

Course Description:

Topics in microprocessor design philosophies, data typing and addressing modes, memory management, and virtual memory, multiprocessing, multitasking, and process communications.

Prerequisites: ENG 312 Digital Circuits and Microprocessors

Corequisites: ELC 343 Microcomputer Systems

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Office Hours: Mon. 9:30–10:50AM, Thur. 2:00–3:20PM, or by appointment

Class: Mon. and Thur. 8:00AM – 9:20 AM AR154

This class contains one intensive design or analytical experiences or other appropriate activity that require each student to significantly increase out-of-class learning.

Required Textbook:

Computer Organization and Design: The Hardware/Software Interface ARM Edition by D. Patterson and J. Hennessy, Morgan Kaufmann, 2016, ISBN: 978-012-8017333.

Grading Procedures:

Homework	5%
Quizzes	20%
Exam 1	20%
Exam 2	20%
Final Exam	30%
Research Paper	5%

All grades will be posted on Canvas.

Letter grade equivalent (%):

A = 100 – 93	C+ = 79.99 – 77	D+ = 69.99 – 67
A– = 92.99 – 90	C = 76.99 – 73	D = 66.99 – 60
B+ = 89.99 – 87	C– = 72.99 – 70	F = 59.99 – 0
B = 86.99 – 83		
B– = 82.99 – 80		

Attendance/Class Participation:

Attendance is required for all classes. Excellent attendance is vital to academic success. Attendance will be taken at the beginning of each class and used to determine the final grade of students who are on the borderline between two grades. If you are late for the class, it is your responsibility to let me know you are there right after the class. If absence is necessary due to illness or emergency, please contact the instructor **prior to the class meeting time** via email. If you do miss class you are responsible for contacting other classmates to obtain any missed information.

Homework Assignments, Quizzes, and Exams:

Homework will be assigned on the course web page. All assignments must be turned in at the beginning of the class on the date specified. **Late assignment** will be penalized 25% per day but exceptions will be made for cases brought to the instructor attention PRIOR to the due date. Completing the assigned homework is vital to your understanding of the subject material. Your homework will also be measured by your performance on quizzes and exams. You should make every effort to complete the homework assignments and seek help with problems you have not been able to solve. The problems on the quizzes and exams will be very closely related to the homework problems and the lectures.

Quizzes may be announced or unannounced. There are **no early or make-up quizzes** (including pop quizzes) under any circumstances for any reason. A make-up exam will be given for **ONLY** a legitimate excuse with full documentation (including death in the immediate family or illness verified by a doctor (not including any nonemergency doctors' appointments that could be scheduled at other times), field trips required for other classes (required an email notification from the instructors prior to the trips), intercollegiate competitions, or activities initialing official representation of TCNJ, and hazardous, weather-induced driving conditions (for commuter students only). The instructor reserves the right to disapprove any explanations for absences presented without prior notice.

The **Final exam** is cumulative and mandatory. You are responsible for making sure that you can attend the final exam. Registering for this course means that you certify that you will be taking the final exam. Let me restate one more time: You must take the final exam at the time determined by the official college exam schedule and you will get a zero if you do not take it.

Research Assignment:

Each group of students will write a short research paper that will analyze in a summarized fashion a set of at least three journal/conference papers on the topics covered in Electrical/Computer Engineering major. The goal of this assignment is exploration of the detailed aspects of the topics. You cannot resubmit or slightly modify a previously submitted paper authored by you or someone else (you need to get written permission from me if you plan to do so). Final paper should be at least 4 pages (typed, 12 pt font, double-column and single-spaced). Please refer to the handout for more details about the format.

1. Choose a topic, and find information and resources:

Due: Thursday, Sept. 15, 2016 (5 pts)

Look through the textbook and choose a topic which interests you. Focus on a limited aspect of the subject. You may want to do some general reading on your topic on the Internet and other reference works. Your proposal includes the topic of the paper, a short abstract that describes your approaches, and the list of varied resources (DO NOT use internet sites). Your topic and resources must be approved by instructor and these cannot be changed without prior approval.

2. Collect your references:

Due: Thursday, Sept. 22, 2016 (3 pts)

Use proper research tool to find and collect your references. You may want to use TCNJ library tools (IEEE Explorer) to search papers. You can have more than three references but at least three

of them are from conference or journal papers. You do not need to bring hardcopies of papers. Upload three articles (pdf files) to Canvas before the due date.

3. Write a draft of the paper:

Due: Thursday, Oct. 20, 2016 (10 pts)

You have done the research and developed some ideas for writing. Now it is time to write the paper. You may want to try as much as possible to put it into required format (see other hand out). The draft should be at least two pages.

4. Finish the research paper:

Due: Thursday, Nov. 10, 2016 (20 pts)

Your final version of the paper should contain three parts: introduction (introductory material), body with subheadings (supporting evidence for your thesis or comparison) and conclusions and future work (statements about your learning and finding). Your final paper should be checked by the Tutoring center staff (make an appointment early). You **MUST** turn in the hardcopy of the evidence (corrections or suggestions by the staff) with your final paper. Also, you need to submit your final paper through Canvas (pdf file only).

