

## CS 4623/5623

### INTRODUCTION TO CYBER PHYSICAL SYSTEMS

**Instructor:** Dr. J. Cecil (j.cecil@okstate.edu)

**Class times:** 1:30 to 2:45 Tue Thur

**Office Hours:** Please setup an appointment with Dr. Cecil by email.

TA: Avinash Gupta

#### **COURSE OUTLINE**

This course will introduce students to principles and technologies dealing with cyber physical systems. Topics covered will include design of cyber physical systems including the role of Virtual Reality (VR) based simulation environments approaches. Students will also be exposed to Virtual Reality technologies and Next Generation Internet frameworks to support the adoption of Cyber Physical methodologies. The role of Information modeling techniques to support the design of collaborative methodologies for CPS contexts will also be addressed.

\*\* A major area of emphasis is a semester long class project involving NASA involving creation of VR/Augmented Reality environments. Students will be assigned to specific teams with specific objectives. The weekly progress in the projects will serve as a homework or quiz.

#### **Pre-requisites**

There are no pre-requisites. Students are expected to have knowledge of at least one programming language. For the class projects, knowledge of C# is preferred.

#### **COURSE OBJECTIVES AND OUTCOMES**

Primary Objective is to introduce students to the emerging domain of cyber physical systems.

Other secondary objectives include introducing students to Virtual Reality technologies and Next Generation Internet frameworks.

#### **Specific Outcomes of completing this class include**

- An ability to design cyber physical approaches to support collaborative activities using information modeling approaches
- An ability to identify the key components and technologies for designing a CPS
- An ability to design and build Virtual Reality based simulation environments for robotic and other application contexts
- An ability to accomplish assembly planning approaches using various algorithms

#### **TEXT**

Lecture material will be provided through class notes.

#### **METHOD OF INSTRUCTION AND INTERACTION**

Class Notes will be provided for lecture and discussion.

Other references for additional reading will be provided. Students are responsible for all material covered in class as well as material used in assigned independent reading.

Regular class attendance is expected.

#### **GRADING POLICY**

Mid-term Project Exam (1): 25%

Final Project Exam: 40%

Homework Assignments and quizzes: 30%

Level of contribution and Team participation: 5%

(this 5% is over and beyond your grade in the various homework and mid term/final project).

Note that if you do not contribute sufficiently or complete your assigned team responsibilities, you will receive a lower grade than your team colleagues).

There may be weekly homework assignments. Weekly progress reports including software demonstrations will form a bulk of such homework assignments. There will be occasional quizzes (from 3 to 5).

Grades for course will be given on a 90, 80, 70, 60 basis (corresponding to A, B, C, D). Scoring less than 60 % will result in an Fail or F grade. The instructor reserves the right to modify the cut-off points.

Most deliverables require students to work on teams. For team-based deliverables, all students are expected to contribute to ensure fairness. Note that peer evaluations will be used to get feedback on contribution and roles of each student in a team. Students who have not contributed to their fair share of work will be given a lower grade point than the grade points given to the overall team.

#### **Topics to be covered in this course:**

- Introduction to fundamental concepts in Cyber-Physical Systems and Virtual Reality/Augmented Reality/Mixed Reality; levels of immersion and levels of abstraction
- Introduction to Unity based 3D VR modeling; in-class and outside class tutorials
- Principles of Human Centered Computing (HCC) and its role in designing VR/AR/MR environments
- Modeling of NASA's MR user interfaces in support of the Moon Mission;
- Design of CPS approaches and frameworks for distributed collaborations
- Information Modeling methods

#### **HOMEWORK AND OTHER SUBMISSIONS**

Homework, project reports and other submissions are expected to be well organized and neatly presented (stapled, collated, with a cover page). If an electronic file is to be submitted in a flash drive, please make sure to include your relevant printouts and the flash drive on a large envelope and you write your first and last names clearly on the envelope. If you are submitting any deliverable as part of a team, the names of all the team members should be written (using first initial and last name) along with the Team number assigned. Along with the team deliverable (on specific deadlines), confidential peer evaluations must be submitted by each team member regarding contribution of each member. This will be used to allocate individual grade points of each student for a given team based deliverable. Failing to submit these peer evaluations will result in zero grade points for that deliverable. A template will be provided for peer evaluations. Students who receive poor peer evaluations will be given a reduced score / grade which can include being given zero points for not contributing to team deliverables.

#### **TEAM SUBMISSIONS**

A student absent from any team based deliverable including team presentations will not receive any points or credit for that assignment or deliverable; extraordinary circumstances involving health reasons or family emergencies will be reviewed on a case by case basis when appropriate documentation is provided. Each student is expected to contribute their equal share in any team based deliverable or submission. Students who miss team meetings and/or do not contribute to any team based deliverable WILL receive zero grade points or a lower grade than the grade points given to other team members. Any student missing class presentations by other teams (on assigned dates of these presentations) will receive a penalty for not being present at other team presentations.

