UNSW Course Outline

ZEIT3224 Electric Machines and Power Electronics - 2024

Published on the 11 Feb 2024

General Course Information

Course Code : ZEIT3224
Year : 2024
Term : Semester 1
Teaching Period : Z1
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Engineering and Technology
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The focus of this course is on developing an understanding of the principles of electrical machines and power electronic circuits. This course builds upon previous study in circuit theory and electromagnetics, focussing on the analysis and design of electrical machines and power

electronic circuits in practical scenarios. This course will cover three-phase circuits and transformers, DC and AC motors and generators, power diodes and transistors, inverters, power supplies, and drives.

Course Aims

This course aims to provide students with an understanding of the fundamental principles of electrical power, machines and power electronics.

Relationship to Other Courses

Prerequisites: ZEIT1206 and ZPEM2502

The machines part of this course relies on basic physics courses on electromagnetics induction and mechanical forces. The power electronic component of the course relies on basic circuit theory and the operation of diodes and transistors as switches. The course relies on the mathematical background in the area of Fourier series, differential equations, solution of linear and nonlinear algebraic equations

Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Professional Engineer (Stage 1)
CLO1 : Identify an appropriate motor drive and describe its technical specifications.	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline
CLO2 : Explain the fundamental principles of operation and the main characteristics of electrical machines.	• PEE3.2 : Effective oral and written communication in professional and lay domains
CLO3 : Demonstrate how to apply different forms of power conversion (e.g., inverters) to power systems.	• PEE2.3 : Application of systematic engineering synthesis and design processes
CLO4 : Explain how power electronic circuits work by controlling switches.	• PEE3.4 : Professional use and management of information
CLO5 : Demonstrate effective control of machines by using power electronics.	• PEE2.1 : Application of established engineering methods to complex engineering problem solving

Course Learning Outcomes	Assessment Item
CLO1 : Identify an appropriate motor drive and describe its technical specifications.	• Lab Report (x3) • Final Exam • In Class Tests (x2)
CLO2 : Explain the fundamental principles of operation and the main characteristics of electrical machines.	• Lab Report (x3)
CLO3 : Demonstrate how to apply different forms of power conversion (e.g., inverters) to power systems.	• Online Quizzes • In Class Tests (x2) • Lab Report (x3)
CLO4 : Explain how power electronic circuits work by controlling switches.	• Final Exam • In Class Tests (x2) • Lab Report (x3)
CLO5 : Demonstrate effective control of machines by using power electronics.	• Final Exam • Lab Report (x3)

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Learning and Teaching in this course

The course consists of 2 hours of lectures followed by 1 hour of tutorial each week. Lecture notes are available on Moodle, but additional textbook resources are available. Solving tutorial problems better prepares you for major formal assessments such as class tests and exams. The laboratories are designed to give an independent learning opportunity.

The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+
» Safari 10+
** Internet Explorer is not recommended

** Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click here.

Log in to Moodle here.

If you need further assistance with Moodle:

For enrolment and login issues please contact:
IT Service Centre
Email: itservicecentre@unsw.edu.au
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support

Email: externalteltsupport@unsw.edu.au
Phone: (02) 9385-3331
International: +61 2 938 53331

Opening hours:
Monday – Friday 7:30am – 9:30 pm
Saturday & Sunday 8:30 am – 4:30pm

Additional Course Information

The learning in this course is achieved via face-to-face lectures, tutorials, and laboratory experiments. The lectures cover both the theory and examples. The tutorials test if the theory in the lectures is properly understood. The tutorials are so designed that students get an opportunity to understand the tutorial problems during the tutorial session and then use the course study time to work through the entire tutorial. Every student should be able to complete the tutorials. Laboratory work is related to the course, but students should think of the principles that can be learned with experimentation. The students should think of the principles of operation of the devices and how the experiments enable them to learn those principles better with experimentation.

Referencing

In this course, students are required to reference following the APA 7 referencing style. Information about referencing styles is available at: https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720

Study at UNSW Canberra

https://www.unsw.adfa.edu.au/study

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters
- Getting your passwords set up
- How to log on to Moodle
- Accessing the Library and other areas.

