KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B100 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B100
2. Course Title: Industrial Design Graphics I
3. Course Author(s): Jason Dixon

4. Course Catalog Description: The application of two-dimensional industrial design techniques (sketching, drafting, and Computer Aided Drafting) taught within the context of automation and process design. Students will gain design and management skills while generating process flow diagrams (PFD’s), piping & instrumentation diagrams (P&ID’s), and control panel layouts.

5. Grading Method:
   Optional: S = Standard Letter
   none

6. Total Units: 3

7. Method of Delivery:
   (face-to-face, hybrid, and/or online) Face-to-Face; Hybrid

8. Instructional Methods:

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<th>Min Units</th>
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<td>Lecture</td>
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9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

   1. Create a process flow diagram (PFD) using AutoCAD for a given systems design scenario. (B.S. PLO 4, ILO 3, Course Objectives 1, 5)
2. Create a piping and instrument diagrams (P&ID) using AutoCAD for a given instrumentation and process control design scenario. (B.S. PLO 4, ILO 3, Course Objectives 1, 4)

3. Design an instrumentation control panel and create AutoCAD diagrams and drawings for the designed panel using parameters and specifications provided by the instructor. (B.S. PLO4, ILO 3, Course Objectives 1, 3)

4. Create an electrical ladder diagram that represents a given control system example. (B.S. PLO 4, ILO 3, Course Objectives 1, 2)

Course Objectives: This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Use the elemental functions of AutoCAD, including navigating through the user interface, to create two-dimensional technical diagrams, flowcharts, and drawings.

2. Recognize the elements of a code-compliant ladder diagram, installation documentation including conduit runs and electrical raceway, and the common ladder diagram symbols used in ladder and industrial electrical diagrams.

3. Develop accurate documentation, and understand the elements of a successful panel design. Understand the entire process of managing control panel and control systems projects.

4. Recognize the elements of a piping diagram system, including the common piping and process instrumentation symbols.

5. Develop accurate process flow diagrams, piping and instrument diagrams (P&ID’s) and control flowcharts using standard symbols and guidelines. Create symbols when needed.

16. Requisites

   Prerequisite(s): ELET B56a
   OR
   ELET B56
   AND
   Admission to Industrial Automation Bachelor’s Degree program

   Advisory: None

17. Detailed Topic Outline (including instructional time devoted to each topic):

   Lecture: 36 hours

   Unit 1: Introduction to AutoCAD (25% of instructional time)

   1.1 Navigating the user interface
1.2 Creating, opening, and saving drawings
1.3 Draw and modify commands
1.4 Coordinate systems: absolute, relative and polar coordinates
1.5 Printing and plotting
1.6 Drawing setup, units, limits, layers, and snap modes
1.7 Placing and modifying text, using the text editor
1.8 Re-using information between drawings
1.9 Adding complex objects and raster images
1.10 Drawing and plotting at different scales

**Unit 2: Instrumentation & Controls Design (25%)**

2.1 National Electrical Code
2.2 Ladder Diagrams
2.3 Instrument details and locations.
2.4 Raceways and boxes

**Unit 3: Panel Design and Project Management (12.5%)**

3.1 Drawing status
3.2 Schedules
3.3 Punch lists
3.4 Material Take offs.
3.5 Bill of Materials

**Unit 4: Overview of Pipe Drafting (18.75%)**

4.1 Valves and Instrumentation
4.2 Pumps, Tanks, Vessels, and Equipment

**Unit 5: Flow diagrams (18.75%)**

5.1 Function of flow diagrams
5.2 Equipment
5.3 CAD Symbol creation
5.4 Piping & Instrumentation Diagrams (P&ID’s)

**Lab: 54 hours**

This course is designed to use AutoCAD for industrial automation and process control. Students will utilize the latest version of AutoCAD and AutoCAD Electrical. Coursework is designed to logically and sequentially develop skills necessary to effectively manipulate the software to produce industry-quality drawings and illustrations for technical documentation and presentations. During the lab session each week, students will work through guided practice and independent application of the concepts introduced in lecture. There will be approximately 3 hours of lab each week.

**18. Methods of Instruction:**

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Laboratory Assignments (CAD drawings)
11. Lab Practical (as able)
11. Field Trips (optional)

19. Outside of Class Assignments:
Outside of class assignments may include, but are not limited to:

Students will be required to complete a design project incorporating elements of this class and ELET B56a “Instrumentation and Process Control”. Students will be given a customer request for quote (RFQ) for a system control panel. Working in teams, students will design a system based on the RFQ requirements and their knowledge and experience from the Industrial Automation program. Students will present their results and answer customer questions as part of the final exam.

20. Methods of Evaluation:
Assessment of student performance may include but are not limited to:
1. Drawings and Symbol Libraries
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

21. Texts, Readings, and Materials:

Required Textbook(s):

AutoCAD course pack – instructor created

Assigned Readings:
None identified

Manuals:
None required

Software:
None required

Other:
None identified

22. Approvals:
Curriculum Committee Approval Date: 10/29/2015
Board of Trustees Approval Date: 12/17/2015
State Approval Date: 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B101 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B101
2. Course Title: Industrial Design Graphics II
3. Course Author (s): Jason Dixon
4. Course Catalog Description: The application of three-dimensional industrial design techniques taught within the context of automation and process design. Students will utilize mechanical Computer Aided Drafting software (SolidWorks/Inventor) to design weldments, piping/conduit systems, and sheet metal assemblies. Design projects will emphasize technical and project management skills.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:

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9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

   1. Design a process piping system and create MCAD drawings for the designed piping system using parameters and specifications provided by the instructor. (B.S. PLO 4, ILO 3, Course Objective 1)
2. Design an instrumentation process system “skid”, create MCAD drawings for the skid, and complete a project proposal, including a detailed components and equipment list, using parameters and specifications provided by the instructor. (B.S. PLO 4, ILO 3, Course Objectives 1, 4)

3. Prepare a sheet metal detail drawing and folding plan using appropriate CAD software for an instructor-assigned project. (B.S. PLO 4, ILO 3, Course Objectives 1, 3)

4. Apply the correct welding symbols to a weldment drawing using appropriate CAD software according to the parameters and specifications provided by the instructor. (B.S. PLO 4, ILO 3, Course Objectives 1, 2)

**Course Objectives:**

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Use MCAD software, including understanding the various functions and how to use them for parts modeling, assembly modeling, and detail drawings.

2. Understand the elements necessary for steel structure design, including structural steel profiles, weldments/welding processes, and related structural steel design elements. Correctly interpret welding symbols and be able to develop cut sheets for structural projects.

3. Understand the processes and tools used to fabricate sheet metal enclosures, and utilize the MCAD software sheet metal design tools and functions to create appropriate documents.

4. Apply the various skills necessary for the design of a comprehensive project, in this case a “skid system” having components of instrumentation and controls (I&C), conduit design, and the overall physical structure of the system. Develop a cost estimate and complete the required document for the designed system.

**16. Requisites**

*Prerequisite(s):*

INDA B100

AND

Admission to Industrial Automation Bachelor’s Degree program

*Advisory:*

None
17. Detailed Topic Outline (including instructional time devoted to each topic):

**Lecture: 36 hours**

**Unit 1: Introduction to MCAD software (25% of instructional time)**

1.1 Parts modelling and editing  
1.2 Assembly modelling and editing  
1.3 Detail drawing  
1.4 Printing and plotting

**Unit 2: Steel Structure Design (25%)**

2.1 Structural steel profiles  
2.2 Weldments and weldment design with MCAD software.  
2.3 Weld symbols.  
2.4 Cut sheets.

**Unit 3: Sheet Metal Enclosures (25%)**

3.1 Introduction to sheet metal tools and procedures.  
3.2 Sheet metal enclosure design principles.  
3.3 Sheet metal design tools within MCAD software.

**Unit 4: Skid System Design Project Management (25%)**

4.1 Determining customer requirements.  
4.2 Instrumentation and Control (I&C) modeling using manufacturer downloads.  
4.3 Electrical conduit design using MCAD,  
4.4 Project cost estimation and documentation.

**Lab: 54 hours**

This course is designed to use 3D solid modeling, also known as mechanical CAD or MCAD, for the design of process control systems. Students will utilize the latest version of Autodesk Inventor or SolidWorks. Coursework is designed to logically and sequentially develop skills necessary to effectively manipulate the software to produce industry-quality drawings and illustrations for technical documentation and presentations. During the lab session each week, students will work through guided practice and independent application of the concepts introduced in lecture. The coursework will equip students with the skills necessary for a final design project integrating weldment design, sheet metal design, electrical conduit and piping design, and project planning based on a customer’s request for proposal (RFP). There will be approximately 3 hours of lab each week.

18. Methods of Instruction:  
1. Lecture  
2. Demonstration  
3. Active Learning  
4. Discussion  
5. Guest Speakers  
6. Instruction through Examination and Quizzing  
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Laboratory Assignments (CAD drawings)
11. Lab Practical (as able)
11. Field Trips (optional)

19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

Students will be required to complete a design project incorporating elements of this class and INDA B100 “Industrial Design Graphics I”. Students will be given a customer request for quote (RFQ) for a skid-mounted instrumentation and control system. Working in teams, students will design a system based on the RFQ requirements and their knowledge and experience from the Industrial Automation program. Students will present their results and answer customer questions as part of the final exam.

20. Methods of Evaluation: Assessment of student performance may include but are not limited to:

1. Drawings and Symbol Libraries
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

21. Texts, Readings, and Materials:

   Required Textbook(s):
   AutoCAD course pack – instructor created

   Assigned Readings: None identified

   Manuals: None required

   Software: None required

   Other: None identified

22. Approvals:

   Curriculum Committee Approval Date: 10/29/2015
   Board of Trustees Approval Date: 12/17/2015
   State Approval Date: 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B105 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B105
2. Course Title: Materials Science for the Technician
3. Course Author(s): Jason Dixon

4. Course Catalog Description: An introduction to materials science for technicians and technologists. Topics to be presented include atomic structure of materials, electrical and mechanical properties, properties testing, basic metallurgy, corrosion and wear, and materials selection. Materials covered include ceramics, polymers and composites, steels, and nonferrous metal alloys. Students will also be introduced to processes including heat treatment, surface treatments, polymer manufacturing, and composite fabrication.

5. Grading Method: S = Standard Letter
   Optional:
   none

6. Total Units: 3

7. Method of Delivery: Face-to-Face; Hybrid
   (face-to-face, hybrid, and/or online)

8. Instructional Methods:

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9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor of Science degree
   Restricted Elective: None
   Elective: None

15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

   1. Select appropriate industrial materials for technical applications based on an analysis of operational requirements of an instructor-
Course Objectives: This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Categorize the types of materials, including the specific atomic, chemical, physical, mechanical, and electrical properties unique to them, as well as the general processes used to create them.

2. Understand the characteristics, uses, and manufacturing methods for polymers, plastics, composite, ceramics, as well as ferrous and non-ferrous metals.

3. Understand the importance of and the basic elements of tribology (the control of friction, wear, and heat through the use of components such as bearings and bushings, and the application of lubricants) as it relates to materials use, manufacturing processes, and overall equipment function and lifespan.

4. Understand the nature of corrosion, and the various types of surface coatings that are used to prevent or limit its effects.

5. Understand the processes and considerations that determine the selection of materials used in products.

Prerequisite(s):

- (PHYS B2A OR PHYS B4A) AND (MATH B1A OR MATH B2 OR MATH B6A) AND Admission to Industrial Automation Bachelor’s Degree program
17. Detailed Topic Outline (including instructional time devoted to each topic):

Lecture: 36 Hours

Unit 1: Introduction (6.25% of instructional time)

1.1 Types of Materials
1.2 Modern material needs
1.3 Relationship between structure, processing, and properties

Unit 2: Elements and Engineering Materials (6.25%)

2.1 The Periodic Table of the Elements
2.2 Metals
2.3 Ceramics
2.4 Polymers
2.5 Composites

Unit 3: Properties of Materials (6.25%)

3.1 Atoms and Bonding
3.2 Chemical Properties
3.3 Physical Properties
3.4 Mechanical Properties
3.5 Electrical Properties

Unit 4: Tribology (6.25%)

4.1 Friction and Wear
4.2 Bearings
4.3 Lubricants
4.4 Preventing wear failures

Unit 5: Corrosion (6.25%)

5.1 Causes of and factors affecting corrosion
5.2 Types of corrosion
5.3 Corrosion Control
5.4 Preventing corrosion failures

Unit 6: Polymers (12.5%)

6.1 The nature of polymers
6.2 Properties of basic polymers
6.3 Controlling polymer properties

Unit 7: Plastics and Composite Fabrication Processes (18.75%)

7.1 Thermoplastics
7.2 Thermoset plastics
7.3 Plastics manufacturing processes
7.4 Polymer composites fabrication
7.5 Plastics recycling

Unit 8: Ceramics (6.25%)

8.1 The nature of ceramic materials
8.2 Ceramics manufacturing processes
8.3 Properties of ceramics
8.4 Applications of ceramic materials

Unit 9: Ferrous Metals (12.5%)

9.1 Steel Products
9.2 Carbon steel alloys
9.3 Tool steel alloys
9.4 Stainless steel alloys
9.5 Cast iron
9.6 Heat treatment

Unit 10: Nonferrous Metals (12.5%)

10.1 Copper
10.2 Aluminum
10.3 Nickel
10.4 Titanium
10.5 Magnesium

Unit 11: Surface Coatings (12.5%)

11.1 Organic coatings
11.2 Electroplating
11.3 Other metallic plating
11.4 Thin film coatings
11.5 Hard-facing
11.6 Coating selection

Unit 12: Material Selection Process (12.5%)

12.1 Performance Requirements
12.2 Candidate materials
12.3 Cost Considerations

Lab: 54 hours

A representation of the types of lab activities that could be implemented as the materials and equipment for the course is purchased:

Orientation and Safety Training
Fatigue Testing
Thermoplastic Processes
Tribology Testing
Case Hardening
Heat Treatment of Steel
Heat Treatment of Aluminum
Tensile Testing
Hardness Testing
Composite Fabrication
Corrosion Testing
Design Project

18. Methods of Instruction:
1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Laboratory Assignments
11. Lab Practical (as able)
12. Field Trips (optional)

19. Outside of Class Assignments:
Outside of class assignments may include, but are not limited to:

Oral Presentations
Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics:

1) Choose from a number of manufactured products, including helmets, aircraft, non-paper/cardboard containers, trucks and automobiles, and others. Research recent advances in materials choice for the particular product, explaining those advances, the reason(s) for choosing the material(s), any evaluation or testing performed and the results of that evaluation, and provide your own predictions for future improvements in that product in terms of materials used.

2) Choose a container (for food and beverages, fluids and chemicals, or long-term storage of hazardous materials) and provide the material(s) of choice, and the various methods of strengthening, pressure containment, ability to handle temperature and pressure changes, and other methods of improvement you would choose to provide a viable product.

Writing/Research Assignments
Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topic:**

1) Selecting a material type from a list of suggestions, perform research on the particular material, providing the following information: a) Cost versus performance, b) Unique characteristics of that particular material in comparison to materials of the same family, c) Manufacturing and Usage requirements that may be unique or challenging for the material, and, d) Recent or eminent advances in that particular material. A three to five page research paper using correct formatting and style will be the product of the assignment.

