

EEL3801: Computer Organization

UCF Official M-mode: Mixed Web & Live Delivery - Summer Sem. 2023

Meetings and Delivery Modes

1. Group:

- *CM01* (“-01”): Mon. & Wed. 12:00PM – 1:50PM in Classroom Bldg #2 room 101 (CB2-101)
- Provides content overview, problem-solving, and group discussions
- UCF Here check-in rate of 67% affords opportunity for score rebuttal

2. Personalized:

- View my YouTube-hosted content lectures via Webcourses videos at any time & place
- Conduct the Module components as organized and scheduled weekly
- Assistance is available during *Class Contact Hours*, *Professor Office Hours*, *Lab GTA Office Hours*, and *Open Tutoring*. See times and places listed below.

3. Lab Sections:

- EEL3801-11: Mon. 9:00AM – 11:50AM in ENGR-1 room 257. GTAs: Mousam Hossain, Hao Fang
- EEL3801-12: Mon. 3:00PM – 5:50PM in ENGR-1, 257. GTAs: Mousam Hossain, Islam Chowdhury
- EEL3801-13: Wed. 9:00AM – 11:50AM in ENGR-1 room 257. GTAs: Marc Jean, Hao Fang
- EEL3801-14: Wed. 3:00PM – 5:50PM in ENGR-1 room 257. GTAs: Marc Jean, Islam Chowdhury

NOTES: **NO LABS during first week of classes** (ECE department policy) i.e. week starting Mon. May 15.
NO LABS during whole weeks that start on: Mon. May 29 and Mon. July 31.

Office Hours: for **quiz/exam score clarification/rebuttal and tutoring** or for **assisting learning/logistics:**

<i>Mon</i>	<i>Tues</i>	<i>Wed</i>
Quiz/Exam Rebuttal: 10:00-11:45 and 2:00-3:00 in HEC-242 <i>Tutoring Assistant provides test score review & tutoring.</i> <i>Use this Appointment Link:</i> Rebuttal-Appointments	Quiz/Exam Rebuttal: 10:30-1:30 and 2:00-6:00 in HEC-242 <i>Tutoring Assistant provides test score review & tutoring.</i> <i>Use this Appointment Link:</i> Rebuttal-Appointments	Quiz/Exam Rebuttal: 9:45-11:45 and 2:00-6:00 in HEC-242 <i>Tutoring Assistant provides test score review & tutoring.</i> <i>Use this Appointment Link:</i> Rebuttal-Appointments
Assisting learning/logistics after rebuttal completed 2:00-5:00 in HEC-310 <i>Professor assistance in-person.</i> <i>Use this Appointment Link:</i> Professor-Office-Hours		Assisting learning/logistics after rebuttal completed 2:00-5:00 in HEC-310 <i>Professor assistance in-person.</i> <i>Appointment Link:</i> Professor-Office-Hours

Course Catalog Description: EEL 3801C ECS-ECE 4(3,3) Computer Organization: PR: EGN 3211 and EEE 3342C both with grades of “C” (2.0) or better. Computer arithmetic, instruction set architecture, performance, data path, control unit, memory hierarchy, I/O interface. Fall, Spring. Course Designation: Required for BS CpE and BS EE programs. Contribution to Professional Degree Component: Math & Science: 1 credits Engr.: 3 credits General Ed.: 0 credits

Textbook Options:

- 1) **PDF/Paper Book Version:** David Patterson & John Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition (2014), Morgan Kaufmann, ISBN: 978-0-12-407726-3.
- 2) **Interactive Electronic Book Version via zyBooks:** David Patterson & John Hennessy, EEL 3801: Computer Organization, ISBN: 978-1-394-14272-9 using the following steps:
 - a) **Sign-in** or create a new account at <https://learn.zybooks.com>
 - b) **Enter** zyBook code: **UCFEEL3801DeMaraSummer2023**
 - c) **Subscribe** (zyBooks subscription costs approximately \$80 which enables access until last day of semester)

– Contact Info –

Professor:

Dr. Ronald F. DeMara, Pegasus Professor of Electrical and Computer Engineering

Harris Engineering Center (HEC) Building room 310

Tel: 407-823-5916

E-mail: ronald.demara@ucf.edu ← *please use this email rather than Webcourses mailer - thank you!*

Prof. DeMara's office hours:

Mon: 2:00PM to 5:00PM in HEC-310

Wed: 2:00PM to 5:00PM in HEC-310

EEL3801-GTAs:

Islam Chowdhury, reyad@knights.ucf.edu

Hao Fang, f.hao@knights.ucf.edu

Mousam Hossain, mousam.hossain@knights.ucf.edu

Marc Jean, marc1988@knights.ucf.edu

EEL3801- UTAs/ULAs:

Axel Maysonet, axelmaysonet@knights.ucf.edu

Casey Jack, cjack@knights.ucf.edu

Francisco Soriano, soriano.francisco@knights.ucf.edu

Request for Authorization of Absence

Students shall use the following procedure for ***Health (including COVID-19) / Legal / University-Authorizable absences*** which are approvable as identified on Page 7 of this Syllabus within **5 business days of the start of the requested absence period:**

Step 1. Submit "Student's Request for Authorization of Absence - Webcourses Quiz for Step 1" which is a non-credit formatted Quiz within Webcourses.

Step 2. Send an email from knights.ucf.edu email account (please do not use email button inside webcourses) to Instructor's email address as follows:

Email to: ronald.demara@ucf.edu

Subject Line: "Consideration of Absence Request"

Email Body Content: "Dear Instructor, I am writing you from my knights.ucf.edu email account to inform that I have submitted in Webcourses the required Step 1 information for a consideration of absence. Thus, if you would please have a look at that and then let me know by reply back to my knights.ucf.edu email address? Thank you"

Please do not provide any further elaboration within that email, nor attach any documents to that email.

After consideration, the Instructor will reply back to the student's knights.ucf.edu e-mail address, regarding any alternate arrangements which are determined as being appropriate for the course requirements. Students approved for extended absence shall follow up with another email sent from the *student's knights email account* to ronald.demara@ucf.edu with subject-line "**Consideration of Return from Absence**" within 5 business days of whenever the student receives the first notification of the date of return to academic activities as advised by the outside authority.

