Course Syllabus Outline:
ENGR 567, Systems Engineering Architecture – System Architecture and Model-Based Systems Engineering

Instructor Information	Dr. John M. "Mike" Borky Office Location: Colorado Springs, Colorado Phone: (719) 640-8423 E-mail: Mike.Borky@colostate.edu Office Hours: By Appointment, primary interactions via Email and phone Dr. Daniel R. Herber Office Location: A202F, Engineering Building Phone: (970) 491-1491 E-mail: Daniel.Herber@colostate.edu Office Hours: By Appointment, primary interactions via Email and phone
Required Texts	Borky, John M. and Bradley, Thomas H., ***Effective Model-Based Systems Engineering,*** Springer, 2019 Soft Cover https://link.springer.com/book/10.1007%2F978-3-319-95669-5 Hard Cover https://www.springer.com/us/book/9783319956688 A list of optional supplementary reading materials will be distributed.
Course Description	This is an introductory graduate course whose principal objectives are to: • Teach a systematic and rigorous approach to developing, modeling, analyzing and optimizing architectures for complex, technology- and information-intensive systems and systems-of-systems. The methodology is called the Model-Based System Architecture Process (MBSAP). • Illustrate the techniques of Model-Based Systems Engineering (MBSE) using an architecture model as the primary source material for Systems Engineering (SE) processes such as requirements analysis, high level and detailed design, performance and design trade studies, configuration management, specialty engineering, and others. The course considers both heuristic and formal aspects of the subject, which can be thought of as the art and science of architecting. It starts with an introduction to the nature and challenges of this domain, an overview of the principles of Object-Oriented Design and the MBSAP methodology, a summary of architecting paradigms and tools, and a taxonomy of systems and enterprises to which this method applies. The course then proceeds through development of Operational, Logical/Functional and Physical Viewpoints that establish the fundamental methodology. Successive topics include real-time architecture, information assurance, executable architecture models,

	enterprise architectures, networked and distributed architectures, reference architectures and frameworks, and architecture assessment and governance. Each student will complete an architecture project based on a system or enterprise of her or his choice to practice the methodology.
Course Objectives and Learning Outcomes	Upon successful completion of this course, students should be able to: • Develop, allocate, and assess Functional and Non-Functional Requirements in the context of system architecture. • Model and analyze complex systems and enterprises using the Systems Modeling Language (SysML) and following the MBSAP methodology. • Develop and analyze Service-Oriented Architecture (SOA) solutions. • Analyze architecture issues associated with real-time systems, information assurance, networked enterprises, and virtual and physical architecture prototypes. • Develop and implement a process of architecture governance and assessment.
Prerequisite	ECE501/ENGR501, Foundations of Systems Engineering May be waived for students with equivalent practical experience.
Credit Hours	3
Teaching Strategies	• This is an online course with lectures and homework assignments. • Student projects and homework will be implemented using graphics, text, tables and similar files. • Students are encouraged to ask questions, both in and outside class, and to share relevant work experiences.
Course Policies and Procedures	***Classroom Procedures:*** **Attendance:** This course is presented in a blended format via the Zoom Video Conferencing system. Students can join classroom sessions live, including questions and discussion, or asynchronously by downloading and viewing Zoom recordings. Students may select their mode of participation from week to week without giving prior notification to the instructor. Information on Zoom meetings and recordings will be published via Canvas and E-mail. Regardless of the method of attendance the student selects, all requirements of the course, especially the class project, must be met. **Academic Honesty:** This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog, the Graduate and Professional Bulletin, and the Student Conduct Code. All students in the course will be subject to the policies including those governing academic integrity, stated in the "Student Responsibilities" section of the Colorado State University General Catalog (http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/). Each student is responsible for his or her work. When a student puts her or his name on an assignment and turns it in for a grade, she or he makes an implicit statement that she or he understands and has applied

the concepts that are demonstrated in the assignment. Students may cooperate in preparing for examinations but may not share answers or receive outside assistance during a test. Presenting work that is not original or that the student does not understand is justification for failing the course and/or facing disciplinary action by the university.

CSU Student Honor Pledge

"I have not given,
received, or used
any unauthorized assistance."

Please see: http://tilt.colostate.edu/integrity/
for more information on the CSU policy regarding academic integrity.

Late Work & Educational Responsibility: Students are expected to employ discipline and time management to complete assignments on time. All assignments and examinations must be completed by the due date unless an alternate due date has been previously approved or documentation has been provided to confirm extreme circumstances. Late submissions will receive reduced credit. It is each student's responsibility to communicate with the instructor about extreme circumstances or questions concerning assignments or examinations and due dates.

Class Projects: An essential element of the learning experience in this course is completion of a project using the MBSAP methodology that deals with a system or enterprise of interest to the student. Projects associated with student employment or past experience are often best, but this is not mandatory. Projects must have sufficient content and complexity to allow demonstration of all the essential skills taught in the course, including time-sensitive or real-time behavior and external interactions involved in a larger system-of-systems or enterprise. The instructor will approve project proposals before work begins.

It is acceptable for projects to be created using text and graphics provided correct SysML syntax and the rules of the MBSAP methodology are employed. Students have the option to create project architecture models using a SysML modeling tool if such is available through an employer or other source.

