

**CMPS 302: COMPUTER ORGANIZATION
FALL 2023**

2017 - 2020 Catalog Data: CMPS 302. COMPUTER ORGANIZATION (Credit, 3 hours). Understanding the behavior of elementary computer hardware. Content of course deals with two-state logic, flip flops, implementation of binary arithmetic, elementary Boolean algebra, computer arithmetic, memory hierarchies, and storage, input/output, and interconnect systems. Use of assembly language programming exercises to explore and analyze microcomputer architecture. Prerequisites: CMPS 191 and CMPS 200 and admission to the department.

Credit Hours: 3
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Textbooks: The Essentials of Computer Organization and Architecture, Fifth Edition, by Linda Null and Lobur, Jones & Bartlett Learning, ISBN: 9781284123036
Computer Organization and Architecture, Designing for Performance, Tenth Edition by William Stallings, Prentice Hall Inc., ISBN 978-0-13-41061-3.

References: Digital Logic & Microprocessor Design, Second Edition by Enoch O. Hwang, Cengage Learning ISBN 978-1-305-85945-6

Supplemental Material: Quatrus II software, MARIE assembly language software.

This course addresses Program Educational Objectives, PEO 1, PEO 2, PEO 3, PEO 4
Program ABET Outcomes, Outcome 1

Target: 70% will perform at the level of performance in achieving ABET Outcomes 1.

Program Educational Objectives: The Educational Objectives of the Computer Science Program are to produce graduates who:

PEO 1: Successfully enter the competitive job market or pursue advanced study;

PEO 2: Are proficient in identifying, formulating, and solving a wide range of computing problems;

PEO 3: Are capable of working collaboratively, and communicating effectively with team members, constituents, and the public;

PEO 4: Uphold professional and ethical responsibilities, and contribute to society through active engagement.

Program ABET Outcomes: Graduates of the program will have the ability to:

Outcome 1: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions; [PEO 1, PEO 2]

Outcome 2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline; [PEO 1, PEO 3]

Outcome 3: Communicate effectively in a variety of professional contexts; [PEO 1, PEO 3]

Outcome 4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles; [PEO 1, PEO 4]

Outcome 5: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline; [PEO 1, PEO 3]

Outcome 6: Apply computer science theory and software development fundamentals to produce computing-based solutions; [PEO 1, PEO 2]

Course Objectives: Students should be able to:

Course Objective 1. Understand the fundamentals of numerical data representation and manipulation in digital computers. Master the skill of converting between various radix systems including binary, fixed-point, and floating-point representation. Understand how errors can occur in computations because of overflow and truncation. Learn about character codes, parity generator, and checking, implement CRC error detection and test it, build a Hamming code error detection and correction, and verify its performance.

Course Objective 2. Understand the relationship between Boolean logic and digital computer circuits. Analyze the behavior of logic gates and flip-flops in combinational and sequential logic applications. Utilize Boolean algebra rules and laws or the K-mapping reduction method to simplify Boolean logic circuits.

Course Objective 3. Learn how to design simple logic circuits. Understand how digital circuits work together to form complex computer systems. Design combinational and arithmetic logic circuits. Write, compile, and simulate the VHDL program to implement and test logic circuits.

Course Objective 4. Learn the components common to every modern computer system. Identify fundamental computer concepts, including the fetch-decode-execute cycle, the data path, clocks, buses, and register transfer notation. Be able to explain how each component contributes to program execution. Understand a simple architecture invented to illuminate these basic concepts, and how it relates to some real architectures. Know how the program assembly process works.

Course Objective 5. Learn operation instruction set architecture, and write an assembly code for instructions. Understand the factors involved in the instruction set architecture design. Gain familiarity with memory addressing modes. Understand the concepts of instruction-level pipelining and its effect on execution performance.

Course Objective 6. Describe the concepts of hierarchical memory organization. Recognize how each level of memory contributes to system performance, and how the performance is measured. Master the concepts behind cache memory, virtual memory, memory segmentation, paging, and address translation.