– Course Objectives –

Instructor's Learning Goals

The *Instructor's Goals* are for all students to learn the fundamental organization of a computer system, the operation of *processor* and *memory*, critical reasoning skills regarding these *components' advantages/disadvantages*, insight into the elegance of the devices used, and how to apply the knowledge to *solve contemporary problems* of interest to employers/self-entrepreneurs.

Organizing Material into Objectives

1. Identify and understand roles of the five basic components of a computer system: *Input, Output, Memory, Datapath, and Control*. Comprehend the functions of each component, and how these components interface with each other and with the software systems in which they enable. {*Critical Skills*}
2. Know the most fundamental equations for computer system performance, expressed as metrics of processor *Clock Speed, Instruction Count, and Instruction Complexity*. Be able to analytically bound the benefit of *Multiple Cores* and *Parallelism* on system execution performance. {*Critical Skills*}
3. Learn the most fundamental *CPU Instructions, Data Formats, and Access Modes* at the root of all processors. Understand these features as *Operators, Operands, and Flow Control* supported by *Assembly Language* on machine hardware. Be able to utilize the Assembly Language instruction types discussed in lecture and apply them creatively in detailed case studies as projects covered in lab. {*Critical Skills*}
4. Design at the system-level and register-level, the most popular *Memory Hierarchy, Cache, and Addressing Schemes*. Understand how these memory schemes operate, and the advantages and disadvantages of each. {*Critical Skills*}
5. Develop skills in utilizing the standard *Assembler tools, Emulators, and Execution Environments* needed to *compose, execute, and debug* a machine-level instruction program. {*Important Skills*}
6. Understand processor's *Instruction Set Architecture* from *hardware architect's perspective*. {*Relevant Skills*}

Accreditation Course Learning Outcomes

CO-EEL3801-1: Understand various data representations in computing systems, such as integers, characters, and floating-point numbers.

CO-EEL3801-2: Be able to evaluate Instruction Set and Clock Rate timing tradeoffs.

CO-EEL3801-3: Be able to understand, write, and debug assembly language programs for a modern CPU.

CO-EEL3801-4: Be familiar with fundamental concepts in memory addressing modes and indexing.

CO-EEL3801-5: Understand performance tradeoffs for CPU architecture and cache, and their cost-effectiveness.

Relationship of Accreditation Course Learning Outcomes to Degree Program Outcomes

- BSCpE/BSEE Degree Program Outcome #3: *an ability to design a system, component, or process to meet desired needs within realistic constraints* (maps to course outcomes CO-EEL3801-1, CO-EEL3801-3).
- BSCpE/BSEE Outcome #5: *... and an ability to identify, formulate, and solve engineering problems* (maps to course outcomes CO-EEL3801-2, CO-EEL3801-4, and CO-EEL3801-5)

Additional Materials for an “Environment That Helps Learning”

- *MARS Processor Simulator/Assembler* - provided by free download.*
- *Lecture Slides* – original and adapted slides provided ahead of time for convenience.*
- *Current Topic Articles* – recent processor features/announcements provided electronically via weblink.*
- *Internet-based Resources* – webpages and videos I have located on the web to communicate ideas/info of processor operation, memory, cache etc. via hotlinks embedded in lecture slides.*

* = materials provided to assist learning at *each students' pace*

– Course Organization –

Organization of Topics: [pace adjusted as needed for best coverage]

- Syllabus and Prerequisite Recap [first lecture 0.5 weeks]
- Computer Abstractions
Text Chapter 1: Page 1 – 23
 - Types of Processors, Levels of Computing Abstractions, Five Components of Computer Systems, Abstract Machine Instructions
- Processor Instructions:
Text Chapter 2 (pages 62-120 and 123-144 and 159-164)
 - Operations, Operands, Data Representation, Logical Operations, Branch/Control Operations, Addressing Modes, High Level vs. Assembly Language
- Processor Performance:
Text Chapter 1: (pages 28 – 39 and 42 – 53)
 - Performance Metrics and Benchmarking, CPI Equation, Power Wall
- Device Technology:
Text Chapter 1: (pages 24 – 28 and 40 – 42)
 - Chip Yield, Moore’s law and Technology Scaling
- Arithmetic Instructions and Circuits:
Text Chapter 3 (pages 178 – 211 and 229 – 235)
 - Addition/Subtraction, Multiplication, Division, Floating Point Representation and Computation
- Constructing a CPU from Gates:
Text Appendix B (pages B26 – B37 and B54 – B67)
 - 1-Bit ALU, 32-Bit ALU, Register Files, Memory Elements, Error Correction
- Memory Devices and Hierarchy:
Text Chapter 5 (pages 374 – 411 and 418 – 423 and 454 – 461)
 - Cache Memory, Direct Mapping, Associative Mapping, Set Associative Mapping, Hit Rate, Replacement Policies
 - Memory Technology: SRAM, DRAM, FLASH, etc.

Course Topic Summary:

Processor Components and Operation

- Levels of Computing Abstractions
- 5 Components of Computer Systems
- Performance Metrics and Benchmarking
- CPI Equation
- Power Wall
- CPU Instructions / Assembly Language
- Execution flow control constructs: branch, loop, jump subroutine
- Registers and Stacks

Register-level Design

- Hardware for Addition/Subtraction, Multiplication, Division
- Floating Point Representation
- Control Signals and ALU/CPU Control
- Instruction Mapping

Memory Systems

- Cache Memory
- Direct Mapping, Associative Mapping, Set Associative Mapping
- Hit Rate, Replacement Policies

Safety: Students are reminded to understand and follow campus safety and emergency procedures including being aware of their surroundings and familiar with actions to take during various types of emergencies.