**Application/Problem Solving/Synthesis**

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Given a particular scenario, choose a material type that will perform as required for the particular product or item for which the scenario prescribes. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

2) Provided a list of specifications, research and choose a particular material that will perform as required. Justify your choice in terms of: cost, durability, physical and chemical properties, ease of manufacturing, aesthetics, and plant safety (i.e.: if the material requires special handling, additional safety precautions, and/or special logistical concerns. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

3) Choose a surface coating that meets the requirements of a particular product. Justify your choice in terms of: cost, durability, physical and chemical properties, ease of application/processing, aesthetics, and plant safety (i.e.: if the material requires special handling, additional safety precautions, and/or special logistical concerns. A completed worksheet, short paper, or oral presentation will be the product of the assignment.
4) Given a specific requirement or limitation, choose the best material for a bicycle from the following material types: aluminum, steel, carbon fiber. Justify your choice in terms of: cost, durability, physical and chemical properties, ease of application/processing, aesthetics, and plant safety (i.e.: if the material requires special handling, additional safety precautions, and/or special logistical concerns. Explain why each of the other material types were not chosen. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

20. Methods of Evaluation:
Assessment of student performance may include but are not limited to:
1. Laboratory Reports
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

21. Texts, Readings, and Materials:


Assigned Readings: None identified

Manuals: None required

Software: None required

Other: None Identified

22. Approvals:
Curriculum Committee Approval Date: 10/29/2015
Board of Trustees Approval Date: 12/17/2015
State Approval Date: 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B110 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B110
2. Course Title: Industrial Automation Networks
3. Course Author(s): Manuel Fernandez
   Sean Caras

4. Course Catalog Description: The basic theory and implementation of industrial automation networks, including digital data, industrial control networks, instrumentation and process control bus and network standards, SCADA (Supervisory Control and Data Acquisition) and DCS (Distributed Control Systems), and essentials of human-machine interface (HMI) panels connection, programming, and modification of programs and features.

5. Grading Method: S = Standard Letter
   Optional: none

6. Total Units: 3

7. Method of Delivery: Face-to-Face; Hybrid
   (face-to-face, hybrid, and/or online)

8. Instructional Methods: Min Min
   Units Hours
   Lecture 2 36
   Lab 1 54
   Activity 0 0

9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None

15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

1. Evaluate DCS and SCADA system applications to arrive at the best option for a given industrial process or industry. (B.S. PLO 1, ILO 1, Course Objectives 1, 2)
Course Objectives:

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Understand the essential components, systems, and methods utilized in the implementation of various industrial network systems, including: digital data acquisition, data transmission methods, networking fundamentals, as well as process control bus and network standards for instrumentation.

2. Explain the various components of, the differences between, and the benefits/disadvantages of the computer-based control systems of SCADA and DCS.

3. Understand the various components of, and the methods of implementing monitoring and control options using terminals, HMI screens, panels, and other display systems.

4. Utilize the basic software functions of an HMI programming application to create the most common elements in an HMI screen/display.

16. Requisites

**Prerequisite(s):**

- ELET B1
- ELET B5
- Admission to Industrial Automation Bachelor’s Degree program

**Advisory:** None

17. Detailed Topic Outline *(including instructional time devoted to each topic):*

**Lecture: 36 hours**

**Unit 1: Digital Data and Networks**

1.1 **Digital Data Acquisition and Interfaces (12.5% of instructional time)**

- 1.1.1 Digital representation of numerical data and text
- 1.1.2 Analog-digital conversion
- 1.1.3 Analog signal conditioning and referencing
- 1.1.4 Digital data communication theory
1.1.5 EIA/TIA-232, 422, and 485 networks

1.2 **Data Transmission Methods (6.25%)**

1.2.1 Transmission lines – copper and fiber
1.2.2 Radio communications and wireless

1.3 **Industrial Networking Fundamentals (6.25%)**

1.3.1 The OSI Model
1.3.2 Ethernet networks
1.3.3 Internet Protocol (IP)
1.3.4 Transmission Control Protocol (TCP) and User Datagram Protocol (UDP)

1.4 **Instrumentation and Process Control Bus and Network Standards (12.5%)**

1.4.1 The HART digital/analog hybrid standard
1.4.2 Modbus
1.4.3 FOUNDATION Fieldbus
1.4.4 Wireless HART

Unit 2: Computer-Based Control Systems

2.1 **Distributed Control Systems (DCS) (12.5%)**

2.1.1 Overview of industrial control systems (SCADA, DCS, PLC)
2.1.2 Elements of an industrial control system (ICS)
   2.1.2.1 Key ICS components
   2.1.2.2 Control components
   2.1.2.3 Network components
2.1.3 DCS implementation
2.1.4 DCS communications topologies
2.1.5 Security and vulnerability of DCS systems
2.1.6 Types and major manufacturers of DCS systems
2.1.7 Advantages and disadvantages of DCS systems

2.2 **Supervisory Control and Data Acquisition (SCADA) (12.5%)**

2.2.1 Differences between SCADA and DCS systems
2.2.2 SCADA system general layout – monolithic, distributed, and networked
   2.2.2.1 Hardware architecture
   2.2.2.2 Software architecture
   2.2.2.3 Communications topologies
   2.2.2.4 Interfacing
   2.2.2.5 Intelligent devices
   2.2.2.6 Human-machine interfaces and operator displays/controls
2.2.3 Alarms and alarm management
2.2.4 Security and vulnerability of SCADA systems
2.2.5 Types and major manufacturers of SCADA systems
2.2.6 Advantages and disadvantages of SCADA systems
Unit 3: Introduction to Monitoring Options

3.1 Human-Machine Interfaces (HMI) and Machine Control/Monitoring Options (37.5%)

3.1.1 Panel/Terminal installation considerations
3.1.2 Panel/Terminal maintenance and troubleshooting
3.1.3 Establishing communication with device
3.1.4 Using data logging, trending, and diagnostics
3.1.5 Modifying and maintaining an HMI project
   3.1.5.1 Configuring driver and OPC communications
   3.1.5.2 Modifying tag database and tag monitor
   3.1.5.3 Creating and modifying graphic displays and objects
   3.1.5.4 Configuring and running activity log files
   3.1.5.5 Configuring trends, security and startup settings
   3.1.5.6 Creating macros and symbols
   3.1.5.7 Configuring and running alarms
   3.1.5.8 Creating and modifying key definition control
   3.1.5.9 Create, modify, and download recipe files
   3.1.5.10 Modify and run derived tag, parameter, and event files and data log models
3.1.6 Additional functional operations

Lab: 54 hours

The following is a potential list of directed lab/hands-on/practical assignment activities that may include but is not limited to:

- Modify a simple SCADA program for the lab equipment in the CIM or Automation lab to perform a series of tasks according to a specification sheet provided.
- Connect, configure, test, and execute a networked PLC system utilizing hardware and software.
- Examine and analyze several different instrumentation interconnection systems, such as: HART, Modbus, FOUNDATION Fieldbus, and/or wireless HART.
- Connect and configure an HMI panel that is connected to a PLC.
- Modify a simple HMI screen attached to a particular system or trainer from among the lab equipment in the CIM or Automation lab to perform a series of tasks according to a specification sheet provided by the “customer”.
- Program a PLC to generate several different types of alarms, and program and configure an HMI panel to display the alarms according to a specification sheet provided by the “customer”.

Since this baccalaureate program is in development, and the actual equipment for the course has not been completely purchased, there will be additional activities possible once the equipment has been determined.

18. Methods of Instruction:
   1. Lecture
   2. Demonstration
   3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et al.)
10. Laboratory Assignments
11. Lab Practical (as able)
11. Field Trips (optional)

19. Outside of Class Assignments:

Outside of class assignments may include, but are not limited to:

**Oral Presentations**

Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Write and present an explanation of one of the topics covered in the class as though it were a training session for managers of a manufacturing or distribution facility, assuming the managers have limited technical experience with industrial automation networks.

2) Write and present a summary of essential knowledge and skills relating to: network/control systems types, alarm management best practices, HMI screen layout and organization best practices, elements of DCS or SCADA systems, or other course-specific topics.

3) Create a PowerPoint presentation that can be used as a study resource for future students related to industrial automation networks, and give the presentation to students in the course.

**Writing/Research Assignments**

Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**
1) Using technical websites, periodicals, industry publications, manufacturer catalogs and brochures, and other resources, write a 3-5 page research paper on a new/emerging technology, trend, best practice, or an overview of a specific implementation of a system/technology from a list of topics provided by the instructor that relate to industrial automation networks.

2) Using technical websites, periodicals, industry publications, manufacturer catalogs and brochures, and other resources, write a 3-5 page research paper on a topic related to HMI displays, including: best practices, alarm management, situational awareness, or other issues related to good HMI design.

3) Using technical websites, periodicals, industry publications, manufacturer catalogs and brochures, and other resources, write a 3-5 page research paper on one manufacturer of a DCS or SCADA system, including factors such as: cost, scalability, remote monitoring and application, ease of programming, benefits and drawbacks, and suitability for the local industries.

**Application/Problem Solving/Synthesis**

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Select the type of control system (SCADA, DCS, or PLC) that would be the best option for a given process or industry application, and support that choice in terms of cost, implementation time, suitability, and other valid criteria.

2) Design a series of HMI screens that adequately monitor and display the system data given a specification sheet.

**20. Methods of Evaluation:**

Assessment of student performance may include but are not limited to:
1. Laboratory Reports
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

**21. Texts, Readings, and Materials:**

**Required Textbook(s):** Kuphaldt, Tony. *Lessons in Industrial Automation*, creative commons license (open source), 2015 (selected portions of the document will be used)
Additional material will be added to the portions of the above document to make up an instructor-created course pack including handouts and materials from various industry trade organizations, workforce development agencies, and manufacturers of equipment and technology used in the industry sectors covered in this course.

**Assigned Readings:** None identified

**Manuals:** None required

**Software:** None required

**Other:** None identified

22. **Approvals:**

   - **Curriculum Committee Approval Date:** 10/29/2015
   - **Board of Trustees Approval Date:** 12/17/2015
   - **State Approval Date:** 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B112 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B112
2. Course Title: Industrial Automation Measurement
3. Course Author(s): Sean Caras
4. Course Catalog Description: Advanced applications of industrial measurement and instrumentation, including instrumented process control based on a PLC. Topics include: instrumentation and process control review, instrumentation documents (process flow diagrams, P&ID’s, loop diagrams, instrument and process equipment symbols, and instrument tags), instrument connections, instrument calibration and calibration programs, diagnostic strategies, continuous analytical measurement, machine vibration measurement, control valves (ranging, sizing, characterization, and problems), process dynamics and PID controller tuning, basic process control strategies, and process safety and instrumentation. This course continues the study of instrumentation from the ELET B56a course, and covers the approximately 40% of the remaining content of the International Society for Automation (ISA) Certified Control Systems Technician (CCST) certification, level 1.

5. Grading Method: S = Standard Letter
   Optional: None
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:

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9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
**Course Objectives:**

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Beyond the specific knowledge students previously gained in process control terminology, process variable categories and measurement devices, and the control algorithms and controller types, students will understand additional instrumentation control and measurement topics like: analytical measurement, machine vibration measurement, and advanced final control elements.

2. Select and explain the specific applications of the various instrument connections, including: pipe fitting, tubing fittings, electrical signal and control wiring, and fiber-optic communication systems between installations.


4. Engage in the study of: process dynamics, process control strategies, and controller tuning methods as used in industrial measurement systems.

5. Understand the necessity of and the various components and strategies of Safety instrumented systems (SIS) used in critical processes.

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**Elective:** None

**15. Student Learning Outcomes:** Upon completion of the course, the student will be able to:

1. Create an accurate P&ID (piping and instrument diagram), including instrument tags, utilizing a given scenario or process flow diagram. (B.S. PLO 1, ILO 1, Course Objectives 2, 5)

2. Choose the correct calibration and verification method for a pressure, differential pressure, and temperature transmitter, given the process application for the instrument. (B.S. PLO 4, ILO 3, Course Objective 3)

3. Assess a given process system or industrial application and determine the correct influence of process variables, choice of final control elements, and the best choice of PID algorithms/control schemes. (B.S. PLO 4, ILO 3, Course Objectives 1, 4)

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**16. Requisites**

**Prerequisite(s):**

ELET B56

AND

Admission to Industrial Automation Bachelor’s Degree program

**Advisory:** None

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**17. Detailed Topic Outline (including instructional time devoted to each topic):**
Lecture: 36 hours

Chemistry, Physics, and Measurement Units Review (Provided as supplemental materials on Moodle – not assigned, but students can access as needed.)

1. Unit conversions and physical constants
   - Unity fractions
   - Conversion formulae for temperature
   - Conversion factors for distance
   - Conversion factors for volume
   - Conversion factors for velocity
   - Conversion factors for mass
   - Conversion factors for force
   - Conversion factors for area
   - Conversion factors for pressure (either all gauge or all absolute)
   - Conversion factors for pressure (absolute pressure units only)
   - Conversion factors for power
   - Terrestrial constants
   - Properties of water
   - Miscellaneous physical constants
   - Weight densities of common materials

2. Elementary thermodynamics
   - Heat versus Temperature
   - Temperature
   - Heat
   - Heat transfer
   - Specific heat and enthalpy
   - Phase changes
   - Phase diagrams and critical points
   - Thermodynamic degrees of freedom
   - Applications of phase changes

3. Fluid mechanics
   - Pressure
   - Pascal's Principle and hydrostatic pressure
   - Fluid density expressions
   - Manometers
   - Systems of pressure measurement
   - Negative pressure
   - Buoyancy
   - Gas Laws
   - Fluid viscosity
   - Reynolds number
   - Law of Continuity
   - Viscous Flow
   - Bernoulli's equation
   - Torricelli's equation
   - Flow through a venturi tube
4. Applied chemistry
   Terms and Definitions
   Atomic theory and chemical symbols
   Periodic table of the elements
   Electronic structure
   Spectroscopy
     Emission spectroscopy
     Absorption spectroscopy
   Energy in chemical reactions
     Heats of reaction and activation energy
     Heats of formation and Hess's Law
   Periodic table of the ions
   Ions in liquid solutions
   pH

Unit 1: Instrumentation Essentials, Documentation, and Connections (31.25% of instructional time)

1.1 Instrumentation and Process Control Review

   1.1.1 Terminology review
     1.1.1.1 Process variables as categories
     1.1.1.2 Process variables as specific quantities
     1.1.1.3 Direct versus indirect/inferred measurements
     1.1.1.4 Setpoint
     1.1.1.5 Error
     1.1.1.6 Controlled versus manipulated variables
     1.1.1.7 Open versus closed control loops
     1.1.1.8 Automatic versus manual control
     1.1.1.9 Point versus continuous measurement

   1.1.2 Process variable categories
     1.1.2.1 Level measurement overview
       1.1.2.1.1 Definitions of level and level measurement
       1.1.2.1.2 Direct and indirect level measurement overview
       1.1.2.1.3 Point versus continuous level measurement overview
       1.1.2.1.4 Level measurement instruments overview
     1.1.2.2 Flow Rate measurement overview
       1.1.2.2.1 Definitions of flow and flow rate measurement
       1.1.2.2.2 Flow rate measurement and instrument overview
     1.1.2.3 Temperature measurement overview
       1.1.2.3.1 Basic definition of temperature
       1.1.2.3.2 Temperature measurement elements/instruments overview
     1.1.2.4 Pressure measurement overview
       1.1.2.4.1 Definitions of pressure and pressure measurement
       1.1.2.4.2 Pressure measurement instruments overview
       1.1.2.4.3 Differential pressure measurement and instrument overview

   1.1.3 Instrumentation device categories
     1.1.3.1 Sensors
     1.1.3.2 Transducers
     1.1.3.3 Indicating devices
     1.1.3.4 Transmitters
     1.1.3.5 Recording devices
1.1.3.6 Controllers
1.1.3.7 Manipulation instruments (final control elements)
1.1.3.8 Interconnections

