Advanced Computer Architecture COSC 5351
School of Engineering and Computing Sciences
Fall 2015

A. COURSE INFORMATION

Course number/section: COSC 5351
Class meeting time: MWF 12:00 – 12:50 p.m.
Class location: CS-103
Course Website: TBA

B. INSTRUCTOR INFORMATION

Instructor: Dr. Dulal Kar
Office location: CI-321
Office hours: 10 a.m. – 11 a.m. (MWF) and 3:30 p.m. – 4:30 p.m. (MW)
Telephone: 361-825-5878
e-mail: dulal.kar@tamucc.edu
Appointments: Required for meetings beyond office hours

C. COURSE DESCRIPTION

Catalog Description
An overview of computer architecture, which stresses the underlying design principles and the impact of these principles on computer performance. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing.

D. PREREQUISITES AND COREQUISITES

Prerequisites
COSC 5331 (Survey of Computer System Software). If you do not have the prerequisites (or equivalents from another university) shown on your TAMUCC records, you may be dropped from class at any time.

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)

Optional Textbook(s) or Other References
None.

Supplies
A calculator for basic math calculation.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:

1. Explain the classes of computers, and new trends and developments in computer architecture.
2. Understand pipelining, instruction set architectures, memory addressing, and performance metrics.
3. Explain the various techniques to enhance a processor's ability to exploit Instruction-level parallelism (ILP), and its challenges.
4. Understand exploiting ILP using dynamic scheduling, multiple issue, and speculation.
5. Understand multithreading by using ILP and supporting thread-level parallelism (TLP).
6. Analyze the performance and efficiency in advanced multiple-issue processors.
8. Understand multiprocessor cache coherence using the directory based and snooping class of protocols.
9. Understand the various models to achieve memory consistency.
10. Explain the several advanced optimizations to achieve cache performance.
11. Understand virtual memory and virtual machines.
12. Explain how to exploit request-level and data-level parallelism in warehouse-scale computers.

G. INSTRUCTIONAL METHODS AND ACTIVITIES

Instructions will be delivered through in-class lectures and presentations using slides. Students will be required to present their papers or projects in the class.

H. MAJOR COURSE REQUIREMENTS AND GRADING

This is a high-level core course. This is a difficult course that demands all students attend all classes! Regular completion of all reading, homework, and other outside assignments, are absolutely essential for success in this course.

Assignments and Quizzes. Approximately five to six assignments and quizzes will be given. Partial credit will be given for incomplete assignments. Assignments will significantly be based
on the material from the lectures and other material considered essential for the successful completion of this course. Hard copies of assignments will be handed out in the class during the lecture sessions. The submission details will be provided to you along with each assignment. Dates for quizzes will be announced in the class.

**Paper/project.** All students are required to write a research or survey paper or work on a project. The topic or problem for the paper or project must be approved by the instructor. An in-class presentation is also required. Additional details on the paper or project will be available later.

**Exams.** There will be three exams. The first mid-term exam will be given on September 28, 2015, and the second mid-term exam will be given on November 2, 2015 during the scheduled class time, and the third exam will be given on November 30, 2015.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
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<tbody>
<tr>
<td>Three Exams</td>
<td>60</td>
</tr>
<tr>
<td>Quizzes</td>
<td>15</td>
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<tr>
<td>Homework</td>
<td>10</td>
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<td>Presentation</td>
<td>5</td>
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<td>Paper</td>
<td>10</td>
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## I. COURSE CONTENT/SCHEDULE