Additional Information as required

CRICOS Provider no. 00098G

The University of New South Wales Canberra.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates	Engineers Australia - Professional Engineer (Stage 1)
Online Quizzes Assessment Format: Individual	5%	Start Date: 22/04/2024 12:00 AM Due Date: Quiz 1 - week 7; Quiz 2 - week 9; Quiz 3 - week 11;	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline
Lab Report (x3) Assessment Format: Individual	30%	Start Date: 13/03/2024 12:00 AM Due Date: Week 3: 11 March - 15 March, Week 4: 18 March - 22 March, Week 5: 25 March - 29 March, Week 6: 01 April - 05 April, Week 9: 06 May - 10 May, Week 13: 03 June - 07 June	• PEE2.1 : Application of established engineering methods to complex engineering problem solving
Final Exam Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: Exam week	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline
Tutorials Assessment Format: Individual	5%	Start Date: Not Applicable Due Date: Not Applicable	• PEE2.1 : Application of established engineering methods to complex engineering problem solving
In Class Tests (x2) Assessment Format: Individual	20%	Start Date: Test 1: 05/04/2024; Test 2: 31/05/2024 Due Date: Not Applicable	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline

Assessment Details

Online Quizzes

Assessment Overview

3 quizzes, worth 1.7%, 1.6%, and 1.7% respectively

Course Learning Outcomes

- CLO3 : Demonstrate how to apply different forms of power conversion (e.g., inverters) to power systems.

Detailed Assessment Description

Quiz 1 (1.7%) - Week 7 22-26 April

Quiz 2 (1.6%) - Week 9 6-10 May

Quiz 3 (1.7%) - Week 11 20-24 May

Assessment Length

One week

Submission notes

Moodle

Assignment submission Turnitin type

Not Applicable

Lab Report (x3)

Assessment Overview

n/a

Course Learning Outcomes

- CLO1 : Identify an appropriate motor drive and describe its technical specifications.
- CLO2 : Explain the fundamental principles of operation and the main characteristics of electrical machines.
- CLO3 : Demonstrate how to apply different forms of power conversion (e.g., inverters) to power systems.
- CLO4 : Explain how power electronic circuits work by controlling switches.
- CLO5 : Demonstrate effective control of machines by using power electronics.

Detailed Assessment Description

Machines (15%)

For the machines part of this course, there are four laboratory exercises:

- Machines Laboratory 1: Three-phase System
- Machines Laboratory 2: Transformers
- Machines Laboratory 3: DC Generators
- Machines Laboratory 4: DC Motoes

All the lab reports in the machines part are of equal weighting. The lab report is due on the Friday of the week in which the laboratory exercise is done.

Power Electronics (15%)

For the power electronics part of this course, there are three laboratory exercises:

- Power Electronics Laboratory 1: AC to DC Converters
- Power Electronics Laboratory 2: DC to DC Converters
- Power Electronics Laboratory 3: Single-Phase Converter

The lab report of Power Electronics Laboratory 1 is of no weighting. The submission of the power electronics lab 1 report is optional. It will not count for the final grade, but formative feedback will be provided. It is due on Fri 10 May (week 9).

There is a single lab report submission for Power Electronics Laboratory 2 and Power Electronics Laboratory 3. The weight of this lab report is 15%. The lab report is due on the Fri 7 June (week 13).

Submission notes

Submission is due on each Friday of the lab. Moodle.

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

n/a

Course Learning Outcomes

- CLO1 : Identify an appropriate motor drive and describe its technical specifications.
- CLO4 : Explain how power electronic circuits work by controlling switches.
- CLO5 : Demonstrate effective control of machines by using power electronics.

Detailed Assessment Description

The examination is during the final examination period.

Submission notes

Moodle

Assignment submission Turnitin type

Not Applicable

Tutorials

Assessment Overview

n/a

Detailed Assessment Description

A tutorial exercise is given weekly for only the machine part of the course. The tutorial is due the following Thursday after the tutorial on Friday. Full marks are given for attempting and uploading the tutorial by the due date. All tutorials have equal weighting.

Submission notes

Moodle.

Assignment submission Turnitin type

Not Applicable

In Class Tests (x2)

Assessment Overview

n/a

Course Learning Outcomes

- CLO1 : Identify an appropriate motor drive and describe its technical specifications.
- CLO3 : Demonstrate how to apply different forms of power conversion (e.g., inverters) to power systems.
- CLO4 : Explain how power electronic circuits work by controlling switches.

Detailed Assessment Description

In class test 1 (10%): Friday, 5 April 2024, 3 - 4 pm.

In class test 2 (10%): Friday, 31 May 2024.

Submission notes

Moodle and in-person

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Written feedback and marks will be provided for laboratory reports in Weeks 3 and 4 before the end of Week 4 (24 March).