1.1.4 Units of measurement applied to instrumentation

1.2 Instrumentation Documents

1.2.1 Process Flow Diagrams
1.2.2 Process and Instrument: Diagrams
1.2.3 Loop diagrams
1.2.4 Functional diagrams

1.2.5 Instrument and process equipment symbols
   1.2.5.1 Line types
   1.2.5.2 Process/Instrument line connections
   1.2.5.3 Instrument bubbles
   1.2.5.4 Process valve types
   1.2.5.5 Valve actuator types
   1.2.5.6 Valve failure mode
   1.2.5.7 Liquid level measurement devices
   1.2.5.8 Flow measurement devices (flowing left-to-right)
   1.2.5.9 Process equipment
   1.2.5.10 Functional diagram symbols
   1.2.5.11 Single-line electrical diagram symbols
   1.2.5.12 Fluid power diagram symbols

1.2.6 Instrument identification tags

1.3 Instrument Connections

1.3.1 Pipe and pipe fittings
   1.3.1.1 Flanged pipe fittings
   1.3.1.2 Tapered thread pipe fittings
   1.3.1.3 Parallel thread pipe fittings
   1.3.1.4 Sanitary pipe fittings

1.3.2 Tube and tube fittings
   1.3.2.1 Compression tube fittings
   1.3.2.2 Common tube fitting types and names
   1.3.2.3 Bending instrument tubing
   1.3.2.4 Special tubing tools

1.3.3 Electrical signal and control wiring
   1.3.3.1 Connections and wire terminations
   1.3.3.2 DIN rail
   1.3.3.3 Cable routing
   1.3.3.4 Signal coupling and cable separation
   1.3.3.5 Electric field (capacitive) decoupling
   1.3.3.6 Magnetic field (inductive) de-coupling
   1.3.3.7 High-frequency signal cables

1.3.4 Fiber optics
   1.3.4.1 Fiber optic data communication
   1.3.4.2 Fiber optic sensing applications
   1.3.4.3 Fiber optic cable construction
   1.3.4.4 Multi-mode and single-mode optical fibers
1.3.4.5 Fiber optic cable connectors, routing, and safety
1.3.4.6 Fiber optic cable testing

Unit 2: Instrument Calibration and Troubleshooting (18.75%)

2.1 Instrument Calibration

2.1.1 Calibration versus re-ranging
2.1.2 Zero and span adjustments (analog instruments)
2.1.3 Calibration errors and testing
   2.1.3.1 Typical calibration errors
   2.1.3.2 As-found and as-left documentation
   2.1.3.3 Up-tests and Down-tests
   2.1.3.4 Automated calibration
2.1.4 Damping adjustments
2.1.5 LRV and URV settings, digital trim (digital transmitters)
2.1.6 An analogy for calibration versus ranging
2.1.7 Calibration procedures
   2.1.7.1 Linear instruments
   2.1.7.2 Nonlinear instruments
   2.1.7.3 Discrete instruments
2.1.8 Instrument turndown
2.1.9 NIST traceability
2.1.10 Practical calibration standards
   2.1.10.1 Electrical standards
   2.1.10.2 Temperature standards
   2.1.10.3 Pressure standards
   2.1.10.4 Flow standards
   2.1.10.5 Analytical standards

2.2 Problem-solving and diagnostic strategies

2.2.1 Learn principles, not procedures
2.2.2 General problem-solving techniques
   2.2.2.1 Identifying and classifying all "known" conditions
   2.2.2.2 Re-cast the problem in a different format
   2.2.2.3 Working backwards from a known solution
   2.2.2.4 Using thought experiments
   2.2.2.5 Explicitly annotating your thoughts
2.2.3 Problem-solving by simplification
   2.2.3.1 Limiting cases
2.2.4 Scientific system diagnosis
   2.2.4.1 Scientific method
   2.2.4.2 Occam's Razor
   2.2.4.3 Diagnosing intermittent problems
   2.2.4.4 Strategy: tracing data paths
2.2.5 Classic diagnostic mistakes
   2.2.5.1 Failing to gather data
   2.2.5.2 Failing to use relevant documentation
   2.2.5.3 Fixating on the first hypothesis
   2.2.5.4 Failing to build and test a new system in stages
2.2.6 Helpful "tricks" using a digital multimeter (DMM)
   2.2.6.1 Recording unattended measurements
   2.2.6.2 Avoiding "phantom" voltage readings
   2.2.6.3 Non-contact AC voltage detection
   2.2.6.4 Detecting AC power harmonics
   2.2.6.5 Identifying noise in DC signal paths
   2.2.6.6 Generating test voltages
   2.2.6.7 Using the meter as a temporary jumper

**Unit 3: Additional Instrumentation Control and Measurement Topics (25%)**

### 3.1 Continuous Analytical Measurement

3.1.1 Conductivity measurement
   3.1.1.1 Dissociation and ionization in aqueous solutions
   3.1.1.2 Two-electrode conductivity probes
   3.1.1.3 Four-electrode conductivity probes
   3.1.1.4 Electrodeless conductivity probes

3.1.2 pH measurement
   3.1.2.1 Colorimetric pH measurement
   3.1.2.2 Potentiometric pH measurement

3.1.3 Chromatography
   3.1.3.1 Manual chromatography methods
   3.1.3.2 Automated chromatographs
   3.1.3.3 Species identification
   3.1.3.4 Chromatograph detectors
   3.1.3.5 Measuring species concentration
   3.1.3.6 Industrial applications of chromatographs
   3.1.3.7 Chromatograph sample valves
   3.1.3.8 Improving chromatograph analysis time

3.1.4 Introduction to optical analyses
3.1.5 Dispersive spectroscopy
3.1.6 Non-dispersive Luft detector spectroscopy
   3.1.6.1 Single-beam analyzer
   3.1.6.2 Dual-beam analyzer
   3.1.6.3 Luft detectors
   3.1.6.4 Filter cells

3.1.7 Gas Filter Correlation (GFC) spectroscopy
3.1.8 Fluorescence
3.1.9 Chemiluminescence
3.1.10 Analyzer sample systems
3.1.11 Safety gas analyzers
   3.1.11.1 Oxygen gas
   3.1.11.2 Lower explosive limit (LEL)
   3.1.11.3 Hydrogen sulfide gas
   3.1.11.4 Carbon monoxide gas
   3.1.11.5 Chlorine gas
3.2 Machine Vibration Measurement

3.2.1 Vibration physics
   3.2.1.1 Sinusoidal vibrations
   3.2.1.2 Non-sinusoidal vibrations

3.2.2 Vibration sensors

3.2.3 Monitoring hardware

3.2.4 Mechanical vibration switches

3.3 Final Control Elements – Additional Information

3.3.1 Control valve type review

3.3.2 Split-ranging
   3.3.2.1 Complementary valve sequencing
   3.3.2.2 Exclusive valve sequencing
   3.3.2.3 Progressive valve sequencing
   3.3.2.4 Valve sequencing implementations

3.3.3 Control valve sizing
   3.3.3.1 Physics of energy dissipation in a turbulent fluid stream
   3.3.3.2 Importance of proper valve sizing
   3.3.3.3 Gas valve sizing
   3.3.3.4 Relative flow capacity

3.3.4 Control valve characterization
   3.3.4.1 Inherent versus installed characteristics
   3.3.4.2 Control valve performance with constant pressure
   3.3.4.3 Control valve performance with varying pressure
   3.3.4.4 Characterized valve trim

3.3.5 Control valve problems
   3.3.5.1 Mechanical friction
   3.3.5.2 Flashing
   3.3.5.3 Cavitation
   3.3.5.4 Choked flow
   3.3.5.5 Valve noise
   3.3.5.6 Erosion
   3.3.5.7 Chemical attack

Unit 4: Additional Process Control Topics (25%)

4.1 Process Dynamics and PID Controller Tuning

4.1.1 Basic control theory review

4.1.2 PID algorithm review

4.1.3 Process characteristics
   4.1.3.1 Self-regulating processes
   4.1.3.2 Integrating processes
   4.1.3.3 Runaway processes
   4.1.3.4 Steady-state process gain
   4.1.3.5 Lag time
   4.1.3.6 Multiple lags (orders)
   4.1.3.7 Dead time
   4.1.3.8 Hysteresis
4.1.4 Before you tune
   4.1.4.1 Identifying operational needs
   4.1.4.2 Identifying process and system hazards
   4.1.4.3 Identifying the problem(s)
   4.1.4.4 Final precautions
4.1.5 Quantitative PID tuning procedures
   4.1.5.1 Ziegler-Nichols closed-loop ("Ultimate Gain")
   4.1.5.2 Ziegler-Nichols open-loop
4.1.6 Heuristic PID tuning procedures
   4.1.6.1 Features of P, I, and D actions
   4.1.6.2 Timing recommendations based on process dynamics
   4.1.6.3 Recognizing an over-tuned controller by phase shift
   4.1.6.4 Recognizing a "porpoising" controller
4.1.7 Tuning techniques compared
   4.1.7.1 Tuning a "generic" process
   4.1.7.2 Tuning a liquid level process
   4.1.7.3 Tuning a temperature process

4.2 Basic Process Control Strategies

   4.2.1 Supervisory control
   4.2.2 Cascade control
   4.2.3 Ratio control
   4.2.4 Relation control
   4.2.5 Feedforward control
      4.2.5.1 Load Compensation
      4.2.5.2 Proportioning feedforward action
   4.2.6 Feedforward with dynamic compensation
      4.2.6.1 Dead time compensation
      4.2.6.2 Lag time compensation
      4.2.6.3 Lead/Lag and dead time function blocks
   4.2.7 Limit, Selector, and Override controls
      4.2.7.1 Limit controls
      4.2.6.2 Selector controls
      4.2.6.3 Override, controls
   4.2.8 Techniques for analyzing control strategies
      4.2.8.1 Explicitly denoting controller actions
   4.2.9 Determining the design purpose of override controls

4.3 Process Safety and Instrumentation Systems (SIS)

   4.3.1 Classified areas and electrical safety measures
      4.3.1.1 Classified area taxonomy
      4.3.1.2 Explosive limits
      4.3.1.3 Protective measures
   4.3.2 Concepts of probability
      4.3.2.1 Mathematical probability
      4.3.2.2 Laws of probability
   4.3.3 Practical measures of reliability
      4.3.3.1 Failure rate and MTBF
      4.3.3.2 The "bathtub" curve
4.3.3 Reliability
4.3.3.4 Probability of failure on demand (PFD)

4.3.4 High-reliability systems
4.3.4.1 Design and selection for reliability
4.3.4.2 Preventive maintenance
4.3.4.3 Component de-rating
4.3.4.4 Redundant components
4.3.4.5 Proof tests and self-diagnostics

4.3.5 Overpressure protection devices
4.3.5.1 Rupture disks
4.3.5.2 Direct-actuated safety and relief valves
4.3.5.3 Pilot-operated safety and relief valves

4.3.6 Safety Instrumented Functions and Systems
4.3.6.1 SIS sensors
4.3.6.2 SIS controllers (logic solvers)
4.3.6.3 SIS final control elements
4.3.6.4 Safety Integrity Levels
4.3.6.5 SIS example: burner management systems
4.3.6.6 SIS example: water treatment oxygen purge system
4.3.6.7 SIS example: nuclear reactor scram controls

Lab: 54 hours

The following is a potential list of directed lab/hands-on/practical assignment activities that may include but is not limited to:

- Calibrate a temperature transmitter with an RTD temperature element.
- Calibrate a pressure transmitter for use with pressure measurement.
- Calibrate a pressure transmitter to obtain a level measurement
- Calibrate a differential pressure transmitter for use with a flow rate measurement system.
- Calibrate a differential pressure transmitter to measure liquid level in a closed vessel.
- Set up and calibrate a bubbler level measurement system.
- Set up a flow rate measurement process utilizing an orifice plate, venturi tube, and Pitot tube with a differential pressure transmitter calibrated to accurately measure flow rate.
- Set up a multi-process and multivariable process control system.
- Set up and calibrate a level measurement system using guided wave radar level transmitter.
- Set up and calibrate a level measurement system using an unguided wave radar level transmitter.
- Set up and calibrate a level measurement system using an ultrasonic level transmitter.
- Set up and calibrate a level measurement system using a laser level transmitter.
- Set up and calibrate an electromagnetic flow measurement system.
- Install the process connections and electrical connections for an instrumentation process using a control system and display or meter device.
- Set up a data recorder/logger to log a temperature control system.
- Set up a temperature transmitter on the Thermal Process Trainers.
- Rebuild, test, and calibrate a pneumatic valve and positioner.

Since this baccalaureate program is in development, and the actual equipment for the course has not been completely purchased, there will be additional activities possible once the equipment has been determined.
18. Methods of Instruction:

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
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11. Lab Practical (as able)
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19. Outside of Class Assignments:

Outside of class assignments may include, but are not limited to:

**Oral Presentations**

Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Given a topic related to PID control or other control types, students will create and present a short talk on the topic, including basic operation, applications where the control type would provide benefit, and illustrate a simple process utilizing the control type.

2) Given a topic related to instrument connections, students will create a simple tutorial to perform the processes related to that topic. The tutorial will be presented or recorded.

3) Given a topic related to instrument calibration, students will create a simple tutorial to perform the processes related to that topic. The tutorial will be presented or recorded.

**Writing/Research Assignments**

Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.
Sample topics:

1) Given a technology related to flow rate, temperature, pressure, level, or analytical instrumentation, students will write a 3-5 page paper explaining a new or emerging trend or technological advancement related to that technology.

2) Given a scenario or process flow diagram, students will research a specific instrumentation or final control element that can be used to implement the process. A 3-5 page paper will be written that provides an overview of the instrument or element, the various considerations that can be made regarding that choice, the approximate cost of the device, and the necessary implementation processes for commissioning the device.

Application/Problem Solving/Synthesis

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics:

1) Given a scenario or process flow diagram, students will create an accurate P&ID diagram including instrument tags that will implement that process.

2) Given a scenario or customer specification, students will choose the instrumentation needed to implement the process. They will explain the selection process, desired results, and the considerations of cost and accuracy.

20. Methods of Evaluation:

Assessment of student performance may include but are not limited to:
1. Laboratory Reports
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

21. Texts, Readings, and Materials:

**Required Textbook(s):** Kuphaldt, Tony. *Lessons in Industrial Automation*, creative commons license (open source), 2015

Additional and supplemental reading material created by instructor

**Assigned Readings:** Assigned readings outside of textbook here

**Manuals:** None required
Software: None required

Other: The following guides are suggested for purchase by students:


All are available online at www.uglysbooks.com

22. Approvals:

   *Curriculum Committee Approval Date:* 10/29/2015
   *Board of Trustees Approval Date:* 12/17/2015
   *State Approval Date:* 5/12/2016
INDA B114 – Industrial Safety Principles and Management – Course Outline of Record

1. Discipline and Course Number: INDA B114
2. Course Title: Industrial Safety Principles and Management
3. Course Author(s): Jason Dixon
4. Course Catalog Description: An overview of components of successful safety and industry hygiene programs, best practices, OSHA reporting requirements, legal and ethical obligations of both employer and employee, principles of safety management, assessment of hazards associated with various industrial processes and facilities, and protective measures used to minimize hazards such as personal protective equipment, hazard management, education and training options, and incentive programs.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid; Online
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:
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9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:
   1. Apply the correct Occupational Safety and Health Administration (OSHA) standards and procedures to industrial scenarios provided by the instructor. (B.S. PLO 1, ILO 1, Course Objectives 1, 2)
2. Assess the possible options for injury prevention and employee safety utilizing personal protective equipment (PPE) and safety resources, general safe operating procedures, and hazardous location precautions, and correctly apply those options to various industrial job classifications. (B.S. PLO 1, ILO 1, Course Objectives 1, 2, 3)

3. Perform a Job Safety Analysis (JSA) for a particular industrial site or educational “shop” or lab environment. (B.S. PLO 1, ILO 1, Course Objectives 1, 2)

4. Complete an OSHA Form 300 (Log of Work Related Injuries and Illnesses) for a fictitious company, using information and data provided by the instructor. (B.S. PLO 1, ILO 1, Course Objective 4)

**Course Objectives:**

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Understand the rules, standards and enforcement organizations, hazardous location precautions, hazardous materials identification, permit systems, injury reporting and documentation, as well as the various controls that are utilized in process measurement safety and industrial measurement safety.

