SJSU SIX SIGMA CERTIFICATE PROGRAM

The revolutions in lean manufacturing and quality have swept the world and broadened into the disciplines of lean enterprise and six-sigma. Six Sigma's emphasis is on improving existing capabilities. Six Sigma is a set of structured methodologies, problem-solving tools and advanced statistical methods for analyzing and improving processes, product designs and services on a broad range of metrics, especially cost, quality, time and variability. It moves beyond treating symptoms and short-term problems to the elimination of root causes, thereby emphasizing lasting improvement. To be effective, lean enterprise and Six Sigma require a guiding infrastructure of business strategy, business planning, enterprise leadership, program management, and team management. It also relies on a supporting infrastructure to enable change management and workforce training and development.

Students who acquire Six Sigma skills are extremely marketable in Silicon Valley's global environment. Hence, the ISE department has developed a new certificate in Six Sigma. The certificate is conveniently available to the ISE graduate students and local professionals. This certification is inexpensive when compared to certifications offered by the professional societies such as ASQ and IIE. Also, ISE graduate students specializing in the area of Production and Quality Assurance can fulfill the requirements of the Six Sigma certificate as part of their MS degree requirements. Requirements are ~~shown below.~~

Requirements for a Green Belt Badge Program

- Completion of ISE 250 - Leading the Six Sigma Improvement Project with a grade of B or better.

Requirements for a Black Belt Certification

- Completion of the following courses with a B or better:

  ISE 202 – Design and Analysis of Engineering Experiments

  ISE 235 - Quality Assurance and Reliability

  ISE 250 - Leading the Six Sigma Improvement Project

  ISE 251 - Orchestrating the Lean Enterprise Improvement Program

- Completion of real-world projects in ISE 202 and ISE 250. A joint project can be completed if a student enrolls in ISE 202 and ISE 250 concurrently.
- Completion of an open book exit exam with a passing grade of 75%.
- Satisfaction of a Probability and Statistics Prerequisite, such as ISE 130 or its equivalent.

Requirements for a MS ISE Degree in the Specialty Area Production and Quality Assurance (30 units)

Below shows how students specializing in the Production and Quality Assurance Area can fulfill the course requirements for the Six Sigma certificate as part of their MS degree.

Four Core Courses
ISE 200 – Financial Methods in Engineering
ISE 230 - Advanced Operations Research
ISE 235 - Quality Assurance and Reliability (six-sigma certificate)
ISE 298 - M.S. Project or ISE 299 – MS Thesis

Specialty Area 2: Production and Quality Assurance (Four out of Six Courses)
ISE 202 – Design and Analysis of Engineering Experiments (six-sigma certificate)
ISE 241 - Advanced Operations Planning and Control
ISE 245 – Advanced Supply Chain Engineering
ISE 250 – Leading the Six Sigma Improvement Project (six-sigma certificate)

ISE 251 – Orchestrating the Lean Enterprise Improvement Program (six-sigma certificate)
ISE 265 - Advanced System Simulation

TWO ELECTIVES: At least one graduate ISE course in other specialty areas/See Graduate Advisor

Course Topics

The specific Six Sigma topics that are included in each course of the certificate are shown on the following pages.

ISE 130: Engineering Probability and Statistics

I. **Six Sigma approach**
   A. **Process analysis and documentation**
      1. Techniques for assuring data accuracy and integrity
   B. **Probability and statistics**
      1. Basic probability concepts
      2. Descriptive statistics
      3. Graphical methods
      4. Central limit theorem and sampling distribution of the mean
      5. Drawing valid statistical conclusions
   C. **Collecting and summarizing data**
      1. Types of data
      2. Measurement scales
      3. Methods for collecting data
      4. Techniques for assuring data accuracy and integrity
   D. **Hypothesis testing**
      1. Fundamental concepts of hypothesis testing
         I. Statistical vs. practical significance
         II. Significance level, power, type I and type II errors
         III. Sample Size
      2. Point and interval estimation
      3. Tests for means, variances, and proportions
      4. Paired-comparison tests
   E. **Properties and applications of probability distributions**
      1. Distributions commonly used by black belts
      2. Other distributions

ISE 202: Design and Analysis of Engineering Experiments

I. **Importance of Six Sigma**
   A. **Value of Six Sigma**
      1. Quality improvement concepts
      2. Financial benefits

II. **Six Sigma approach**
   A. **Hypothesis testing**
      1. Fundamental concepts of hypothesis testing
         I. Statistical vs. practical significance
         II. Significance level, power, type I and type II errors
         III. Sample Size
      2. Point and interval estimation
      3. Tests for means, variances, and proportions
      4. Paired-comparison tests
      5. Goodness-of-fit tests
      6. Analysis of variance (ANOVA)
      7. Contingency tables
   B. **Properties and applications of probability distributions**
      1. Distributions commonly used by black belts
      2. Other distributions

