Start-up Notes for ECE 414 Electronics II

1) **414. Electronics II** Prerequisite: ECE 300, ECE 311 or equivalent (3)

Review of solid state device properties and circuit analysis. Design of electronic circuits such as operational amplifiers, power amplifiers, power supplies, oscillators, switching and digital circuits. Design projects. Two lecture hours and one three hour laboratory per week.

Goals: Illustrate design and analysis of electronic circuits using classical and computer-aided design techniques.

Reminder: Experience suggests emphasizing that course prerequisites are ECE 300, ECE 311 or equivalents. The Registrar checks course prerequisites by computer and an omission may lead to automatic withdrawal from the class; you are subject to whatever academic AND financial penalties apply when that is done. This is an administrative procedure in which I am not involved other than possibly to be advised of the deficiency.

2) I maintain a folder called ECE 414 linked from my web page; content will be added/selected as the term progresses and/or need arises. You can link to my web page starting from the ECE Department page, and then bookmark the page URL. With infrequent exception files are in .pdf format.

In addition I have arranged for a course email address for questions and constructive comments; the address is ece414@elvis.umd.umich.edu. Use this address to assure a reasonably prompt reply for course-related questions. (If you mail me re course material at another address I likely will not respond in a timely fashion if at all.) I broadcast to all ‘registered’ email addresses special information, notices, corrections, reminders, and on occasion technical information of general interest. If you wish to be included in this mailing please send an initial individual email to the course address so that I can establish a valid class address book entry.

2) The specified lecture period is (*to be determined*. Note that 10:40 (for example) is the lecture start time; the canonical 10-minute grace period starts at 10:30AM!)

A lab period is to be arranged. However almost all lab work will involve report writing and computer computations; specific arrangements will be left largely to the discretion of the individual or project team involved. Computer analysis and report editing may be done using either college facilities or on personal computers or both, subject to the prescribed format requirements.

In place of a regular lab period I am designating the (*to be determined*) time period as a second 'lecture' period to be used as needed. This time period should be free in common for everyone. I will use this period for an occasional lecture when and as necessary, for example to get started efficiently at the beginning of the course. For the most part however I plan to use this time for office hours. This designation provides an established time for, say, an occasional collective consultation with, or a demonstration by, a project team.

3) **A project report is required** for each project, and shall be delivered in a timely manner; a late report is penalized. A request for a delay must include a substantive reason for the delay. This written request, if a delay is authorized, becomes an appendix of the project report. Pressures associated with other courses or even unexpected really important social events are not substantive reasons.

Standards for report format and content specifications are provided elsewhere. In general you are not free to depart from the basic specifications, although some leeway in detail is allowable (all this is discussed elsewhere). You can consult the stricter standards for ECE 498, the senior design project course to get an appreciation of more professional requirements. (The manual for that course is linked to the ECE department web page.

For the more extensive projects a project team will consist of no fewer than two, and generally three or even more students for each project. Teamwork in organizing and implementing a project is an important part of the project experience. The course instructor specifies team assignments in a more or less random selection. Ordinarily only one project report is required from each team. A project
combines individual and cooperative efforts, and the report must make explicit the contributions separately and jointly of the team members. While not unusual it is not necessary that all members of a team receive the same grade for a report, i.e. it is not just the report as a whole that is evaluated but the contributions of the team members individually. All team members share responsibility for the report as a whole.

4) You may anticipate, at least this is my intention, that at least one project will have an oral as well as a written report component, i.e. each team should be prepared to present their work before the class (and any visitors), and respond to questions. The idea is to emulate a presentation before one or another sort of professional audience. In this respect being an active part of the audience also is important. Listeners should be able to understand and evaluate a technical presentation, and ask informed questions. Indeed you should not be surprised if a project is discussed and assigned in a lecture, with no special written material provided; in other words what you hear is what you get.

All project team members are expected to participate in any presentation. All project members are assumed to be generally familiar with the project as a whole, and specifically familiar in detail with the part of the project for which they are assigned primary responsibility.