Specific goals for the course:

A. Specific outcomes of instruction:

Course Learning Outcomes [CLO]: Upon successful completion of the course, students will demonstrate the following ability:

CLO 1. Perform manipulations, conversions, and arithmetic at the machine level using various types of data including two's-complement integer, floating point, and character codes. Estimate the performance of the error-detecting and error-correcting codes and verify their output is correct. [ABET 1] [Course Objective 1]

CLO 2. Describe the function of logic gates and flip-flops. Analyze logic circuits by applying Boolean rules and laws or the K-mapping reduction method to simplify the logic circuits. Write the Boolean equation for combinational and sequential logic circuits. Utilize the K-mapping reduction method. [ABET 1] [Course Objective 2]

CLO 3. Design combinational and arithmetic logic circuits based on design requirements. Design, analyze and test the arithmetic logic units, decoders, multiplexers, registers, and memory units. Write, compile, and simulate in VHDL programming environment to implement logic circuits. Verify the function of the designed system. [ABET 1] [Course Objective 3]

CLO 4. Explain the organization of a computer, including major functional units, instruction sets, instruction formats, instruction execution, interrupts, and I/O operations. [ABET 1] [Course Objective 4]

CLO 5. Program in an assembly language and transfer these understandings to computer architecture at the instruction set level. Explain the instruction processing, assembler, and microarchitecture. Explain memory organization and computer addressing mode. [ABET 1] [Course Objective 5].

CLO 6. Outline the basic memory concepts, such as RAM and the various memory devices, and advanced concepts of the memory hierarchy, including cache memory and virtual memory. Design direct mapping, associative mapping, and set-associative mapping. Define overlays, paging and segmentation, TLBs, and the various algorithms and devices associated with each. [ABET 1] [Course Objective 6].

Student outcomes addressed by the course:

ABET Outcome 1: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.

Course Weekly Content:

Week Topic

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|------|---|
| 1 | Introduction: Overview. Components of a Computer |
| 2 | Introduction: The Computer Level Hierarchy. Cloud Computing: Computing as a Service. Computer Models. Parallel Processors and Parallel Computing. (Assignment: Homework 1, Quiz 1). |
| 3-4 | Data Representation: Positional Numbering Systems. Converting Between Bases. Signed Integer Representation. (Assignment: Homework 2, Quiz 2, calculator required) |
| 5 | Digital Logic: Boolean algebra. |
| 6 | Digital Logic: Logic Gates. Karnaugh Maps. Digital Components. (Assignment: Homework 3, Quiz 3) |
| 7-8 | Digital Logic: Combinational Circuits. Sequential Circuits. Designing Circuits. (Assignment: Homework 4 with design problem, Quiz 4, Quartus II simulation software required). |
| 9-10 | VHDL programming to implement logic circuits. (Assignment: Design Project, Quartus II simulation software required). |
| 11 | CPU Basics and Organization. The Bus. Clocks. The I/O Subsystem. Memory Organization and Addressing. Interrupts. |
| 12 | A Discussion on Assemblers. Extending Our Instruction Set. A Discussion on Decoding |
| 13 | Architecture Instruction Processing. (Assignment: Homework 5, Quiz 5, MARIE Assembly Language simulator required). |
| 14 | Instruction Types, Addressing, Instruction Pipelining. (Assignment: Homework 6, Quiz 7) |
| 15 | Computer Memory (Assignment: Homework 7, Quiz 8) |

Educational Activities:

1. Access online course materials to obtain lecture notes, instructional video, homework assignments, quizzes, project assignments, exams and related materials.
2. Study lecture notes and review solved examples.
3. Read related subject chapter.
4. Attend scheduled discussion sessions and ask questions for more clarification.
5. Complete written assignments and graded activity at the scheduled time.

Grading Distribution:

- Students' assessment based on comprehensive homework, quizzes, and project assignment.
- Each homework has five to twelve comprehensive analytical problems.
- One homework has three comprehensive design problems. One design problem requires the implementation of rapid prototyping software to test the design.
- Quizzes designed based on the fundamental concepts and analytical techniques discussed in the course.
- Design project is a detailed analytical system design. Students will build the circuit based on the design requirement. Then, develop a computer program to simulate the design, then interpret the result to whether or not meets the design requirements.

- Students assessed according to their solution correctness, precision, and organization.
- Midterm and final exams designed based on the fundamental concepts and analytical techniques discussed in the course.

Required Tools:

1. Scientific calculator.
2. MARIE, Assembly Language simulator.
3. Quartus II for FPGA programming and rapid prototyping.
4. Zoom, Microsoft Teams, computer, webcam, microphone, internet access.
5. Moodle quiz tool
6. Moodle assignment tool
7. Watermark assessment tool
8. Word processing software for documents (Word, PDF).

