

**Wilberforce University**

**Division : PSD**

**Course Syllabus: integrated circuit design**

<b>Course:</b>	
<b>Term:</b>	<b>Spring 2012</b>
<b>Instructor:</b>	<b>Name: Arkan Kadum</b> <b>Email Address: <a href="mailto:akadum@wilberforce.edu">akadum@wilberforce.edu</a></b> <b>Phone Number: (937) 708-5682</b>
<b>Catalog Description:</b>	<b>Introduction to digital and analog integrated circuits. TTL and CMOS technologies. VLSI design and SPICE analysis.</b>
<b>Prerequisites</b>	<b>Senior standing</b>
<b>Course Level Learning Outcomes:</b>	<b>Learning Outcomes</b> Having successfully completed the module, you will be able to demonstrate knowledge and understanding of: <ul style="list-style-type: none"><li>• Design rules and their relationship to circuit topology</li><li>• Alternative circuit and system design strategies.</li><li>• The role of SPICE simulation in IC design and verification.</li><li>• The CMOS design tradeoffs in terms of area, speed and power.</li><li>• Understanding of VLSI technology</li></ul>
<b>Materials:</b>	<b>Textbook:</b> "CMOS Digital Integrated Circuits: Analysis and Design" by Sung-Mo Kang and Yusuf Leblebici, 3rd Ed., McGraw-Hill, 2003.  <b>References:</b> "Analysis and Design of Digital Integrated Circuits" by D. A. Hodges, H. G. Jackson, and R. A. Saleh, 3rd Ed., McGraw-Hill, 2004. "Microelectronic Circuits", Sedra and Smith, 5th Ed., Oxford, 2004.
<b>Grading:</b>	<b>Grading Scale</b> Assignments: 40% (20% HW + 20% Quizzes and Class Participation)

	<p>Test #1: 20%</p> <p>Test #2: 20%</p> <p>Final: 20%</p> <p>90 - 100% = A</p> <p>89 - 90% = B</p> <p>79 - 80% = C</p> <p>69 - 70% = D</p> <p>Below 60% = F</p> <p>Show how students will earn each grade based on projects, labs, attendance, class participation and exams.</p>
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	<p>A student's proficiency in course work is measured in terms of the following Alphabetical symbols. Minuses and pluses are not accepted.</p> <p>A: Excellent</p> <p>B: Good</p> <p>C: Satisfactory (Grade C or better required in major courses).</p> <p>D: Poor (passing, except in major courses).</p> <p>F: Earned Failure. (Removed only by repeating the course). Upon successfully passing the course, the first grade is "excluded" from grade point average. The second grade is "included in the recalculation of the grade point average.</p> <p>I: Incomplete (student performing satisfactorily, but unable to complete coursework due to valid reason).</p> <p>N: Used in cases where grades are not yet submitted.</p> <p>W: Withdrew before course drop deadline.</p> <p>WP: Student withdraws from University. Withdrew passing after course drop deadline (2 weeks after mid-term).</p> <p>WF: Student withdraws from University. Withdrew failing after course drop deadline (2 weeks after mid-term. WF is</p>
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	<p>treated as an F (punitive grade).  CR: Credit/pass</p> <p>NC: No credit/fail</p> <p>Z: Failed course for non-attendance/unofficial withdrawal (treated the same as an F grade). Last date of attendance is reported by faculty.</p>
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<p><b>Activities:</b></p>	<ul style="list-style-type: none"> <li>• <b>Class participation:</b> Students are expected to attend classes and to be on time. <b>Attendance</b> will routinely be checked .</li> <li>• <b>Homework assignments</b> are due at the beginning of the class. No late assignments will be accepted without the prior authorization of the instructor. Homework not turned in will result in a grade of zero.</li> <li>• <b>Quizzes</b> may be announced or unannounced. Absence from a quiz will result in a zero (if you cannot attend a lecture inform your instructor).</li> </ul>
<p><b>Policy Statements:</b></p>	<ol style="list-style-type: none"> <li>1. <b>American with Disabilities Policy:</b> Students are responsible information the instructor of any instructional accommodation and/or special needs at the beginning of the semester.</li> <li>2. <b>Final examination:</b> The final examination must be taken at the scheduled time, so make your travel arguments for after your final exam.</li> <li>3. <b>Make-up exams</b> will only be given for extenuating circumstances (acceptable reasons for missing an exam are: illness, family emergencies, or incarceration) and they must be arranged before the exam. Unannounced absence from an exam will result in a zero.</li> <li>4. <b>Academic misconduct:</b> Students are considered to have cheated if they copy the work of others during examinations or turn in assignments written, in whole or in part, by someone else.</li> </ol>
<p><b>University Policies:</b></p>	<p><u>Academic Honesty:</u>  Plagiarism and cheating are completely unacceptable in an institution of higher</p>