– Point Rubric –

Weight	Component	Description
15%	Quizzes	<ul style="list-style-type: none"> based on <i>Study Sets</i> Study Sets provide practice problems with detailed solutions there are 3 Quizzes throughout the Semester worth: <ul style="list-style-type: none"> Quiz 1: 5% Quiz 2: 5% Quiz 3: 5% each quiz is allotted 50 minutes duration which is delivered in EPC
20%	Laboratory Project #1 Score: 9% Collaboration Activity #1 Score: 1% Project #2 Score: 9% Collaboration Activity #2 Score: 1%	<ul style="list-style-type: none"> Laboratory component scored by your Lab Instructor GTA Project Score = $0.4 * (\text{Code grade}) + 0.4 * (\text{In Lab Assessment grade}) + 0.2 * (\text{Report and/or Portfolio grade})$ Rubrics available are specified in project Task Description for Projects Collaboration Activities are two distinct large teamwork-based activities during your enrolled lab session held on the days to be identified during the semester Lab components: <ul style="list-style-type: none"> completed <u>only</u> during your enrolled lab section and due when specified lab assessment covers questions about the lab activities and/or examples solved during the previous lab session <u>skipping lab session or not submitting during the lab period will reduce Laboratory score accordingly</u>
20%	Midterm Exam 1	<ul style="list-style-type: none"> covers first third of course: up to 2:00 hr:min duration delivered in EPC
20%	Midterm Exam 2	<ul style="list-style-type: none"> covers middle third of course: up to 2:00 hr:min duration delivered in EPC
25%	Final Exam	<ul style="list-style-type: none"> cumulative material: up to 2:50 hr:min duration delivered in EPC
Varies	Extra Credit	<ul style="list-style-type: none"> as offered during Group Sessions or otherwise announced via Webcourses

Letter Grading Thresholds

Letter grade thresholds are (no more demanding than) A \geq 84, B \geq 79, C \geq 63, D \geq 60, F $<$ 60 which at the instructor's discretion letter grades may be curved to reduce (but not to increase) the threshold for a letter grade cutoff. Additionally, plus/minus grades are given for roughly a point or so above/below letter grade threshold.

Grading Rubrics

Lab project reports are graded using a rubric identifying point values of components. The rubric will be applied for grading and will be annotated with comments specific to each students' submission. This provides fair, uniform, and constructive *Feedback on Performance*.

On-time Submission Policy

All submissions considered for a grade must reside in Webcourses **no later than the specified due date and time**. No other form of submittal nor submittal record can be accepted. Please do not email your submissions.

- Uploads are locked out at due date/time by Webcourses, thus *late submissions are not feasible*.
- Everyone is responsible to *verify the success and accuracy of submission uploads. Only the content present in Webcourses prior to the deadline can be graded.*
- Fair policy for everyone about Late Work:* it can be useful for studying, but cannot be used for credit.
- Professional Accountability* includes keeping current with the course milestones, course announcements, and any amendments.

– Professional Conduct –

Academic Integrity

Cheating of any kind will result in a score of zero for the evaluation element and depending on severity may result in a grade “F” for the course. All cases are subject to referral to the UCF Office of Student Conduct. This course adheres to the UCF academic creed *which excludes sharing questions, answers, or attempting to do so*. See the *UCF Golden Rule* guidelines for detailed information.

Availability Commitments

- Enrolling in a course is professional academic commitment to be present for all Course Meetings, Labs, and Quizzes/Exams.
- Enrolling in a Mixed-Mode delivery course (“M-mode”) is a voluntary election to receive the designated course components via the web.
- Voluntary participation in Extra Credit activities during Group Session requires having a WiFi-capable laptop or tablet computer. Participants are responsible for properly-functioning equipment operation, including having a sufficient battery charge and a properly-functioning browser capable device with internet access via campus WiFi connection.

Professionalism Points

Whereas corporate and graduate school protocols are based on *professional respect and conduct*, two (2) course points are deducted for:

- *Misconduct*:
 - disturbances in class or electronically
 - distributing course materials/solutions to others/internet: slides/tests/labs/solutions copyrighted
 - emailing your code/submissions: please visit instructor’s or GTA’s office hours for assistance
- *Seeking Unfair Advantage*:
 - seeking unapproved exception to grading, exam, or submission policies
 - seeking invalid consideration of mis-uploads to Webcourses (wrong filename/version), Webcourses unreliability (didn’t work), or canceled/incorrect EPC appointments (differing from official logs), and/or other claims found to contradict *Webcourses Access Reports* of page-level clicks/usage or UCF computing services. Any claims determined to be without supporting evidence are unprofessional.

E-mails Regarding Grades are Prohibited

U.S. Federal FERPA laws prohibit Instructors from replying to emails regarding evaluation components, e.g. a score of any quiz/exam/lab submission and overall course score/grade. If interested may refer to a clear explanation as to why here: http://psych.fullerton.edu/mbirnbaum/psych101/grades_by_email.htm. Thus, please do not send any emails mentioning grades. Instructors are not allowed to respond to such emails. Instead, simply visit office hours of the Tutors and if unresolved then visit the Professor during days/times listed on the first page of this syllabus, which does not require, nor should incur, any emails/request for appointment to assist.

When Seeking Assistance

Please bring preliminary attempts at prototypes to lab instructors or the professor, so that we can assist you quickly. Students must be capable *to explain any aspect in their design/solution* to avoid plagiarism concerns.

Accessibility Statement

UCF is committed to reasonable accommodations for all persons. Students requesting accommodations must register with Student Accessibility Services, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116.

Copyright Notice

This course provides copyrighted materials created by the Professor such as audio or video, images, text, etc. Items from the public domain used within Fair Use doctrine allowed for educational purposes. Course materials are authorized for your own use only and distribution/posting are prohibited.

– Quiz/Exam Delivery –

Location: Exams and quizzes occur in the *Evaluation and Proficiency Center (EPC)* located on the second floor of the Engineering Building 2 (ENG2) Room 201. It provides a quiet, uniform, and convenient environment for assessments and post-test score rebuttal.

Scheduling: A Testing Window period is allotted for each quiz/exam. Each student is *required to schedule an appointment* in advance to take the quiz/exam as described at: <https://www.cecs.ucf.edu/epc/> **NOTE: Walk-ins are not accommodated.**

The EPC does not remain open after its stated closing time regardless of the time which one begins taking a test. Regardless of the cause and regardless of who is at fault, **if you do not have a submission before the Testing Window period closes, then you shall receive a score of zero for that test.**

Identification: Each student is required to present their valid UCF ID Card to enter and exit the EPC.

Materials and Aides: Only materials which are explicitly authorized for quizzes/exams shall be used. Authorized materials are pencils, pens, erasers, an instructor-supplied “Testing Reference Sheet” provided automatically within the testing software interface which opens in a new browser tab, and an authorized calculator. **Texas Instruments calculators are provided free of charge for use in the room.** These are non-programmable non-graphing calculators that lack hexadecimal and binary capabilities. Disposable earplugs are available upon request.