Class tests and exams from 2023 are an excellent guide to what to expect. A good understanding of the subject will make it easy to get good grades. An ability to understand the tutorial problems, i.e., what the problem is asking you to do, is the first test; the second test is if you can start to solve the problem entirely using your resources (including textbooks, the Internet, and software like Matlab); the third test is if you can get to the end of the solution. The final test is if you can apply some logic to check the correctness of the solution.

For lab reports, marks are given on original statements on what you learnt from the lab, any sources of error in your experimentation, and any idea you wanted to try for yourself. Try to keep it brief but original.

Late Submission of Assessment

UNSW has standardised the penalties for late submissions. Unless prior arrangement is made with the lecturer or a formal application for special consideration is submitted, a penalty of 5% of the total available mark for the assessment will apply for each day that an assessment item is late up to a maximum of 5 days (120 hours) after which an assessment can no longer be submitted and a grade of 0 will be applied.

Use of Generative AI in Assessments

4. FULL ASSISTANCE WITH ATTRIBUTION

You can use generative AI software in this assessment to the extent specified in the assessment instructions. Any output of generative software within your assessment must be attributed with full referencing.

If the outputs of generative AI such as ChatGPT form part of your submission and is not

appropriately attributed, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

** To cite: OpenAI (Year Accessed). ChatGPT. OpenAI. https://openai.com/models/chatgpt/*

** Please note that the outputs from these tools are not always accurate, appropriate, nor properly referenced. You should ensure that you have moderated and critically evaluated the outputs from generative AI tools such as ChatGPT before submission.*

Grading Basis

Standard

Requirements to pass course

Fifty per cent mark is needed to pass the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 26 February - 1 March	Blended	3-Phase Circuits; real and reactive power - Hemanshu Pota Lectures Monday, Wed & Thur, and Friday (Please attend the lecture in your lab period). Tutorial Friday
Week 2 : 4 March - 8 March	Blended	Basic princiles of electromagnetics - Hemanshu Pota Lectures Monday, Wed & Thur, and Friday (Please attend the lecture in your lab period). Tutorial Friday
Week 3 : 11 March - 15 March	Blended	Transforners - Hemanshu Pota Lectures on Monday and Friday Tutorial Friday Machines Laboratory 1 - Three-Phase Systems - Wed or Thursday, depending on your group.
	Assessment	Machines Laboratory 1 - Three-Phase System report by Friday.
Week 4 : 18 March - 22 March	Blended	Basic principles of DC machines - Hemanshu Pota Lectures on Monday and Friday Tutorial Friday Machines Laboratory 2 - Transformers - Wednesday or Thursday, depending on your group.
	Assessment	Machines Laboratory 2 - Transformers by Friday.
Week 5 : 25 March - 29 March	Blended	DC Machines - Hemanshu Pota Lectures on Monday and Friday Tutorial Friday Machines Laboratory 3 - DC Generator - Wed or Thursday, depending on your group.
	Assessment	Machines Laboratory 3 - DC Generator by Friday.
Week 6 : 1 April - 5 April	Blended	AC Machines - Hemanshu Pota Lectures on Monday and Friday Tutorial Friday Machines Laboratory 4 - DC Motors - Wed or Thursday, depending on your group.
	Assessment	Machines Laboratory 4 - DC Motors by Friday. Class Test 1 - Fri 3 - 4 pm.
Week 7 : 22 April - 26 April	Blended	General Reflection and Revision - Haroldo Hattori Lectures on Monday and Friday Tutorial Friday
	Assessment	Online Quiz 1
Week 8 : 29 April - 3 May	Blended	AC-DC Converters - Haroldo Hattori Lectures on Monday and Friday Tutorial Friday Power Electronics Laboratory 1 - AC to DC Converter - Wed or Thursday, depending on your group.
Week 9 : 6 May - 10 May	Blended	DC-DC Converters - Haroldo Hattori Lectures on Monday and Friday Tutorial Friday Power Electronics Laboratory 2 - DC to DC Converter - Wed or Thursday, depending on your group.
	Assessment	Online Quiz 2
Week 10 : 13 May - 17 May	Blended	DC-DC Converters - Haroldo Hattori Lectures on Monday and Friday Tutorial Friday Power Electronics Laboratory 3 - Single-phase converters - Wed or Thursday, depending on your group.
Week 11 : 20 May - 24 May	Blended	DC-AC Converters - Haroldo Hattori Lectures on Monday and Friday Tutorial Friday
	Assessment	Online Quiz 3
Week 12 : 27 May - 31 May	Blended	DC-AC Converters - - Haroldo Hattori Lectures on Monday and Friday Tutorial Friday
Week 13 : 3 June - 7 June	Assessment	Lab Report of Power Electronics Laboratory 2 & Power Electronics Laboratory 3 is due on Friday.