education and learning. Such behavior deprives the student involved of the desired education and development of an appropriate value system. It is extremely unfair to other students, and it severely diminishes the value and integrity of a University degree.

Plagiarism occurs whenever another's work is submitted as one's own. This includes the use of information from an Internet site or from a published author's ideas and words without proper attribution or documentation. It also includes the copying of term papers, other unpublished works, homework, case reports, computer programs and spreadsheets, and any other course assignments which are submitted for course credit as the student's own effort.

Each instructor shall state the specific penalties for plagiarism and cheating in the course syllabus. The instructor has final responsibility for assessing the penalty in such cases regarding the course grade.

All cases of plagiarism and cheating will be referred to the Vice President for Academic Affairs for possible further action. Additional penalties may be imposed for the egregious cases of plagiarism and cheating.

### Drops and Withdrawals

#### Dropping Courses:

A course may be dropped up through the end of the second week of the semester without any record on the transcript. After this date, a course may be dropped up to two weeks after mid-term grade reports are due, with a W appearing on the transcript. Withdrawals after mid-terms must be approved by the Vice-president of academic Affairs.

In certain General Studies core courses, students' assignments to course sections may be changed by faculty with written notification given to the Registrar. In all other cases, a student wishing to move from one section of a course to another must accomplish this by using a drop-add form to drop the old section and add the new section.

#### Withdrawal/Grading Policies

The following procedures will apply to all students withdrawing from the University. Grades will be given in regard to the time of withdrawal. Contact the Registrar's Office for forms and assistance.

- **W** (official withdrawal initiated by the student): To be given when a student withdraws between the first day of class/registration and the last day to drop courses, this is two weeks after mid-term exams.
- **AW** (unofficial withdrawal not initiated by the student): The student does not inform anyone that he/she is leaving campus ( the student walks out). The university may also administratively withdraw a student for disciplinary reasons, academic legal anytime during the semester.

#### Special Accommodations:

A student who is ill or who has or develops medical conditions including but not limited to illness, physical or other disability or pregnancy must notify the Director of Health Services immediately.

Classroom Conduct:

- 1. Show respect for the teacher, other classmates, and their property. This includes talking during class instruction without the teacher's permission.
- 2. The student is not allowed to get on the internet without permission from the teacher, and if caught on a website deemed inappropriate, the student will receive an automatic discipline referral
- 3. Food and drinks are NOT ALLOWED in the classroom.
- 4. No cell phones – please turn them completely off during class, if there are special circumstances please let the instructor know and arrangements can be made;
- 5. no computer games, chatting, email, Internet surfing etc. during classroom lecture – if you are seen being off task during class, you will be asked to leave.

Contact Hours:

All classes meet for full time stated on schedule

**Course Policies :**

Attendance at all classes is expected, however I understand that a perfect attendance record is difficult to achieve. Lecture attendance will not be enforced but the tests reflect the lectures, not necessarily what's in the book, so the tests will be that much harder if you miss class regularly. If you must miss class (car trouble, etc.), email me at [akadum@wilberfoce.edu](mailto:akadum@wilberfoce.edu) just in case I assigned some homework during class.

Please do not eat, talk on the phone, surf the web, chat, etc. in the classroom.

If something urgent comes up (need to use the restroom, make a phone call, etc.) just go ahead and get up and leave the room for a few minutes, no need to get my permission.

