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.

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TA Office hours: 2:45 to 3:45 pm Tue Thur

Some of the key points may appear as Capital fonts. Note: such use of CAPITAL fonts is meant to highlight important points. It does not mean the instructor is yelling at you!

COURSE OUTLINE
This course will introduce students to concepts 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 as a link between cyber and physical environments. Students will also be exposed to Virtual / Mixed Reality (VR/MR) modeling and technologies using software tools and VR/MR platforms. Concepts, algorithms, and implementation approaches will be discussed using process contexts involving micro devices assembly. 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 creation of VR/Augmented Reality environments to support cyber-physical interactions. 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 a knowledge of programming in C#.

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 design and building Virtual / Mixed Reality (VR/MR) environments using software tools and VR/MR platforms.

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 /Mixed Reality based simulation environments for various application contexts.
- An ability to create an information model as a basis to design and build Cyber Physical environments.
- 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. Some of the class lectures will be posted as recording.
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
One Mid-term Project Exam: 20%
Final Project Exam: 40%
Final Quiz (end of semester): 5%
Quiz and Canvas based discussions: 15%
Homework Assignments: 15%
Class participation: 2%
(cell phone use even once in the semester leads to zero points in class participation grade)
Level of contribution in Team Project: 3%
(Reg this this 3%, this is going to be given at the end of semester by instructor based on your overall class participation and how well you have contributed to your team’s effort and success in the final project. This is over and beyond your grade in the various homework and semester project. Note that if you do not contribute sufficiently or complete your assigned team responsibilities, or if you miss classes often, or tend to give excuses for not contributing to your team, you will receive a lower grade than your team colleagues. Your percentage points for this category can range from zero to a max of 3 %).
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 (no min or max number – this varies each semester depending on class participation and performance).
Canvas based class discussions will be posted occasionally (may be biweekly or with more frequency if instructor notices lack interaction on a specific topic).
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 a Fail or F grade. The instructor reserves the right to modify the cut-off points.

HONOR STUDENTS: There is no honors option for this course. If you have registered by mistake, please talk to the instructor to drop this option.

GRADUATE STUDENTS: Graduate students will be expected to do more work than undergraduate students in this class. They will be required to work on a programming assignment or given other requirements related to an additional homework or additional work pertaining to the mid-term and final exam project deliverables.
Most deliverables require students to work as part 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 that 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
- Design of CPS approaches and frameworks for distributed collaborations
- Principles of Human Centered Computing (HCC) and its role in designing VR/AR/MR environments in support of CPS frameworks
- Information Modeling methods
- Review of case studies and research papers in CPS and related topics
- Potential class projects: Robotics factory, Modeling of NASA’s MR user interfaces in support of the Moon Mission; other topics

Preparation before coming to class:
The instructor MAY post recording of some class lectures before that lecture occurs (sometimes). When this occurs, the instructor or TA will email the class to listen to the lecture before coming to class. THIS IS REQUIRED. A Pop quiz may occur sometimes in such situations. STUDENTS ARE REQUIRED TO LISTEN TO SUCH POSTED LECTURE RECORDINGS.

HOMEWORK AND OTHER SUBMISSIONS
Homework, project reports and other submissions are expected to be well organized – IN SOME CASES, TEAMS WILL BE REQUIRED TO SUBMIT A PHYSICAL PRINTOUT ALONG WITH AN ELECTRONIC SUBMISSION ON CANVAS. When a physical report is required, it needs to be well organized and professionally presented (stapled, collated, with a cover page). 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. If an electronic file is to be submitted on canvas, please make sure to submit it well before the deadline as canvas will close your submission folder exactly at the deadline date/time. 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 evaluation. Students who do not contribute their equal share of effort and work in any team deliverable will be given a reduced score / grade which can include being given zero points.

TEAM SUBMISSIONS
A student absents 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. If a student falls sick, a letter from a medical doctor is required (a note from a nurse is insufficient, see more information on this below). If the instructor is not convinced about the medical reason given is legitimate, that student may not get an opportunity to re-do the presentation. In case of team presentations in class, all students are expected to be
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), 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 and TA 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 simple note from a nurse or doctor that you have seen them is not adequate – a letter is needed. The letter MUST not share any personal medical details of the health condition but should clearly indicate what date/time the student was seen by the physician. If the student stays home and does not see a doctor, he/she forfeits the opportunity to be given any consideration for a makeup presentation or attempting a makeup deliverable. 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 classroom. 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 teammates, being impolite to instructor or TA or each other or indulging in any unprofessional or improper behavior will be reported to campus authorities.

ACADEMIC DISHONESTY AND PLAGIARISM

Any instance of cheating or plagiarism will be reported to university authorities 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 proofread 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)
- Using ChatGPT or any other software or AI tool for helping you with any of your class work.
- 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