Etiquette (Classroom and Online): This is an online course in which students joining a class session in real time via Zoom have the option to ask questions, make comments, participate in discussions, etc. via voice or a chat room. Normal courtesy is expected in dealing with instructors and other students. Questions and discussion are strongly encouraged, and every effort will be made to resolve issues as they arise. However, questions that are not of general interest may be deferred to a private session with the instructor.

E-mail Procedure: Since students and the primary instructor are remote from the CSU campus, E-mail, supplemented by scheduled phone calls, is the normal medium for interaction. Students are encouraged to

send as many questions, comments or concerns as they like. The instructor's CSU E-mail is the primary and should be used whenever possible. Professional courtesy, including avoidance of broadcast messages that are not appropriate to all recipients, is expected. Sending E-mail that violates the rules stated above or standards defined by the University may result in disciplinary action.

Academic Policies:

Assignments: In general, weekly homework consists of (a) answering questions on assigned chapters in the course text, and (b) completing an increment of work on the class project. As noted above, the expectation is that all work will be submitted on time. The instructor will provide feedback on weekly project assignments and students can both correct and expand their work before the final submittal. Project content that exceeds minimum requirements is eligible for extra credit.

Examinations: There will be Midterm and Final Exams. Both will be take-home tests that are conducted as assignments except that each will only be available for a 48 hour window. Proctoring is not required for this course.

Intellectual Property: Any intellectual property developed or used in the course will be subject to the policies stated in Section J.12, "Academic Materials," of the Colorado State University Faculty Manual.

Grading Policy: Projects and assignments will be submitted through Canvas in the assignment area for each week. Assignments will not be accepted via email unless explicitly approved by the instructor. All assignments related to class must be posted in order to be graded.

Grading Scale: Grades are based on each student's demonstration of mastery of the concepts and skills taught in the course. Competence is assessed by factors and percentages below under Evaluation Breakdown.

This class uses a traditional A-F (4.0-0.0) grading system, with grades assigned on the following basis:

"A" – student has demonstrated understanding and proficiency in all essential concepts and techniques

"B" – student has demonstrated substantial understanding and proficiency, but some test results and submitted products are deficient in one or more material aspects

"C" – student has demonstrated basic understanding and proficiency but has failed to show this in one or more essential concepts and techniques

"D" – student has shown major deficiencies and demonstrated only a rudimentary understanding of course material

"F" – student has failed the course

"+ and -" Grades – allow finer-grained recognition of achievement.

Numerical scores will be computed from the factors and percentages in the Evaluation Breakdown and compared to the above criteria. A rough

indication of the scores corresponding to letter grades is as follows:

GRADE	COURSE CREDIT	NUMERICAL EQUIVALENT*
A	4.0	93-100
A-	3.7	90-92.9
B+	3.3	87-89.9
B	3.0	83-86.9
B-	2.7	80-82.9
C+	2.3	77-79.9
C	2.0	73-76.9
D	1.0	60-65.9
F	0	0-59.9

This scale may be adjusted to account for overall class performance.

Technical Support

If you have a technical question regarding information technology, specifically the Zoom tool used to broadcast and record lectures, please email or call Ed Gudemann, ed.gudemann@colostate.edu, 970.491.3234. Please include the course number in the subject line and indicate the nature of the problem in the email.

If you have a technical question regarding Canvas, please contact the Morgen Library Help Desk, 970.491.7276, help@colostate.edu.

Evaluation Breakdown

ITEM	PERCENT OF TOTAL SCORE
Weekly Assignments	10%
Midterm Exam	25%
Final Exam	35%
Class Project	30%

Session Structure

General Course Session Structure:

5:15-6:30 pm	First Half of Weekly Presentation
6:30-6:45 pm	Break
6:45-8:00 pm	Second Half of Weekly Presentation

Course Schedule:

Session	Date	Topics
1	8/26/19	**Introduction** • **Course Introduction and Overview** • **Introduction to System Architecting**
	9/2/19	**Labor Day Holiday**
2	9/9/19	**Theoretical Basis for Model-Based Systems Engineering (MBSE)** • **Object Orientation for System Architecture** • **Summary of the Unified Modeling Language (UML)** • **Summary of the System Modeling Language (SysML) Profile**
3	9/16/19	**The Model-Based System Architecture Process (MBSAP) Methodology, 1** • **Summary of the Methodology** • **Operational Viewpoint, Part 1**
4	9/23/19	**The Model-Based System Architecture Process (MBSAP) Methodology, 2** • **Operational Viewpoint, Concluded** • **Logical/Functional Viewpoint, Part 1**
5	9/30/19	**The Model-Based System Architecture Process (MBSAP) Methodology, 3** • **Logical/Functional Viewpoint, Concluded**
6	10/7/19	**The Model-Based System Architecture Process (MBSAP) Methodology, 4** • **Physical Viewpoint**
7	10/14/19	**Midterm Exam (48 hours to complete)**
8	10/21/19	**Service-Oriented Architecture (SOA), 1**
9	10/28/19	**Service-Oriented Architecture (SOA), 2**
10	11/4/19	**Real-Time Architecture**
11	11/11/19	**Networking and Enterprise Architecture**
12	11/18/19	**Security Architecture and Information Assurance**
	11/25/18	**Thanksgiving Recess**
13	12/2/19	**Prototyping and Reference Architectures**
14	12/9/19	**Architecture Assessment, Governance, and Special Topics**
	12/16/19	**Final Exam (48 hours to complete)**