

# Dordt College, Engineering Department

## EGR 323, Electronics II

### Spring 2017

<b>2014–2015 Catalog Description</b>	<b>EGR 323 Electronics II (4 credit hours)</b> <span style="float: right;">(Spring, Odd)</span> A continuation of Engineering 322. Topics include biasing strategies for discrete and integrated circuit designs, current mirrors, differential and multistage amplifiers, frequency response, feedback and stability. The laboratory includes construction of a kit, which introduces students to power output stages, tuned amplifiers, and demodulator circuits. The laboratory also includes a short design problem. Prerequisite: Engineering 322.														
<b>Textbook</b>	Sedra and Smith, <i>Microelectronic Circuits</i> , 6th ed., Oxford, 2010. (ISBN 978-0-19-532303-0)														
<b>References</b>	Horowitz and Hill, <i>The Art of Electronics</i> , 3rd ed., Cambridge University Press.  Tuinenga, Paul W., <i>SPICE: A Guide to Circuit Analysis and Simulation Using Pspice</i> , 3rd edition, Prentice Hall, 1995.														
<b>Instructor</b>	Douglas F. De Boer, Professor of Engineering, <a href="http://homepages.dordt.edu/ddeboer">http://homepages.dordt.edu/ddeboer</a> Office Phone: 712-722-6245; Office location: SB237 (Office hours posted on homepage, or just call.) E-mail <a href="mailto:Douglas.DeBoer@Dordt.edu">Douglas.DeBoer@Dordt.edu</a> , Home Phone: <b>722-1414</b> , please call before 10 PM.														
<b>Goals</b>	<p><i>Creational Structure:</i> Students will understand elementary semiconductor device physics at the level of equations which model the terminal characteristics of diodes and transistors. This means that students will be able to represent a diode or transistor circuit via a well labeled schematic drawing, derive appropriate equations from the schematic, and know how to solve those equations. Students will be able to carry out these analyses in the frequency domain when appropriate.</p> <p><i>Creational Development:</i> Students will be able to apply several design techniques for stabilizing bias levels. They will understand tradeoffs involved in choosing a bias technique. Students will be able to design circuits involving one or two transistors used in well-known configurations such as a current mirror, cascode amplifier, feedback amplifier, etc. They will understand a historical perspective of how these techniques have improved over time. This will be the main goal of this course.</p>														
<b>Prerequisites by topic</b>	Calculus, Linear Systems, A first course in electronics covering diodes, rectifier, clamping and clipping circuits and FET transistors used in logic gates and single-stage amplifiers..														
<b>Lecture Topics</b>	<table border="0" style="width: 100%;"> <tr> <td style="width: 80%;">BJT Transistors and applications</td> <td style="text-align: right;">(8 classes)</td> </tr> <tr> <td>IC design philosophy and multi-transistor circuits including differential amplifiers</td> <td style="text-align: right;">(12 classes)</td> </tr> <tr> <td>Frequency response</td> <td style="text-align: right;">(7 classes)</td> </tr> <tr> <td>Feedback</td> <td style="text-align: right;">(9 classes)</td> </tr> <tr> <td>Stability</td> <td style="text-align: right;">(3 classes)</td> </tr> <tr> <td>Tests and review</td> <td style="text-align: right;">(5 classes)</td> </tr> <tr> <td colspan="2">(Three 50 minute lectures per week, MWF)</td> </tr> </table>	BJT Transistors and applications	(8 classes)	IC design philosophy and multi-transistor circuits including differential amplifiers	(12 classes)	Frequency response	(7 classes)	Feedback	(9 classes)	Stability	(3 classes)	Tests and review	(5 classes)	(Three 50 minute lectures per week, MWF)	
BJT Transistors and applications	(8 classes)														
IC design philosophy and multi-transistor circuits including differential amplifiers	(12 classes)														
Frequency response	(7 classes)														
Feedback	(9 classes)														
Stability	(3 classes)														
Tests and review	(5 classes)														
(Three 50 minute lectures per week, MWF)															
<b>Lab Topics</b>	<table border="0" style="width: 100%;"> <tr> <td style="width: 80%;">One design project running concurrently with the construction of an AM/FM radio</td> <td style="text-align: right;">(7 week)</td> </tr> <tr> <td>BJT applications</td> <td style="text-align: right;">(3 weeks)</td> </tr> <tr> <td>Single transistor BJT circuits</td> <td style="text-align: right;">(2 weeks)</td> </tr> <tr> <td>Miscellaneous topics including current mirrors, network analyzer, CMOS and TTL gates</td> <td style="text-align: right;">(4 weeks)</td> </tr> <tr> <td colspan="2">(One Three-hour lab session per week)</td> </tr> </table>	One design project running concurrently with the construction of an AM/FM radio	(7 week)	BJT applications	(3 weeks)	Single transistor BJT circuits	(2 weeks)	Miscellaneous topics including current mirrors, network analyzer, CMOS and TTL gates	(4 weeks)	(One Three-hour lab session per week)					
One design project running concurrently with the construction of an AM/FM radio	(7 week)														
BJT applications	(3 weeks)														
Single transistor BJT circuits	(2 weeks)														
Miscellaneous topics including current mirrors, network analyzer, CMOS and TTL gates	(4 weeks)														
(One Three-hour lab session per week)															
<b>Computer Use</b>	Orcad-Pspice is used for circuit simulation. Students are encouraged (but not required) to use programs such as Mathcad or Matlab for homework solutions when appropriate.														
<b>Academic Integrity</b>	Students must do their own work and on time. Students may discuss homework but may not show papers to each other. Detail on this policy can be found on the web at <a href="http://homepages.dordt.edu/ddeboer/integrity#DYOW">http://homepages.dordt.edu/ddeboer/integrity#DYOW</a> . See the section headed "Do Your Own Work." This policy applies to the whole course, not just homework.														
<b>Accommodations</b>	Students who require assistance or accommodations based on the impact of a documented disability must contact Marliss Van Der Zwaag, the Coordinator of Services for Students with Disabilities to access accommodations. Telephone 722-6490, e-mail <a href="mailto:Marliss.VanDerZwaag@dordt.edu">Marliss.VanDerZwaag@dordt.edu</a>														
<b>Means of Evaluation</b>	Homework (10%), Two Tests (25% each), Final Exam (25%), Lab (15%). For details, follow the link titled "grading policy" at <a href="http://homepages.dordt.edu/ddeboer">http://homepages.dordt.edu/ddeboer</a>														