All quizzes and exams, including the final exam, utilize a **Closed Book** and **Closed Notes** format without the use of a student-prepared formula sheet. However, an instructor-supplied “Testing Reference Sheet” is provided electronically and automatically for each quiz/exam. Blank paper worksheets will be provided by the EPC which are scanned-in upon conclusion of the test. It is necessary to indicate your final answer to each question in Webcourses, whereas such constitutes your final answer and only final answers can be substantiated for credit.

Approval Reason For Absence (ARFA) constituting possible exception to Submission Requirements:

To be fair to all students, the **only** exceptions to Quiz / Exam / Lab Submission requirements are:

ARFA #1: Students *timely supplying a medical doctor’s notification* regarding health-related absence consideration. *COVID-related concerns* require student’s statement of COVID-19 test outcome which will follow CDC guidelines, while all other medical concerns besides COVID-19 must have medical doctor’s note listing specific dates of suggested absence at the time which the initial request is made.

ARFA #2: Students *timely supplying official documentation from funeral home when attending in-person a funeral of a close family member.* For out-of-town travel, attach for airfare, gas/charging, and hotel to substantiate dates of travel at the time the request is made.

ARFA #3: Students *already* having paperwork for an approved absence to attend an *official U.S. government (military, jury duty, immigration, court appearance)* wherein appearance is governed by law.

ARFA #4: Students *already* having pre-existing paperwork for *an official UCF university-level sanctioned event* according to UCF Policy 4.401.2 (<https://policies.ucf.edu/documents/4-401.pdf> and <https://osrr.sdes.ucf.edu/wp-content/uploads/sites/45/2018/11/Program-Verification-Form.pdf>) such as varsity athletics or other *UCF-endorsable academic activity (e.g. attending a Professional Conference, Academic Competition, etc.)* including documentation of the event and travel dates submitted at time of initial request.

ARFA #5: Students *already* having pre-existing paperwork for an approved absence due to UCF-announced *health closure, dorm/housing closure, or other campus emergency closure or Regulation 5.020* (<https://regulations.ucf.edu/chapter5/documents/5.020ReligiousObservancesFINALJan19.pdf>).

Regardless of cause or urgency, any other events such as outside responsibilities, employment commitments, internship responsibilities, job interviews, job fairs, mechanical failures, traffic, parking, and other reasons are ineligible for exception, in order to maintain fairness to all students.

– Feedback on Performance –

Feedback on Performance: Submissions are graded quickly and returned for the next class meeting. Individual scores will be posting in Webcourses upon the closing of the testing window. *Feedback on Performance* will be provided for every assessment. This includes *Course High Score*, *Course Low Score*, *Course Mean*, and a *Histogram Distribution* of performance.

Post-Testing Rebuttal for all except Quiz 3 and Final Exam: Students who check-in using UCF Here for at least 67% of the instances used during on campus in-class lectures are afforded an opportunity to review their computerized *Pre-Scores* to receive personalized *Feedback on Performance*. To be eligible:

1) Install the UCF Here app from Apple app store or Andriod app store.

2) Check-in using UCF Here whenever the QR code is displayed during lecture.

3) Those who checked in at least 67% of those instances may make an appointment within 2 weeks following the close of testing window with the Assistant listed in the table on the first page of this syllabus. Simply enter your FIRST AND LAST NAME into the time slot (up to 2 adjacent 15-min appointments can be booked)

2) visit the Assistant only upon receiving an e-mail confirm your appointment time. They will have access to your quiz submission and scanned scratch sheets to review with you.

All requests for rebuttal of questions on exams, quizzes, and projects shall be originated in-person with the Assistants during that two-week Score Clarification period. The Assistants will resolve your concern immediately to adjust the grade which the student can rebut on *up to 3 numbered questions* per each exam or *1 numbered question per quiz*. If the concern is not resolved to your satisfaction, then please meet the Professor **after** discussing it with the Assistants who will send an email to the Professor with details. The Professor can assist everyone enrolled more fully to provide detailed help for learning, as well additional guidance, by everyone maintaining this flow to see Assistant first.

Quiz 3 Score Rebuttal: is offered for 1 week duration due to end of semester timing constraints.

Final Exam Score Rebuttal:

Final Course Letter Grades (and course point totals, including Final Exam score) will be posted in Webcourses as soon as they are computed. An extra privilege of one-on-one review of Final Exam scores is afforded to those who are eligible, i.e total during semester of UCFhere $\geq 67\%$. This is conducted in-person with the Professor **only** during the day/time/place listed on the Course Milestone page of this syllabus. Any student not attending this Grade Clarification session forfeits the opportunity to rebut/clarify/change the Final Exam score and/or Course Letter grade calculation.

All course Component Scores and all Course Letter Grades become **frozen at the conclusion of the Course Grade clarification session**. Requests for treatment otherwise, e.g. via email or via Webcourses, are unprofessional and cannot receive a reply to due to FERPA laws.

– Procedures to Assist Learning –

Webcourses and Knights E-mail

Each student is expected login regularly to **webcourses.ucf.edu** to view *Announcements*, obtain *Lecture Slides*, *Study Sets*, *Videos*, and view *Feedback on Performance*, as well upload designated submissions before the due date. Use of **knights.ucf.edu** e-mail is required per UCF policy. **Please do not use the Webcourses mailer to contact the Professor / GTAs / Graders / ULAs: the Webcourses mailer is non-compliant with archiving and staff support forwarding/reply needs, and hence only knights.ucf.edu email shall be used.**

Group Sessions

We will start each class on time and manage class time extremely well. Class flow will begin with a *brief summary recap* for orientation within the course as a whole, identification of the current day's *learning objective*, presentation of *lecture slides which should be annotated by each student* either electronically or hardcopy as preferred. Highlighting of the long-term “take-away” concepts from the lecture material and any related *job-recruiting tips* will be emphasized throughout.

Question and Answer during class

A *Socratic environment that helps learning* will be promoted as per http://en.wikipedia.org/wiki/Socratic_questioning So if you have a question then please ask during the Group Sessions. If you do then others can benefit too. Current topic For-Your-Info (FYI) for job interviews, etc. will be posted as Webcourses *Announcements* to maximize learning for all students.

