**Microprocessors**

1. **Course number and name**: ECE 344L Microprocessors
2. **Credits and contact hours**: 4 Credit Hours
3. **Instructor’s name**: Dr. Edward Nava
4. **Additional information:**
   1. Office Location: ECE 225C
   2. Office Hours: MW 1:00 – 2:30 pm
   3. Class Meeting Day(s): Tuesdays and Thursdays
   4. Class Location / Room: Dane Smith Hall 129
   5. Email: ejnava@unm.edu
   6. Office Phone: 277-0809
   7. Teaching Assistants: Connor Halsey, chalsey@unm**.**edu

Sajay Paruthiyil, sajayparuthiyil@unm.edu

* 1. Class Time: 12:30 – 1:45 pm
  2. Lab Time: TA Schedule posted on Learn and in the lab
  3. Term / Semester: Spring 2020
  4. Final Exam date: Thursday, May 14, 2020

1. **Specific course information**
   1. brief description of the content of the course (catalog description)

This course builds on the concepts of the digital logic design and instrumentation courses. Now the students will learn about computers and microprocessor-based system design. Specifically, they will learn about: architecture, assembly language programming, implementing input/output functions, and using interrupts to implement multiple program execution flows. They will gain hands-on experience developing software for execution on hardware, using development boards, in multiple lab exercises.

* 1. prerequisites or co-requisites

ECE 206L – Instrumentation

ECE238 – Computer Logic Design

ECE321L – Electronics I

1. **Course Goals**
   1. **Knowledge** -

Students will know the basic principles of how to program microcontrollers and interface them to external components to implement functional systems.

* 1. **Skill** –

Students will be able to develop both assembly and higher level language software for microcontrollers.

Students will be use laboratory instruments to monitor interface signals to ensure proper operation.

1. **Specific learning outcomes for the course** [1-7 criteria as required by ABET]

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

3. an ability to communicate effectively with a range of audiences.

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

1. **Text book, title, author, and year:** “MIPS Assembly Language Programming”, by Robert L. Britton.

Recommend Supplement: “Programming 32-Bit Microcontrollers in C, Exploring the PIC32”, by Lucio Di Jasio.

* 1. other supplemental materials
* Cerebott MX7™ Board Reference Manual
* MPLAB® Assembler, Linker and Utilities for PIC32 MCUs User’s Guide
* MPLAB® IDE User’s Guide with MPLAB Editor and MPLAB SIM Simulator
* MIPS® Architecture For Programmers Volume II-A: The MIPS32® Instruction Set
* PIC32MX3XX/4XX Data Sheet

**Text**: The text books that we use do not cover all of the details that you will need to learn in this class. The nature of this topic requires that you refer extensively to product reference manuals for much of the information you need. We will discuss many of these details in the lectures. This means that you need to take good notes during the lectures, and ask questions, as necessary.  *If you are uncertain about something presented in class or needed for a laboratory, be sure to make use of the office hours and the course teaching assistant.*

On the learn web-site for the class, there are materials extracted from Internet sources, plus some that have been created specifically for this class. These materials will be useful for both laboratory and course work. Handouts will be made available from time to time to give specific information about a topic.

**Computer information:** you will use your UNM NETid account for the laboratory computer systems; we will be using software that runs on these machines in order to create and debug software. You will be expected to create both assembly language and other routines on the departmental machines, then download this information to the trainer boards in the laboratory. More information on this procedure will be available at a later date.

1. **Course Requirements**

This is a laboratory oriented class. In addition to tests and quizzes, you will have laboratory assignments that are designed to apply the concepts that are covered in the lectures.

This is a four credit-hour course. Class meets for two 75-minute sessions of direct instruction for fifteen weeks during the Fall 2019 semester. Students are expected to complete a three-hour laboratory assignment and a minimum of six hours of out-of-class work (or homework, study, assignment completion, and class preparation) each week.

**Laboratory:** The laboratory for ECE 344L is located in ECE 129. Laboratory work will begin during the second week of classes. This work involves writing, testing, and documenting routines for the MIPS systems in the laboratory, demonstrating the results to the laboratory assistant, and answering questions about the material and activity. Students are required to check out their laboratory assignment with a teaching assistant when completed. In order for a student to receive “partial” credit, he/she should be able to demonstrate partial results, and answer pertinent questions for a laboratory assistant. For each lab, you will generate a lab report **that follows the format prescribed by the document posted on Learn. Your lab report grade will be lowered if you do not follow the format.**

Most laboratory assignments will be done on an individual basis. The last lab assignment(s) will be done on a team basis, as indicated on the assignment sheet.

**Lab Report Submission:** Lab reports will be turned in per the directions provided when the assignment is issued. Late submissions will generally not be accepted unless prior arrangements have been made. In rare, extenuating circumstances, where prior arrangements have not been made, contact me and I will try and work out an accommodation, if appropriate. In general, I encourage you to start work on the lab assignments early.

**Attendance and Class Participation Policy:** Regular and punctual attendance is required. UNM Pathfinder policies apply, which in part means instructor drops based on non-attendance are possible. This policy applies regardless of the grading option you have chosen. You are also expected to be actively engaged in the class.

