information

If you are experiencing difficulties with your studies or assignments, have personal or life-planning issues, disability or illness which may affect your course of study, you are advised to raise these with the unit coordinator in the first instance.

In addition to Learning Support, there is a range of University-wide support services available to you including Student Advisers, Disability Services, and more which can be found on the Study Support and Resources and Safety, Health and Wellbeing pages from the Current Students portal of the University website.

Should you require assistance in accessing the Library, visit their website for more information.