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**Documentation to Support the Approval of the**

**SOFTWARE DEVELOPMENT FOR  
AEROSPACE AND DEFENSE  
APPLICATIONS CERTIFICATE PROGRAM**



*Submitted by*  
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## **UCSC Extension**

### **SOFTWARE DEVELOPMENT FOR AEROSPACE AND DEFENSE APPLICATIONS CERTIFICATE PROGRAM**

#### **Program Overview**

This certificate program was developed in response to a request from NOVA (North Valley Workforce Investment Board) who worked with the California Space Authority and the South Bay Economic Development Partnership (SBEDP) as proposal partners. A grant was awarded to develop and deliver a training program to retrain displaced software engineers with skills that would prepare them to apply for new positions in the aerospace and defense industries. The grant will fully fund two groups of 14 participants each for the entire certificate. Vendor companies and employees from the aerospace and defense industries will participate in a guest lecture series that will be a free companion component to the certificate program. The classes will also be open to other fee-paying interested participants.

#### **Audience & Program Benefits**

The program was developed to retrain displaced software engineers who wish to move into the aerospace and defense industries. Although there are and will continue to be layoffs in these companies, one third of the existing workforce for Lockheed and other similar companies is retirement-eligible now and there is a need to replace at least a portion of that group. Although this program was designed for the displaced worker, it is believed that other software engineers from high tech may be interested in moving into this rewarding field. Participants may also be eligible to participate in a paid internship at companies such as Lockheed and NASA upon completion of the certificate program.

#### **Certificate Requirements**

To obtain the Certificate in Software Development for Aerospace and Defense Applications, participants must successfully complete 7 required courses. Although the certificate requirements may change after the grant program is complete, at this point there are no electives. Participants must also achieve an overall 3.0 GPA for all courses.

## **Prerequisites**

Minimum of a B.A. or B.S. in computer science or engineering. Participants are also expected to be eligible to receive a security clearance.

## **Recommended Course Sequence**

Courses may be taken in any order but are scheduled initially in the following sequence

Understanding Space: An Introduction to Astrodynamics and Space Systems  
Agile Modeling with UML  
Essential Team Performance Skills  
Real-Time Embedded Systems Programming  
Relational Database Concepts using Oracle  
Software Quality and Testing of Embedded Systems  
Defense/Aerospace Project & Systems Acquisition Management

## **Required Courses (7)**

Understanding Space: An Introduction to Astrodynamics and Space Systems  
Real-Time Embedded Systems Programming  
Relational Database Concepts using Oracle  
Agile Modeling with UML  
Software Quality and Testing of Embedded Systems  
Defense/Aerospace Project & Systems Acquisition Management  
Essential Team Performance Skills

## **Certificate Application**

Grant-funded students will be required to establish candidacy in the certificate program upon enrollment in the first course. Other students will be encouraged to do so early in their studies. By doing so, they lock in program requirements, receive notification of updates to the program and priority enrollment in fully-enrolled courses.

If the program is discontinued, students who are not funded by the grant and who choose not to take the complete program during the 2 times it is being offered may apply their classes to a number of other certificate programs at Extension.

## **Transferring Credit From Other Schools**

Not applicable for grant participants but for other participants and subject to departmental approval, students may substitute one equivalent course from another institution for one in the certificate program. The course must have

been taken within the past five years with a grade of C or better, cover the same material as the required course, carry equivalent or more credit, and be from an accredited academic institution.

### **Advisory Committee**

#### **Dilip Dedhia: Certificate Coordinator**

Interim Director, Engineering and Technology, UCSC Extension

DILIP DEDHIA, Ph.D., is president and principal engineer at Engineering Mechanics Technology, Inc., a consulting firm specializing in software development, statistical data analysis and engineering modeling. His expertise includes Java, .NET and database technologies.

#### **Associate Professor Luca De Alfaro, Campus Faculty Advisor**

Computer Engineering Dept., Baskin School of Engineering, UC Santa Cruz

Professor De Alfaro has extensive knowledge of System Design, Modeling, and Verification

#### **Associate Professor Jim Whitehead, Campus Faculty Advisor Computer Science, UC Santa Cruz**

Prior to beginning his graduate studies and moving to a career in academia, Professor Whitehead worked as a software engineering for Raytheon from 1989 to 1992.

#### **Mike Curran, Director, NOVA**

Mike Curran has been the Director of NOVA (or North Valley Job Training Consortium) since 1986. NOVA is located in the heart of the Silicon Valley, California, which has continuously been challenged by the rise and fall of business opportunities, and the creation/elimination of hundreds of thousands of jobs. Mr. Curran was co-author of the original grant proposal.

#### **Warran Bailey, SBIRS - Modeling and Simulation Lead, Lockheed Martin Space Systems Company**

Mr. Bailey has been a manager of programmers and scientists for over 15 years experience in simulation development, use of simulation for analysis and requirements verification in various phases of Aerospace and Defense projects.

