ELEC2075

Nonlinear Circuits and Devices

Session 2, Weekday attendance, North Ryde 2020

School of Engineering

Contents

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and ot her small group learning activities on campus for the second half-year, while keeping an online ver sion available for those students unable to return or those who choose to continue their studies onli ne.

To check the availability of face-to-face and onlin e activities for your unit, please go to timetable vi ewer. To check detailed information on unit asses sments visit your unit's iLearn space or consult yo ur unit convenor.

General Information

Unit convenor and teaching staff
Lecturer (Lead Convener)
David Payne
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Room 362, 9WW
Wednesdays 2pm-4pm

Lecturer (Co-Convener)
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Tutor
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Credit points
10

Prerequisites
ELEC2070 or ELEC270

Corequisites

Co-badged status

Unit description
This unit builds on ELEC2070 and introduces non-linear and active circuit elements in theory and in the laboratory. The goal is to understand and apply simple electronic design to active circuits such as amplifiers, wave shaping circuits, rectifiers etc. It consists of 4 modules: operational amplifiers, diodes, BJTs and MOSFETs. The operational principles of each device are discussed and applied to circuit design. Models for circuit analysis are presented for each device including large and small signal analysis. Computer simulation and analysis of simple circuits is introduced and used in the laboratory. Laboratory sessions also include building and testing circuits and subsequent formal report writing.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

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

ULO1: Analyse circuits with nonlinear components to determine device states, node conditions, and transfer characteristics

ULO2: Use equivalent circuit models to simplify complex linear and nonlinear circuits

ULO3: Explain the working principles of nonlinear devices, including operational amplifiers, diodes and transistors

ULO4: Construct and accurately simulate linear and nonlinear circuits using established modelling tools

ULO5: Physically construct and experimentally characterise circuits with one or more nonlinear components

ULO6: Write concise scientific reports summarising key concepts, methodologies used, results acquired and their impact

General Assessment Information

Notifications

Formal notification of assessment tasks, grading rubrics and due dates will be posted on iLearn. Although all reasonable measures to ensure the information is accurate, The University reserves the right to make changes without notice. Each student is responsible for checking iLearn for changes and updates.

Weekly Plan

A weekly plan of lectures, assignments, tests, laboratory and workshop sessions will be posted on iLearn. Students are expected to consult it and be aware of possible minor variations.

There will be no laboratory or tutorial session in week 1.

Assignment Tasks

Assignment questions will be posted on iLearn at least one week before their submission date.

Assignments will be in the form of iLearn quizzes and must be completed and electronically submitted prior to their due date. Correct answers and feedback will be provided within weeks of the submission due date.

All assignments should be prepared individually. It is expected that students consult tutors, lecturers or other students while learning the concepts, but copying assignments from others is not accepted. Students are expected to have read and understood the academic honesty policy.

Assignment questions will come from a question bank and in some cases have variable numbers. Whilst all students will face similar questions, the numerical details and therefore the correct solution will vary.

Absences

Late notices or absences from tests, workshops and laboratories will be considered under extenuating circumstances upon lodgement and approval of a formal notice of disruption of studies.

Grading

In order to pass this unit a student must obtain a mark of 50 or more overall or obtain a passing grade P/ CR/ D/ HD. For further details about grading, please refer below in the policies and procedures section.

Late submissions & Special Consideration

Late submissions of assignment or lab reports will not be allowed unless a formal disruption of studies has been submitted.

If you receive special consideration for the final exam, a supplementary exam will be scheduled by the faculty during a supplementary exam period, typically about 3 to 4 weeks after the normal exam period. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Final Examination	40%	No	In the formal exam period
Pre-classroom online quiz	5%	No	Weekly - closing at the lecture start time (Weeks 2 - 11)
Laboratory	21%	No	Refer to weekly schedule and laboratory section on iLearn
Class test	5%	No	Refer to weekly schedule on iLearn
Lab report	9%	No	Refer to weekly schedule and laboratory section on iLearn
Take-home assignment	20%	No	4 Assignments, refer to weekly schedule on iLearn for dates

Final Examination

Assessment Type [1]: Examination

Indicative Time on Task [2]: 3 hours
Due: **In the formal exam period**
Weighting: **40%**

A final closed-book examination will be conducted during the formal examination period. A formula sheet will be provided. Calculators with no text-recall functions are permitted. This examination will assess all topics discussed in the unit unless otherwise specified.