5. Present your findings:

TBD (10 pts)

The total length of each presentation is 10 minutes. Plan to present for 7 – 8 minutes (no less than 7 min.) and answer questions for 2–3 minutes. Your presentation should include title and name of presenter, outline, description of your readings, highlights of findings, and conclusions. You **MUST** give a computer-aided presentation (e.g., using PowerPoint) and your presentation will be evaluated by everyone in the class.

6. Evaluate other presentations:

TBD (2 pts)

You will be asked to evaluate other presentations. You need to use criteria and adding comments (a hand-out will be given) to evaluate presentations. Use this evaluation process to develop and improve your own presentations.

Things to turn in at the end of your presentation: final report (softcopy and hardcopy), references (softcopies), and ppt file.

Other Notes:

- Don't procrastinate! The due dates will arrive rapidly and it will coincide with other demands in this course.
- Don't Plagiarize! Your research paper must be your own work.
- Do ask questions! If you have any questions or concerns, please do not hesitate to contact me anytime.

Educational Objectives

(What TCNJ ECE engineers should be able to accomplish during the first few years after graduation)

- To contribute to the economic development of New Jersey and the nation through the ethical practice of engineering;

- To become successful in their chosen career path, whether it is in the practice of engineering, in advanced studies in engineering or science, or in other complementary disciplines;
- To assume leadership roles in industry or public service through engineering ability;
- To maintain career skills through life-long learning.

Electrical and Computer Engineering Student Outcomes

(What TCNJ Electrical and Computer Engineering students are expected to know and be able to do at graduation. What knowledge, abilities, tools and skills the program gives the graduates to enable them to accomplish the Educational Objectives)

The Student Outcomes listed below are expected of all graduates of the Electrical or Computer Engineering program.

ECE graduates will have:

- an ability to apply knowledge of mathematics, science and engineering;**
 - **Binary math used extensively in homework problems and tests.**
- an ability to design and conduct experiments, as well as to analyze and interpret data;
- an ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;**
 - **Students do design in homework problems.**
- an ability to function in multidisciplinary teams;
- an ability to identify, formulate and solve engineering problems;**
 - **Students do homework problems.**
- an understanding of professional and ethical responsibility;
- an ability to communicate effectively;**
 - **Students do presentations and write reports.**
- the broad education necessary to understand the impact of engineering solutions in a global and societal context;
- a recognition of the need for and an ability to engage in life-long learning;
- a knowledge of contemporary issues;
- an ability to use the techniques, skills and modern engineering tools necessary for engineering practice;**
 - **Modern computer design tools are discussed heavily throughout the course.**

Course Objectives¹:

Objective 1 To understand system organization (processors, memory and management, I/O interfaces). [a, c, e] [1, 2]

¹ Small letters in brackets refer to the Student Outcomes

- Objective 2 To understand the various tradeoffs associated with Instruction Set Architectures (instruction formats, expanding op-codes, addressing modes), and learn the tools of microprocessor system design. [a, c, e, k] [1]
- Objective 3 To examine the various CPU controls (hardwired, microsequencer). [a, c, e, g, k] [1, 2]
- Objective 4 To explore cache and virtual memory, and I/O-related topics in relation to microprocessor system design. [a, c, e, k] [1, 2, 4]

Topics Covered:

1. Digital Logic Review
2. CPU Design
3. Computer Organization
4. Performance
5. Instructions Set Architectures
6. MIPS instructions
7. Computer Arithmetic, IEEE Floating Point Standards
8. Datapath Design
9. Pipelined Datapath and Control
10. Memory Organization – Physical vs. Cache, Virtual Memory
11. Parallel Processors and Cloud Computing

Evaluation:

1. Examinations
2. Research Assignment
3. Project Assignments
4. Homework Assignments

Performance Criteria²:

- Objective 1 Students will learn how to program in a hardware description language. [B, C]
- Objective 2 Students will author the major components of a microprocessor. [B, C]
- Objective 3 Students will be able to apply digital design principles to machine design. [A, B, C]
- Objective 4 Students will apply reasoning techniques to the solution of a micro-system design problem. [A, B, C]

Cell Phone and Text Messaging Policy

Cell phones are not permitted during class. Please turn your cell phone off or put it onto silent (in case of an emergency situation) before class starts. Do not place your cell phone on the desk. Any student leaving during class/lab to answer a vibrating phone will not be permitted to return to class. Text messaging will not be permitted during class. Any student whose cell phone rings (or text messaging) during class will be asked to leave and marked as an absence.

² Capital letters in brackets refer to the evaluation methods used to assess student performance.

Selected TCNJ Policies

TCNJ's Final Examination Policy is available on the web:

<http://www.tcnj.edu/~academic/policy/finalevaluations.htm>

Attendance

TCNJ's attendance policy is available on the web:

<http://www.tcnj.edu/~recreg/policies/attendance.html>

Academic Integrity Policy

TCNJ's academic integrity policy is available on the web:

<http://www.tcnj.edu/~academic/policy/integrity.html>.