#### **Dorothy McKinney, Chief Software Architect, Lockheed Martin Space Systems Company**

Dorothy McKinney, M.S. in Computer Engineering from Stanford University, M.B.A. from Pepperdine University, is employed by the Lockheed Martin Space

Systems Company, Missiles & Space Sunnyvale Operations. Currently she is Chief Software Architect; her previous assignments at MSO were Director of Software Engineering and Technical Director for Mission Success. In all of these capacities, Dorothy helps Missiles & Space to apply best practices and lessons learned from across Lockheed Martin and industry to meet immediate program needs and reduce risks.

**David Stofko, Executive Director of Systems Analysis and Software Engineering (SASE), Space Systems/Loral**

Mr. Stofko is responsible for hiring most of the new engineers for SASE.

**Aaron Shuman, Software Engineering Manager, Lockheed Martin Space Systems Co.**

Mr. Shuman was a manager in the Biosciences field for over 15 years and recently made a successful transition to the aerospace industry. He is responsible for managing and hiring software engineers for his division.

**Kris Tueller, LMSSC, LMSSC Tech Ops Sr. Mgr**

Ms Tueller is responsible for recruiting engineers for three divisions at Lockheed.

**Jon Pearce, Professor of mathematics and computer science, SJSU**

Dr. Pearce has won many awards including a NATO Fellowship. He has also served as Visiting Fulbright Scholar.

**Faysal Shaarani, MBA, Senior IT engineer, Data Warehousing Group, Cisco**

Shaarani is a senior IT engineer who has more than 10 years of technical and project management experience with Oracle Corporation. He currently leads cross-functional development projects with the Data Warehousing Group at Cisco Systems.

**John Dillard, MS, Senior lecturer, U.S. Naval Postgraduate School**

Mr. Dillard has served as a senior project manager and as a regional contract administrator for the Department of Defense. He was formerly the head of contract administration for the DOD in the New York metropolitan area.

**Claudia Dencker, President, SETT Corporation**

Ms Dencker has more than 25 years of experience in software testing and quality assurance working with teams who developed embedded systems, wireless and medical devices, client/server ERP systems and Web application products.

**Robert Printis, MS and Ph.D., Owner, Printis and Associates**

Dr. Printis has more than 30 years of experience in industry, including work at the IBM Thomas J. Watson Research Center, Bell Telephone Laboratories, and Xerox Palo Alto. His experience includes networking and telecommunications technologies as a contributor to many of the early networking and workstation products from Xerox. He also developed several successful embedded network switches and routing products.

**Siva Prasad (Sivaprasad Raghavareddy) MBA, MS, Owner, RK Pathy Services**

Mr. Prasad has extensive experience in Linux, open architecture systems and networking protocols. His recent work includes system design, BSP development using Linux and VXWorks and writing device drivers for embedded systems.

**Michelle Jackman, M.S.W., M.S., Owner, Michelle Jackman Enterprises**

Ms Jackman has provided consulting and training on service delivery, quality, employee retention and organizational development to clients including Cisco, Sun Microsystems, Oracle, AT&T, and Deckers. She also worked as a consultant for many years with the defense industry, most notably The Pentagon.

**Also consulted:**

Julie Hill  
Software Engineering Manager  
Rockwell Collins

Richard Marasas  
Operations Researcher, Senior Staff  
Technology, Planning and Analysis – Business Dev.  
Space Systems Company, Lockheed Martin

Dwight Wrench  
Senior Manager & Site Lead  
Computer Systems & Software Engineering (CS&SE)  
Lockheed Martin Space Systems Co.

Larry Gordon  
Advanced Software Applications Development  
Lockheed Martin Space Systems Company

Connie Alvarez  
LM Integrated Systems and Solutions  
Regional Staffing Lead

Linda Jensen  
NASA's Workforce Development Branch.

Jeanette Langdell  
Employment Training Manager  
NOVA

Cindy Stahl  
Training Counselor  
NOVA





## **Required Courses Descriptions**

### **Understanding Space: An Introduction to Astrodynamics and Space Systems**

X400.033 NATSC (1.5)

Many newcomers to the space field, although thoroughly grounded in their own disciplines, lack an in-depth understanding of the processes involved in designing and operating space systems. This course is designed to provide that in-depth fundamental understanding of astronautics. It provides the “big picture” to the entire space discipline.

The course outline includes:

- Why Space? (The big picture of why space is important and how the pieces fit together),
- Industry Trends (What the future holds),
- Exploring Space (History of early explorers and the coming of the space age),
- The Space Environment (What its like in space, key concepts and terms),
- Space System Design (Space system design is an iterative process),
- Understanding Orbits (Around the world in a day or less, key concepts, laws, and terms),
- Maneuvering in Space (Learning to get from here to there isn't always a straight line!),
- Interplanetary Travel (Conquering the final frontier, key concepts and terms),
- Payloads and Spacecraft Design (Focuses on remote sensing payloads and the spacecraft "bus"),
- Spacecraft Subsystems (What each part does and how they work together),
- Rockets (Fundamentals of propulsion systems and launch vehicles),
- Space Mission Operations (The expensive glue holding the mission together),
- Space System Cost (The real bottom line).