**Dordt College, Engineering Department**  
**EGR 323, Electronics II**  
**Spring 2017**

Class Dates			Class 9:00 – 8:50 a.m. MWF, Rm SB2803	Laboratory 2 – 5 p.m W. Rm SB2803
1/11	1/13		Current mirrors (FET and BJT) <i>Text: Chapter 8</i>	No lab
1/16	1/18	1/20	Intrinsic gain, Cascode amplifier <i>Text: Chapter 8</i>	1.) Logic Gates
1/23	1/25	1/27	Compound connections, Darlington, Sziklai pairs, Class B and AB amplifier, cascode mirror. <i>Text: Chapter 12 and Text Chapter 8</i>	2.) Class B and Class C Amplifiers
1/30	2/01	2/03	MOS and BJT differential amplifiers <i>Text: Chapter 9</i>	3.) AM/FM Radio Project, AF Section
2/06	2/08 No class on 2/10, reading day		DC offset and other diff. amp. imperfections <i>Text: Chapter 9</i>	4.)
2/13	2/15	2/17	Differential amplifiers with active loads. Multistage differential amplifiers <i>Text: Chapter 9</i>	5.) AM/FM Radio Project, AM detector, IF, and mixer sections
2/20	<b>2/22</b>	2/24	Low-frequency limitations of amplifiers, <i>Text: Chapter 10</i> <b>Test #1 Wednesday 2/22</b>	6.) AM/FM Radio Project, AM RF section and alignment.
2/27	3/01 (Spring Break, 3/03 – 3/13)		Parasitic capacities in MOSFETS and BJT's Miller effect. High frequency limitations of CS, CE amplifiers <i>Text: Chapter 10</i>	7.) AM/FM Radio Project FM detector and IF and mixer sections
	3/15	3/17	Effects of non-dominant poles and zeros High frequency limitations of CG, CB, cascode <i>Text: Chapter 10</i>	(No lab, Spring Break)
3/20	3/22	3/24	CD, CC (follower) amplifiers and diff. amps. Source and emitter degeneration <i>Text Chapter 10</i>	8.) AM/FM Radio Project FM RF section and alignment.
3/27	3/29	3/31	Feedback: Four configurations <i>Text Chapter 11</i>	9.) Conclusion of the design project
4/3	4/5	<b>4/07</b>	Voltage feedback amplifiers <i>Text Chapter 10</i> <b>Test #2, Friday, 4/07</b>	10.) Multi-Transistor Circuits
4/10	4/12	4/14	Other feedback amplifier types. <i>Text: Chapter 10</i>	11.) Introduction to the network analyzer
4/17	4/19	4/21	Feedback and stability <i>Text: Chapter 11</i>	To Be Announced
4/24	4/26	4/28	Frequency compensation of feedback to achieve stability.	(no lab—dead week)
<b>Monday, 5/01</b>			<b>Final Exam 3:30 pm – 5:30 p.m.</b>	

**Dordt College, Engineering Department**  
**EGR 323, Electronics II**  
**Spring 2017**

page 3 of 6

**Note on the class schedule**

The actual class schedule may vary from the content shown on the previous page to accommodate student interests and abilities. The schedule shown is merely a reasonable projection based on past offerings of this course.