## INDIVIDUAL SUBMISSIONS

If a student is unable to be present in class (due to extraordinary health or family emergencies or circumstances) to personally handover an individual homework submission (or deliverable), they are expected to arrange for someone to drop this off before the deadline of the submission. It is the student's responsibility to call the instructor as soon as possible (preferably the same day before the deadline) AND SEND AN EMAIL to instructor to explain the extraordinary circumstances which should be supported by appropriate documentation. Falling sick on the day of the deliverable is not an automatic excuse for a late submission or for a makeup exam; without adequate documentation (see below), students may not be given an opportunity for a makeup exam. Undocumented absences during any presentations or deliverables will result in zero grade points. Undocumented late submissions will be evaluated based on the late assignment policy indicated earlier. Students who cannot participate in a team presentation or deliverable due to attending a conference or for other official reasons need to discuss this with the instructor AT LEAST 2 WEEKS BEFORE any such absence. Alternatives will be discussed on a case by case basis.

Any student who provides medical documentation for missing class or any other activity will need to provide the following (no excuses): The medical physician should provide a letter (using the Hospital or Health Care facility's letterhead) along with a signature, and time/day of the doctor's appointment or treatment along with a phone number. Submitting a sheet of paper without adequate details is not acceptable (for eg: a doctor's note that you have seen them is not adequate – a letter is needed). If the medical documentation is not adequate, students will not be excused.

If a student has to miss an exam due a family emergency, they may be allowed to take a makeup exam after the planned class exam date (not before). Students who fall sick on the day of an exam must contact the instructor as soon as possible along with explicit documentation from a physician or health center explaining the reasons for missing the exam (simply turning in a signed note from a nurse does not constitute adequate documentation). Instructor reserves the right to reduce the exam grade or assign a grade of zero points for makeup exams.

## CLASSROOM ETIQUETTE

All students are expected to arrive on time. In case of late arrival because of unforeseen circumstances (vehicle breakdown, inclement weather, etc.), students should occupy the first available empty seat to minimize disruption caused. Use of any electronic devices including laptops is prohibited during the regular class period.

ALL STUDENT CELL PHONES MUST BE TURNED OFF before class begins. Students are expected to be respectful to each other and the instructor. Texting each other, using the cell phone, or causing other distractions or disturbances are violations of class policy. The instructor reserves the right to ask students who violate these policies to leave the class room.

Students should not be using cell phones during class for any reason (cell phones should be turned off at the beginning of class). If a student is observed using a cell phone (for any reason), he or she will receive zero points for class participation (2% of overall grade). They can also expect to receive penalty points deducted from their overall grade at the end of the semester. Laptops can be used only when the instructor indicates it is allowed to research a topic on the internet during a specific class (they should not be turned on during a class without specific

instructor authorization). In other situations, students should not be using their laptops or tablets or any other computers during class.

Students are expected to be respectful to instructor, the TA and each other during all interactions including lecture sessions and other interactions including when meeting outside of the classroom to discuss class activities. Rudeness and impolite behavior will not be tolerated. Students engaging in improper conduct including harassing team mates, being impolite to instructor or TA or each other or indulging in any unprofessional or improper behavior will be reported to campus authorities.

## **CHEATING**

Any instance of cheating or plagiarism will be reported to the Dean of students for appropriate action (which includes possible failure in the course and/or dismissal from the University). Copying of homework and failure to cite a source or acknowledge assistance received are considered as acts of academic dishonesty.

Academic dishonesty (cheating) will not be tolerated. Any work submitted by a student must be his/her own work. Students are specifically not allowed to ask their peers, parents, campus staff or anyone else to proof read their reports or any other submissions.

Some examples of academic dishonesty include:

- Soliciting answers from a fellow student during a quiz or examination;
- Looking or glancing at another student's paper during any in-class activity such as an individual quiz or examination (discussion during certain team based activities is permitted only when indicated by instructor)
- Forging or 'Making' your own medical letters with forged signatures of physicians or health care personnel
- Using a cell phone (or any other resource not approved by instructor) to answer questions during a quiz or exam or any other deliverable in the classroom or any other evaluation room;
- When the instructor feels beyond reasonable doubt that dishonesty has occurred, he will take disciplinary action in accordance with university policies and procedures.
- For more information, please refer to the *Oklahoma State University Student Rights and Responsibilities Governing Student Behavior* and also the following website:  
<http://academicintegrity.okstate.edu>