2. Select the appropriate precautions, protective equipment and processes, and general operating procedures when working with the following potentially-hazardous environments: gasses and vapors, particulates, liquid and chemical substances, as well as environmental hazards including blood borne pathogens.

3. Select and distinguish between the various types and categories of personal protective equipment (PPE) and work site safety tools and equipment.

4. Understand the implications of the various regulatory agencies on safe work environments, hazard management, industrial hygiene, safety programs, and the management and safe disposal of hazardous waste materials.

5. Apply the various safety and personal protection measures to specific process systems.

**16. Requisites**

*Prerequisite(s):* Admission to Industrial Automation Bachelor’s Degree program

*Advisory:* None

**17. Detailed Topic Outline (including instructional time devoted to each topic):**

*Lecture: 54 hours*
Unit 1: Process Safety Introduction, Hazard Categories, and Hazard Classifications (50% of instructional time)

1.1 Introduction to Process Safety and Course Topic Overview

1.1.1 Process safety
1.1.2 Personal protective equipment (PPE)
1.1.3 Attitudes and behaviors
1.1.4 General plant safety rules
1.1.5 Job hazard analysis
1.1.6 Types of fire extinguishers
1.1.7 Types of permits
1.1.8 Weapons of mass destruction
1.1.9 Natural disasters

1.2 Hazard Classification

1.2.1 Common industrial hazards
1.2.2 Physical, chemical, ergonomic, and biological hazards
1.2.3 Industrial noise hazards
1.2.4 Radiation hazards
1.2.5 Hazard recognition
1.2.6 Accident prevention
1.2.7 Accident investigation

1.3 Routes of Entry and Environmental Effects

1.3.1 Routes of entry
1.3.2 Dose-response relationship
1.3.3 Environmental effects
1.3.4 Air pollution and air pollution control
1.3.5 Agencies
1.3.6 Air permitting
1.3.7 Water pollution control; National water quality standards and permitting

1.4 Gases, Vapors, Particulates, and Toxic Metals

1.4.1 Physical and health hazards associated with gases, vapors, particulates, and toxic materials
1.4.2 Asbestos
1.4.3 Particulates
1.4.4 Dust and gases; dust explosions
1.4.5 Flammable gasses and gas cylinders
1.4.6 Metallic substances and compounds; metals that are fire hazards

1.5 Hazards of Liquids

1.5.1 Handling, storing, and transporting hazardous chemicals safely
1.5.2 Physical and health hazards associated with liquids
1.5.3 Pressure and pressurized equipment
1.5.4 Flammable liquid storage
1.5.5 Spontaneous combustion
1.5.6 Oxidizers
1.5.7 Hazards of steam, water, and light-ends
1.5.8 Acids and caustics
1.5.9 Solvents, paint, and adhesives
1.5.10 Hematopoietic system toxins and hepatotoxic agents

1.6 Electrical, Noise, Heat, Radiation, Ergonomic, and Biological Hazards

1.6.1 Plant-specific hazards
1.6.2 Bonding and grounding
1.6.3 Heat and radiation
1.6.4 Hearing conservation and industrial noise
1.6.5 Ergonomic hazards
1.6.6 Confined spaces
1.6.7 Hazards of lifting
1.6.8 Biological hazards and blood-borne pathogens

1.7 Process System Hazards

1.7.1 Operating hazards
1.7.2 Equipment- and system-related hazards
1.7.3 Steam generation
1.7.4 Flare system
1.7.5 Weather-related hazards
1.7.6 Chemicals- and chemistry-related hazards
1.7.7 Reactors
1.7.8 Distillation systems
1.7.9 Human factors

1.8 Weapons of Mass Destruction, Hurricanes, and Natural Disasters

1.8.1 Various scenarios of man-made situations and acts
1.8.2 Various natural disaster and weather-related conditions
1.8.3 Emergency preparedness

Unit 2: Hazardous Substance Identification, Protection and Precautions, and Fire and Explosion Prevention/Mitigation/Elimination (25 %)

2.1 Hazardous Chemical Identification: Hazcom, Toxicology, and DOT

2.1.1 Hazard Communication Program (Hazcom) – “The Worker’s Right-to-Know Act”
2.1.2 Material Safety Data Sheets (MSDS)
2.1.3 Toxicology
2.1.4 Safety signs, tags, and warning labels
2.1.5 Hazardous Materials Identification System (HMIS), DOT labeling system
2.1.6 National Fire Protection Association (NFPA)

2.2 Fire and Explosion

2.2.1 Fire, explosion, and detonation
2.2.2 Chemical explosions
2.2.3 Polymers and fire
2.2.4 Flammable, explosive, and radioactive hazards and materials
2.2.5 Fundamentals of fire prevention, protection, and control
2.2.6 Physical and chemical processes of fire, fire stages, fire-related terms and concepts
2.2.7 Fire classification system
2.2.8 Types of fire extinguishers, use, and fire fighting

2.3 Safety Permitting Systems and Processes

2.3.1 Types of permits
2.3.2 Confined space entry
2.3.3 Control of hazardous energy; Lockout/Tagout
2.3.4 Opening or blinding permits
2.3.5 Routine maintenance permits

2.4 Personal Protective Equipment

2.4.1 Types and categories of personal protective equipment
2.4.2 Written respiratory protection programs

Unit 3: Safety Management, Regulatory Oversight, and Training (25%)

3.1 Engineering Controls

3.1.1 Risk evaluation
3.1.2 Design and operation of plants for safety
3.1.3 Alarms and indicators
3.1.4 Fire alarms, toxic gas alarms, and detection systems
3.1.5 Redundant alarm and shutdown devices, interlocks, automatic shutdown devices
3.1.6 Process containment and upset controls
3.1.7 Closed systems/closed loop sampling
3.1.8 Floating roof tank and ventilation systems
3.1.9 Effluent control and waste treatment
3.1.10 Noise abatement
3.1.11 Flares
3.1.12 Pressure relief devices
3.1.13 Deluge systems and explosion suppression systems

3.2 Administrative Controls

3.2.1 Community awareness and emergency response
3.2.2 Job safety analysis (JSA)
3.2.3 Hazards and operability study
3.2.4 Training and mandated training
3.2.5 Housekeeping
3.2.6 Safety inspection and audits
3.2.7 Monitoring equipment
3.2.8 First aid

3.3 Regulatory Overview: OSHA, PSM, EPA, NFDA, and DOT
3.3.1 Occupational Safety and Health Act
3.3.2 Process Safety Management (CFR 29 1910.119)
3.3.3 Environmental Protection Agency

3.4 **HAZWOPER and Miscellaneous Training Categories**

3.4.1 Fall protection
3.4.2 Hoisting equipment
3.4.3 HAZWOPER (Hazardous Waste Operations and Emergency Response)
3.4.4 Unit monitors and field survey instruments
3.4.5 Bunker gear
3.4.6 Cutting, welding, and brazing

**Lab:**

There is no lab component in this course.

18. **Methods of Instruction:**
   1. Lecture
   2. Demonstration
   3. Active Learning
   4. Discussion
   5. Guest Speakers
   6. Instruction through Examination and Quizzing
   7. Outside Reading and Outside of Class Work
   8. Problem-Solving Assignments and Scenarios
   9. Written Materials (including worksheets, calculation sheets, et. al.)
   10. Field Trips *(optional)*

19. **Outside of Class Assignments:**

   Outside of class assignments may include, but are not limited to:

   **Oral Presentations**
   
   Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

   **Sample topics:**

   1) Given a specific industrial scenario, choose the proper Personal Protective Equipment (PPE) for the situation. Prepare and deliver an explanation why you chose each of the items in terms of: industrial environment, OSHA and NFPE requirements, and all other industrial safety and health elements you chose to enhance an employee’s safety and injury prevention.

   2) Given a list of possible NFPA 70e standards (Electrical Safety), Prepare and deliver an explanation of the standard in terms of: actual text of the standard, common-sense implementation, assessment of implementation effectiveness, and implications for an industrial or commercial environment.
Writing/Research Assignments

Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topic:

1) Given a list of topic options, research a specific safety practice, type of PPE, or regulation/legislated standard. Provide the initial justification for the item or practice, the improvements or changes made, and the results (in terms of deaths or injuries prevented, change in lost work days and lost production, monetary impacts, long-term health issues that were minimized or eliminated, etc.) A three to five page research paper using correct formatting and style will be the product of the assignment.

Application/Problem Solving/Synthesis

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics:

1) Complete OSHA accident reports using scenarios, and following the correct methods and requirements as specified in OSHA guidelines. Work product will be completed OSHA accident reports.

2) Perform a Job Safety Assessment (JSA) of a particular industrial plant, school lab facility, or other industrial space according to the format provided by the instructor and using applicable safety regulations from OSHA, NFPA, and industry trade organizations, e.g. ISA, SME, NASP, ASSE, etc. Work product will be a completed Job Safety Assessment report.

3) Complete an OSHA Form 300 (Log of Work Related Injuries and Illnesses) for a fictitious company, using information and data provided by the instructor.

20. Methods of Evaluation:

Assessment of student performance may include but are not limited to:

1. Laboratory Reports
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

21. Texts, Readings, and Materials:


   Assigned Readings: None identified

   Manuals: None required

   Software: None required

   Other: None identified

22. Approvals:

   Curriculum Committee Approval Date: 10/29/2015
   Board of Trustees Approval Date: 12/17/2015
   State Approval Date: 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B120 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B120
2. Course Title: Industrial Automation Systems
3. Course Author(s): Manuel Fernandez
   Sean Caras
4. Course Catalog Description: This course provides additional study and hands-on lab activities beyond
   the Computer Integrated Manufacturing course, and will cover industrial
   automation systems, including: principles of robotics, power supplies and
   movement systems, sensing and end-of-arm tooling, and control systems
   and maintenance.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:

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9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

   1. Select the appropriate automated system components, including
      robotic systems, power systems, electromechanical systems,
      sensing and end-of-arm tooling, and vision systems, in order to
      implement an automated system or process according to a scenario
and specifications provided by the instructor. (B.S. PLO 1, ILO 1, Course Objective 1)

2. Develop a basic automated control systems maintenance plan for a set of equipment used in a sample production line provided by the instructor. (B.S. PLO 4, ILO 3, Course Objective 2)

3. Perform basic robotic manipulations and program modification utilizing the functions available within the robotics software available in lab. (B.S. PLO 4, ILO 3, Course Objective 3)

4. Implement a series of automation processes utilizing the available automation equipment according to a scenario and specifications provided by the instructor. (B.S. PLO 1, ILO 1, Course Objective 3)

Course Objectives:
This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Understand and apply the basic principles of robotics and industrial automation systems including: robotic systems, power systems, electromechanical systems, sensing and end-of-arm tooling, and vision systems.

2. Understand and apply the essential elements of control systems maintenance and troubleshooting as it applies to automated systems.

3. Implement automated processes utilizing the various methods, instructions, control systems types, and equipment covered in this course.

16. Requisites

Prerequisite(s): ELET B4 AND Admission to Industrial Automation Bachelor’s Degree program

Advisory: None

17. Detailed Topic Outline (including instructional time devoted to each topic):

Lecture: 36 hours

Unit 1: Principles of Robotics (25% of instructional time)

1.1 Introduction to Industrial Robotics

1.2 Fundamentals of Robotics

1.3 Programming the Robot

1.4 Industrial Applications
Unit 2: Power Supplies and Movement Systems (18.75%)

2.1 Electromechanical Systems

2.2 Fluid Power Systems

Unit 3: Sensing and End-of-Arm Tooling (18.75%)

3.1 Sensors

3.2 End Effectors

Unit 4: Control Systems and Maintenance (37.5%)

4.1 Computer Systems and Digital Electronics

4.2 Interfacing and Vision Systems

4.3 Maintaining Robotic Systems

**Lab: 54 hours**

Lab topics may include, but are not limited to the following:

- CNC/robot application
- Basics of robotic actuators and sensors
- Vision systems
- Motion planning
- Task modeling
- Human-machine interface
- Powering up and jogging
- Recovery from faults
- Production operations execution
- CNC cell program modification and execution
- Integrated Robotics simulation software

Since this baccalaureate program is in development, and the actual equipment for the course has not been completely purchased, there will be additional activities possible once the equipment has been determined.

**18. Methods of Instruction:**

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Laboratory Assignments
19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

**Oral Presentations**
Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Given a specific automation systems course topic, prepare and deliver a presentation that explains the particular topic selected to an audience of technical employees that will need to understand the basic information and principles of that particular topic. Make sure the content of the presentation is to the proper technical depth and explains/defines technical vocabulary terms if not expected common knowledge to the audience.

2) Prepare and deliver a presentation on the safety requirements or a maintenance plan for a particular automation system that explains the topic selected to an audience of technical employees. Make sure the content of the presentation is to the proper technical depth and explains/defines technical vocabulary terms if not expected common knowledge to the audience.

**Writing/Research Assignments**
Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topic:**

1) Selecting an element of an automation system from a list of suggestions, perform research on the particular system, providing the following information: a) overview of the automation system, b) current trends and eminent advances, and, c) implications for various processes and industry sectors. A three to five page research paper using correct formatting and style will be the product of the assignment.

**Application/Problem Solving/Synthesis**
Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topic:

1) Given a scenario of a particular process or series of processes that need to be automated, select the automation systems needed to implement the desired automation. Explain how you came to select those systems, what tradeoffs were made in order to come to that conclusion, and the anticipated benefit of those automation systems in terms of: safety, production quality, economic benefits, and production output. Work product will be a directed worksheet, a paper and/or a presentation, or some other type of tangible product.

20. Methods of Evaluation:

Assessment of student performance may include but are not limited to:
1. Laboratory Reports
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

21. Texts, Readings, and Materials:

Required Textbook(s):
Ross, Larry, Stephen Fardo, James Masterson, and Robert Towers. 

Assigned Readings:
None identified

Manuals:
None required

Software:
None required

Other:
None identified

22. Approvals:

Curriculum Committee Approval Date: 10/29/2015
Board of Trustees Approval Date: 12/17/2015
State Approval Date: 5/12/2016
1. Discipline and Course Number: INDA B122
2. Course Title: Industrial Motion Control
3. Course Author(s): Sean Caras
4. Course Catalog Description: Methods of implementing motion control utilizing VFD’s (Variable Frequency Drives) including general purpose drives and vector drives, servo controllers and drives, stepper controllers and drives, and other motion control devices. Utilization of test equipment for testing and troubleshooting will be covered, as well as an overview in maintenance program development and management. Lab activities will be provided with actual equipment and software used in industry.