5) All reports, both text and figures shall be prepared on a computer

6) Anticipate at least two exams, possibly three, during the term, on material associated with previously completed projects and lectures. There are no makeup exams so make sure you take the exam at the arranged time. Email reminders will be sent to registered students. These exams will constitute 40% of the grade. The other 60% accrue from the project reports, which will be considered individually as a kind of take-home exam. A report grade (for each team member) will be based on
   a) Successful completion of the project
   b) Overall quality of the report, both presentation and content
   c) Specific contribution(s) from the individual team member

7) The designation of the laboratory work as ‘projects’ tends to mislead students. While suggestions from the class are welcome the course instructor makes the final decision as to what constitutes a ‘project’. There are no substitutions.

In general projects are intended to emphasize ‘electronic design’ rather than technical analysis alone. By and large up to this point your education has emphasized at least indirectly the idea that engineering is a more or less exact discipline; laboratory reports regularly refer to a difference between theoretically expected performance and a laboratory measurement as an ‘error’. In this course you should begin to understand that engineering calculations are far from exact. Part of the work done will focus on surviving in an inexact world, analyzing and interpreting electronic circuit performance against expected behavioral models.

There is a converse side to the process of analysis; this is synthesis. A problem of analysis involves a defined system, all components are known, and the engineering problem is to evaluate system performance. A synthesis (or ‘design’) process starts in general with desired system performance, and the objective is to describe a system that achieves (within some acceptable margin) the specified performance. There is no certainty that a design can be achieved, and in general there is not a unique design determined by some algorithmic process. Rather choices have to be made and consequences of these choices evaluated.

There are many professional considerations other than technical ones associated with a design: ethical, social, environmental, and economic considerations are some examples. While such aspects are emphasized in the senior design course they generally will not be emphasized in this course. Nevertheless you may be asked on occasion to include in the report a brief comment with respect to one or another of these considerations. For example a pertinent request is for a reasonable estimate of cost (parts list, fabrication, assembly, distribution, sales, advertising, etc.).
The project report is an essential, not an incidental part of the design task; it should provide someone not familiar with the specific subject matter but reasonably skilled in the art the information necessary to duplicate the work if desired, including an understanding and appreciation of various design choices made.

Again: Design problems typically are ones for which there are fewer equations than unknowns, requiring informed choices to be made. Almost always there is not a unique solution so that it is necessary to develop the ability to compare and evaluate alternatives, and make considered choices. Not the least part of the process is an ability to convey clearly and accurately what it is you have to say. **It is not simply a matter of providing something that ‘works’; engineering is a high-stakes game quite inappropriate for penny-ante players.**

8) A CD containing a PSpice computer analysis program can be obtained on request through the website [http://www.orcad.com](http://www.orcad.com). I have on hand an older (but more than adequate version for which the installation program is available. College and ECE Department computers have the program installed. You should be or should quickly become familiar with PSpice, or an equivalent circuit-analysis program. Device models for this program are sufficiently accurate to allow a computer-aided 'experimental' evaluation of operation. Of course the computer merely computes; deciding what to compute and what the computational results mean is the responsibility of the project team.

9) The first project is a combined 'assessment' and tutorial. The assessment is a general departmental/college requirement to evaluate in part the effectiveness of course prerequisites and student preparation. The tutorial part is to promote a general appreciation of project report requirements in a relatively straightforward and familiar technical context. Technical details for this introductory project are specified elsewhere, and there will be an opportunity to ask questions.

This **assessment/tutorial** report is evaluated, and the evaluation reviewed with the project team. ‘Grading’ is on a Pass/Fail basis. Provided a responsible, even if faulty effort, is made the report will be accepted with full marks, otherwise it is graded zero. The evaluation involves not only technical merits but also the clarity and completeness of the presentation. (In this respect please do not use color printing or decorative fonts or cute drawings; these are distractions without much merit in the present context.)

The report will include (in the format described more fully elsewhere):

a) Title, authors, course, instructor, date (title page template provided)
b) Executive summary of project results (no more than one page; half a page preferably)c) Short table or list specifically describing and apportioning effort between authors on major tasks; preferably on the same page as item b).
d) Circuit diagram(s) as appropriate, with element values for the final design (the same component values as used for supporting computations and calculations).
e) A meaningful rational for the design choices, for example reasons for a particular circuit configuration used and any or all important element values.
f) Results (graphical and tabular as appropriate) of a PSpice (or equivalent) analysis of the circuit, including for example bias currents and voltages, frequency response, and transient response.
g) In at least one instance (if all goes well) a physical demonstration of circuit performance will be required; however, unless otherwise specified explicitly, a PSpice computational 'virtual' evaluation will suffice.