Elements to Help Students Achieve Course Objectives:

- 1) *Organization of many helpful materials*
 - Course content has been well-organized:
 - Slides, Videos, Animations, Web resources, Study Sets, and Software tools.
 - Latest contemporary technologies/techniques will be discussed.
 - Materials/resources provided by the university to all students may be accessed via <http://library.ucf.edu> and <https://cdl.ucf.edu/support/student/>
 - Precise textbook pages covered and course milestone dates identified on first day of class
- 2) *Communicating Ideas and Info*
 - All concepts and learning requirements in Lecture.
 - Small group and individual learning occur each week.
 - Webcourses updated and emails replied promptly.
- 3) *Environment that helps learning*
 - Custom and adapted Lecture Slides provided ahead of time.
 - Stimulation of Interest using current topics.
 - Feedback on performance for each assessment/evaluation.
- 4) *Respect and Concern*
 - Welcome to assist during office hours: office hours (for help with course topics),
 - open tutoring with ULAs (for pre-test preparation, post-test review, open tutoring)
 - Grading rubrics with point values identified in advance for Expectations of Performance.
 - Fairness in applying evaluations

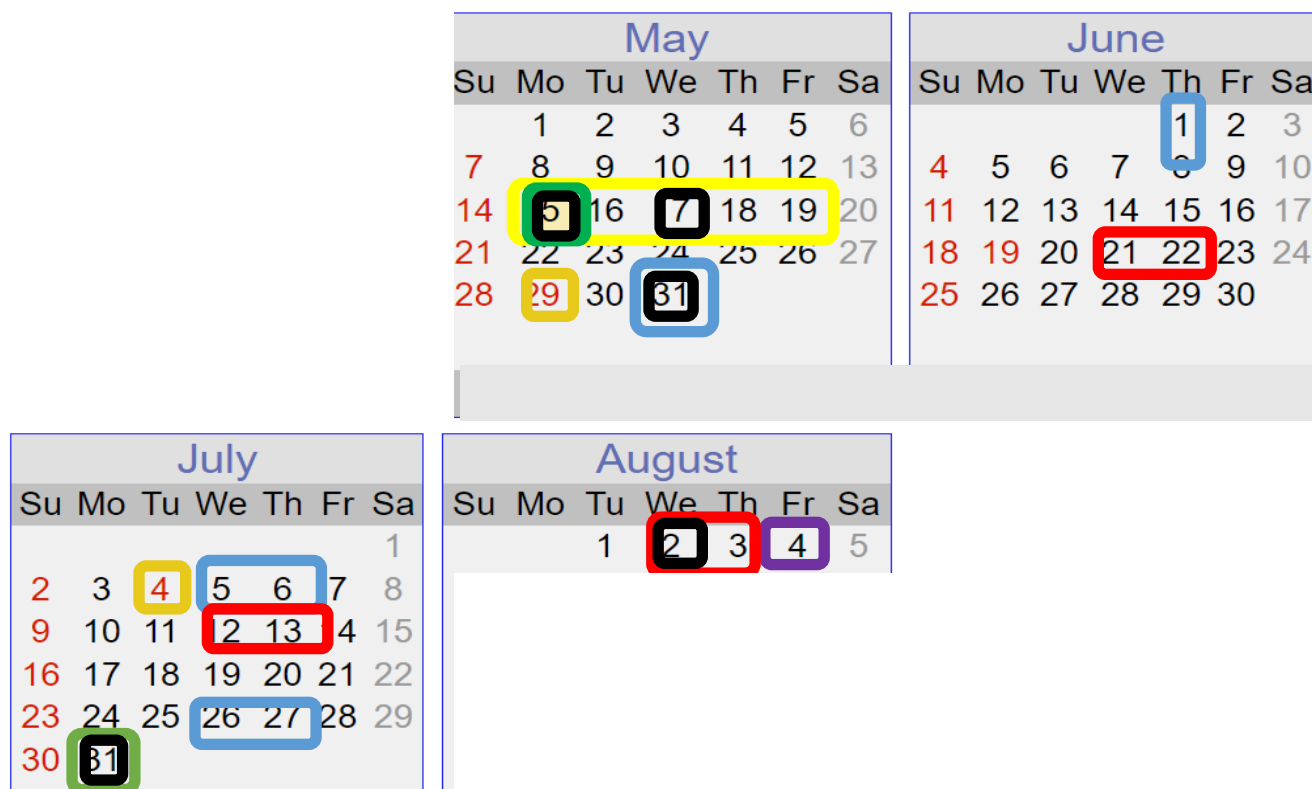
Financial Aid Participation:

Professors are required to document students' academic activity at the beginning of each course. In order to document that a student began this course, please complete the required Financial Aid Quiz as listed in the Course Milestone page of this syllabus. Failure to do so may result in a delay or loss in the disbursement of your financial aid according to Federal regulations. This activity is completed only in the EPC for official tracking and cannot be done in person nor via office hours.

– Course Milestones –

NOTE: Any revisions posted in Webcourses Announcements will prevail as official amendments.

Financial Aid Participation	Completed in EPC during {Mon. 15 May 2023 → Fri. 19 May 2023} 0:10 hr:min duration
First Class Meeting	First meeting is class on Mon. 15 May 2023 with NO LABS during first week of classes
Memorial Day Closures	NO CLASS/LAB on Mon. 29 May 2023 and NO LABS that whole week keep synchronized
Quiz 1 Window	Completed in EPC during {Wed. 31 May 2023 → Thur. 1 Jun. 2023} 0:50 hr:min duration
Midterm Exam 1 Window	Completed in EPC during {Wed. 21 Jun. 2023 → Thur. 22 Jun. 2023} 2:00 hr:min
Independence Day	No impact on this course
Quiz 2 Window	Completed in EPC during {Wed. 5 Jul. 2023 → Thur. 6 Jul. 2023} 0:50 hr:min duration
Midterm Exam 2 Window	Completed in EPC during {Wed. 12 Jul. 2023 → Thur. 13 Jul. 2023} 2:00 hr:min duration
Quiz 3 Window	Completed in EPC during {Wed. 26 Jul. 2023 → Thur. 27 Jul. 2023} 0:50 hr:min duration
Last Class Mtg	Last meeting is Mon. 31 July, 2023 and NO LABS that whole week keep synchronized due to final exam period during last week of class during summer semester
Final Exam Window	Completed in EPC during {Wed. Aug. 2, 2023 – Thur. Aug. 3, 2023} with a 2:50 hr:min duration due to registrar's policy: final exam period during last week of class during summer
Grade Clarification Day	Grade Clarification Fri. Aug. 4, 2023 from 1:00noon-3:00PM only in EPC