5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:
   Min Units Min Hours
   Lecture 2 36
   Lab 1 54
   Activity 0 0
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:
   1. Design a simple motion control system utilizing at least one type of motion control “drive” technology according to parameters and guidelines provided to the student. (B.S. PLO 1, ILO 1, Course Objectives 1, 2)
2. Propose a preventative maintenance program or management structure that will meet provided specifications and expectations provided to the student. (B.S. PLO 2, ILO 2, Course Objective 3)

3. Solve selected troubleshooting problems independently and using standard test equipment. (B.S. PLO 4, ILO 3, Course Objective 3)

Course Objectives:

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Understand the function, general capabilities, and programming processes for the following variable frequency drive types: inverter and servo, and incorporate those systems as well as stepper-based motion into various motion control systems.

2. Understand the various fundamentals of motion control, including equipment, design essentials, installation, configuration, and testing.

3. Develop preventative maintenance processes and follow troubleshooting processes when working with industrial motion and automated production equipment.

16. Requisites

Prerequisite(s):

ELET B55
OR
ELET B55a
AND
Admission to Industrial Automation Bachelor’s Degree program

Advisory:
None

17. Detailed Topic Outline (including instructional time devoted to each topic):

Lecture: 36 hours

Unit 1: Orientation and Motor Drives (31.25% of instructional time)

1.1 Course Orientation and Electric Motor Review

1.1.1 Orientation
1.1.2 Motor Principles
1.1.3 DC motor components
1.1.4 Single phase and three-phase power; three phase configurations
1.1.5 Single phase motor types
1.1.6 Three phase motor types
1.1.7 Motor control devices review
1.1.8 Motor control circuit review
1.2 Variable Frequency Drive Basics and Drive Types

1.2.1 Drive Basics
   1.2.1.1 Functional blocks of AC drives
   1.2.1.2 Inverter types
   1.2.1.3 Output signal types
   1.2.1.4 Volts-per-Hertz ratio

1.2.2 General purpose AC drives

1.2.3 Vector drives

1.2.4 Servo drives

1.3 Other Motor Drive Systems

1.3.1 DC Motor drives
1.3.2 Stepper motors and drives

1.4 VFD Installation and Programming

1.4.1 Parameters
1.4.2 Drive selection
1.4.3 Line and load reactors
1.4.4 Location
1.4.5 Enclosures
1.4.6 Mounting techniques
1.4.7 Operator interface
1.4.8 Electromagnetic interference
1.4.9 Grounding
1.4.10 Bypass capacitor
1.4.11 Disconnecting means
1.4.12 Motor protection
1.4.13 Braking
1.4.14 Ramping
1.4.15 Control inputs and outputs
1.4.16 Motor nameplate data
1.4.17 Derating
1.4.18 PID control
1.4.19 Parameter programming

Unit 2: Motion Control Using Servo Drives and Motion Controllers (25%)

2.1 Motion Control Fundamentals

2.1.1 Digital servo motion controllers
2.1.2 Functionality of DC and AC servo motors and servo drives
2.1.3 Functionality of feedback devices and software servo loop
2.1.4 Applying motion profiles
2.1.5 Apply electronic gearing and camming profiles

2.2 Installing, Configuring, and Testing Motion Control Servo Systems

2.2.1 System design essentials
2.2.2 System installation
2.2.3 System configuration
2.2.4 System testing

Unit 3: Electromechanical System Maintenance (18.75%)

3.1 Maintenance Overview

3.1.1 Importance of maintenance
3.1.2 Maintenance organization
3.1.3 Maintenance personnel
3.1.4 Scheduling
3.1.5 Maintenance recordkeeping and predictive maintenance
3.1.6 Reducing downtime

3.2 Maintenance Processes

3.2.1 Mechanical systems maintenance
3.2.2 Electrical systems maintenance

Unit 4: Electromechanical System Troubleshooting (25%)

4.1 Troubleshooting Overview

4.1.1 Introduction to troubleshooting
4.1.2 Troubleshooting techniques
  4.1.2.1 Job responsibilities
  4.1.2.2 Recognizing and learning about normal operation
  4.1.2.3 Simple testing and observation
4.1.3 Aids to troubleshooting
  4.1.3.1 Assembling and using resources
  4.1.3.2 Determining machine history and PM history
  4.1.3.3 Using clamp-on ammeters for troubleshooting
  4.1.3.4 Using multimeters for troubleshooting
  4.1.3.5 Using megohmmeters (”meggers”) for troubleshooting
  4.1.3.6 Using hand-held oscilloscopes for troubleshooting
  4.1.3.7 Using thermal imaging for troubleshooting
  4.1.3.8 Using laser shaft alignment equipment
  4.1.3.9 Performing vibration analysis
  4.1.3.10 Electrical balance and mechanical load analysis
  4.1.3.11 Electrical power quality monitoring equipment and methods
  4.1.3.12 Using schematic diagrams

4.2 Generalized Troubleshooting Processes and Suggestions

4.2.1 Solving mechanical problems
  4.2.1.1 Testing belts/sheaves, gears, and chains/sprocket drive types
  4.2.1.2 Power transmission troubleshooting and repair
  4.2.1.3 Bearing and bushing troubleshooting and repair
  4.2.1.4 Synchronous drives troubleshooting and repair
  4.2.1.5 Conveyance systems troubleshooting and repair
4.2.1.6 Other mechanical systems troubleshooting and repair

4.2.2 Solving electrical problems
4.2.2.1 VFD and motion control device testing troubleshooting
4.2.2.2 Electrical connection problems and diagnosis
4.2.2.3 Motor Control Systems (MCS) problem diagnosis and repair
4.2.2.4 Control systems troubleshooting – discrete systems and PLC’s
4.2.2.5 Thermal diagnosis of electrical problems
4.2.2.6 Determining harmonics problems
4.2.2.7 Diagnosing power quality problems
4.2.2.8 Diagnosing signal problems
4.2.2.9 Other electrical systems problems

Lab: 54 hours

The following is a potential list of directed lab/hands-on/practical assignment activities that may include but is not limited to:

- Allen-Bradley Rockwell Kinetix 6000 servo drivers and motor systems (or similar):
- General purpose drive programming: general programming, speed and torque control, remote control, analog control, interfacing to a network, network control of a VFD system
- Vector drive programming and testing
- Servo drive programming and testing
- Soft-start and solid state starter programming and operation
- Implementing multiple control circuits in a motor control panel
- Troubleshooting control circuits
- Motor shaft alignment
- Motor braking systems

Since this baccalaureate program is in development, and the actual equipment for the course has not been completely purchased, there will be additional activities possible once the equipment has been determined.

18. Methods of Instruction:

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Laboratory Assignments
11. Lab Practical (as able)
11. Lab Practical (as able)
11. Field Trips (optional)

19. Outside of Class Assignments:

Outside of class assignments may include, but are not limited to:

Oral Presentations
Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication
department, and the criteria and expectations will be presented to the students prior to starting the
assignment. It is expected that this rubric, criteria, and explanations will be standardized among the
upper-division coursework. At least one oral presentation in some form is desired for upper-division
technical courses. An example of sample topic(s) is/are presented below to illustrate assignment
depth and connection to course topics and objectives.

Sample topics:

1) Create a PowerPoint presentation that can be used as a study resource for future
students related to one of the variable frequency drive types (and a particular feature
of that drive) covered in the class, and give the presentation to students in the course.

2) Create a PowerPoint presentation that can be used as a study resource for future
students related to one of the troubleshooting or maintenance topics covered in the
class, and give the presentation to students in the course.

Writing/Research Assignments

Students can be assigned a research paper to provide practice in researching, organizing information,
communicating in a clear and accurate manner, and following proper styles and citation methods. The
research papers in the program courses will follow guidelines developed through collaboration with
the English department and Librarians that meet the expectations of upper-division student work, and
a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria,
and explanations will be standardized among the upper-division coursework. An example of sample
topic(s) is/are presented below to illustrate assignment depth and connection to course topics and
objectives.

Sample topics:

1) Using technical websites, periodicals, industry publications, manufacturer catalogs
and brochures, and other resources, write a 3-5 page research paper on a
new/emerging technology, trend, best practice, or an overview of a specific
implementation of a system/technology from a list of topics provided by the
instructor that relate to one of the motion control drives/systems covered in this
course.

2) Using technical websites, periodicals, industry publications, manufacturer catalogs
and brochures, and other resources, write a 3-5 page research paper on a given piece
of test equipment or troubleshooting methodology, including: use, cost,
considerations for choosing this equipment or methodology, suitability for processes
or systems, and other related information.

Application/Problem Solving/Synthesis

Students in each upper-division technical course for this degree program will be given at least one
assignment that calls upon them to apply the higher-level thinking skills of: application, analysis,
synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be
employed for these types of assignments. They will be based upon scenarios, comparisons, or
connections between various topics covered in the course. Grading will be accomplished through
similar methods among upper-division technical courses, the process and expectations of which will be
standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Design a simple motion control system utilizing at least one type of motion control system according to parameters and guidelines and a specific material handling or process system.

2) For a generic industry plant or production process, design a maintenance program and management structure for both preventative maintenance and preventative replacement/equipment overhaul.

3) Given a faulted piece of equipment or control panel, troubleshoot the fault, locate and price replacement components, and design a testing procedure to verify successful repair of the piece of equipment.

**20. Methods of Evaluation:**

Assessment of student performance may include but are not limited to:
1. Laboratory Reports
2. Exams and Quizzes
3. Written Work (outside of class assignments, worksheets, et. al.)
4. Class Performance
5. Class Presentations
6. Lab Practical Tests and Quizzes

**21. Texts, Readings, and Materials:**

**Required Textbook(s):**


Industrial motion controls course pack – instructor created

**Assigned Readings:**

None identified

**Manuals:**

None required

**Software:**

None required

**Other:**


(Available at [www.uglysbooks.com](http://www.uglysbooks.com))

**22. Approvals:**

*Curriculum Committee Approval Date:* 10/29/2015

*Board of Trustees Approval Date:* 12/17/2015

*State Approval Date:* 5/12/2016
1. Discipline and Course Number: INDA B124
2. Course Title: Industry Sector Seminar: Applied Automation
3. Course Author(s): Sean Caras
4. Course Catalog Description: A study of the specific automation processes related to the following industry sectors: Petroleum (the application of automation and process control in oilfield operations and processes, and commodities transport processes), logistics and distribution (the application of automation in distribution centers and warehousing), cogeneration and renewable energy, as well as automation support professions.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid; Online
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:

<table>
<thead>
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<th>Units</th>
<th>Hours</th>
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<tr>
<td>Lecture</td>
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</tr>
<tr>
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<td>0</td>
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</tbody>
</table>
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:
   1. Compare and contrast various manufacturing industry sectors by examining similar and different processes, and the application of similar and different process technologies among the industry sectors covered in this seminar course. (B.S. PLO 1, ILO 1, Course Objectives 1,2,3)
2. Categorize the various industry safety, hygiene, quality control/quality assurance, and overall plant management of each of the industry sectors covered in this seminar course, in terms of: regulatory oversight, applicable standards, level of automation and process control, and level of driving-force technological improvements. (B.S. PLO 4, ILO 3, Course Objective 4)

3. Analyze several different industry sectors from among those covered in this seminar course according to the criteria provided. (B.S. PLO 5, ILO 4, Course Objectives 1,2,3,5)

Course Objectives:
This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Explain the processes followed for upstream and midstream petroleum exploration and production, including: exploration and drilling, oilfield processes and equipment categories, natural gas production, and midstream activities (transportation and storage), and be able to compare the automation and process control applications with the other industry sectors covered in the course.

2. Explain the various activities and operations within the warehousing/distribution center industry sector, including: the distribution network, inventory control, management and support operations, material handling operations, supply chain fundamentals and management, transportation operations, and cold storage standards, and be able to compare the automation and process control applications with the other industry sectors covered in the course.

3. Explain how the various types of renewable energy and the maximization operation of cogeneration work, the types of automation and control systems employed by those operations, the implications of utilizing those operations, and be able to compare those factors with the other industry sectors covered in the course.

4. Explain the various industry safety, hygiene, quality control/quality assurance, and overall plant management of each of the industry sectors covered in this seminar course, in terms of: regulatory oversight, applicable standards, level of automation and process control, and level of driving-force technological improvements.

5. List and explain the nature of services offered by the various types of automation support professions, including: engineering services, automation development services, electrical services, and electronic systems and instrumentation services, and provide the types of business units that would utilize those areas of automation support.
16. Requisites

Prerequisite(s): Admission to Industrial Automation Bachelor’s Degree program

Advisory: None

17. Detailed Topic Outline (including instructional time devoted to each topic):

Lecture: 54 hours

Unit 1: The Petroleum (Oil and Natural Gas) Industry – Upstream and Midstream (43.75% of instructional time)

1.1 Overview of Well Reservoir Exploration and Drilling Operations

1.1.1 Locating Reservoirs
1.1.2 Drilling Operations
1.1.3 Well Creation and Maintenance

1.2 Overall Processes in the Oilfield

1.2.1 Liquid Separation
1.2.2 Natural Gas
1.2.3 Common Processes
   1.2.3.1 Oil/Water Separation
   1.2.3.2 Flotation (WEMCO’s and IGF’s)
   1.2.3.3 Metering
   1.2.3.4 Filtration
   1.2.3.5 Chemical Reactions
   1.2.3.6 Heat Sources
   1.2.3.7 Pumping/Compression
1.2.4 Hydraulic Fracturing

1.3 Natural Gas Production and Issues

1.3.1 Overview of Terms and Acronyms
1.3.2 Determining Field (Fracture) Sizes and Potential
1.3.3 Well Testing
1.3.4 Manifolds
1.3.5 CVR Gas Handling
1.3.6 Compression
1.3.7 H2S Removal
1.3.8 Sales Gas

1.4 Equipment, Procedures, and Mechanical Devices Used in the Field (Facilities)

1.4.1 Pumps
1.4.2 Tanks and Vessels
1.4.3 Oil Plant and Water Plant
1.4.4 Gathering and Distribution Systems
1.4.5 Fired Equipment
1.4.6 Pollution Control Systems
1.5 Midstream Activities

1.5.1 Characteristics of Midstream Segments
1.5.2 Midstream Processing Operations
1.5.3 Transportation
1.5.4 Storage

Unit 2: The Logistics and Distribution Industry (18.75%)

2.1 Warehousing/Distribution Center Overview

2.1.1 The Role of Warehousing and Basic Functions
2.1.2 The Distribution Network
2.1.3 Inventory Fundamentals and Control Systems
2.1.4 Elements of Design of a Warehouse/Distribution Center
2.1.5 Managing Operations
2.1.6 Support Operations
2.1.7 Material Handling Operations
2.1.8 Supply Chain Fundamentals and Management
2.1.9 Transportation Operations
2.1.10 Cold Storage Standards

Unit 3: Cogeneration and Renewable Energy (12.5%)

3.1 Cogeneration

3.1.1 Cogeneration Operations and System Types
3.1.2 Benefits and Advantages
3.1.3 Local Systems and Applications

3.2 Renewable Energy Sectors

3.2.1 Energy from Wind
3.2.2 Energy from Solar
   3.2.2.1 Photovoltaic Panels
   3.2.2.2 Solar Hot Water Systems
3.2.3 Energy from Thermal Sources
   3.2.3.1 Reflected Sunlight
   3.2.3.2 Geothermal
3.2.4 Energy from Biomass
3.2.5 Tidal Energy Creation
3.2.6 Anaerobic Digestion
3.2.7 Energy Storage Options and Limitations

Unit 4: Automation Support Professions (25 %)

4.1 Engineering Services

4.1.1 Civil Engineering Applied to Automated Industries
4.1.2 Mechanical Engineering Applied to Automated Industries
4.1.3 Electrical Engineering Applied to Automated Industries
4.1.4 Control Systems Engineering
4.1.5 Project Management Services
4.1.6 Site Development Services
4.1.7 Certified Automation Professional (CAP) Certification

4.2 Automation Development Services

4.2.1 PLC, HMI, SCADA, and DCS Programming
4.2.2 Facilities Design Services
4.2.3 Database Development and Data Applications Services
4.2.4 System Integration
4.2.5 Preventative and Predictive Maintenance Solutions

4.3 Electrical Services

4.3.1 High Voltage Distribution Systems
4.3.2 Commercial Electrical Systems
4.3.3 Automation and Control Systems Infrastructure

4.4 Electronic Systems and Instrumentation Services

4.4.1 Process Instrumentation
4.4.2 Radio and Telecommunications Systems
4.4.3 Process Control Systems
4.4.4 Telemetry, Calibration, and Equipment Service Providers
4.4.5 Distributors and Original Equipment Manufacturers Field Support Services

Lab:
This is a lecture-only course. There is no lab component.

