ELECTENG 734 - Power Electronics

Course Outline – 2023

Power electronics has been one of the major growth industries during the past two decades and can be found in applications ranging from micro-watt level biomedical implants to mega-watt level HVDC links. It is a very interesting and challenging area to work in and is accompanied by feelings of extreme lows (for example when a $300 device blows up for no apparent reason) and extreme highs (when a circuit actually works). To be successful in this field requires not just knowledge of electronics, but also control systems, electromagnetics and signal processing. The course is designed to introduce you to some of the basic "building blocks" of power electronics and several important applications through an electronic design project and provide some hands-on experience.

This course is 100 % design based and has two 2-hour lecture sessions 'scheduled' per week. However, only about 12 two-hour lecture sessions (about 24 one-hour lectures) are used to cover the course material. The remaining scheduled lecture times, during the last four weeks of the semester, are therefore allocated to work on the electronic design project. In addition, all students must attend the compulsory design support laboratory sessions in Multi-disciplinary Learning Spaces (MDLSs), scheduled at specific time periods. Given the practical nature of this course, you may need to spend extra hours every week on self-learning around topics covered in each lecture.

Lecturers

Dr. Seho Kim (Course coordinator) (Rm: 405.655, Email: seho.kim@auckland.ac.nz)
Dr. Jackman Lin (Rm: 405.655, Email: jackman.lin@auckland.ac.nz)
Dr. Matthew Pearce (Rm: 405.655, Email: matthew.pearce@auckland.ac.nz)

Assessments[1]

10 %	**Simulation labs** x 2: individual assessment
15 %	**Assignments** x 3: individual assessment
30 %	**Test**: closed book[2]
45 %	**Design Project Coursework**[3]
|→ 25 %	**Design report and PCB schematic:** group assessment
|→ 7 %	**Final interviews:** individual assessment
|→ 10 %	**Bench test:** individual and group assessments
|→ 3 %	**Time trials**: group assessment

Coursework Dates:

Lab Assessments:	IPT lab	Wednesday 15th of March
	Buck-converter lab	Wednesday 29th of March
Assignments:	Assignment 1	Friday 17th of March
	Assignment 2	Friday 31st of March
	Assignment 3	Wednesday 26th April
Test:	Closed book test	Monday 5th April
Design Report:	Group report	Thursday 4th May
Interviews:	Interviews	Friday 26th May
Bench Test:	Bench test	Monday 29th May
Time Trials:	Testing in an RC car	Wednesday 31st May
Peer Review:	Confidential peer review	Friday 2nd June
Race Day:	Race challenge	Friday 2nd June

[1] The University of Auckland will not tolerate cheating, or assisting others to cheat, and views cheating in coursework as a serious offence. The work that a student submits for grading must be the student's own work, reflecting his or her learning.

[2] Faculty restricted calculator (RC) policy will be enforced during the tests.

[3] Your group assessment marks may be scaled based on the peer reviews.

Course Syllabus

	Topic	Presenter
	Introduction	All
1	Inductive Power Transfer (IPT)	JL
2	DC Output Power	JL
3	Magnetic Design	MP
4	Buck Converter	SK
5	Control of Buck Converter	SK
6	Boost and Buck-Boost Converter	MP
7	Practical Considerations	MP
	Wrapup	All

Assigned Text

Erickson, R. and Maksimović, D "Fundamentals of Power Electronics", Second Edn (Springer, 2001).

Course Planner[4, 5]

Week	Month	Monday	Tuesday	Wednesday	Thursday	Friday
1	Feb	27 SK/JL/MP	28 JL	1	2	3
2	Mar	6 JL IPT Lab	7 JL	8 IPT Lab	9	10 IPT Lab
3	Mar	13 MP IPT Lab	14 SK	15 IPT Lab	16	17 IPT Lab Assign. 1
4	Mar	20 SK Buck Lab	21 SK	22 Buck Lab	23	24 Buck Lab
5	Mar	27 MP Buck Lab	28 MP	29 Buck Lab	30	31 Buck Lab Assign. 2
6	Apr	3 MP Sim. Lab	4 JL	5 Test	6	7 Good Friday
	Apr	10 Easter Mon.	11 Univ. Holiday	12	13	14
	Apr	17	18	19	20	21
7	Apr	24 Sim. Lab	25 ANZAC Day	26 Assign. 3	27	28 Sim. Lab
8	May	1 Sim. Lab	2	3 Sim. Lab	4 Design report	5 Building
9	May	8 Building	9	10 Building	11	12 Building
10	May	15 Building	16	17 Building	18	19 Building
11	May	22 Building	23	24 Building	25	26 Interviews
12	May	29 Bench Test	30	31 Time Trial	1	2 Car race

[4] Lectures: Monday & Tuesday 12-2pm in room : 405-430
[5] Labs: Monday & Wednesday 4-6pm & Friday 12-2pm in room 405-552/564.

Recommended Text

Mohan, N. “Power Electronics: Converters, Applications, and Design”, Third Edn (Wiley, 2002).

Recommended Reading

Topic	Mohan Section
Introduction	Ch 7 & 10
Introduction analysis and design of IPT systems	Ch 7
Introduction to boost converter and control	Ch 7
Analysis and design of buck converters	Ch 7
Voltage mode PWM control	Ch 10
Current mode control	Ch 10
Slope compensation	Ch 10
Analysis and modelling	Ch 8
Design of high frequency inductor	Ch 3 & 30
Capacitor selection	Ch 28
Electrical isolation	Ch 10 & 28
Circuit protection	Ch 10
Mixed power supplies	Ch 10
Electromagnetic compatibility	Ch 10 & 18
Snubbers	Ch 27
Heatsinking	Ch 29