- **Green** = First and Last Class meetings for this course
- **Yellow** = Financial Aid Quiz Window in EPC
- **Black** = No lab that day
- **Blue** = Quiz Testing Window in EPC
- **Red** = Exam Testing Window in EPC
- **Gold** = Holiday/No lab/No class
- **Purple** = Grade Clarification Day in EPC

– Weekly Schedule –

Legend

“Prior to Class” at your pace w/ tutoring assistance	<p>→ View lectures via Webcourses videos at any time & place: YouTube playlist: https://tinyurl.com/EEL3801-videos</p> <p>→ Conduct the Module components as organized</p> <p>→ Personalized assistance available:</p> <ul style="list-style-type: none"> ▪ Professor Office Hours, GTA Office Hours, Undergrad. Assistant Tutoring ▪ Please see table on Page 1 of this Syllabus for days/times of assistance multiple days each week
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Tasks & Events

Week	Starting	Assignments	Submission Required
1	Monday 5/15	1. No Labs in EEL3801 this week – ECE policy during 1 st week of classes 2. Download <i>Quickstart</i> via link on Webcourse homepage – prior to class 3. Conduct <i>Module 1</i> activities on MODULES button in Webcourses: -View <i>Module 1ab Videos</i> (links provided in Module 1 in Webcourses) & -Attempt <i>Study Set 1</i> in Quickstart files (Study Sets are not collected) 4. Prerequisite Quiz for Financial Aid {M → F} in EPC (required even if you are NOT a recipient of financial aid) 5. Attend Class for Course Overview and start of Module 1 content	1. N 2. N 3. N 4. Y 5. N
1 (cont)	Wed. 5/17	1. View Module 2ab Videos – prior to class 2. Complete Study Set 1 and 2 – prior to class 3. Attend Class for Module 1&2 Group Session	1. N 2. N 3. N
2	Monday 5/22	1. View Module 3ab Videos – prior to class (slides 1-25 only) 2. Complete Study Set 3ab – prior to class (pages 2,3,6, and 7 only) 3. Attend Class for Module 3ab Group Session	1. N 2. N 3. N
3	Monday 5/29	1. Quiz 1: Modules 1 & 2 from {W → Th} in EPC 2. View Module 3cd Videos (slides 26-end) 3. Complete Study Set 3cd Material (remaining pages) 4. Attend Class for Module 3cd Group Session	1. Y 2. N 3. N 4. N
4	Monday 6/5	1. View Module 4abc Videos – prior to class 2. Complete Study Set 4 Material – prior to class 3. Attend Class for Module 4 Group Session	1. N 2. N 3. N
5	Monday 6/12	1. View Module 5 Video – prior to class 2. Complete Study Set 5 – prior to class 3. Attend Class for Module 5 Group Session	1. N 2. N 3. N

Week	Starting	Assignments	Submission Required
6	Monday 6/19	1. Midterm Exam 1: Modules 1,2,3, and 4 from {W → Th} in EPC 2. View Module 6ab Videos – prior to class (covers slides 1-35 only) 3. Complete Study Set 6ab – prior to class (pages 1-7 only) 4. Attend Class for Module 6ab Group Session	1. Y 2. N 3. N 4. N
7	Monday 6/26	1. View Module 6cd Videos – prior to class (slides 36-end) 2. Complete Study Set 6cd – prior to class (pages 8 onward) 3. Attend Class for Module 6cd Group Session	1. N 2. N 3. N
8	Wed 7/5	1. Quiz 2: Modules 5&6 from {W → Th} in EPC 2. View Module 8abc Videos (NOTE: there is <u>no</u> Module 7 coverage: procedure calls are moved to the embedded systems course, so no worries that Module 7 is skipped) 3. Complete Study Set 8 – prior to class 4. Attend Class for Module 8 Group Session	1. Y 2. N 3. N 4. N
9	Monday 7/10	1. Midterm Exam 2: Modules 5,6, and 8 from {W → Th} in EPC 2. View Module 9ab Videos (up to video & slide 1-13, i.e. thirteen) 3. Complete Study Set 9ab – prior to class (pages 1-9 only) 4. Attend Class for Module 9ab Group Session	1. Y 2. N 3. N 4. N
10	Monday 7/17	1. View Module 9cd Videos – prior to class (slides 13-end) 2. Complete Study Set 9cd Material (pages 10 onward) 3. Attend Class for Module 9cd Group Session	2. N 3. N 4. N
11	Monday 7/24	1. Quiz 3: Modules 9&10 from {W → Th} in EPC 2. View Module 10ab Videos – prior to class 3. Complete Study Set 10 Material – prior to class 4. Attend Class for Module 10 Group Session	1. Y 2. N 3. N 4. N
12	Monday 7/31	1. No Labs this week & Final Examination period begins 2. View Module 11ab Videos – prior to class (slide 1-29) 3. Complete Study Set 11ab – prior to class (pages 1-6 only) 4. Attend Class for Module 11ab Group Session 5. Final Exam: Modules (1-6 & 9-11) from {W→Th} in EPC (Monday 8/1 is last day of office hours due to Final Exam period) 6. Optional Grade Clarification conducted on Friday 8/5/2023 only from 12:00noon-4:00PM in EPC (Final Exam Score & Project 2 Only)	1. N 2. N 3. N 4. N 5. Y 6. N

Evaluation and Proficiency Center

Syllabus Insert Summary regarding Policy and Procedures

<https://www.cecs.ucf.edu/epc/>

This document summarizes the operation, policies, and procedures of the Evaluation and Proficiency Center (EPC) as condensed to a concise syllabus insert. Complete information is available from the EPC Manager listed at <https://www.cecs.ucf.edu/epc/>

Students shall review and comply with the following information regarding the EPC:

- ◆ **Appointments**: An appointment is **required** to take a quiz/exam in the EPC. To schedule an appointment, please visit the EPC website <https://www.cecs.ucf.edu/epc/>
- ◆ **Check-in/out Procedures**: **A valid UCF Student ID card is required to gain entrance to the EPC.** Your UCF ID will be swiped by the EPC staff to electronically access your photo of record to authenticate your access to the EPC. Your UCF ID card shall be scanned again when checking out of the EPC.
- ◆ **Reporting of Concerns**: Students who encounter an issue with any equipment or software in the EPC shall report the problem to an EPC staff member immediately to obtain assistance. Do not attempt to fix the problem on your own. Whereas tests have time limits, reporting a technical problem as quickly as possible will minimize the time required for you to get back online and complete the test.
- ◆ **Hours of Operation**: Operating hours are posted at the EPC website. The EPC is closed during campus holidays, applicable football game intervals, and during periods of emergency closure. **Students are required to vacate the EPC at its stated closing time, regardless of their appointment time or their arrival time.**
- ◆ **Acceptable Use**: Students shall utilize the EPC's resources in accordance with the *Use of Information Technology and Resources Policy* posted at the <http://policies.ucf.edu/> website. Computer workstations shall not be turned off, moved, unplugged, or modified with respect to their hardware, software, or network characteristics. Moreover, devices having a USB port are prohibited within the testing area. When departing the testing area, each student should return their station to its initial operating condition.