Americans with Disabilities Act (ADA) Policy

TCNJ's Americans with Disabilities Act (ADA) policy is available on the web:

<http://policies.tcnj.edu/policies/viewPolicy.php?docId=8082> .

Course and Instructor Evaluation

A formal course and instructor evaluation will be conducted at the end of the semester. Suggestions for improving the instruction and course content are welcome at any time and are particularly appreciated.

Feedback Mechanism

All student homework assignments, exams and design project deliverables will be evaluated and marked by the instructor.

ELC 451: ADDITIONAL INFORMATION

1. DESCRIPTION OF DESIGN ACTIVITY

N/A

2. ENGINEERING STANDARDS

ASCII code and IEEE floating point.

3. REALISTIC CONSTRAINTS

Economic: The cost reduction impact of Very Large Scale Integration (VLSI) semiconductor circuits in the price and performance of modern computers is covered in this course.

Environmental: The impact of smaller and more powerful computers that require less electrical power is discussed in light of the environmental benefits of electronic equipment that requires less energy and less physical space.

Sustainability: Different models for implementing computer control are discussed. These are hardwired and microprogrammed. The different sustainability levels for these models are discussed.

Ethical: Computer security is discussed in this course.

Social Impact: The impact that computers have had in society is discussed: new computer related laws, computer piracy, hacking, computer crimes, as well as the benefits of computers for society in terms of how society works, learns, and is entertained in entirely new ways that did not exist before the advent of computers.

4. MODERN AND PROFESSIONAL ENGINEERING TOOLS USAGE

N/A

5. COMPUTER USAGE

Students use computers during to prepare reports on reading assignments.

6. FEEDBACK MECHANISMS

Examinations: Students are given two mid-term examinations and a final one.

Reports: Students are graded on reports, which include not only the technical aspects, but also the level of communication skills.

Homework: Homework problems are assigned and graded. Not all the problems are graded. These are selected randomly, but students do not know in advanced which problems are going to be graded, so they are behooved to do all assigned problems. These problems are a mixture of analysis and design problems.

Tentative Schedule

Updated course schedules and assignments are on the web at: <http://www.DrSeungKim.com>

#	Week	Lecture Topics	Due
1	Thur, Sept. 1	Computer Abstractions and Tech. (Chapter 1)	
	Mon, Sept. 5	No Class (Labor Day)	
2	Tue. Sept. 6	Chapter 1 (cont.)	
3	Thur, Sept. 8	Instructions (Chapter 2)	HW 1 (Ch.1) Due
4	Mon, Sept. 12	Chapter 2 (cont.)	
5	Thur, Sept. 15	Chapter 2 (cont.)	Research Proposal Due
6	Mon, Sept. 19	Chapter 2 (cont.)	HW 2 (Perf.) Due
7	Thur, Sept. 22	Arithmetic for Computers (Chapter 3)	Rsrch Reference Due
8	Mon, Sept. 26	Chapter 3 (cont.)	HW 3 (Neg.#) Due
9	Thur, Sept. 29	Chapter 3 (cont.)	HW 4 (Ch. 2) Due
10	Mon, Oct. 3	Review & The Processor (Chapter 4)	HW 5 (App. B) Due
11	Thur, Oct. 6	Exam I (Chap. 1, 2, and 3)	HW 6 (Ch. 3) Due
	Mon, Oct. 10	Mid-Semester Break – No Classes	
12	Thur, Oct. 13	Chapter 4 (cont.)	
13	Mon, Oct. 17	Chapter 4 (cont.)	
14	Thur, Oct. 20	Chapter 4 (cont.)	Research Draft Due
15	Mon, Oct. 24	Chapter 4 (cont.)	HW 7 (Ch. 4) Due
16	Thur, Oct. 27	Chapter 4 (cont.)	
17	Mon, Oct. 31	Chapter 4 (cont.)	
18	Thur, Nov. 3	Large and Fast: Exploiting Memory Hierarchy (Chapter 5)	HW 8 (Ch. 4) Due
19	Mon, Nov. 7	Chapter 5 (cont.)	
20	Thur. Nov. 10	Chapter 5 (cont.)	
21	Mon, Nov. 14	Review & Parallel Processors (Chapter 6)	Rsrch Paper PPT
22	Thur, Nov. 17	Exam II (Chap. 4 and 5)	Rsrch Final Paper Due HW 9 (Ch. 5) Due
23	Mon, Nov. 21	Chapter 6 (cont.)	Rsrch Paper PPT
	Thur, Nov. 24	Thanksgiving Break – No Classes	
24	Mon, Nov. 28	Chapter 6 (cont.)	Rsrch Paper PPT
25	Thur, Dec. 1	Chapter 6 (cont.)	Rsrch Paper PPT
26	Mon, Dec. 5	Chapter 6 (cont.)	Rsrch Paper PPT HW 10 (Ch. 6) Due
27	Thur. Dec. 8	Review	

The instructor reserves the right to change any portion of this syllabus whenever necessary. In the event that this action becomes necessary, students will be notified in a reasonable and timely fashion.