18. Methods of Instruction: 1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Field Trips (optional)

19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

Oral Presentations
Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division
technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topic:**

1) Create a presentation that analyzes a specific industry sector from among those covered in this course in terms of: contribution to our local and state economy, the workforce and employee types for technical and management positions, the emerging trends and deployment of technology, and the opportunity for increased automation. Then while listening to the other presentations, complete an information map of the other industry sectors.

**Writing/Research Assignments**

Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topic:**

1) Using technical websites, periodicals, industry publications, manufacturer catalogs and brochures, and other resources, write a 3-5 page research paper that compares and contrasts the various manufacturing sectors by examining similar and different processes and the application of similar and different process technologies among the various industry sectors covered in this seminar course.

**Application/Problem Solving/Synthesis**

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topic:**

1) Research and write a technical summary that categorizes and compares the various industry safety, hygiene, quality control/assurance, and overall plant management of each of the industry sectors covered in this seminar course. Students will be presented with a framework and rubric to guide their development of this technical summary. Specific areas of information include: regulatory oversight, applicable standards, level of automation and process control, and the level of driving-force technological improvements for each industry sector.
20. Methods of Evaluation: Assessment of student performance may include but are not limited to:
1. Exams and Quizzes
2. Written Work (outside of class assignments, worksheets, et. al.)
3. Class Performance
4. Class Presentations

21. Texts, Readings, and Materials:

   Required Textbook(s): Instructor-created course pack including handouts and materials from various industry trade organizations, workforce development agencies, and manufacturers of equipment and technology used in the industry sectors covered in this course.

   Assigned Readings: None identified

   Manuals: None required

   Software: None required

   Other: None identified

22. Approvals:

   Curriculum Committee Approval Date: 10/29/2015
   Board of Trustees Approval Date: 12/17/2015
   State Approval Date: 5/12/2016
1. Discipline and Course Number: INDA B130
2. Course Title: Industrial Manufacturing Processes
3. Course Author (s): Sean Caras
4. Course Catalog Description: An overview of the specific processes used in manufacturing, including but not limited to: forming, casting, extrusion, blow-molding, material addition and removal, welding and joining, folding, pressing, and shearing operations, measurement and insertion of products into packaging, coating and sealing, and other processes used in manufacturing industries.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid; Online
   (face-to-face, hybrid, and/or online)
8. Instructional Methods: Min Min
   Units Hours
   Lecture 3 54
   Lab 0 0
   Activity 0 0
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:
   1. Categorize the various processes of separation, fabrication, conditioning, and finishing for the common materials used in manufacturing and production of non-food products.
2. Select the most appropriate manufacturing processes for a given product.

3. Develop a manufacturing plan for a particular product utilizing the manufacturing processes that best implement that plan.

**Course Objectives:**

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. To develop an understanding of the processes used to form, separate, fabricate, condition, and finish metallic materials.

2. To develop an understanding of the processes used to form, separate, fabricate, condition, and finish plastic materials.

3. To develop an understanding of the processes used to form, separate, fabricate, condition, and finish ceramic materials and glass.

4. To develop an understanding of the processes used to form, separate, fabricate, condition, and finish composite materials.

5. To develop an understanding of the processes used to form, separate, fabricate, condition, and finish wood materials.

**16. Requisites**

**Prerequisite(s):**

INDA B105

AND

Admission to Industrial Automation Bachelor of Science Degree program

**Advisory:**

None

**17. Detailed Topic Outline (including instructional time devoted to each topic):**

**Lecture: 54 hours total**

**Unit 1: Introduction and Materials Review – 12.5% of course**

1.1 Course Introduction and Introduction to Manufacturing

1.2 Material and Process Classifications
   1.2.1 Manufactured Consumer Products
   1.2.2 Major Material Families
   1.2.3 Material Processing in Manufacturing
   1.2.4 Major Material Families
   1.2.5 Material Processing Families
   1.2.6 Process Action

**Unit 2: Metallic Materials – 25% of course**

2.1. Processes Used to Form Metallic Materials
   2.1.1 Forging
2.1.2 Coining
2.1.3 Rotary Forming Processes
2.1.4 Swaging
2.1.5 Extrusion
2.1.6 Upsetting
2.1.7 Cold Forming
2.1.7.1 Stamping
2.1.7.2 Embossing
2.1.7.3 Drawing
2.1.7.4 Expanding
2.1.7.5 Bulging
2.1.7.6 Necking
2.1.7.7 Nosing
2.1.8 Electromagnetic Forming
2.1.9 Contouring
2.1.10 Peen Forming
2.1.11 Explosive Forming
2.1.12 HERF
2.1.13 Spinning
2.1.14 Casting and Molding

2.2 Processes Used to Separate Metallic Materials
2.2.1 Shearing
2.2.2 Blanking and Punching
2.2.3 Nibbling
2.2.4 Turning
2.2.5 Planing
2.2.6 Milling
2.2.7 Drilling
2.2.8 Reaming
2.2.9 Tapping
2.2.10 Grinding
2.2.11 Abrasive Jet Machining
2.2.12 Water Jet Machining
2.2.13 Laser Cutting
2.2.14 Chemical Milling
2.2.15 Ultrasonic Machining
2.2.16 Electrochemical Machining
2.2.17 Electron Beam Machining
2.2.18 Electrodischarge Machining
2.2.19 Traveling Wire EDM

2.3 Processes Used to Fabricate Metallic Materials
2.3.1 Mechanical Joining
2.3.2 Welding Processes
2.3.3 Brazing and Soldering

2.4 Processes Used to Condition Metallic Materials
2.4.1 Steel Structure
2.4.2 Processes Used for Conditioning
2.4.2.1 Full Hardening
2.4.2.2 Precipitation Hardening
2.4.2.3 Case Hardening
2.4.2.4 Cyaniding
2.4.2.5 Nitriding
2.4.2.6 Carbonitriding
2.4.2.7 Flame Hardening
2.4.2.8 Induction Hardening
2.4.2.9 Softening Processes
2.4.2.10 Cryogenic Conditioning

2.5. Processes Used to Finish Metallic Materials
2.5.1 Surface Preparation
2.5.2 Finishing Processes

Unit 3: Plastic Materials – 18.75% of course

3.1. Processes Used to Form Plastic Materials
   3.1.1 Compressing Molding
   3.1.2 Injection Molding
   3.1.3 Rotational Molding
   3.1.4 Blow Molding
   3.1.5 Thermoforming
   3.1.6 Extrusion
   3.1.7 Hand Layup
   3.1.8 Casting

3.2. Processes Used to Separate Plastic Materials

3.3. Processes Used to Fabricate Plastic Materials
   3.3.1 Cohesion Processes
   3.3.2 Cementing and Bonding
   3.3.3 Filament Winding
   3.3.4 3-D Modeling

3.4. Processes Used to Condition Plastic Materials
   3.4.1 Annealing
   3.4.2 Radiation Processing
   3.4.3 Conductive Plastics
   3.4.4 Plastic Additives
   3.4.5 Mineral Fillers

3.5. Processes Used to Finish Plastic Materials
   3.5.1 Material-Removal Processes
   3.5.2 Coating Processes
   3.5.3 Other Finishing Processes

Unit 4: Ceramic Materials and Glass – 12.5% of course

4.1. Processes Used to Form Ceramic Materials
   4.1.1 Dry Forming Processes
   4.1.2 Wet Forming Processes
4.1.3 Glass Forming Processes

4.2. Processes Used to Separate Ceramic Materials
   4.2.1 Unifying Mixture
   4.2.2 Milling
   4.2.3 Filter Pressing
   4.2.4 Pugging
   4.2.5 Spray Drying
   4.2.6 Grinding
   4.2.7 Etching

4.3. Processes Used to Fabricate Ceramic Materials
   4.3.1 Direct Bonding Processes
   4.3.2 Mechanical Attachment Processes

4.4. Processes Used to Condition Ceramic Materials
   4.4.1 Primary Processing
   4.4.2 Densification
   4.4.3 Calcination
   4.4.4 Freeze-Drying
   4.4.5 Firing
   4.4.6 Vitirification
   4.4.7 Transformation Toughening
   4.4.8 Vapor Deposition Coating Processes
   4.4.9 Ion Implantation
   4.4.10 Annealing
   4.4.11 Tempering

4.5. Processes Used to Finish Ceramic Materials
   4.5.1 Grinding
   4.5.2 Flame Polishing
   4.5.3 Flame and Plasma Spraying
   4.5.4 Laser Processing
   4.5.5 Glazing

Unit 5: Composite Materials – 18.75% of course

5.1. Processes Used to Form Composite Materials
   5.1.1 Open Molding
   5.1.2 Infusion Molding or Closed System Molding
   5.1.3 Resin Transfer Molding Processes
   5.1.4 Thermal Expansion Resin Transfer Molding
   5.1.5 Expansion Molding
   5.1.6 Pultrusion
   5.1.7 Filament Winding

5.2. Processes Used to Separate Composite Materials
   5.2.1 Diamond Wire Cutting
   5.2.2 Waterjet Cutting
   5.2.3 Laser Machining
   5.2.4 Ultrasonic Machining
5.3. Processes Used to Fabricate Composite Materials
   5.3.1 Fabrication of Composites
   5.3.2 Attaching Components to Composite Matrices

5.4. Processes Used to Condition Composite Materials
   5.4.1 Irradiation
   5.4.2 Improving Bonding of Composites
   5.4.3 Protection from Weathering
   5.4.4 Changing Composite Characteristics
   5.4.5 Temperature Degradation of Composites

5.5. Processes Used to Finish Composite Materials
   5.5.1 Surface Finishes
   5.5.2 Integral Finishes

Unit 6: Wood Materials – 12.5% of course

6.1. Processes Used to Form Wood Materials
   6.1.1 Bonding Processes
   6.1.2 Lamination Processes
   6.1.3 Bending Processes

6.2. Processes Used to Separate Wood Materials
   6.2.1 Planing
   6.2.2 Jointing
   6.2.3 Shaping
   6.2.4 Routing
   6.2.5 Turning
   6.2.6 Sawing
   6.2.7 Drilling
   6.2.8 Boring
   6.2.9 Mortising and Tenoning

6.3. Processes Used to Fabricate Wood Materials
   6.3.1 Mechanical Fasteners
   6.3.2 Adhesives

6.4. Processes Used to Condition Wood Materials
   6.4.1 Radio Frequency Dielectric Heating
   6.4.2 Wood Plastic Composition
   6.4.3 Plasticized Wood
   6.4.4 Staypak
   6.4.5 Pressure-Treated Wood
   6.4.6 Polyethylene Glycol

6.5. Processes Used to Finish Wood Materials
   6.5.1 Surface Preparation
   6.5.2 Finish Coatings
Lab: None – this is a lecture-only course

18. Methods of Instruction:
1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Field Trips (optional)

19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

**Oral Presentations**

Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Choose from a number of manufacturing processes provided by the instructor. Research recent advances in that particular manufacturing process, explaining those advances, the reason(s) for choosing the process over similar processes, any evaluation or testing performed and the results of that evaluation, and provide your own predictions for future improvements in that manufacturing process in terms of: efficiency, safety, economy, production output, or other factors that improve product quality, production improvements, durability, or similar improvements. Present your findings to your instructor and students in the course.

2) Compare and contrast two similar manufacturing processes, explaining: the reasons for choosing each of the processes, benefits and disadvantages of the processes, and, potential for increased usage among manufacturing facilities. Present your findings to your instructor and students in the course.

**Writing/Research Assignments**

Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.
Sample topic:

1) Selecting a manufacturing process from a list of suggestions provided by your instructor, perform research on the particular process, providing the following information: a) Cost of implementation versus performance benefits, b) Unique characteristics of that particular industrial process in comparison to similar processes, c) Implementation and usage requirements that may be unique or challenging for the process, and, d) Recent or eminent advances in that particular process. A three to five page research paper using correct formatting and style will be the product of the assignment.

Application/Problem Solving/Synthesis

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. These will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics:

1) Using a case study for a particular industry sector or product, choose the manufacturing processes that best accomplish the major production steps, explaining the following: a) Justifications used for selecting those processes, including cost, efficiency, safety, internal plant requirements, and the other factors impacting the production operations in terms of the chosen processes, b) Potential benefits of using the chosen specific manufacturing processes over similar processes, and, c) specific factors that a company would need to research before making the decision to select those manufacturing processes. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

2) Using a case study for a particular industry sector or product, research the specific elements that impact the return on investment (ROI) for the manufacturing processes that were selected. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

3) Given a particular simple product to be manufactured, select the best choices for the manufacturing processes needed to produce that product. Provide the justifications used for selecting those processes, including: cost, efficiency, safety, internal plant requirements, and the other factors impacting the production operations in terms of the chosen processes. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

20. Methods of Evaluation: Assessment of student performance may include but are not limited to:
1. Exams and Quizzes
2. Written Work (outside of class assignments, worksheets, et. al.)
21. Texts, Readings, and Materials:


   **Assigned Readings:** None identified

   **Manuals:** None required

   **Software:** None required

   **Other:** None identified

22. Approvals:

   **Curriculum Committee Approval Date:** 3/3/2016

   **Board of Trustees Approval Date:** 4/14/2016

   **State Approval Date:** 5/12/2016
1. Discipline and Course Number: INDA B132
2. Course Title: Project Management and Budgeting
3. Course Author(s): Roy Allard
4. Course Catalog Description: This course provides hard information and skills to work successfully in a project environment and to accomplish project objectives. It will equip students by explaining concepts and techniques and by using numerous examples to show how they can be skillfully applied. Topics covered in this course include project management life cycle and process; identifying and selecting projects; developing a project proposal; techniques for planning, scheduling, resource assignment, budgeting, and controlling project performance; project risks; project manager responsibilities and skills; project team development and effectiveness; project communication and documentation; and project management organizational structures. The concepts in the course support the project management knowledge areas of the Project Management Institute's A Guide to the Project Management Body of Knowledge (PMBOK® Guide).
5. Grading Method: S = Standard Letter
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid; Online
8. Instructional Methods:

<table>
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<tr>
<th>Min Units</th>
<th>Min Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>3</td>
</tr>
<tr>
<td>Lab</td>
<td>0</td>
</tr>
<tr>
<td>Activity</td>
<td>0</td>
</tr>
</tbody>
</table>
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability

- Required: Industrial Automation Bachelor’s of Science degree
- Restricted Elective: None
- Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

1. Appraise and defend the understanding of project management, the benefits of utilizing project management, and techniques to manage projects.