**Audience and Role of this Course**

This course is taught at the junior/senior level. It is required for engineering majors taking the electrical emphasis and is optional for other students including some in computer science.

**Missed Tests or Exams**

**Put this course's tests on your calendar.**

Do not skip a test! If you anticipate a difficulty with a test date, discuss that in advance with Prof. De Boer. During the first two or three weeks of classes students may negotiate to change the test dates for the entire class to avoid a conflict for any one student. Negotiation of a changed test date may possibly occur at other times if there is good cause. However in the week before a test Prof. De Boer is very reluctant to change the test date. If your reasons are sound for requesting a special test date, Prof. De Boer may schedule a special test time just for you. This special test time will usually be in advance of the regular test date. In this case Prof. De Boer reserves the right to give you a different test than he gives the others.

**If you arrive late to a test** you must still finish at the normal time.

This applies no matter how late you arrive. Additionally, if you have a pattern of tardiness or absence or if there are other demerits Prof. De Boer reserves the right to treat any test started late as a test entirely skipped.

**If you miss a test entirely** the test will go in the grade book as a blank score which will count as an "F." At the end of the semester Prof. De Boer will reassess the situation. He might choose to estimate what he thinks you might have earned on the test based on any evidence he can find relevant to the situation. Any grade given may be a docked grade if negligence is a factor in missing the exam. A malfunctioning cell phone alarm is an example of negligence. (Set a backup alarm for important times.)

**If a test is missed due to illness** Prof. De Boer will decide how to act on a case-by-case basis and may wait until the end of the semester to make a final decision. It is to your advantage if you **report your illness to student services** in as timely a way as is reasonable. Grounds for claiming illness are fever, nausea, etc. Unfortunately, a "bad cold" is too common to automatically exempt you from a test. If you have a cold come to the test as prepared as possible and talk to Prof. De Boer before the test. You will probably have to take the test.

**If you become ill during a test** Prof. De Boer will decide how act on a case-by-case basis and may wait until the end of the semester to make a final decision on how to handle the case.

**Dordt College, Engineering Department**  
**EGR 323, Electronics II**  
**Spring 2017**

page 4 of 6

**Late work. . .** is unprofessional. **Start assigned work promptly.** You may need to **make use of office hours** to get questions answered. Working the assignments over more than one sitting, reading all assigned textbook sections, gathering questions for an office visit helps you use time efficiently and turn your work in on time with minimum stress.

**All work is expected to be on time.** If you expect to need extra time, at your earliest opportunity try negotiating an extension with Prof. De Boer so that your work does not get shunted. Prof. De Boer expects professional management of your due dates. He does not routinely keep track of “days late” and mark off for such, as might occur in high school. (Engineering companies demote or fire engineers for unexpectedly late work.) Any late work in this course will be handled on a case-by-case basis within the guidelines below:

**Anything handed in late will be accepted for possible grading.** If there is no pattern of lateness and Prof. De Boer or the grader has time, the work may be graded with the next regular assignment with no deduction for lateness. Otherwise he might hold it for a while, often until the end of the semester. If he decides to hold it, it will not be returned to you and the blank grade in the grade book will usually function equivalently to an “F.”

For work that is held, if in the judgment of Prof. De Boer, all the following conditions are true, he will grade the late work or estimate a grade for the late work. To get an estimated or actual grade, these conditions must be true:

- The work must be late for a reasonable cause.
- There is no pattern of carelessness or continuing late work.
- A non-zero grade on the item must matter relative to your course grade.

**If a pattern of late work develops,** Professor De Boer will privately warn you. After that warning if the problem is not resolved, **a discounted course grade might result** and/or the student may be classified as “uncooperative” which could lead to dismissal from the course.

**Class  
Participation**

**Participation is expected of all students,** thus Prof. De Boer does not routinely grade class participation or attendance. He does respond to non-participation. If there is a problem Prof. De Boer will talk about it privately with you. Usually mere attendance is adequate participation, presuming you are not sleeping in class or hung over or distracted by video games on your cell phone, etc. If class participation becomes a problem that is not resolved, then a discounted course grade may result.

