Catalog Description
Design of a complete industrial system including quality function deployment, technology trends, financial analysis, functional specifications, process design, production capability, quality management, manufacturing resource planning, equipment requirements, human resource management, management information systems, facility design, and project management.

Course Description
This course is the second course in a two-semester sequence in which each student will work in a group of 2 – 5 on a specific design project in Industrial Engineering. In the College of Engineering at SJSU, we believe that it is critical that engineering students integrate the GE student learning outcomes into their engineering studies. In your senior project course and the Engr 195A course, you will be challenged to understand the relationship of engineering to the broader community both in the U.S. and worldwide. In addition to the assignments in Engr 195A, the engineering faculty have created linked activities in your senior project course that allows you to apply these concepts to your engineering discipline.

Prerequisites: IE 140 and ISE 195A (with grade of “C” or better).

Corequisite: Engr 195B

Required Textbooks: None

Additional Materials:
Handouts, etc. to be provided as needed on website or in class

Student Learning Objectives
Upon successful completion of this course, students will be able to:
1. Integrate all ISE material through emphasis in different parts of the capstone senior design course in solving a real-world problem
3. Demonstrate the ability of designing a complete process, and the facility, resources, and organizational elements necessary to produce it
4. Evaluate relative economic merit of alternative processes
5. Develop and maintain project schedule.
6. Make an effective formal oral and written presentation
7. Describe the social and global impact of engineering on society
8. Discuss the role of the impact of US culture on other cultures, and how cultures outside the US, affect US culture with respect to technology (Integration of GE Area V and Engineering)
Student Learning Objectives for Area V of SJSU Studies (Advanced GE)

V-LO1: compare systematically the ideas, values, images, cultural artifacts, economic structures, technological developments, and/or attitudes of people from more than one culture outside the U.S.

- ENGR 195B Essay 3: Write an essay that compares the ideas, values, technological developments, and/or attitudes of people from at least two different countries outside the US. Your essay must focus on renewable energy and one of your countries in your essay must be from your article (see details on individual assignment) (1000 words).
- ISE 195B Paper 2: An article from the designated Industrial Engineer magazine that compares strategies and ideas from other countries outside of the US in regards to their economic structures, technological developments, and/or attitudes. (500 words).
- ISE 195B Senior design project: In regards to your senior design project, address the human, social, and cultural barriers that may result in difficulties implementing your project in a country outside of the United States. (minimum 1500 words)

V-LO2: identify the historical context of ideas and cultural traditions outside the U.S. and how they have influenced American culture

- ENGR 195B Essay 1: Choose one of the following technological developments that were discussed in the web tutorial: the mechanical clock, gunpowder, the Great or Jersey wheel, printing, or the compass. Write an essay that addresses the following topics. When you respond to these topics, you should be specific and cite specific details either from the web tutorial or your own research. You should cite specific events and/or cultures as you answer these questions. (minimum length 500 words).
  - Discuss the history of the technology from its early beginnings to the Renaissance. Please discuss at least three different events in the history of the mechanical clock.
  - Describe one force (e.g., historical, cultural, social, economic, political) that affected the development of the technology?
  - How did the development and use of the technology affect Europe in the Middle Ages?
  - Overall, how did the technology affect the United States?
- ISE 195B Essay 1. Consider the history of Total Quality Management (TQM) which was developed in Japan. (a) Describe the cultural and social factors that led to the “invention” of TQM (b) How has the TQM management philosophy affected U.S. manufacturers? (250-500 words)

V-LO3: explain how a culture outside the U.S. has changed in response to internal and external pressures.

- ENGR 195B Essay 2: Imagine you are part as part of a group of Engineers to Guatemala at the request of Habitat for Humanity. You have been hired to come up with a plan that will alleviate or at least mitigate the effects of Hurricane Stan on the Mayan communities in the Highlands. When thinking about your plan, you must consider all angles of the problem (for example, language barriers, culture, disease, landforms, seasonal weather, transportation, building materials, distrust and fear, etc.) (1000 words)
- ISE 195B Reflection Paper: Assume your project has turned into a successful company in the US, describe how your product will put pressure on a culture outside the US. (You have to choose a specific country.) Use the social and cultural processes introduced in ENGR195A&B to guide your answer. (500-750 words)
Course Requirements

Students will work in assigned teams and will meet with the course instructor once per week at a scheduled meeting time. All team members are required to attend each meeting. Class sessions may also be scheduled, a schedule to be determined. Weekly presentations of assigned project content requirements. Cumulative presentation of project results. Final project report. An ISE Culminating Exam, developed by faculty with the assistance of industry professionals, will be administered near the end of the semester on a date to be scheduled. The exam will consist of both written and oral sections.

