



*Systems Engineering at Cal Poly:
Crosscutting Capabilities to Support
Multidisciplinary Project Based Learning*

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Systems Engineering



- ***Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem:***
 - ***Operations***
 - ***Cost & Schedule***
 - ***Performance***
 - ***Training & Support***
 - ***Test***
 - ***Disposal***
 - ***Manufacturing***

- ***Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.***

(INCOSE WEBSITE)

Systems Engineering

@ Cal Poly



- ***Grassroots effort at faculty level***
- ***Three compatible programs:***
 - ***Lockheed Martin Space Systems Engineering Masters Program***
 - ***St. Jude Medical Biomedical Engineering Masters Program***
 - ***Integrated Technology Management Program***

Space Systems Engineering



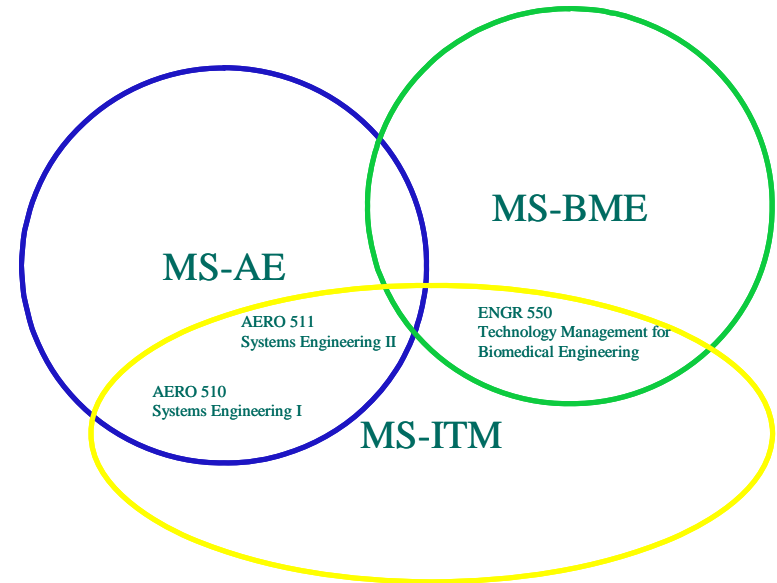
- ***Sponsored by Lockheed Martin***
- ***Targeted Systems Engineering Program***
 - ***Space Systems Focus***
- ***Multidisciplinary (multi-department support)***
- ***Target Students:***
 - ***Industry Professionals & Cal Poly Grad Students***
 - ***All Science and Engineering Backgrounds***
- ***Distance Learning Component***
 - ***2-Way Video Conference***

Current Course Offerings



Cal Poly currently offers three graduate-level distance learning classes that cover the fundamentals of Systems Engineering:

- **ENGR 550 Technology Management for Biomedical Engineering**
- **AERO 510 Systems Engineering I – Systems Engineering Management**
- **AERO 511 Systems Engineering II – Systems Analysis & Integration**



A distinguishing feature of these courses is that they are geared towards a Systems approach to product development of low-volume, high-reliability, complex products subject to government regulation. Thus there is much crossover in best practices between Aerospace and Biomedical Devices.

Proposed SJM Distance Learning Curriculum



3 Courses (35 hours content each), 5 Segments per course (7 hours content each)
4 Classes per segment (1.75 hours content each)
Technology Management and Engineering Process Classes

Course Segment	ENGR 509 Technology Management	ENGR 510 Systems Engineering	ENGR 511 Systems Analysis & Integration
1 Four classes	Engineering Research & Product Development Processes	SE Development Cycle (role of SE in product development)	System Modeling & Simulation
2 Four classes	Project Management Tools & Techniques	Requirements Analysis & Functional Allocation	Design Optimization & System Integration
3 Four classes	Managing Research Projects (risk, uncertainty)	Decisions & Design Synthesis (econ LCC evaluation focus)	HW/SW Test & Validation/Verification
4 Four classes	Managing Product Development Projects (cost, time, quality)	Configuration Definition & Management	Design for: Reliability / Maintainability / Serviceability
5 Four classes	Technology Strategic Management	Risk & Uncertainty	Design for: Produceability / Usability

*Plans already exist to add two additional proposed courses:
 ENGR 512 (Software SE), ENGR 513 (Product Development under Regulatory Environment)*

AERO/ENGR 511 – Systems Engineering II (Systems Analysis)



- Dr. Kurt Colvin (IME) – Manufacturing, Producability, Human Factors
- Dr. Roya Javadpour (IME) – Project Management, Simulation
- Dr. Jose Macedo (IME) – Optimization
- Dr. Dan Waldorf (IME) – Reliability, Maintainability
- Dr. David Marshall (AERO) – SW Test & Validation
- Dr. Eric Mehiel (AERO) – Systems Modeling & Simulation

“The Needs of Industry”



- ***Not all Systems Engineering is the same “flavor”...
...but much of it is!***
- ***Masters vs. Certificate vs. Certification***
- ***Distance Learning***

Industry Certification



- **Project Management – *Project Management Professional (issued by the Project Management Institute)***
- **Systems Engineering – *INCOSE Systems Engineering Certification (issued by the International Council on Systems Engineering)***
- **Engineering Management – *Engineering Management Certification (issued by the ASME/ASChE)***

Distance Learning



What's Next



- ***Web based delivery***
 - ***Class recordings available on-line***
 - ***Live Web-cast***
- ***Highly modular, asynchronous curriculum***
 - ***Allow specialists from various Cal Poly engineering disciplines to participate***
 - ***Allow industry professionals to participate over a spectrum of commitment***
 - ***Allow modification on a per-company basis (include corporate instructors)***
- ***Develop Certificate programs with fewer classes***

Multidisciplinary Participation



- *Dr. Robert Crockett (BMED) – Systems Engineering Management*
- *Dr. Jordi Puig-Suari (AERO) – Space Systems Engineering*
- *Dr. Kurt Colvin (IME) – Manufacturing, Producability, Human Factors*
- *Dr. Roya Javadpour (IME) – Project Management, Simulation*
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- *In addition to the abovementioned Cal Poly faculty members, appropriate faculty from the EE and CS/CPE departments will be utilized for specialized topics. Industry is also encouraged to participate as instructors in the modular format of the curriculum.*

Funding Track Record



- ***Lockheed Martin:***
 - ***\$300K to Develop Aerospace SE Curriculum***
 - ***First cadre of 20 Distance Learning students currently in program***
- ***CSA/WIRED Grant:***
 - ***\$200K/3 yr grant to enhance SE learning opportunities for working professionals***
- ***St. Jude Medical:***
 - ***Proposed \$60K effort to develop asynchronous SE Curriculum***