Minimum Technology Requirements:

To successfully complete the course, you will need the following:

- Computer or Tablet
- Reliable internet access or data plan
- Microphone (may be built in or attached to tablet or laptop)
- Camera (may be built in or attached to tablet or laptop)
- PDF Converter (try Cute PDF Writer; it is free and easy to use)
- Must know how to use WebVPN to access Cade Library off campus

COURSE RULES AND PROCEDURES

Read the Announcements.

Make a habit of checking the Announcements forum every time you log into your dashboard. Read all announcements posted. The announcements contain helpful information on completing assignments, due dates, viewing feedback, and more. Use the tools in Moodle to keep track of your progress in this course.

Attendance policy and class participation: Students are expected to be present and on time and participate in class (whether virtual or in-person attendance) from the beginning through the end of the class period. Though attendance is strongly encouraged, merely attending classes does not guarantee a passing grade. It is every student's responsibility to make sure that he/she signs the roll during class.

Makeup test or exam: No makeup test or exam will be given except in the case of an emergency such as the student being sick, or he/she is unable to come to class due to some unforeseen event. An official proof **MUST** be presented to the instructor and the student is required to take the makeup test/exam as soon he/she returns to class in the following class session. Failure to comply will result in a zero (0) grade for the test/exam.

Assignment policy: Students are NOT allowed to share their assignments or to communicate during tests or exams. No late assignments will be accepted and no make-up for assignments and quizzes.

Grading Distribution:

- Students' assessment is based on comprehensive homework, quizzes, and project assignment.
- Each homework has five to twelve comprehensive analytical problems.
- One homework has three comprehensive design problems. One design problem requires the implementation of rapid prototyping software to test the design.
- Quizzes are designed based on the fundamental concepts and analytical techniques discussed in the course.
- Design project is a detailed analytical system design. Students will build the circuit based on the design requirement. Then, develop a computer program to simulate the design, then interpret the result to whether or not meets the design requirements.
- Students are assessed according to their solution correctness, precision, and organization.
- Midterm and final exams are designed based on the fundamental concepts and analytical techniques discussed in the course.

A student's grade at the end of the semester will be determined by the following percentages.

Homework (25%)

Quizzes (25%)

Midterm Exam (25%)

Final Exam (25%)

Grading Scale: A=90 - 100, B=80 - 89, C=70 - 79, D=60 - 69, F= Below 60

MOODLE ACCESS – Southern University and A&M College at Baton Rouge will use Moodle extensively in this course. Moodle is a learning management system designed to help teachers and students communicate effectively online. The course syllabus and class materials (e.g., handouts, PowerPoint slides, journal articles, assignments, readings, etc.) will be placed on Moodle. The student should check Moodle DAILY for all assignments submitted via Moodle. If the student has problems with his Moodle account, he/she should contact Ms. Chrisena Williams-Brown in the Division of Information Technology via email at chrisena_williams@subr.edu or via phone at (225) 771-5017.

INSTITUTIONAL POLICIES

ACADEMIC DISHONESTY – Southern University and A&M College's *Student Code of Conduct* (Code 1.1) identifies academic dishonesty as any deliberate attempt to gain an unfair advantage in academic work. Examples of academic dishonesty include cheating, falsification of information, fraud, plagiarism, unauthorized access to academic records, providing information, material, or other assistance with the knowledge that such assistance could be used in violation of the *Student Code of Conduct* or other University policies, or providing false information in connection with any inquiry regarding academic dishonesty.

[Academic Dishonesty Policy](#) - link to PDF [Report Academic Dishonesty](#) - link to PDF

ACADEMIC GRIEVANCES – Southern University and A&M College students may seek redress in academic decisions when they believe the decision is unfair or ungrounded. The academic grievance procedure provides prompt and equitable resolutions to student academic grievances. Classroom-related matters should be subjected to these procedures only when the grievance cannot be settled in the ordinary course of immediate post-class discussion. Academic grievances are not handled by the Office of the Dean of Students.