Grading Information

Individual Participation: 45%
- GE Assignments 25%
- Symposium Attendance 5%
- 1st presentation 5%
- Project presentation 10%

Team Project: 40%
- Report contents 35%
  (Must address GE SLO as Stated above)
- Team presentation 5%

ISE Culminating Exam: 15%

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of forty-five hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

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Grading Percentage Breakdown

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<td>89% - 87%</td>
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Dropping and Adding
Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester’s Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic calendar web page located at http://www.sjsu.edu/calendars/.

The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/. Students should be aware of the current deadlines and penalties for dropping classes. Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/

University Policies
Academic integrity
Students should know that the University’s Academic Integrity Policy is available at http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf. Your own commitment to learning, as evidenced by your enrollment at San Jose State University and the University’s integrity policy, require you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The website for Student Conduct and Ethical Development is available at http://www.sa.sjsu.edu/judicial_affairs/index.html.

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person’s ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include in your assignment any material you have submitted, or plan to submit for another class, please note that SJSU’s Academic Policy F06-1 requires approval of instructors.

Campus Policy in Compliance with the American Disabilities Act
If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the DRC (Disability Resource Center) to establish a record of their disability.

Additional Policies or information required by the department, or college
Participation and attendance at scheduled meetings is mandatory. Students who miss more than 3 scheduled meetings during the semester or 2 scheduled meetings consecutively (Except in the cases of medical or family emergency or pre notification of an anticipated absence due to illness or family crisis) will be given an F grade for the class. Team meetings are scheduled for 45 min. Meetings will not begin until all team members are present, and will end at the scheduled end time so the following team has their full time for discussion.

Dropping and Adding
Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester’s Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current
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Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

SJSU Writing Center
The SJSU Writing Center is located in Room 126 in Clark Hall. It is staffed by professional instructors and upper-division or graduate-level writing specialists from each of the seven SJSU colleges. Our writing specialists have met a rigorous GPA requirement, and they are well trained to assist all students at all levels within all disciplines to become better writers. The Writing Center website is located at http://www.sjsu.edu/writingcenter/about/staff/.

Technology Resources
Computer labs for student use are available in the Academic Success Center located on the 1st floor of Clark Hall and on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library.

A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include digital and VHS camcorders, VHS and Beta video players, 16 mm, slide, overhead, DVD, CD, and audiotape players, sound systems, wireless microphones, projection screens and monitors.

GUIDELINE CHECK LIST TO EVALUATE PROJECT REPORT (Not all sections must be included use only as guideline as appropriate to your project)
(D: description, T: table, F: figure)
TABLE OF CONTENTS (required)
TABLE OF FIGURES (required)
TABLE OF TABLES (required)

EXECUTIVE SUMMARY (required)
D-One page summary to the executive board members including mission, vision, goals, objectives, and critical success factors

1.0 MARKET RESEARCH

1.1 Current Products Review (for three competing products and your own)
D-Highlights of current products
T- Comparison of different products with their features, and prices

1.2 Manufacturers Profiles (for three competing products and your own)
D-Company highlights
T- For each company, lists its name, address, employee numbers, description of business, strengths and weaknesses, and financial summary over past 3-5 years
F- Summary of current shares of the industry
F- Summary of proposed market share of your company

1.3 Customer Values Assessment
1.4 Functional Description
D-Unique functions of individual products
F- Key functions of your product
T- Comparison with products from other manufacturers on key functions

1.5 Technology Trends (for the product class)
D-Summary of key product features
D-Trends of functions, costs, quality, delivery, and service
T-Weight, dimensions, interfaces, power ranges and requirements, environmental range, etc.
F- Trends of key product features
F-Technology and market progress over time

2.0 PRODUCT DESCRIPTION

2.1 Product Drawings
D-Summary
F- Drawings (photos OK) of finished product (level 0 on BOM)
F- Drawings (CAD drawings) of sub-assemblies (level 1 on BOM) [Isometric p39, Fig 2.10]
F- Drawings (CAD drawings) of other key components
F- Drawings (CAD drawings) assembly drawing of product [p39, Fig 2.9]