2. Support the understanding of the Project Management Knowledge Areas of the Project Management Body of Knowledge (PMBOK) guide.

3. Analyze the concepts of project management terms and techniques such as initiating, planning, executing, monitoring, controlling, and closing projects, selection methods, work breakdown structures, Gantt charts, network diagrams, critical path analysis, and cost estimates.

4. Apply the use of project management software to plan and manage a project including assignment and tracking of resources, tasks, budgets, costs and milestones.

5. Examine basic accounting concepts including generally accepted accounting principles, accounting basics, financial statements, and budgets. They will defend the ethics of these principles.

Course Objectives: This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. To describe what project management is, the benefits of utilizing project management, and techniques to manage projects.

2. To recognize the Project Management Knowledge Areas of the Project Management Body of Knowledge (PMBOK) guide.

3. To implement the concepts of project management terms and techniques such as initiating, planning, executing, monitoring, controlling, and closing projects, selection methods, work breakdown structures, Gantt charts, network diagrams, critical path analysis, and cost estimates.

4. To operate project management software to plan and manage a project including assignment and tracking of resources, tasks, budgets, costs and milestones.

5. To describe basic accounting concepts including generally accepted accounting principles, accounting basics, financial statements, and budgets.

16. Requisites

Prerequisite(s): Admission to the Industrial Automation Bachelor of Science degree program.

Advisory: None.
17. Detailed Topic Outline (including instructional time devoted to each topic):

**Lecture: 54 Hours total**

**Unit 1: Introduction to Project Management (Duration 12%)**

1.1 Defining a Project
   1.1.1 Project Attributes
   1.1.2 Project Constraints
   1.1.3 The Project Life Cycle

1.2 Defining Project Management
   1.2.1 Project Management Process
   1.2.2 Process Elements
   1.2.3 Benefits of Project Management

1.3 PMI and the PMBOK Guide

**Unit 2: Project Management Initiation (Duration 16%)**

2.1 Identifying and selecting Projects
   2.1.1 Project Charter

2.2 Project initiation and scope

2.3 Request for Proposal process (RFP)
   2.3.1 Creation of RFP
   2.3.2 Solicitation of proposals
   2.3.3 Responding to RFPs
      2.3.3.1 Proposal Contents

2.3.4 RFP Submission and Evaluation

**Unit 3: Accounting Basics and Budgeting (Duration 16%)**

3.1 Identifying what is accounting and its purpose

3.2 Generally accepted accounting guidelines (GAAP)
   3.2.1 Ethics in business and financial accounting
   3.2.2 Basic accounting rules and guidelines
   3.2.3 The Financial Accounting Standards Board and the Securities and Exchange Commission

3.3 Difference of general accounting, cost accounting and budgeting

3.4 Understanding the chart of accounts and the general ledger
   3.4.1 Credits verses Debits
   3.4.2 Recording transactions
   3.4.3 Making journal entries
3.5 Overview of business financial statements
   3.5.1 Income Statement
   3.5.2 Balance Sheet
   3.5.3 Statement of Cash Flows

3.6 Budgeting
   3.6.1 The importance and benefits from budgeting
   3.6.2 Different types of budgets in business
   3.6.3 Preparing a project budget
   3.6.4 Understanding variances

Unit 4: Project Integration, Scope, Quality and Time Management (Duration 20%)

4.1 Project Objective and Scope
   4.1.1 Planning Tasks and Project Deliverables

4.2 Project Quality
   4.2.1 Creating a Quality Plan
   4.2.2 Quality Assurance Methods
   4.2.3 Quality Control

4.3 Developing Work Breakdown Structures
   4.3.1 Work Packages and Project Deliverables

4.4 Time Management Planning Tasks
   4.4.1 Activity List
   4.4.2 Network Diagrams
   4.4.3 Schedule Development
      4.4.3.1 Estimated Resources
      4.4.3.2 Estimated Durations
   4.4.4 Critical Path Analysis

4.5 Project Quality

Unit 5: Human Resource, Cost and Risk Management (Duration 18%)

5.1 Resources Requirements Plan
   5.1.1 Force to Load Planning

5.2 Cost Management
   5.2.1 Estimating Budgeted Cost
   5.2.2 Actual and Committed Costs
   5.2.3 Variance of Budgeted and Actual Costs
   5.2.4 Managing Cash Flow

5.3 Managing Risk
   5.3.1 Identification and Risk Assessment

Unit 6: Using Microsoft Project (Duration 18%)

6.1 Using the new the Ribbon to navigate the application
6.2 Create a Work Breakdown Structure
6.3 Identify Task Relationships
6.4 Define Resources within Project
6.5 Make Work Package Estimates
6.6 Create an Initial Schedule
6.7 Create a Resource Leveled Schedule
6.8 Capture actual performance data
6.9 Format Output and Print Reports
6.10 Set up a Project with a Calendar, Start date, and scheduling method
6.11 Set project baselines and use them to measure progress
6.12 Integrate Multiple Projects

**Lab:** None – this is a lecture-only course.

**18. Methods of Instruction:**
1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)

**19. Outside of Class Assignments:** Outside of class assignments may include, but are not limited to:

**Oral Presentations**
Using a grading rubric developed in collaboration with the Communication department, and after the criteria and expectations are presented, students will prepare and deliver at least one oral presentation for the other students in the course section.

**Sample topics:**

1) Students will conduct a pre-bid meeting presenting the project scope and request for proposal (RFP) for installation of an automation system to be installed in their facility. The class students not presenting will be the responders to the RFP and will ask questions of the students presenting to clarify pertinent information to ensure sufficient information and understanding of the project scope and RFP are obtained for bidding purposes.

2) Students will respond to a request for proposal (RFP) at a bid meeting and present pertinent information in response to the RFP. The response should include a project timeline, budget, force allocation and contingency planning to ensure all aspects of the RFP is met. Students should also scrutinize the RFP for other possible solutions.
to present cost saving measures if the project was handled differently from the RFP. The students not presenting will review the presentation and ask clarifying questions of the presenting students.

Writing/Research Assignments
The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work. A uniform grading rubric will be provided, and the expectations for the assignment will be covered prior to the assignment.

Sample topics:

1) In this paper students will analyze implementing a new project utilizing the concepts of project management, the benefits of utilizing project management, and techniques to manage projects.

2) In this paper students will examine the benefits of utilizing project management and defend the techniques used to manage projects.

3) Through analysis students will compare and contrast the benefits of general accounting versus job cost accounting. They will defend their choice from different scenarios.

Application/Problem Solving/Synthesis
These assignments are based upon scenarios, comparisons, or connections between various topics covered in the course.

Sample topics:

1) Students will assess a project that is over budget. They will use analytical thinking and creative problem solving methods to bring the project back into meeting the project budget.

2) Students will assess a project that needs to be completed in a shorter timeline than the force allocation allows. They will use analytical thinking and creative problem solving methods to complete the project within the timeline and keep the project budget within a 10% variance.

20. Methods of Evaluation: Assessment of student performance may include but are not limited to:
1. Exams and Quizzes
2. Written Work (outside of class assignments, worksheets, et. al.)
3. Class Performance
4. Class Presentations

21. Tests, Readings, and Materials:


Assigned Readings: None identified

Manuals: None required

Software: Microsoft Project 2013 (a trial version of Microsoft Project 2013 is packaged with every textbook)
22. Approvals:

   *Curriculum Committee Approval Date:* 3/3/2016
   *Board of Trustees Approval Date:* 4/14/2016
   *State Approval Date:* 5/12/2016
1. Discipline and Course Number: INDA B134
2. Course Title: Industry Sector Seminar: Manufacturing and Production
3. Course Author(s): Sean Caras

4. Course Catalog Description: A study of the specific automation processes related to the following industry sectors: petroleum (refining and materials processing of petroleum-related products including gasses, plastics and polystyrene foam), food and value-added agriculture processing (including processing, packaging, food safety, good manufacturing processes, quality assurance processes, and other topics of importance to the food processing industry), materials processing (including building materials, minerals, and other non-food products created from natural resources), as well as equipment, industrial manufacturing, and aerospace industries.

5. Grading Method: S = Standard Letter

Optional: None

6. Total Units: 3

7. Method of Delivery: Face-to-Face; Hybrid; Online
   (face-to-face, hybrid, and/or online)

8. Instructional Methods:
   Min Units  Min Hours
   Lecture  3  54
   Lab  0  0
   Activity  0  0

9. Repeatability: Non-Repeatable Credit

10. Materials Fee: None

11. Credit by Examination: No

12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)

13. Stand Alone: No

14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes:

Upon completion of the course, the student will be able to:

1. Compare and contrast the various industry sectors by examining similar and different processes, and the application of similar and different process technologies among them (B.S. PLO 1, ILO 1, Course Objectives 1,2,4,5)

2. Categorize the various industries covered in this seminar course in terms of: safety and hygiene needs and regulations, quality control/quality assurance efforts, and overall plant management in terms of: regulatory oversight, applicable standards, level of automation and process control, and level of driving-force technological improvements. (B.S. PLO 4, ILO 3, Course Objective 3)

3. Analyze various industry sectors from among those covered in this seminar course in terms of: contribution to our local and state economy, the workforce and employee types for technical and management positions, the emerging trends and deployment of technology, and the opportunity for increased automation. (B.S. PLO 5, ILO 4, Course Objectives 1,2,4,5)

Course Objectives:

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Explain the processes followed for downstream petroleum-based material manufacturing, including refinery operations, plastics and expanded polystyrene foam manufacturing, as well as gasses and products produced by natural gasses, and be able to compare the automation and process control applications with the other industry sectors covered in the course.

2. Explain the processes followed by the food and value-added agriculture industry sector, including packing and packaging, agricultural products processing, beverage processing, as well as water and wastewater treatment, and be able to compare the automation and process control applications with the other industry sectors covered in the course.

3. List and explain the various food safety and good manufacturing processes (GMP) guidelines, regulations, and implementation strategies. Identify the regulatory agencies responsible for setting and enforcing those standards.

4. Explain the processes followed in the various materials processing industries, including building materials, minerals and metals, lumber and paper, and composite materials, and be able to compare the automation and process control applications with the other industry sectors covered in the course.
5. Explain the processes followed in the various equipment manufacturing, fabrication, and aerospace industries within our geographic location, and be able to compare the automation and process control applications with the other industry sectors covered in the course.

16. Requisites

**Prerequisite(s):** Admission to Industrial Automation Bachelor’s Degree program

**Advisory:** None

17. Detailed Topic Outline *(including instructional time devoted to each topic):*

**Lecture: 54 hours**

**Unit 1: The Petroleum Industry – Downstream and Petroleum-Based Material Manufacturing (25% of instructional time)**

**1.1 Refinery Operations**

- 1.1.1 Desalting
- 1.1.2 Atmospheric distillation
- 1.1.3 Vacuum distillation
- 1.1.4 Hydrotreatment
- 1.1.5 Catalytic reforming
- 1.1.6 Distillation hydrotreatment
- 1.1.7 Fluid Catalytic Cracking
- 1.1.8 Hydrocracking
- 1.1.9 Visbreaking
- 1.1.10 Methods for removing mercapans
- 1.1.11 Coking
- 1.1.12 Alkylation
- 1.1.13 Dimerization
- 1.1.14 Isomerization
- 1.1.15 Steam reforming
- 1.1.16 Conversion of hydrogen sulfide into sulphur
- 1.1.17 Wastewater collection and treatment
- 1.1.18 Additional processes and treatments

**1.2 Plastics and Expanded Polystyrene Foam Manufacturing**

- 1.2.1 Introduction to plastics and polymers
- 1.2.2 Acquiring the raw material (monomer)
- 1.2.3 Synthesizing the basic polymer/ polymer structure
- 1.2.4 Compounding the polymer into a material used for fabrication
- 1.2.5 Additives
- 1.2.6 Product manufacturing methods – overview
- 1.2.7 Manufacturing expanded polystyrene foam
- 1.2.8 Thermoplastic and thermoset processing
- 1.2.9 Calendering and film blowing
- 1.2.10 Expanded bead blowing
1.2.11 Extrusion and injection molding
1.2.12 Rotational molding
1.2.13 Compression molding
1.2.14 Casting
1.2.15 Blow molding and thermoforming
1.2.16 Local Industry Connections

1.3 Gasses and Products Produced by Natural Gasses

1.3.1 Natural and petroleum gas types: methane, butane, propane, and related gasses
1.3.2 Primary gas processing
1.3.3 Common products produced by natural gasses
   1.3.3.1 Ammonia
   1.3.3.2 Mineral Fertilizers
   1.3.3.3 Complex chemical products

Unit 2: Food and Value Added Agriculture Industries (37.5%)

2.1 Packing and Packaging

2.1.1 Processing operations
   2.1.1.1 Pasteurization
   2.1.1.2 Homogenization
   2.1.1.3 Emulsifying
   2.1.1.4 Flash freezing
   2.1.1.5 Dehydration and freeze-drying
   2.1.1.6 Pickling
   2.1.1.7 Fermentation
2.1.2 Produce Packing and Processing
2.1.3 Agricultural Products Packaging
   2.1.3.1 Canning
   2.1.3.2 Bottling
   2.1.3.3 Packaging Types and Methods for Food Products
2.1.4 Local Industry Connections

2.2 Agricultural Products Processing

2.2.1 Production of Essential Juices, Pulp/Fiber, and other Products
2.2.2 Nut Processing
2.2.3 Cotton Ginning
2.2.4 Snack Foods: Chips, Nuts, Snacks
2.2.5 Frozen Products: Ice Cream
2.2.6 Local Industry Connections

2.3 Beverage Processing

2.3.1 Beer and Lager Production
2.3.2 Soft Drink Production
2.3.3 Bottled Water Production
2.3.4 Blended Beverage Production
2.3.5 Local Industry Connections
2.4 Food Safety and Good Manufacturing Processes

  2.4.1 HACCP (Hazard analysis and critical control points)
  2.4.2 GMP (Good manufacturing practices)
  2.4.3 Quality control and food sciences
  2.4.4 Recordkeeping requirements

2.5 Water and Wastewater Treatment

  2.5.1 Water treatment and purification methods and processes
  2.5.2 Wastewater treatment methods and processes
  2.5.3 Industrial water treatment methods and processes

Unit 3: Materials Processing Industries (18.75%)

3.1 Building Materials

  3.1.1 Asphalt Production
  3.1.2 Shingles and Roofing Production
  3.1.3 Cement Production
  3.1.4 Brick and Block Production
  3.1.5 Local Industry Connections

3.2 Minerals and Metals

  3.2.1 Mining and Processing of Minerals
  3.2.2 Mining and Processing of Metals
  3.2.3 Local Industry Connections

3.3 Lumber and Paper

  3.3.1 Milling and Production of Lumber and Wood-related Products
  3.3.2 Paper Manufacturing Process Overview

3.4 Composite Materials

  3.4.1 Common composite material types
  3.4.2 Composites fabrication methods overview
  3.4.3 Local Industry Connections

Unit 4: Equipment Manufacturing, Fabrication, and Aerospace Industries (18.75%)

4.1 Manufacturing in California

  4.1.1 Manufacturing by region and labor market data
  4.1.2 Manufacturing industry subsectors
    4.1.2.1 Agricultural and food machinery and equipment
    4.1.2.2 Construction machinery and related equipment
    4.1.2.3 Manufacturing machinery
    4.1.2.4 Industrial process machinery
4.1.2.5 Power and Energy equipment
4.1.3 Local Industry Connections

4.2 Fabrication Industries
4.2.1 Metal fabrication
4.2.2 Related processing and manufacturing areas within the fabrication sector
4.2.3 Local Industry Connections

4.3 Aerospace Industries
4.3.1 Industry overview
4.3.2 Occupational analysis for aerospace industries and occupation profiles
4.3.3 Local Industry Connections

Lab:

There is no lab component for this course.