[Student Academic Grievance Procedures](#) - link to PDF

ADA COMPLIANCE – Southern University Baton Rouge is committed to providing reasonable accommodations for students with documented disabilities in compliance with the Americans with Disabilities Act (ADA). Students may request accommodations by registering with the Coordinator for Disability Services. It is important to do this early each semester because ADA accommodations are not retroactive. Upon completion of the application, the Coordinator will be responsible for forwarding the letter of accommodation to the student's professors. Accommodations will begin upon acknowledgment that the professor has received the letter of accommodations. All discussions with the faculty/student/Coordinator will remain confidential.

Contact Information

The Office of Disability Services is in Office # 246, A. C. Blanks Hall, in the center of the campus.

Southern University Office of Disability Services

Jada J. Netters, Coordinator P.O. Box 11298 Baton Rouge, LA 70813 Phone: (225) 771-3546 (V/TTDD) Email: ods@subr.edu Website: www.subr.edu/ods

The Office of Disability Services (ODS), under the auspices of the University Counseling Center, assists students in meeting their unique academic/educational, personal, vocational, and social needs that would otherwise prove to be an obstacle to educational pursuits. The Office of Disability Services (ODS) provides confidential services to those students who, in this post-secondary setting, **must request and provide the necessary documentation to verify a special needs request**. Diagnostic educational evaluations/examinations are not conducted through ODS. Academic accommodations are made based on a student's documented disabilities.

Disruption of the Academic Process—The University's Student Code of Conduct (Codes 1.6 and 2.2) broadly defines disruption/obstruction as any major/minor action which obstructs, or attempts to obstruct, an official University function, such as teaching, research, administration, or other campus activity.

[Disruption Policy](#) - link to PDF [Report Classroom Disruption](#) - link to PDF

Southern University Statement of Non-Discrimination—In compliance with Title IX of the Education Amendments of 1972, Title VI and VII of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, and other federal, state, and local laws, Southern University and A&M College forbids discriminating or harassing conduct that is based on an individual's race, color, religion, sex, ethnicity, national origin or ancestry, age, physical or mental disability, sexual orientation, gender identity, gender expression, genetic information, veteran or military status, membership in Uniformed Services, and all other categories protected by applicable state and federal laws. This commitment applies but is not limited to decisions made concerning hiring and promotion, the administration of educational programs and policies, scholarship and loan programs, and athletic or other College administered programs. Discriminatory acts of any kind are strictly forbidden.

Any member of the Southern University and A&M College community has the right to raise concerns or make a complaint regarding discrimination without fear of retaliation. All inquiries regarding the application of this statement and related policies may be referred to:

Cedric Upshaw, Title IX Coordinator, at (225) 771-5565.

Complaints may also be made via email at titleix@subr.edu or by visiting www.subr.edu/titleix.

Standards for Satisfactory Academic Progress—The Higher Education Act of 1965 as amended and final regulations set by the United States Department of Education (34CFR668.16) require that institutions of higher education establish reasonable standards of Satisfactory Academic Progress (SAP) as a condition of continuing eligibility for federal aid programs. Financial aid recipients are expected to make reasonable progress as a condition of receiving and continuing to receive student financial aid. Student progress is assessed according to both qualitative and quantitative measures. The University has developed this policy to provide a framework for monitoring and determining a student's Satisfactory Academic Progress by Federal and Institutional requirements. This policy applies to all new, transfer, re-entry, re-admit with transfer work, and continuing students at Southern University.

For additional information, please visit www.subr.edu/cusa

Student Email Policy—Email is a universal service that has greatly enhanced communication both internally within the Southern University and A&M College community and externally to users, including prospective students, alumni, and the public at large. The purpose of the University's general email policy is to describe the appropriate use of University email facilities, associated responsibilities, and rights of all users of University email facilities and official Southern University and A&M College email accounts. This student email policy is a supplement to the University's general email policy.

[Student Email Policy](#) - link to PDF

Tobacco-Free Campus Policy—The Southern University System (SUS) maintains a 100% Tobacco-Free Policy. Smoking and tobacco use of any kind will be prohibited on all SUS campuses and/or other properties owned and/or leased locations/premises; all internal and external areas, parking garages, and parking lots; all entrances and exits; and in all SUS owned and/or leased vehicles. Students may not smoke in their own or others' vehicles when the vehicles are parked on SUS properties. This policy will be in place at all Southern University and A&M

College-sponsored events-both on our premises and external locations hosting such events, including non-University hours, and will further apply to all faculty, staff, students, and visitors.

[SUBR Tobacco Free Policy](#) - link to PDF