

Dordt College Engineering Department

EGR 304, Embedded Microcontroller Systems

Spring Semester, 2017

2015-16 Catalog Data	<p>A course on the design of microcontroller-based systems and the associated software and hardware. Software issues such as modular design, interrupt driven I/O, and design for reliability are covered. Hardware issues such as serial and parallel interfacing, bus structures, grounding and shielding, and D/A and A/D conversions are also studied. Lab exercises provide design experience using a particular microcontroller or soft processor foundation in an FPGA. Prerequisites: Engineering 204, 220, Computer Science 115 or 116 or permission of instructor. (4 credit hours)</p>
Textbooks	Readings assigned from the Internet are used in place of a traditional textbook.
References	<p>Derek Molloy, <i>Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux</i>, Wiley, 2016.</p> <p>Sedra and Smith, <i>Microelectronic Circuits</i>, Oxford</p> <p>Circuit Cellar magazine and Circuit Cellar Online. http://www.circuitcellar.com</p> <p>Nuts and Volts magazine. http://www.nutsvolts.com</p>
Instructor	<p>Douglas F. De Boer, Professor of Engineering, http://homepages.dordt.edu/ddeboer</p> <p>Office Phone: 712-722-6245; Office location: SB2608; Office hours—see link above.</p> <p>E-mail Douglas.DeBoer@Dordt.edu, Home Phone: 722-1414, call before 10 PM.</p>
Goals	<p><i>Creational Structure:</i> Students will design a system that uses an embedded processor. The design will incorporate input/output and a sensor to measure a physical quantity such as temperature, pressure, a radio signal, etc. This is a primary goal of this course.</p> <p><i>Contemporary Response:</i> Students will consider the application of norms for the design of appropriate ergonomics for an I/O interface.</p> <p><i>Creational Development:</i> Students will study the historical development of some standards, such as for serial interfacing, reflect on how these past developments now influence modern trends in computer engineering, and develop a professional demeanor toward new technology that recognizes technology's human origin.</p>
Prerequisites by topic	Linear circuit analysis, elementary electronics, digital logic circuits, programming.
Laboratory	<p>One or two design projects will be completed, each with a formal written report. Design projects may be proposed by the students but must be approved in advance by the instructor. Depending on the scope of the project work undertaken, there usually will also be a number of short lab exercises that may be ungraded or may require informal reports graded as homework.</p>
Computer use	A development environment based on the Python language will be used for most projects. Students are encouraged (but not required) to use programs such as Mathcad or Matlab or PSpice, etc. for homework solutions where appropriate.
Canvas	All assignments and most handouts will be available via Dordt's course management system. Portions of this course's "Canvas@dordt" information are available to the world via a public web portal at http://homepages.dordt.edu/ddeboer/S17/304S17.HTM
Means of Evaluation	<p>Homework (10%), Two Tests (22% each) Laboratory Project(s) (22%), Final Exam (24%) Most grades are curved. Grades are tallied on a 0 to 4.00 grade-point system. For details, follow the "grading philosophy" link near the bottom of the Web page at http://homepages.dordt.edu/ddeboer/</p>

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Academic Integrity

Students must do their own work. More detail on this policy can be found on the web at <https://www.dordt.edu/campus-life/student-handbook/general-information/#AcademicIntegrity> This applies to the whole course.

Accommodations

Students who require assistance or accommodations based on the impact of disability must contact the Coordinator of Services for Students with Disabilities, Marliss Van Der Zwaag, to access accommodations. Telephone 722-6490, e-mail Marliss.VanDerZwaag@Dordt.edu

Course Outline

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Class meets for two 75-minute periods per week, Tuesday and Thursday starting at 8:00 AM in room SB2803. The lab meets once a week for 180 minutes on Fridays starting at 2:00 PM in room SB2803.

Class Dates (one row per week)		Class (timing is approximate. Adjustments are usually needed to facilitate lab work, etc.)	Laboratory Proposed Schedule)
1/10	1/12	Intro: Microcontrollers & Microprocessors; Version Cont'l	Intro to Git
1/17	1/19	Ports, Digital I/O drivers interfacing strategies. Parallel I/O	Set up R-Pi
1/24	1/26	Serial Interfacing—RS-232 and similar schemes	Blind cycle I/O
1/31	2/02	Serial Interfacing—Transmission lines	Transmission Lines
2/07	(no class)	Serial Interfacing—Ethernet (Th: IEEE/ASME field trips)	Project I (4 weeks)
2/14	2/16	Serial Interfacing—USB, Test #1, Thursday 2/16	
2/21	2/23	Interrupt driven I/O	
2/28	3/02	Interrupt driven I/O	
		(no class 3/07, 3/09, Spring Break)	(no lab on 3/7)
3/14	3/16	Memory Interfacing	
3/21	3/23	Motor control, analog I/O	Project II (5 weeks)
3/28	3/30	Thyristors and AC load control	
4/04	4/06	Position encoders,	
4/11	4/13	Test #2, Tuesday 4/11	
4/18	(no class)	(Th: Ideafest)	
4/25	4/27	Review, project discussion, or selected topics (no class 3/19 due to Assessment Day)	

Exams 5/4

Final Exam, Thursday 5/4, 10:30 AM – 12:30 PM

Prof. De Boer presents the above schedule as a possible example of the way the course might progress. He reserves the right to make substantive changes in response to student interests and other opportunities.