**Cell Phones, Laptops, and Other Devices:** As a matter of courtesy, please turn off cell phones, and other devices prior to the beginning of class. Notify me in advance if you are monitoring an emergency, for which cell phone ringers should be switched to vibrate.

**Grading:**

|  |  |
| --- | --- |
| **Items** | **Final Grade Weighting** |
| Quizzes, Attendance, & Participation | 5% |
| Mid Term Exams (2) | 30% |
| Laboratory Assignments | 55% |
| Final Exam | 10% |

List of topics covered

|  |  |  |
| --- | --- | --- |
| **Topic** | | **Date** |
| Overview of computer systems | Processor Systems (Macro) | Week 1 |
| Microprocessors & microcontrollers |  |
| Operating system information |  |
| Information Representation | Integer number systems | Week 2 |
| Floating point number systems |  |
| Other coding methodologies |  |
| Doing arithmetic on MIPS/PIC32 |  |
| Instruction sets & architecture | Role of instruction set in processor | Week 2, 3 |
| Hardware/software tradeoffs |  |
| Types of instructions |  |
| Placement of operands |  |
| Coding of instructions | Week 4 - 6 |
| Addressing modes |  |
| Memory systems & organization | Models of memory | Week 4 |
| Systems of memory |  |
| Technologies of memory |  |
| Hierarchy of memories |  |
| PIC 32 Microcontroller | PIC 32 Architecture and MIPS core | Week 6 - 8 |
| Using PIC 32 peripheral components |  |
|  | **Exam** | Week 8 |
| Interrupts/exceptions | Purposes and procedures | Week 9 - 11 |
| Real time activities |  |
| Processor behavior |  |
| Interrupt service routines |  |
| I/O methods | Programmed I/O | Week 13 - 15 |
| Interrupt driven I/O |  |
| Serial and Parallel I/O |  |
| Busing concepts |  |
|  | **Exam** | Week 13 |
| I/O methods | Analog I/O | Week 15 - 16 |
| Pulse width modulation |  |
| Servo motor control |  |
| Stepper motor control |  |

The Schedule of Activities is subject to change. Minor changes will be announced in class, major ones provided in writing.

1. **Accommodation Statement:** Accessibility Services (Mesa Vista Hall 2021, 277-3506) provides academic support to students who have disabilities. If you think you need alternative accessible formats for undertaking and completing coursework, you should contact this service right away to assure your needs are met in a timely manner. If you need local assistance in contacting Accessibility Services, see the Bachelor and Graduate Programs office.
2. **Academic Integrity:** The University of New Mexico believes that academic honesty is a foundation principle for personal and academic development. All University policies regarding academic honesty apply to this course. Academic dishonesty includes, but is not limited to, cheating or copying, plagiarism (claiming credit for the words or works of another from any type of source such as print, Internet or electronic database, or failing to cite the source), fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. The University's full statement on academic honesty and the consequences for failure to comply is available in the college catalog and in the Pathfinder.
3. **Title IX Statement:** In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered “responsible employees” by the Department of Education (see pg 15 -http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404–title-ix.pdf). This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). For more information on the campus policy regarding sexual misconduct, see: https://policy.unm.edu/university-policies/2000/2740.html
4. **Library and Tutorial Services:** UNM-Main campus provides many library services and some tutorial services for distance students. For library services, go to http://www.unm.edu/libraries/ to link to a specific library or to contact a librarian. For tutorial services, go to http://caps.unm.edu/online to explore UNM’s online services.
5. **UNM Copyright Policy and Law - University Counsel's Office  
   Subject to change without notice**

The unauthorized distribution of copyrighted material, including through peer-to-peer file sharing, may subject a student to criminal and civil penalties. The laws that govern copyright are not specific to any one technology. Students can violate the rights of a copyright holder using many different types of technology. Both uploading and downloading of files can pose a violation of the copyright law. Students should be cautious when obtaining any copyrighted material. As a rule of thumb, before a student receives anything for free, they should research whether that source provides material licensed by the copyright owner. A group called EDUCAUSE has a list of legal file sharing alternatives at <http://www.educause.edu/legalcontent>.

Individuals who violate copyright law by illegally uploading and downloading copyrighted files may be subject to civil penalties of between $750 and $150,000 per song. These penalties are established by federal law. In the past, pre-litigation settlements offered by copyright owners have been in the $3,000 to $4,000 and up range while juries in some jurisdictions have issued verdicts of hundreds of thousands and up. In addition, a court may, in its discretion, grant the copyright owner reasonable attorney fees. Although criminal prosecution of students for file sharing is extremely rare, federal law lays out criminal penalties for intentional copyright infringement which can include fines and jail time. In addition to potentially violating the law, unauthorized distribution or receipt of copyrighted material is a violation of University Business Policies and Procedures Manual 2500. That policy states that: “Users shall respect all copyrights including software copyrights…Use of University computing services in violation of applicable laws or University policy may result in sanctions, including withdrawal of use privilege; disciplinary action, up to and including, expulsion from the University or discharge from a position; and legal prosecution under applicable federal and/or state law.”