	Blended	Basic principles of DC machines - - Haroldo Hattori Lectures on Monday and Friday Tutorial Friday

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

Lectures: Mon 2 – 4 pm Seminar Room 04 & Fri 2 – 3 pm Seminar Room 04

Tutorial Fri 3 – 4 pm Seminar Room 04

Labs Wed 2 – 5 pm & Thur 3 – 6 pm, Room 119 Building 16

We will miss lectures on Mon 11 March, Mon 1 Apri, and Fri 29 March due to public holidays. We will miss the tutorial on Fri 29 March due to a public holiday.

Course Resources

Prescribed Resources

Compulsory texts

1. P. C. Sen, Principles of Electric Machines and Power Electronics, 3rd Edition | Wiley, 3rd edition, 2013.
2. M. H. Rashid, *Power electronics: devices, circuits and applications,* Pearson, 4th edition, 2014.
3. N. Mohan, T. M. Underland, W. P. Robbins, *Power electronics: converters, applications and design,* Wiley, 3rd edition.

Software

1. Matlab
2. Maple.
3. Altium Designer or PSpice educational version

Course Evaluation and Development

Feedback from previous years will be shared with the students, and a detailed explanation will be given as to what has been done with the feedback to improve the student learning experience.

Students are requested to provide feedback during the semester while it is time to address their concern to improve the course.

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the "On-going Student Feedback" link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	HEMANSHU POTA		Room 214, Building 15	0251145197	Thursdays 2 -3 pm or by appointment	No	Yes
	Haroldo Hattori		SR102 - Office C (below LTN)	+61 2 5114 5155	10-12 Monday or by appointment	No	No

Other Useful Information

Academic Information

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of each course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the

“On-going Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups (where applicable). Student opinions really do make a difference. Refer to the Moodle site for your course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct.

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Equitable Learning Services (ELS)

Students living with neurodivergent, physical and/or mental health conditions or caring for someone with these conditions may be eligible for support through the Equitible Learning Services team. Equitable Learning Services is a free and confidential service that provides practical support to ensure your mental or physical health conditions do not adversely affect your studies.

Our team of dedicated **Equitable Learning Facilitators** (ELFs) are here to assist you through this process. We offer a number of services to make your education at UNSW easier and more equitable.

Further information about ELS for currently enrolled students can be found at: https://www.student.unsw.edu.au/equitable-learning

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW’s Student Code of Conduct. Find relevant information at: Student Code of Conduct (unsw.edu.au)

Plagiarism undermines academic integrity and is not tolerated at UNSW. It is defined as using the words or ideas of others and passing them off as your own, and can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

https://student.unsw.edu.au/plagiarism

Submission of Assessment Tasks

Special Consideration

Special Consideration is the process for assessing and addressing the impact on students of short-term events, that are beyond the control of the student, and that affect performance in a specific assessment task or tasks.

Applications for Special Consideration will be accepted in the following circumstances only:

- Where academic work has been hampered to a substantial degree by illness or other cause;
- The circumstances are unexpected and beyond the student's control;
- The circumstances could not have reasonably been anticipated, avoided or guarded against by the student; and either:

(i) they occurred during a critical study period and was 3 consecutive days or more duration, or a total of 5 days within the critical study period; or

(ii) they prevented the ability to complete, attend or submit an assessment task for a specific date (e.g. final exam, in class test/quiz, in class presentation)

Applications for Special Consideration must be made as soon as practicable after the problem occurs and at the latest within three working days of the assessment or the period covered by the supporting documentation.

By sitting or submitting the assessment task the student is declaring that they are fit to do so and cannot later apply for Special Consideration (UNSW 'fit to sit or submit' requirement).

Sitting, accessing or submitting an assessment task on the scheduled assessment date, after applying for special consideration, renders the special consideration application void.

Find more information about special consideration at: https://www.student.unsw.edu.au/special/consideration/guide

Or apply for special consideration through your MyUNSW portal.

Late Submission of assessment tasks (other than examinations)

UNSW has a standard late submission penalty of:

- 5% per day,

- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Electronic submission of assessment

Except where the nature of an assessment task precludes its electronic submission, all assessments must be submitted to an electronic repository, approved by UNSW or the Faculty, for archiving and subsequent marking and analysis.

Release of final mark

All marks obtained for assessment items during the session are provisional. The final mark as published by the university following the assessment review group meeting is the only official mark.