2.2 Bill of Materials
D - Summary
F - Multilevel tree structure [p392, Fig 11.3] (including options and features)
T - Indented BOM

2.3 Materials, Suppliers, and Supply Chain
T- Supplier selection criteria
T- Assessment of supplier capability
T- Value chain analysis
F- Supply chain management
T- Material sources: BOM vs. vendor
T- Planning BOM in matrix format: part vs. description, U/M, and models

3.0 BUSINESS PLAN

3.1 Product/Process Life Cycle
D-Forecasting methodologies and assumptions
T- Forecasting calculations
F- Life cycles for individual product: volumes (or revenue) vs. time
3.2 Cost/Pricing/Volume/Profit
D-Summary, assumptions and equations
T- For individual product: volume, unit price, unit cost, and gross profit vs. time

3.3 Financial Statements (for your product)
D-Summary, assumptions, procedure
T- Pro forma income statement for each quarter
T- Pro forma balance sheet for each quarter
T- Pro forma cash flow statement for each quarter

4.0 PROCESS DESIGN

4.1 Methods and Technologies
D-Product position strategy (make-to-stock, assemble-to-order, make-to order) Process position strategy (flow shop, job shop, fixed site) Technology choices (EDI, CAD, CAPP, CAS&MP, CAM, CAI, GT, FMS) Operations planning and control methods (MRP, ROP, JIT, CFM, TOC)
T-Manufacturing strategy for each year (market characteristics, manufacturing task, manufacturing features, master production schedule, detailed material planning, shop-floor systems)

4.2 Routing/Operations Sheets
D- Summary
F- Assembly Charts [p137, Fig 5.1]
F- Assembly charts for scheduling production [p137, Fig 5.2]
F- Operation process chart [p138, Fig 5.3] [p33, Fig 2.8]
F- Production routing sheet [p140, Fig 5.5]

4.3 Production Capacity
D-Assumptions, input variables, summary
D-Line balancing, definitions of lead-time, cycle-time, yield, and throughput [p56]
T- Production requirements from forecasting
T- Required production capacity for each work center (Rough cut plan)

4.4 Process Flow
D-Summary
F- Flow Chart of Overall Process
F- Work Place Diagram (CAD Drawing) Work Flow Diagram [p39, Fig 2.13, 2.14]
F- Material Flow Process Chart for major operations [p144, Fig 5.9] [p37, Fig 2.11]
F- Material Flow Process Chart for rework operations
F- Material Flow Process Chart for sub-assemblies

5.0 PRODUCTION RESOURCES

5.1 Machines and Equipment (Production/MFG only, no Material Handling)
D-Equipment grouped in areas, assumptions for life cycle economic evaluation
T-Life cycle economic evaluation: alternatives vs. costs (operation, maintenance, etc.)
T-Life cycle economic evaluation: alternatives vs. net present values
T-Capital expenditures over time: equipment vs. quantity, cost
T- Depreciation of machines and equipment
T- Computers and controllers (PCs, PLCs CNC/NC controls)
5.2 Labor Requirement  (Linear Programming solution)
D- Linear program formulation and results, sources of cost data, assumptions in cost data tables,
T- Input cost data: Demand Forecast per quarter, Cost of Hiring an Employee, 
     Cost of Firing an Employee, Cost of labor for regular time, Cost of Labor for Overtime, 
     Cost of Labor for Idle time, Cost per hour of Carrying Inventory per period, 
     Cost per hour of a unit of backorder per period, 
T - Initial inventory level, initial number of employees, Total number of regular hours available per quarter. 
F - Math formulation of aggregate production planning problem for Q1, 
D - Results of solving aggregate problem formulation for Quarters 1- 4 of the first year 
T- Production Plan for first 4 quarters to meet forecasted demand that minimizes total inventory holding and backorder costs, Total cost of your production plan for each quarter, 
   production quantity per quarter, ending inventory Per quarter, number of units backordered each quarter. 
T- Values of all variables in the formulated problem for Quarters: 1- 4.