<table>
<thead>
<tr>
<th>DATE (BY DAY OR WEEK)</th>
<th>TOPIC</th>
<th>CHAPTER(S)</th>
<th>ASSIGNMENTS</th>
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<tbody>
<tr>
<td>1</td>
<td>Fundamentals of Computer Design</td>
<td>Chapter 1</td>
<td>TBD</td>
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<tr>
<td>2</td>
<td>Review of Memory Hierarchy</td>
<td>Appendix B</td>
<td>TBD</td>
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<tr>
<td>3</td>
<td>Memory Hierarchy Design</td>
<td>Chapter 2</td>
<td>TBD</td>
</tr>
<tr>
<td>4</td>
<td>Memory Hierarchy Design</td>
<td>Chapter 2</td>
<td>TBD</td>
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<tr>
<td>5</td>
<td>Exam 1, September 28, 2015</td>
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<tr>
<td>6</td>
<td>Pipelining: Basic and Intermediate Concepts</td>
<td>Appendix C</td>
<td>TBD</td>
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<tr>
<td>7</td>
<td>Instruction-Level Parallelism and Its Exploitation</td>
<td>Chapter 3</td>
<td>TBD</td>
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<td>8</td>
<td>Instruction-Level Parallelism and Its Exploitation; Data-Level Parallelism in Vector, SIMD, and GPU Architectures</td>
<td>Chapter 3 and Chapter 4</td>
<td>TBD</td>
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<tr>
<td>9</td>
<td>Data-Level Parallelism in Vector, SIMD, and GPU</td>
<td>Chapter 4</td>
<td>TBD</td>
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<td>Architectures</td>
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<tr>
<td>10</td>
<td><strong>Exam 2, November 2, 2015</strong></td>
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<tr>
<td>11</td>
<td>Thread-Level Parallelism</td>
<td>Chapter 5</td>
<td>TBD</td>
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<td>12</td>
<td>Thread-Level Parallelism; Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism</td>
<td>Chapter 5 and Chapter 6</td>
<td>TBD</td>
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<tr>
<td>13</td>
<td>Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism</td>
<td>Chapter 6</td>
<td>TBD</td>
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<td>14</td>
<td><strong>Exam 3, November 30, 2015</strong></td>
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<td>15</td>
<td>Paper or project presentations on the final exam day as scheduled by the university</td>
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Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

**J. COURSE POLICIES**

**Attendance/Tardiness**
You must attend all classes. You are responsible for any materials covered or handed out or announcements made for the tests, quizzes, and homework assignments in your absence. Records of your attendance will be maintained and reported to the university. Students found missing classes without the instructor's permission will be automatically withdrawn from the course. Students are responsible for all materials covered in class and assigned. Should a student be absent from class, it is his/her responsibility to get the notes, etc. for that missed class. More important, should there be assignments, it is the student’s responsibility to obtain such assignments. No excuse will be accepted for assignments not turned in because the student was absent when it was due.

**Late Work and Make-up Exams**
All the assignments are due at the beginning of the class on the due date. If the student is absent on the assignment due date, it is the student's responsibility to make sure that the assignment is submitted on the designated date. An assignment that is turned in after the class on the due date is considered one day late. There is a penalty for late submissions. Late assignments will be counted 20% off for each day after the due time. No credit will be given if an assignment is submitted after 5 days. If you have not completed your assignment by the due date, you should submit the work you have done for partial credit. No work will be accepted once the graded work has been returned or the solution has been disclosed to the class, except for unusual circumstances. Exams must be taken on the hour they are scheduled. In the event, if you cannot attend the class to take the exam due to some emergency or some unavoidable situation (such as serious illness, death in
the family, participation in university sports, religious observations, and so on) you must notify me as soon as possible before the exam and also you must validate your absence by providing me a document (e.g., with a letter from your doctor).

**Extra Credit**
None.

**Cell Phone Use**
Set your cell phone/electronic device in silent mode when you are in class.

**Laptop Use**
You can use your laptop to view course documents or slides.

**Food in Class**
Not allowed.

**Missed Exam**
No makeup exam will be given without prior agreement.

**Participation**
You are encouraged to ask questions related to course topics that can help you and others attending the class.

**K. COLLEGE AND UNIVERSITIY POLICIES**

- **Academic Integrity (University)**
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to
disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar ([http://www.tamucc.edu/academics/calendar/](http://www.tamucc.edu/academics/calendar/)) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at [http://www.tamucc.edu/provost/university_rules/index.html](http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage at [http://sci.tamucc.edu/students/GradeAppeal.html](http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other
things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

http://disabilityservices.tamucc.edu/

• **Statement of Academic Continuity**
In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

• **Academic Advising**
The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

**GENERAL DISCLAIMER**
I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.