◆ Only Authorized Materials are allowed in the Testing Room of the EPC:

Some lockers having electronic locks are provided to stow all materials which have not been authorized for use during testing. The lockers can accommodate a modest number of books, bags, laptops/tablets, cell phones, and programmable calculators. The EPC is not responsible for lost or stolen items. Blank worksheets are provided by the EPC.

Authorized materials are identified in the course syllabus and/or Webcourses. In particular, **cell phones are not allowed in the room. Enforcement includes that a video of the suspected incident shall be submitted to the UCF Office of Student Conduct, along with a description of the events which transpired including:**

- If a student is caught with a cell phone out of their pockets in the EPC, and/or
- If a cell phone rings, vibrate, dings, etc.

at which time that student shall be escorted from the testing center and their exam submitted as-is pending an investigation by the UCF Office of Student Conduct.

◆ Recording devices are prohibited: Video recording and/or audio recording devices of any type are prohibited within the EPC testing room and proficiency room. Use and/or possession of a device with recording capability is a violation that will be referred to the UCF Office of Student Conduct.

◆ Suspected Incidents of Academic Dishonesty: Suspected incidents of academic dishonesty are documented utilizing, but not limited to, statements from EPC staff, digital camera recordings, network data, Webcourses data, and screen captures. **All incidents of suspected academic dishonesty are forwarded by the EPC Manager to the UCF Office of Student Conduct for action and resolution.**

Notice: The EPC and its equipment are electronically monitored/recorded/archived, including video surveillance.

◆ Leaving the EPC: Once a student is seated for an exam, he or she is not expected to move from that location for the duration of the exam. Should an emergency occur in which a student must leave the exam, he or she will be accompanied by a proctor or workstudy if he or she wishes to return to the exam.

◆ Lost and Found Items: The EPC is not responsible for lost items or data. Any items found by the staff will be placed at the front desk of the EPC for the remainder of the day they are found and in the CECS Academic Affairs Office in Engineering Building 1 room 107 beginning the next day. It is recommended that students do not bring valuables with them when visiting the EPC..

EEL3801 Testing Reference Sheet

MIPS Instruction Formats

op	rs	rt	rd	shamt	funct
op	rs	rt	immediate		
op	jump target				

R format

I format

J format

Field	Width
op	6-bits
rs	5-bits
rt	5-bits
rd	5-bits
shamt	5-bits
funct	6-bits

Register Encoding:

\$t0 - \$t7 = register number 8 – 15
 \$t8 - \$t9 = register number 24 – 25
 \$s0 - \$s7 = register number 16 – 23
 \$v0 - \$v1 = register number 2 – 3
 \$a0 - \$a3 = register number 4 – 7
 \$sp = register number 29
 \$fp = register number 30
 \$ra = register number 31

	Opcode	Funct		Opcode	Funct
add	0x00	0x20	nor	0x00	0x27
addi	0x08	NA	xor	0x00	0x26
addiu	0x09	NA	or	0x00	0x25
addu	0x00	0x21	ori	0x0D	NA
and	0x00	0x24	sb	0x28	NA
andi	0x0C	NA	sll	0x00	0x2A
beq	0x04	NA	slti	0x0A	NA
bne	0x05	NA	sltiu	0x0B	NA
lw	0x23	NA	slltu	0x00	0x2B
lbu	0x24	NA	sll	0x00	0x00
lb	0x20	NA	sw	0x2B	NA
j	0x02	NA	srl	0x00	0x02
jal	0x03	NA	sra	0x00	0x03
jr	0x00	0x08	sub	0x00	0x22

ASCII Value	Character	ASCII Value	Character	ASCII Value	Character
32	(space)	64	@	96	`
33	!	65	A	97	a
34	"	66	B	98	b
35	#	67	C	99	c
36	\$	68	D	100	d
37	%	69	E	101	e
38	&	70	F	102	f
39	'	71	G	103	g
40	(	72	H	104	h
41	)	73	I	105	i
42	*	74	J	106	j
43	+	75	K	107	k
44	,	76	L	108	l
45	-	77	M	109	m
46	.	78	N	110	n
47	/	79	O	111	o
48	0	80	P	112	p
49	1	81	Q	113	q
50	2	82	R	114	r
51	3	83	S	115	s
52	4	84	T	116	t
53	5	85	U	117	u
54	6	86	V	118	v
55	7	87	W	119	w
56	8	88	X	120	x
57	9	89	Y	121	y
58	:	90	Z	122	z
59	;	91	[	123	{
60	<	92	\	124	|
61	=	93	]	125	}
62	>	94	^	126	~
63	?	95	_	127	o

Syscall - Available Services

Service	\$v0	Arguments
print integer	1	\$a0 = integer to print
print string	4	\$a0 = address of null-terminated string
read integer	5	\$v0 = integer read
read string	8	\$a0=address \$a1= max chars
exit	10	none
print binary	35	\$a0 = integer to print

Metrics

"rate at which work is done" → **Throughput** = $\frac{[\text{Number of Outputs Produced}]}{[\text{Time Interval}]}$ } operations/second
 "what the user sees" → **Response Time** = $[\text{CPU Time}] + [\text{Memory Time}] + [\text{Disk Time}] + [\text{Network Time}]$ } seconds
 "processor time" → **Execution Time** = $[\text{CPU Time}]$
 "transfer delay" → **Latency** = $[\text{Transmission Delay}] = [\text{Data Transfer Time or Bit "Fly Time"}]$

$$\text{Cost Effectiveness} = \frac{\text{Cost}}{\text{Performance Metric}} = \frac{\text{Cost}}{\text{Throughput}} \quad \text{Performance} \propto \frac{1}{\text{Execution Time}}$$