5.3 Material Handling – Mfg (conveyers, carts, trolleys, roller-rack/bin systems) [p100]
T- Machine to Machine Material Handling Table
D-Equipment grouped in areas, assumptions for life cycle economic evaluation 
T-Life cycle economic evaluation: alternatives vs. costs (operation, maintenance, etc.) 
T-Life cycle economic evaluation: alternatives vs. net present values 
T-Capital expenditures over time: equipment vs. quantity, cost 
T- Depreciation of material handling equipment

6.0 FACILITY DESIGN
6.1 Facilities and Plant Layout
D-Decision procedure, assumptions, justifications 
T- Production area space requirements [p437, Table 12.1] 
T- Office space requirements [p438, Table 12.2] 
T- Facility space requirements [p437, Table 12.1] 
T- Relationship chart priority codes [p438, Table 12.3] [p114, Table 3.3] 
T- Activity Relationship chart [p438, Table 12.4] [p113, Table 3.20] 
T- Value chart [p444, Table 12.14] 
F- Nodal diagram [p445, Table 12.4, 12.5] 
T- Block calculations [p445, Table 12.15] 
F- Block diagram of layout (CAD diagram) [p449, Table 12.12] 
F- Plant layout: production area layout (CAD diagram) 
F- Plant layout: plant site layout (CAD diagram) [p466, Table 12.20]

6.2 Material Handling – Overall Facilities (lift trucks, conveyer, hand trucks, etc.)
D-Equipment grouped in areas, assumptions for life cycle economic evaluation 
T-Life cycle economic evaluation: alternatives vs. costs (operation, maintenance, etc.) 
T-Life cycle economic evaluation: alternatives vs. net present values 
T-Capital expenditures over time: equipment vs. quantity, cost 
T- Depreciation of material handling equipment

6.3 Inbound Storage and Warehousing
D-Storage policy, functions, location, size, staffing, operations, and performance 
F- Material Flow Chart
7.0 MANAGEMENT PLANNING

7.1 System Simulation
D- Modeling objectives, Input variables, Assumptions, formation, explanation of model outputs, validation methodology
T- Work center reliability – mean of exponentially distributed time between failures, mean of exponentially distributed repair time for each work center
T- Product processing time at each work center
T- Standard deviation of product processing times
T- Travel time to/from each work station
T- Routings of the product
T- Setup times at each work center – min per lot
T – Output results: manufacturing cycle time, Throughput, total cost
T – Validation results
T - WIP, utilization
F – Simulation model layout

7.1A Design of Experiment
D – DOE objectives and approach
T – Experimental design (vary 3 input variables at 2 levels – Response variable selected from Output result list above)
T – Results of DOE analysis

7.2 Financial Analysis
D-Summary and Equations
T- Loan amortization schedule
T- Depreciation schedule
F- Learning curve effects: variable costs vs. time (Engr Econ p53-54)
T- Ratio analysis: ratios (ROI, IROR, ROA) vs. time (Engr. Econ Analysis)
F. Break-even-point analysis: revenue and cost vs. volume

7.3 Computer Information System (handout)
D-Applications: CAD/CAM, MRP, AP/AR/GL/PR
D-Planning, analysis, design, implementation, and support phases
F-Data modeling: entity relationship diagrams
F-Process modeling: data flow diagrams
F-Network modeling: connectivity diagrams
T- Hardware and software configurations

7.4 Quality Assurance
D-Principles and implementation plan of TQM
D-Quality assurance plan with SPC, process capability and design of experiments D-Plan for ISO 9000 registration
D-Quality assurance manual including supplier relations, manufacture, inspection, test, measurement, field performance, and customer service

7.5 Manpower and Organization
D-Management philosophy, corporation culture, and organization styles
7.6 Implementation Schedule
D-Decision procedure, assumptions, justifications
F- Start-up implementation schedule - Gantt, CPM/PERT charts [p26-27, Fig 2.4]

7.7 Global Implementation
In regards to your senior design project, address the human, social, and cultural barriers that may result in difficulties implementing your project in a country outside of the United States.

REFERENCES
D-Textbooks, articles, company reports, Internet home pages

APPENDICES
T- Detailed tables
F- Detailed figures

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<th>Class Plan</th>
<th>HW #</th>
<th>Assignment</th>
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<tr>
<td>1</td>
<td>Intro: project topics, pick groups</td>
<td>HW 1</td>
<td>IE Magazine Individual Analysis (Article 1)</td>
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<td>2</td>
<td>IE Article small group discussion; relate to Area V questions list</td>
<td>HW 2</td>
<td>Site Meeting Review, highlight Area V questions</td>
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<tr>
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<td>Weekly Update</td>
<td>Ongoing project work; begin project update for weekly meetings</td>
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