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Note on the class schedule

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

This is a messy course

It is the nature of embedded systems that some of the software and hardware we use may be incompletely or poorly documented and may have more bugs than found in typical commercial software sold to the general public. Developing a professional demeanor while dealing with bugs, poor documentation, and such, is a possible learning outcome of this course. It is very likely that students will encounter frustrating technical details that the professor has never seen before. We will work through these struggles together.

Audience and Role of this Course

This course is intended for junior and senior engineering and computer science majors. It is required for engineering majors who select the electrical concentration and for computer science students who select the hardware concentration.

Schedule Conflicts With Tests, Missed Tests or Exams

Professor De Boer announces his test schedule in the first week of classes. During the first two or three weeks of classes, and possibly at other times if there is good cause, students may negotiate to change the test date(s) for the entire class to avoid a conflict for any one student. However in the week before a test Prof. De Boer is very reluctant to negotiate the date because this can cause hardship for those who have been carefully planning. If you realize that you have a schedule conflict with a test date that cannot be resolved by the means above, discuss this with Prof. De Boer as soon as possible. If your reasons are sound, 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 to the rest of the class.

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

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 after all your course work is complete Prof. De Boer will reassess the situation and 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. If an estimated grade is granted, it probably will still be discounted to a lower grade than the other tests and exams you completed if negligence is a partial cause for missing the exam. A dead cell phone battery that causes you to miss an alarm is an example of negligence. If a test is missed due to illness (fever, nausea, etc., not just a "bad cold") then be sure to report the illness to student services before the test (at least leave a message) in a timely way relative to the type of illness. If student services can verify your illness to Prof. De Boer, an estimated grade that is non-punitive will be given at the end of the semester. If you become ill during a test 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 on how to handle the case.

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A large amount of information from this point onward in this document is copied from the Student Handbook as per policy in Dordt College's "Syllabus Checklist." Copied information is rendered in italic text, except this paragraph is not copied! There is some additional information specific to this course as well.

Additional information is in the normal typeface.

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.*

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.*

Professor De Boer expects to be notified by e-mail at least a day in advance if you can reasonably be expected to have known that far in advance of a time when you will have to miss a class for a scheduled event of higher priority. In addition to the options listed above, missing classes without notification or for insubstantial reasons could be cause 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.

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Late work

Anything handed in late will be accepted for possible grading, but usually no grade will be entered in the grade book. The work will not be returned to you. The empty grade will function as a zero or an “F.” Usually the item will never be graded. If, in the judgment of Prof. De Boer, grading the late item might improve the course grade, and if the reasons for the late work seem acceptable and if there is no pattern of carelessness, then Prof. De Boer may choose to estimate a grade or actually grade the late work and replace the empty grade(s) in the grade book with the estimate(s) or actual grade(s). Prof. De Boer may make a decision to estimate or fully grade a late item at any time after the item is handed in, but usually will do so only at the end of the course after all student course activities are complete. Additionally, if a pattern of late work develops, Professor De Boer will warn the student. After that warning if the problem is not resolved, a reduced course grade might result and/or the student may be classified as “uncooperative” which could lead to dismissal from the course.

Class Participation

Professor De Boer does not grade class participation. It is expected of all students. If your participation is a problem Prof. De Boer will talk about it privately with you. Usually mere attendance will prompt your adequate participation, presuming you are not sleeping in class or hungover. If you are sleeping in class or hungover you will be considered absent on those days and the attendance policy will apply.

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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. For students, this means not lying, cheating, or stealing others' work to gain academic advantage; it also means opposing academic dishonesty.

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 reading or hearing another's work or ideas and using them as one's own; quoting, paraphrasing, or condensing another's work without giving proper credit; purchasing or receiving another's work and using, handling, or submitting it as one's own work.*

***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.*

Students must do their own work. In Prof. De Boer's courses students may verbally discuss homework but may not show ungraded papers to each other. This policy applies to the whole course, not just homework. Detail on this policy and more can be found on the web at <http://homepages.dordt.edu/ddeboer/integrity/#DYOW>.