**Dordt College, Engineering Department**  
**EGR 323, Electronics II**  
**Spring 2017**

page 5 of 6

A large fraction of this document, from this point onward, is copied from the Student Handbook as per policy in Dordt College's "Syllabus Checklist." There is some additional information specific to this course as well. Additional information specific to the course is in the normal typeface. *Copied information is rendered in italic text (except this sentence is not copied).*

**Attendance**

*Students are expected to be present for every class and laboratory period. Penalties for absence from class are left to the instructor. No designated number of skips is permitted.*

***Student Responsibility:*** *Students shall notify each professor concerning the reason for absence prior to or immediately upon returning to class or in accordance with the instructor's method of accounting for absences. Students shall notify student services concerning all illnesses.*

**Professor De Boer expects to be notified** by e-mail at least a day in advance any time when you will have to miss a class for a scheduled event of higher priority. An excused absence will most likely be granted. An excused absence does not automatically extend any due date. In addition to the options listed below, unexcused absences can be grounds for being classified as an "uncooperative student" which could lead to dismissal from the course. Professor De Boer will give a warning before invoking the uncooperative student process.

***Unexcused absences*** are defined as failing to notify the instructor of the reason for the absence, or if the instructor deems the reason as illegitimate.

***Faculty initiatives:*** *The instructor may contact student services to check on the illness record of the students. They should also alert student services and contact the student directly concerning excessive absences, and must, if asked, report attendance patterns. Any instructor may, after due warning and according to guidelines established in the class syllabus, penalize the student by reducing the semester grade by a given percentage.*

***Student Services Responsibility:*** *Normally, student services does not notify instructors concerning student illness. Student services may alert instructors to serious problems. Decisions to inform instructors about serious problems will be made balancing the need to respect confidentiality and the responsibility to keep instructors appropriately informed about their students. Any student with serious problems is strongly advised to work closely with student services and follow the process to insure adequate communication between all parties in as efficient a way as possible.*

***Excused Absence for Activities:*** *Students have obligations in many realms, so special care shall be taken not to demand commitments for participation in extra-curricular events that cause neglect in other areas. Sponsors/coaches shall inform students from the beginning of the time and effort expected of them. Sponsors/coaches shall demand a minimum of absences from other classes, restrict student involvement to only those crucially involved, and make efforts to choose a time/date for the event that is least invasive of classroom or lab time. In the case of conflicts, resolution shall be the responsibility of the sponsor/coach and the instructor with no penalty to the student (The appeals process outlined in the section titled Complaints Regarding Instruction in the Student Handbook shall be used if needed). The sponsor shall email faculty and student services a list of names, dates, and activities in advance of the event. The student must contact the instructor and make arrangements for any missed work.*

**Dordt College, Engineering Department**  
**EGR 323, Electronics II**  
**Spring 2017**

page 6 of 6

**Academic Integrity**

*Dordt College is committed to developing a community of Christian scholars where all members accept the responsibility of practicing personal and academic integrity in obedience to biblical teaching. . . .*

*Academic Dishonesty. Students found to be academically dishonest will receive academic sanctions from their professor (from a failing grade on the particular academic task to a failing grade in the course), who will report the incident and the sanction given to the Student Life Committee for possible institutional sanctions (from a warning to dismissal from the college).*

*Appeals in such matters will be handled by the student disciplinary process as outlined in the Student Handbook.*

**Definitions**

**Academic dishonesty** at Dordt College includes, but is not limited to, the following behaviors:

**Stealing/Plagiarizing:** *copying another's work or ideas and creating the impression that they are one's own by failing to give proper credit or citation. This includes. . . [See the student handbook for the list, <https://www.dordt.edu/campus-life/student-handbook> ]*

**Cheating:** *unauthorized use of any study aids, equipment, or another's work during an academic task. This includes using unauthorized aids or other equipment during an examination; copying or looking at another individual's examination; taking or passing information to another individual during or after an examination; taking an examination for another individual; allowing another individual to take one's examination; stealing examinations.*

*All graded academic tasks are expected to be performed on an individual basis unless otherwise stated by the instructor.*

*An academic task may not be submitted by a student for course credit in more than one course without the permission of all instructors.*

**Lying/Fabricating:** *the intentional, unauthorized falsification or invention of any information or citation during an academic task. This includes changing or adding an answer on an examination and resubmitting it to change the grade; inventing data for a laboratory exercise or report.*

**Facilitating Academic Dishonesty:** *knowingly allowing or helping another individual to plagiarize, cheat, or fabricate information.*

**In Prof. De Boer's courses students may verbally discuss assigned work but may not show ungraded work to each other.** This policy applies to the whole course, not just homework. Students may not share their course-related personally-created computer work in any form except with official team members (e.g. in a lab project), and except they may verbally discuss it with anyone. More detail on this policy can be found on the Web at <http://homepages.dordt.edu/ddeboer/integrity#DYOW>.