Execution Time

$$\frac{\text{Performance}_x}{\text{Performance}_y} = \frac{\text{Execution time}_y}{\text{Execution time}_x} = n \quad \text{where } n \text{ yields an } n\text{-fold increase in speed}$$

$$[\text{CPU Time}] = [\text{Clocks}] \times [\text{Period}] \quad \text{Effective CPI} = \sum_{i=1}^n (\text{CPI}_i \times \text{Proportion}_i)$$

$$[\text{Clocks}] = [\text{Instruction Count}] \times \text{CPI}$$

$$[\text{CPU Time}] = [\text{Instruction Count}] \times \text{CPI} \times [\text{Cycle Time}]$$

Instruction Rates

$$\text{MIPS} = [\text{Instruction Count}] / ([\text{Clock Period}] \times 10^6) = F / (\text{CPI} \times 10^6)$$

$$\text{MFLOPS} = [\text{number of floating-point operations}] / [\text{execution time} \times 10^6]$$

Benchmarking

$$\frac{\text{SPECRatio}_A}{\text{SPECRatio}_B} = \frac{\frac{\text{Execution time}_{\text{reference}}}{\text{Execution time}_A}}{\frac{\text{Execution time}_{\text{reference}}}{\text{Execution time}_B}} = \frac{\text{Execution time}_B}{\text{Execution time}_A} = \frac{\text{Performance}_A}{\text{Performance}_B} \quad \text{Geometric mean} = \sqrt[n]{\prod_{i=1}^n \text{sample}_i}$$

Amdahl's Law

$$\text{Speedup}_{\text{overall}} = \frac{\text{Execution time}_{\text{old}}}{\text{Execution time}_{\text{new}}} = \frac{1}{(1 - \text{Fraction}_{\text{enhanced}}) + \frac{\text{Fraction}_{\text{enhanced}}}{\text{Speedup}_{\text{enhanced}}}}$$

$$\text{Speedup} = \frac{\text{time to execute program on a single processor}}{\text{time to execute program on } N \text{ parallel processors}} = \frac{T(1-f) + Tf}{T(1-f) + \frac{Tf}{N}} = \frac{1}{(1-f) + \frac{f}{N}}$$

$$T_{\text{Improved}} = \frac{T_{\text{affected}}}{\text{improvement factor}} + T_{\text{unaffected}}$$

Example Instruction Encodings

Name	Format	Example						Comments
add	R	0	18	19	17	0	32	add \$s1,\$s2,\$s3
sub	R	0	18	19	17	0	34	sub \$s1,\$s2,\$s3
lw	I	35	18	17	100			lw \$s1,100(\$s2)
sw	I	43	18	17	100			sw \$s1,100(\$s2)
and	R	0	18	19	17	0	36	and \$s1,\$s2,\$s3
or	R	0	18	19	17	0	37	or \$s1,\$s2,\$s3
nor	R	0	18	19	17	0	39	nor \$s1,\$s2,\$s3
andl	I	12	18	17	100			andl \$s1,\$s2,100
orl	I	13	18	17	100			orl \$s1,\$s2,100
sll	R	0	0	18	17	10	0	sll \$s1,\$s2,10
srl	R	0	0	18	17	10	2	srl \$s1,\$s2,10
beq	I	4	17	18	25			beq \$s1,\$s2,100
bne	I	5	17	18	25			bne \$s1,\$s2,100
slt	R	0	18	19	17	0	42	slt \$s1,\$s2,\$s3
j	J	2	2500					j 10000 (see Section 2.9)
jr	R	0	31	0	0	0	8	jr \$ra
jal	J	3	2500					jal 10000 (see Section 2.9)
Field size		6 bits	5 bits	5 bits	5 bits	5 bits	6 bits	All MIPS instructions 32 bits
R-format	R	op	rs	rt	rd	shamt	funct	Arithmetic instruction format
I-format	I	op	rs	rt	address			Data transfer, branch format

Device Technology

$$[\text{Dies on a Wafer}] \approx [\text{Wafer Area}] / [\text{Die Area}]$$

$$[\text{Yield}] = \frac{1}{(1 + \{0.5 \times [\text{Defect Density}] \times [\text{Die Area}]\})^2}$$

$$[\text{Die Fabrication Cost}] = \frac{[\text{Photolithography Cost}]}{[\text{Dies on a Wafer}] \times [\text{Yield}]}$$

← number of working dies

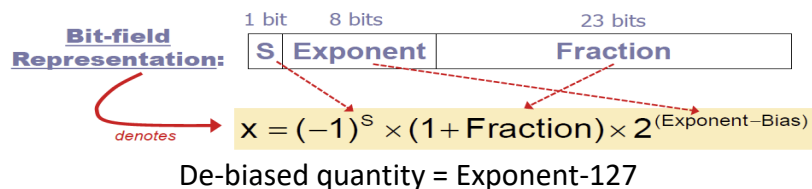
$$[\text{Power}] = [\text{Capacitance}] \times [\text{Voltage}]^2 \times [\text{Frequency}]$$

$$[\text{Energy}] = [\text{Power}] \times [\text{Running Time}]$$

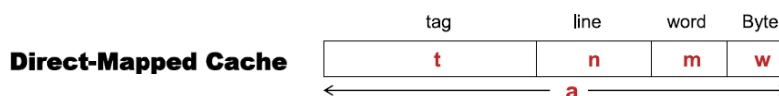
ALU Design and Floating-Point

$$T_{\text{mult right-shift-and-add}} = w * [T_{\text{add}} + T_{\text{load}} + T_{\text{shift}}] \quad T_{\text{mult AND-array-binary-tree}} = 1 + w$$

$$\text{Watt} = \text{Volt} * \text{Amp} \quad \text{Watt} = \text{Joule} / \text{sec}$$



Main Memory and Cache



$$\text{Wires} = A + D + C$$

$$h = 1 - m$$

$$\# \text{ bits per line cache} = \# \text{v bits} + \# \text{ tag bits} + \# \text{data word bits} = 2^n * [(2^{(m+5)} + a - n - m - 1)]$$

$$\text{AMAT} = \text{Hit time} + \text{Miss rate} \times \text{Miss penalty}$$