<div align="center">

COURSE SYLLABUS

CEN 502 (Offered as CEN 591) Computer Systems II (Fall 2012)
MW 1:30 – 2:45pm, BYAC 150

</div>

Instructor: Sandeep Gupta,
Contact: Email: Sandeep.Gupta@asu.edu; **Phone**: 480-965-3806
Office hours: MW: 3-4:30pm (or by appointment).
Office Location: BYENG 522
TA: Zahra Abbasi, Zahra.abbasi@asu.edu, **office hours**: MT: 11-12
TA Office Location: BYENG 517AE

Online Course Material:
- **Course URL**: http://impact.asu.edu/cen591fa12.html (check this page often for course material such as course slides.)
- **Course Blackboard**: Some information about the course would be made available via blackboard (e.g. grades). Students will be able to take practice tests and quizzes via Blackboard.

E-mail Policy: Students are permitted to email the instructor. Make sure that the subject of email has **cen591fa12** keyword. Depending upon the nature of the email the instructor will choose to respond to it directly or in the class (many times several students have same concern and it is more effective to respond in the class). **Note that lack of direct response doesn't imply that your email is being ignored**!

Course Description: The combination of CEN501 and CEN502 (CEN 591 in current offering) serves to integrate the required knowledge of electrical engineering and computer science to ensure that all students have the necessary background to pursue advanced study in the areas of computer engineering. CEN501 focuses on circuit and logic design, topics that span the electrical engineering to computer engineering interface. CEN502 begins with fundamentals of computer architecture and focuses on basic principles of systems programming, operating systems, compilers, and networking topics that cover the computer science to computer engineering interface. Together this pair of courses provides a common and necessary background for all students in the program to pursue further advanced study in the six areas of the program. As such, these courses must be taken early in the student's course of graduate study.

The goal of CEN502 is to prepare incoming computer engineering graduate students for taking advance level computer systems courses in the areas such as computer architecture, compilers, operating systems, mobile and embedded systems.

Learning Objectives: By the end of the course the student will

1. Understand the importance of system-oriented view of computing systems and would be able to identify inter-relationships between computer software and hardware.
2. Have knowledge of how science of computation is applied to building computer systems and has knowledge of overarching principles in computer systems design as well as technological trends and forces guiding the evolution of computer systems.
3. Have skills and background knowledge to take advanced courses which deal with advanced topics on and new paradigms of computing and computer systems.

Learning Outcomes:

1. Student will be familiar with programming in system programming languages such as C and OS shells and scripting languages.
2. Student will be familiar with end-to-end program development process on various computer systems.
3. Student will be able to evaluate a program's performance in terms of throughput, latency, and energy consumption using sound experimental methods and would be able to present and compare system performance using relevant performance metrics.
4. Student is aware of the interplay between computer hardware and software to meet requirement of performance (quality-of-service), reliability, security, and sustainability.
5. Student will be able to develop parallel programs on multiple computing platforms.
6. Student will be able to analyze a program for various forms of parallelism and synchronization needed to maximize its performance.
7. Student will be able to describe all the levels of processing (and associated systems software) required to execute a program.
8. Student will have understanding of the importance of layered system software design and have knowledge of the various layers of operating systems and networking.
9. Student will be able to make technical presentation, write technical papers using document development and presentation tools on topics related to computer systems.
10. Student will be aware of major technical conferences and journals as well as major online resources to obtain reliable technical materials related to computer systems.

Course Topics: The general course topics are listed below.

1. **Introduction**
   a. Technology trends in computer systems: multicore, embedded, mobile systems.
   b. Primers on computer architecture
   c. Primers on computer system design
   d. Fundamentals of quantitative design and analysis of computer systems
   e. Computer System Principles: End-to-End Principle, Amdahl's Law
2. **System Programming**
   a. Programming in C
   b. Shell programming
   c. Inter-process communication
3. **Computer architecture**
   a. Processor design – pipelining, superscalar, multicore
   b. Memory hierarchy, memory protection and virtual machine memory protection, cache-coherence
   c. Types of parallelism: Instruction-Level Parallelism, Data level parallelism, Task-level
   d. GPU architecture
4. **Machine level representation of programs and data**
   a. Representing and manipulating information
   b. Machine level representation of programs
   c. Program execution
5. **Operating system**
   a. Processes and Interrupt handling
   b. Process synchronization
   c. Virtual memory
   d. System I/O
6. **System software**
   a. Preprocessors, Assemblers and Compilers (Lexer, Parser, Code Generator)
   b. Linkers and loaders
   c. Dynamic memory management – garbage collector
7. **Networking**
   a. Layered architecture
   b. Wired and wireless networks
   c. TCP/IP
   d. Medium access control
   e. network programming
8. **Emerging computing paradigms and systems**
   a. Data centers and warehouse computing
   b. Cloud, Service-oriented computing

    c.   Green and sustainable (energy, power, and thermal-aware) computing
    d.   Futuristic computing models: Quantum computing
9. **Computer System Performance Modeling and Evaluation**
    a.   Basics of queuing theory
    b.   Principles of reporting computer system performance
    c.   Performance metrics e.g. for throughput, reliability, energy consumption