III. **Quality improvement tools and techniques**
   A. Design of experiments (DOE)
      - ✓ Terminology
      - ✓ Planning and organizing experiments
      - ✓ Design principles
      - ✓ Design and analysis of one-factor experiments
      - ✓ Design and analysis of full-factorial experiments
      - ✓ Design and analysis of two-level fractional factorial experiments
      - ✓ Taguchi robustness concepts
      - ✓ Mixture experiments
      - ✓ Response surface methodology
      - ✓ Steepest ascent/descent experiments
      - ✓ Higher-order experiments
      - ✓ Evolutionary operations (EVOP)

ISE 235: Quality Assurance and Reliability

I. **Importance of Six Sigma**
    1. Six Sigma – basic premise
    2. Quality improvement concepts

II. **Six Sigma objectives**
    1. Measurement systems that are discriminate, repeatable, and reproducible
    2. Processes in statistical control
    3. Statistically capable processes
    4. Long term capability

III. **Six Sigma approach**
    A. **Process analysis and documentation**
        1. Data collection methods
        2. Multi-vari studies
    B. **Measurement systems**
        1. Measurement methods *(not now)*
        2. Measurement system analysis
        3. Metrology *(not now)*

IV. **Quality improvement tools and techniques**
    A. **Tools most commonly used in projects**
        1. Control charts
            - ✓ Rational subgrouping
            - ✓ Populations versus samples
            - ✓ Random sample
            - ✓ Analysis of control charts
        2. PRE-control chart
    B. **Tools to address challenging situations**
        1. Advanced statistical process control
    C. **Process capability and performance**
        1. Process performance vs. specification
        2. Calculate process potential
        3. Process performance indices
        4. Design for Six Sigma (DFSS) in the organization *(not now)*

ISE 250: Leading the Six Sigma Improvement Project

I. **Importance of Six Sigma**
   A. Six Sigma – basic premise
   B. Goals of the lean enterprise

II. **Methodology**
   A. DMAIC
   B. Utility of a standard methodology

III. **Define**
   A. **Project management**
      1. Project charter and problem statement
      2. Charter negotiation
      3. Project planning tools
      4. Project documentation
      5. Project metrics
      6. Project tracking
      7. Project risk analysis
      8. Project closure
   B. **Team management**
      1. Initiating teams
      2. Selecting team members
      3. Team stages and dynamics
      4. Roles and responsibilities
      5. Team tools
      6. Team facilitation techniques
      7. Teambuilding
      8. Team performance evaluation
      9. Motivation techniques
      10. Communication
      11. Negotiation and conflict resolution techniques
   C. **Change management**
      1. Managing change
      2. Organizational roadblocks
   D. **Voice of the customer**
      1. Customer focus
      2. Owners and stakeholders
   E. **Process thinking**
      1. Process mapping (flowcharts)
      2. Value stream mapping
      3. Identify key process input variables and process output variables (SIPOC), and document their relationships through relational matrices, etc.

IV.

Measure

A. **Voice of the customer**
    1. Collect customer data
    2. Analyze customer data
B. **Key process and product/service parameters**
C. **Pareto chart**

V. **Analyze**

A. **Process map analysis**
    1. Value-added and non-value-added activities
    2. Characterize the classic wastes
    3. To-be flowchart
B. **Failure mode and effects analysis (FMEA)**
C. **Ishikawa tools**

VI. **Improve**

A. **Solution brainstorming**
B. **Lean solutions**
    1. Visual workplace/factory
    2. Standard operating procedures
    3. 5-s
    4. Error proofing/Mistake proofing/Poka yoke
    5. Audits
    6. Quick changeovers/single minute exchange of dies (SMED)
    7. Total productive maintenance (TPM)
    8. Level production
C. **Solution prioritization**
D. **Pilots**
E. **Implementation planning and execution**

VII. **Control**

A. **Control charts**
B. **Scorecards**

ISE 251: Orchestrating the Lean Enterprise Improvement Program

I. **Strategic capabilities**
   A. **Core capabilities**
   B. **Drivers and metrics**
      1. Revenue
      2. Cost
      3. Experience curve
      4. Quality
      5. Time
      6. Complexity
      7. Variance
      8. Uncertainty

II. **Improvement paradigms**
   A. **Lean**
   B. **Six Sigma**
   C. **Theory of Constraints**
   D. **Reengineering**
   E. **Benchmarking**
   F. **Voice of the customer (Quality Function Deployment/House of Quality)**

III. **Program management**
   A. **Program organization**
   B. **Project prioritization**
   C. **Managing uncertainty**
   D. **Kaizen blitz events**
   E. **Hoshin planning/stretch goals**

IV. **High-performance organizations**
   A. **Work groups**
   B. **Motivation**
   C. **Performance management**
   D. **Reward systems**