On successful completion you will be able to:

- Analyse circuits with nonlinear components to determine device states, node conditions, and transfer characteristics
- Use equivalent circuit models to simplify complex linear and nonlinear circuits
- Explain the working principles of nonlinear devices, including operational amplifiers, diodes and transistors

Pre-classroom online quiz

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 3 hours
Due: **Weekly - closing at the lecture start time (Weeks 2 - 11)**
Weighting: **5%**

Students are expected to go through the online learning content, understand the theory and attempt the online quiz each week before attending the classroom activities of that week.

On successful completion you will be able to:

- Analyse circuits with nonlinear components to determine device states, node conditions, and transfer characteristics
- Use equivalent circuit models to simplify complex linear and nonlinear circuits
- Explain the working principles of nonlinear devices, including operational amplifiers, diodes and transistors

Laboratory

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 21 hours
Due: **Refer to weekly schedule and laboratory section on iLearn**
Weighting: **21%**

The experiments are designed to explore the practical aspects of the theory discussed in the unit. Laboratory sessions will include circuit simulation, physical implementation, and characterisation. Laboratory worksheets will be provided to guide student work and will be available on iLearn.

On successful completion you will be able to:

- Analyse circuits with nonlinear components to determine device states, node conditions, and transfer characteristics
- Construct and accurately simulate linear and nonlinear circuits using established modelling tools
- Physically construct and experimentally characterise circuits with one or more nonlinear components

Class test

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 1 hours
Due: **Refer to weekly schedule on iLearn**
Weighting: **5%**

This is a one-hour closed-book test.

On successful completion you will be able to:

- Analyse circuits with nonlinear components to determine device states, node conditions, and transfer characteristics
- Use equivalent circuit models to simplify complex linear and nonlinear circuits
- Explain the working principles of nonlinear devices, including operational amplifiers, diodes and transistors

Lab report

Assessment Type [1]: Lab report
Indicative Time on Task [2]: 4 hours
Due: **Refer to weekly schedule and laboratory section on iLearn**
Weighting: **9%**

Students are required to submit two individually written reports on two of the lab modules. Lab reports will be assessed on the basis of originality, format, clarity, relevance, analysis of the results and the quality of technical writing.

On successful completion you will be able to:

- Explain the working principles of nonlinear devices, including operational amplifiers, diodes and transistors
- Construct and accurately simulate linear and nonlinear circuits using established modelling tools
- Physically construct and experimentally characterise circuits with one or more nonlinear components
- Write concise scientific reports summarising key concepts, methodologies used, results acquired and their impact

Take-home assignment

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 8 hours
Due: **4 Assignments, refer to weekly schedule on iLearn for dates**
Weighting: **20%**

Take-home assignments mainly consist of numerical problems on the concepts learned. The answers are to be submitted online via iLearn. There will be four assignments in total.

On successful completion you will be able to:

- Analyse circuits with nonlinear components to determine device states, node conditions, and transfer characteristics
- Use equivalent circuit models to simplify complex linear and nonlinear circuits
- Explain the working principles of nonlinear devices, including operational amplifiers, diodes and transistors

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Textbooks

1. A. D. Sedra and K. C. Smith, "Microelectronic circuits", 4th edition or higher (1982 or newer)
2. A. R. Hambley, “Electrical Engineering, Principles and Applications, International Sixth Edition,” Pearson, 2014.

Technology used

Typical electronic and electrical laboratory instruments such as voltage and current sources, voltmeters, ammeters, oscilloscopes will be used for parts of campus-based lab activities.

Analog Discovery 2 portable laboratory kits along with basic electronic components kits will also be used for laboratory exercises, these are available for loan as portable take-home kits. Instructions on how to loan out equipment will be available in the laboratories section on the iLearn page.

LTspice simulation software will be used throughout, this software is freely available.

Unit Schedule

A detailed unit schedule is available on the unit's iLearn page.

This is subject to updates and students are encouraged to regularly check the latest schedule version. Any major updates will be announced on the unit's iLearn Forum.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Changes from Previous Offering

Weekly lecture time has been reduced from 2 hours to 1 hours, and is now supplemented by additional original online learning content which is also posted weekly. The simulation software used throughout this unit has been changed from AWR to LTspice. Laboratory exercises have been updated so they can be carried out using Analog Discovery portable electronics lab kits, enabling more flexibility in how students can approach the practical learning elements of this unit.

Changes in Response to Student Feedback

The simulation software used throughout this unit has been changed from AWR to LTspice after student feedback from previous offerings noted the steep learning curve and non-intuitive interface of AWR. LTspice also has the advantage of having no licence restrictions.