Grading and course work:

- Homework and Programming Assignments - one every two to three weeks; 20% of the grade.
- Reading assignments (will be assigned in the class) and quizzes - every week - 10% of the grade.
- Midterms (two – tentative dates: W Oct 10, 2012, and W Nov 7, 2012) and Final Exam (in class on Friday Dec. 14, 9:50 to 11:40am)– total 70% of the grade – tentative weightage 10%, 20%, 40%, respectively.

Letter grades (using +/- scale) will be assigned. The cut-offs for various grades will be based on weighted score distribution in the class.

Lecture Format, In-class and Outside class Activities:
- The course will use a combination of in-class lectures, pre-recorded lectures, and class discussion and group/individual activities (in a flipped class format).
- Some lectures will be recorded and made available online.
- Students may be required to make class presentation or discuss ideas/solve problems on the white board.
- Class may take a trip to ASU datacenter and other appropriate computing facilities.
- Some topics will be covered by the TA (either in-class or outside class per ad hoc arrangement).

Reference books: The following books are recommended for reference purpose (students can in most cases use any other equivalent book on the topic):
    a.   Computer Systems: A Programmer's Perspective 2ed, Randal E. Bryant and David R. O'Hallaron
    b.   Computer Architecture: A quantitative approach, John L. Hennessy and David A Patterson.
    c.   Operating Systems Concepts, Silberschatz et al.
    d.   Compilers, Principles, Techniques, and Tools, Aho et al.
    e.   Computer Networking: A Top-Down Approach, Kurose and Ross.

f. Fundamentals of Mobile and Pervasive Computing, Adelstein et al.

Class Behavior and Attendance Policy:
- Use of any electronic devices is strictly prohibited unless permitted by the instructor.
- Students are expected to come on time to the class and are expected to attend all the classes in the semester. Student should inform the instructor of absence due to travel etc. at least one week in advance. Absence due to medical reasons requires a note from a medical professional in-charge of the student's treatment. Absence due to other unseen circumstance requires relevant documentation.
- Students should refrain from talking among themselves (unless instructed by the instructor) and making comments or remarks which are not relevant to the topic of the class.

Policy Requiring Academic Integrity and Against Plagiarism: Any incidence of cheating in this class will be severely dealt with. This applies to homework assignments, programming assignments, quizzes and tests. The minimum penalty for cheating will be that the student will not obtain any credit for that particular assignment. (This means that if in a test and/or assignment a student is found have cheated, he/she will obtain zero in that test and/or assignment.) For the homework and the programming assignments students may discuss the problems with others, but one is expected to turn in the results of one's own effort (not the results of a friend's efforts). One tends to get very suspicious if two identically wrong results show up in the homework assignment and/or tests. The names of the offenders will be maintained in the departmental files. The repeat offenders may be debarred from the University. Please familiarize yourself with Student Resources on the Academic Integrity web site: http://provost.asu.edu/academicintegrity.

Policy against Disruptive, Threatening, or Violent Behaviors: Actions will be taken in accordance with SSM 104-02 (http://www.asu.edu/aad/manuals/ssm/ssm104-02.html). Please read it!

Policy for Reporting Offensive Material: The course is on computer systems technology and in general it is unlikely that any material in the class would be offensive to any student in the class. Nevertheless, please bring to the notice of the instructor any class material which you find offensive. Reasonable accommodations would be made in accordance with the ASU's policies to remove the material in question from the course.

Accommodation for Disability: The student must be registered with Disability Resource Center (DRC) - http://www.asu.edu/studentaffairs/ed/drc/. The student must provide proper documentation from DRC.

Other Accommodations: Accommodations for say religious observations would be made in accordance with University guidelines e.g. http://www.asu.edu/aad/manuals/acd/acd304-04.html.

Copyright Notice: All content of this course including lectures and notes taken from the lectures (including inclass and online) are copyrighted material and student may not sell these in any form.

Disclaimer: The content of this syllabus with the exception of grade and absence policies are subject to change with reasonable advance notice.

Errata Notification: Please let instructor know of any error/inconsistency in this document.