### **Real-Time Embedded Systems Programming**

X400.250 CMPS (3.0)

This course helps students understand how to design and implement multi-tasking applications (real-time and non-real-time). The course takes a "learn by doing" approach by focusing on programming projects. The student learns through experience rather than by memorization of abstract concepts. Topics covered include embedded hardware architectures and components (hardware background not necessary), the boot-up process, interrupts, how real-time operating systems work and why they are useful (includes RTOS internals),

real-time vs. non-real-time operating systems, state machine methodology, preemption vs. non-preemption, time-slicing, resource management, inter-task communication mechanisms, time-dependent errors, critical regions, priorities, semaphores, message passing, task instantiation, memory management, debugging techniques.

### **Relational Database Concepts using Oracle**

X400.446 CMPS (1.5)

This course introduces the students to the basic concepts of Relation Database design and focuses on the Oracle Relational Database Software, which is the platform for implementing applications based on the Relational Database Theory. Students will get to use the Oracle RDBMS 10G software. Students will have an opportunity to work on laboratory exercises to practice the ideas presented in lecture.

#### **Topics covered:**

- Relational Database Concepts
- E-R diagrams, Modeling
- Database Normalization
- Oracle RDBMS Architecture, Database Files, Instances
- Tables, Indexes, Views, Sequences, Constraints, Synonyms

### **Agile Modeling with UML**

X400.443 CMPS (3.0)

Agile Model-Driven Development (AMDD) is a methodology developed by Scott Ambler ([www.agilemodeling.com](http://www.agilemodeling.com)). Unlike heavyweight methodologies such as RUP, AMDD models allow developers to focus on code rather than documentation.

This course introduces requirements modeling, domain modeling, design modeling, and deployment/component modeling, and testing. The UML diagrams and design patterns relevant to each type of model will be covered in detail. The use of CASE tools to create and manage models will also be covered. Case studies will be presented. Students will have an opportunity to work on laboratory exercises to practice the ideas presented in lecture.

#### **Topics covered:**

- Review of object-oriented concepts
- Overview of UML modeling
- Requirements modeling
- Domain modeling
- Case studies

## **Software Quality and Testing of Embedded Systems**

X400.435 CMPS (2.0)

Embedded systems are special-purpose systems in which the computer is completely encapsulated by the device it controls. Different specialized embedded systems typically require different specialized test approaches. This course presents techniques, which assist in assembling suitable test approaches for these systems spanning both software and hardware. The course includes discussions of various planning methods, test tools, testing methodology and testing infrastructure. The student will learn how these elements work and how they are applied in practice. The course consists of lectures, slides with handouts, and class exercises.

## **Defense/Aerospace Project & Systems Acquisition Management**

X400.072 BUSAD (1.5)

This course is intended to be an introduction to the field of project and systems acquisition management. The primary objective of this course is to acquaint students with a broad basic overview of project management, within the context of the defense or aerospace industry, and the role of a project manager throughout the five primary processes of managing projects. This course is intended to enable participants to understand the intent of project plans, schedule and acquisition choices of the environment they will be working in, how to tell on an ongoing basis if this business purpose is being adequately served and what to do if they become aware that this business purposed is not being served.

This course also exposes private industry to the inner workings of US Defense systems acquisition management -- How the federal government designs and acquires material for our armed forces. Students will examine current policies, contractual processes, and program management concepts. Examples of successful developments, as well as failures, will be discussed.

- Requirements Determination
- Overview of the five primary project management processes
- How to write an effective project plan
- How to develop successful project schedules
- How to execute and control the project plan
- The "triple constraint" and how it affects the project manager
- Cost as an Independent Variable
- Understanding project phases and project life cycles
- Acquisition Players & Organizations
- Government Contracts - Pre-Award & Post-Award Activities

## **Essential Team Performance Skills**

X400.074 BUSAD (1.5)

In addition to technical skills, valued employees must also have team performance skills--the ability to build effective working relationships with

peers and contractors under all kinds of conditions, and within various types of projects. This course reviews the necessary skill sets and simulates the various types of teams so that participants can become valued members of project teams. You will learn what is expected and how you can excel.

**Topics Include:**

- **Your Team Role and Responsibilities:** How can you become a key player? Overview of possible team roles in the standard development cycle of products and services. The stages of team participation during the phases of team development and ways to increase your effectiveness and influence. Team performance evaluation. Why teams fail and how to prevent costly mistakes.
- **Skill sets of a key player:** Includes an audit of communication skills-- active listening, giving and receiving feedback, presenting ideas, e-mail and v-mail management.
- **Working on various types of teams:** Roles and expectations. Possible team roles will be compared and contrasted. Each one emphasizes a different skill set. Skills and behaviors critical to success will be discussed.