If you miss a class you are responsible for getting any assignments that may have been made, or if any work is due you must get it to me prior to the class.

All homework is due on the date specified - at the beginning of class.

I expect everyone to take the exams on the scheduled dates, however if you are unable to do so you must make other arrangements

	<p>with me before the exam is given.  I expect that all homework, and exams to represent individual effort. Each student should turn in her own work.  All sources of answers to homework should be paraphrased and not copied directly.  Homework are due as hardcopies in class at the beginning of class on the due date, unless I specify otherwise.  While the amount of time required of the student to successfully complete this course varies from student to student plan on spending at least 6-8 hours per week outside of class.</p>
<p><b>Weekly Schedules:</b></p>	<p>Week 1: Course Overview, A Digital Circuit Design Example, The Structure and Layout of MOSFET and CMOS (Chapters 1 &amp; 2 of Kang &amp;Leblebici)  Week 2: MOS Transistor: Threshold Voltage, Current-Voltage Characteristics, Capacitances (Chapter 3 of Kang &amp;Leblebici)  Week 3: Modelling of MOSFET Using SPICE (Chapter 4 of Kang &amp;Leblebici)  Transistor Modeling  Advanced MOS Models, Capacitance Models ( Hodges, &amp; Jackson)  Week 4: MOS Inverters: Static Characteristics, Resistive-Load Inverter, Inverters with N-MOS Load, CMOS Inverter (Chapter 5 of Kang &amp;Leblebici)  Week 5: Simulation with SPICE, Inverter VTC, noise margins CMOS Gates, Clocking/Flip-flop Design Issues ( Hodges, &amp; Jackson)  Week 6: Fabrication, Layout, Power Dissipation ( Hodges, &amp; Jackson)  Week 7 : Interconnect  Week 8: MOS Inverters: Switching Characteristics, Delay Times, Interconnect Parasitics, Switching Power Dissipation (Chapter 6 of Kang &amp;Leblebici)  Week 9: Combinational MOS Logic Circuits (Chapter 7 of Kang &amp;Leblebici)  Week 10: Bipolar Junction Transistor: Transistor Operation, Terminal Currents,</p>

	<p>Modes of Operation,          SPICE BJT Model (Chapter 5 of Hodges &amp; Jackson)</p> <p>Week 11: Bipolar Digital Gate Circuits: RTL, DTL (Chapter 7 of Hodges &amp; Jackson)</p> <p>Week 12: Bipolar Digital Gate Circuits: TTL, ECL (Chapter 7 of Hodges &amp; Jackson)</p> <p>Week 13: Sequential MOS Logic Circuits (Chapter 8 of Kang &amp;Leblebici)</p> <p>Week 14: Regenerative Logic Circuits: Schmitt Trigger, Multivibrator Circuits, IC Timer (Chapter 8 of Hodges &amp; Jackson)</p> <p>Week 15: Semiconductor Memories: ROM, SRAM, DRAM, CCD, PLA, FPGA (Chapter 10 of Kang &amp;Leblebici)</p> <p>Week 16: Column I/O design, Peripheral Circuits</p> <p>Week 17: Course Summary and Review</p>
<p><b>Advising &amp; Tutorial Support:</b></p>	<p><b>Suggestion on how to study for Integrated Circuit Design:</b></p> <ol style="list-style-type: none"> <li>1. Spend some time on this course between every two consecutive class meetings. The time spend should follow a regular schedule as to time and place. Expect to put in at least two hours of study for each 50 minutes of class time.</li> <li>2. Try to work the problems unassisted. If your early attempts at solving a problem are unsuccessful, you should seek help from your instructor. Look at the answer in text only after you have exhausted all of your resources in solving a problem.</li> <li>3. The value of the class time will be greatly enhanced if you look over the portion of the text to be discussed before attending class. When homework problems are to be discussed, it is also important to have attempted the assigned problems before the discussion in the class. Even if the attempts are unsuccessful, you will find the discussion in the class far more</li> </ol>

	valuable as a result of your earlier attempts at solutions.
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