18. Methods of Instruction:
   1. Lecture
   2. Demonstration
   3. Active Learning
   4. Discussion
   5. Guest Speakers
   6. Instruction through Examination and Quizzing
   7. Outside Reading and Outside of Class Work
   8. Problem-Solving Assignments and Scenarios
   9. Written Materials (including worksheets, calculation sheets, et. al.)
   10. Field Trips (optional)

19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

   Oral Presentations
   Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

   Sample topic:
   1) Create a presentation that analyzes a specific industry sector from among those covered in this course in terms of: contribution to our local and state economy, the workforce and employee types for technical and management positions, the emerging trends and deployment of technology, and the opportunity for increased automation. Then while listening to the other presentations, complete an information map of the other industry sectors.
Writing/Research Assignments

Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topic:

1) Using technical websites, periodicals, industry publications, manufacturer catalogs and brochures, and other resources, write a 3-5 page research paper that compares and contrasts the various manufacturing sectors by examining similar and different processes and the application of similar and different process technologies among the various industry sectors covered in this seminar course.

Application/Problem Solving/Synthesis

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topic:

1) Research and write a technical summary that categorizes and compares the various industry safety, hygiene, quality control/assurance, and overall plant management of each of the industry sectors covered in this seminar course. Students will be presented with a framework and rubric to guide their development of this technical summary. Specific areas of information include: regulatory oversight, applicable standards, level of automation and process control, and the level of driving-force technological improvements for each industry sector.

20. Methods of Evaluation:

Assessment of student performance may include but are not limited to:
1. Exams and Quizzes
2. Written Work (outside of class assignments, worksheets, et. al.)
3. Class Performance
4. Class Presentations

21. Texts, Readings, and Materials:

Required Textbook(s): Instructor-created course pack including handouts and materials from various industry trade organizations, workforce development agencies,
and manufacturers of equipment and technology used in the industry sectors covered in this course.

**Assigned Readings:** None identified

**Manuals:** None required

**Software:** None required

**Other:** None identified

### 22. Approvals:

- **Curriculum Committee Approval Date:** 10/29/2015
- **Board of Trustees Approval Date:** 12/17/2015
- **State Approval Date:** 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B140 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B140
2. Course Title: Quality Management
3. Course Author(s): Jason Dixon
4. Course Catalog Description: An overview of the various methods of quality assurance (the systematic process of determining whether products meet customers' expectations), quality control (the systematic process of determining the quality and consistency of products), and efficient manufacturing processes (using techniques that determine the most efficient method of manufacturing and logistics). Strategies such as Six-Sigma, Lean Manufacturing, Failure Mode Analysis, ISO 9001, and various continuous improvement programs will be examined.

5. Grading Method: S = Standard Letter
   Optional: none

6. Total Units: 3

7. Method of Delivery: Face-to-Face; Hybrid; Online
   (face-to-face, hybrid, and/or online)

8. Instructional Methods:

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<tr>
<th>Instructional Methods</th>
<th>Min Units</th>
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<tr>
<td>Lecture</td>
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9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor of Science Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability

   Required: Industrial Automation Bachelor of Science degree
   Restricted Elective: None
   Elective: None

15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

   1. Describe concepts of quality management and improvement.
   2. Assess the role of technology, managers, employees, and customers in developing a quality-based workplace.
3. Assess an organization or process through the application of Total Quality Improvement including, statistical process control, control charts, and quality function deployment techniques.

4. Collect data and analyze utilizing tools as related to process control and process capability.

5. Describe current trends and benchmark organizations related to Quality Management.

6. Appraise the ethical issues as related to quality of services and products.

**Course Objectives:**
This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Understanding of the fundamental principles of quality management
2. Understanding of terminology related to quality management
3. Applying quality management principles to problems in various contexts
4. Giving examples of quality in different industrial contexts

**16. Prerequisites**

**Prerequisite(s):** Admission to the Bachelor of Science, Industrial Automation Program

**Advisory:** None

**17. Detailed Topic Outline (including instructional time devoted to each topic):**

**Lecture:**

1. Definitions of Quality (5%)
2. Quality and global competitiveness – Why quality matters (5%)
3. Strategic Management (5%)
4. Quality Management (10%)
5. Customer Satisfaction (5%)
6. Employee Empowerment (5%)
7. Effective Communication for quality Managers (10%)
8. ISO 9000 Certification and Total Quality Management (8%)
9. Total quality tools (8%)
10. Problem Solving Techniques (8%)
11. Quality Function Deployment (5%)
12. Statistical Process Control and Analysis (8%)
13. Six Sigma and Lean Manufacturing Methodologies (10%)
14. Benchmarking Techniques (8%)
Lab:
For this lecture-only course, there is no lab component.

18. Methods of Instruction:
1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Field Trips (optional)

19. Outside of Class Assignments:
Outside of class assignments may include, but are not limited to:

Oral Presentations
Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topic:

1) From the various quality management strategies provided by your instructor, select one of them to create a short presentation suitable for technicians, operators, and managers that covers the following information: a) an overview of the strategy, b) the type of organization, facility, or industry sector where that particular strategy is best suited, c) the key features of that strategy, d) the advantages of utilizing that strategy in terms of: economy/financial efficiency, resource management, production quality, the ability to provide products in the appropriate time frame of the customer, and other key benefits, and, e) several examples of companies or industries that have utilized that particular quality management strategy, and the benefits they have received as a result of doing so.

Writing/Research Assignments
Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topic:
1) Given a specific quality management strategy, research the following information and issues related to that strategy: a) general steps in implementation, b) the extent to which that particular strategy is used in one of the industry sectors covered in this program, c) the potential benefits of a company implementing that particular strategy, d) the required resources a company would need in order to implement the strategy, and, e) the potential methods for evaluating the effectiveness of the strategy. A three to five page research paper using correct formatting and style will be the product of the assignment.

**Application/Problem Solving/Synthesis**

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Compare and contrast two of the quality management strategies covered in the course in terms of: potential effectiveness and benefits for particular industry sectors, ease of implementation, ability to scale the process in the event of plant/company/production expansions, the requirements for continuous implementation, and other key elements as provided in the assignment. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

2) Using a case study for a particular industry sector or product, research the specific elements that impact the return on investment (ROI) for implementing the quality management strategy that was selected. In addition, a student may determine elements that impact ROI that were not included in the assignment, and will cover the elements in terms of their impact on the ROI. A completed worksheet, short paper, or oral presentation will be the product of the assignment.

**20. Methods of Evaluation:**

Assessment of student performance may include but are not limited to:
1. Exams and Quizzes
2. Written Work (outside of class assignments, worksheets, et. al.)
3. Class Performance
4. Class Presentations

**21. Texts, Readings, and Materials:**


*Assigned Readings:* Assigned readings outside of textbook here

*Manuals:* None required

*Software:* None required
Other: List other materials here

22. Approvals:
   - Curriculum Committee Approval Date: 3/3/2016
   - Board of Trustees Approval Date: 4/14/2016
   - State Approval Date: 5/12/2016
1. Discipline and Course Number: INDA B142  
2. Course Title: Facilities Planning and Operations  
3. Course Author(s): Jason Dixon  
4. Course Catalog Description: An overview of the processes used in planning and operating an industrial facility, including but not limited to: efficient design of workflow, quality assurance, material handling, time and motion study, scheduling, inventory control, examining the application of automation through a cost-benefit analysis, organizing production and facilities operation, and structuring management operations efficiently.

5. Grading Method:  
   S = Standard Letter  
   Optional: none  
6. Total Units: 3  
7. Method of Delivery: Face-to-Face; Hybrid; Online  
8. Instructional Methods:  
<table>
<thead>
<tr>
<th>Min Units</th>
<th>Min Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>3</td>
</tr>
<tr>
<td>Lab</td>
<td>0</td>
</tr>
<tr>
<td>Activity</td>
<td>0</td>
</tr>
</tbody>
</table>
9. Repeatability: Non-Repeatable Credit  
10. Materials Fee: None  
11. Credit by Examination: No  
12. Core Mission Applicability: Bachelor of Science Degree Applicable; Career and Technical Education (CTE)  
13. Stand Alone: No  
14. Program Applicability  
   | Required: Industrial Automation Bachelor of Science degree  
   | Restricted Elective: None  
   | Elective: None  
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:  
   1. Define and analyze product, process and schedule design interactions by studying the functions involved in the product development cycle.  
   2. Analyze facility design problems by with cost-modelling techniques.
3. Solve facility location problems by applying analytical facilities location methods.

4. Prepare and present a facilities planning project report by using facility layout model techniques and applying standards of professional and ethical responsibility.

5. Design and analyze building systems based on safety, environmental, economic, and sustainability requirements.

Course Objectives: This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Understand how facilities are planned and why
2. Learning facilities layout techniques
3. Studying examples of various facilities layouts
4. Understanding sustainability and efficiency as related to facilities.

16. Requisites

Prerequisite(s): Admission to the Bachelor of Science, Industrial Automation Program

Advisory: None

17. Detailed Topic Outline (including instructional time devoted to each topic):

Lecture:

1. Facility Types and Management Methods (7%)
2. Sustainable Maintenance Operations (7%)
3. Outsourcing Services (6%)
4. Financial Management and Control (9%)
5. Construction Management and Sustainable Design (9%)
6. Emergency Management, Fire Prevention, and Security (9%)
7. Facility and Global Environmental Management (7%)
8. Building Systems and Controls (9%)
9. Major Building Equipment and Subsystems (9%)
10. Energy Management and Renewable Energy (7%)
11. Building Site and Interior Management (7%)
12. Green Building Construction (7%)
13. Strategic Planning and Project Financial Analysis (7%)

Lab:

Because this is a lecture-only course, there is no lab component.

18. Methods of Instruction:

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Field Trips (optional)

19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

Oral Presentations
Students can be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. At least one oral presentation in some form is desired for upper-division technical courses. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics:

1) How can the Facility Manager use the elements of TQM to meet the requirements of the lease and to go beyond lease requirements?

2) Discuss the considerations when develop a project scope for a new facility.

Writing/Research Assignments
Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that this rubric, criteria, and explanations will be standardized among the upper-division coursework. An example of sample topic(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics:

1) A company wants to build a 57,000-square-foot grocery store. What type of construction contract would best suit this project? Explain.

2) Green roof installation can turn an area of the building from something that is unusable into a space for visitors and tenants. What special precautions should be taken when tenants are given roof access? How can a green roof become a profit center for the building?

3) Discuss the possible advantages of chilled beam systems over conventional main building cooling systems that use cooling coils in a main air handler.

Application/Problem Solving/Synthesis
Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through
similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics:

1) Using provided cost data develop a plan to utilize the budgeted funds efficiently. Provide a rationale you’re your choices and present the information in the form of a spreadsheet. Note that it is important to consider the useful life of the equipment discussed. Assume that any apartment/building items not mentioned are in very good condition.

2) Could a Council House 2–type of building be constructed in a location with four seasons and temperature extremes? What systems might you want to augment with additional equipment?

20. Methods of Evaluation: Assessment of student performance may include but are not limited to:

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)
10. Field Trips (optional)

21. Texts, Readings, and Materials:


Assigned Readings: None identified

Manuals: None required

Software: None required

Other: None identified

22. Approvals:

Curriculum Committee Approval Date: 3/3/2016
Board of Trustees Approval Date: 4/14/2016
State Approval Date: 5/12/2016
1. Discipline and Course Number: INDA B144
2. Course Title: Leadership and Entrepreneurship
3. Course Author (s): Roy Allard
4. Course Catalog Description: Students strengthen personal and organizational leadership skills. The course increases understanding of and experience with decision making, problem solving, and communication. An investigation of the factors that determine leadership with special emphasis on the leader's vision. The study and analysis of the issues and options which must be faced in developing a successful technological venture and on the creation of a winning business plan. Particular attention is directed to the identification of technology-based venture opportunities, evaluation of technical feasibility and commercial potential, and planning for successful commercialization.

5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid; Online
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:
   \[
   \begin{array}{c|c|c}
   \text{Min} & \text{Min} \\
   \text{Units} & \text{Hours} \\
   \text{Lecture} & 3 & 54 \\
   \text{Lab} & 0 & 0 \\
   \text{Activity} & 0 & 0 \\
   \end{array}
   \]
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   \[
   \begin{align*}
   \text{Required:} & \quad \text{Industrial Automation Bachelor’s of Science degree} \\
   \text{Restricted Elective:} & \quad \text{None} \\
   \text{Elective:} & \quad \text{None}
   \end{align*}
   \]
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

1. Define what leadership is including the elements of leadership, indicate its importance, and describe how to create and implement a powerful vision.

2. Support ethics in the workplace, analyze the values that guide your moral compass and the role of the leader in setting the moral tone and ethical climate of the workplace.

3. Appraise the practical steps a leader can take to empower others and develop a high-performance workplace; including how to motivate employees, apply skills for managing change, problem solving and decision making.

4. Create a new technology business plan including an elevator pitch to gain support for the venture.

5. Apply a strategy for growth and manage the implications of growth use capital budgeting that includes cost of capital, leverage and dividend policy in a financial management context and know how to acquire resources for growth from external sources.

Course Objectives: This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. To describe what leadership means and the functions of leadership in the workplace.

2. To recognize the morals that shape ethics in the workplace.

3. To discuss the steps a leader uses to be an effective leader.

4. To execute the process to create and launch a new venture including how to create an effective business plan and presentation to assist in launching the new venture

5. To recognize and discuss the growth strategies and implications for launching a new venture to include budgeting, cost of capital, financial management and learn how to raise capital funding.

16. Requisites

Prerequisite(s): Admission to the Industrial Automation Bachelor of Science degree program

Advisory: None
17. Detailed Topic Outline (including instructional time devoted to each topic):

**Lecture: 54 hours total**

**Unit 1: The Importance of Leadership (Duration 7%)**

1.1 Defining Leadership

1.2 Types of Leaders
   1.2.1 Teachers
   1.2.2 Heroes
   1.2.3 Rulers

1.3 What People Want in a Leader

1.4 Nine key areas of leadership
   1.4.1 The Leadership Equation
   1.4.2 Vision
   1.4.3 Ethics
   1.4.4 Empowerment
   1.4.5 Relationships
   1.4.6 Understanding people
   1.4.7 Delegation
   1.4.8 Developing others
   1.4.9 Performance management

**Unit 2: Leadership Variables and Vision (Duration 14%)**

2.1 Six Traits of Leadership

2.2 Leadership Behaviors
   2.2.1 Concern for People/Production

2.3 Leadership Qualities
   2.3.1 Vision; Ability, Enthusiasm; Stability; Concern for others; Self-confidence; Persistence; Vitality; Charisma; Integrity
   2.3.2 The importance of trust

2.4 Characteristics of followers

2.5 Situational Factors
   2.5.1 Organization size; social climate; Employment patterns; Purpose of work

2.6 Leadership styles
   2.6.1 Directive; Participative; Free-Reign

2.7 The Importance of Vision
   2.7.1 Vision; Mission; Values
   2.7.2 Visioning Process and Principles

2.8 Social Motives for Leadership
   2.8.1 Power; Achievement; Affiliation

2.9 Organizational Climate
2.10 Patterns of Leadership
   2.10.1 Exploitive; Impoverished; Supportive; Enlightened

Unit 3: Ethics (Duration 7%)

3.1 The Importance of Ethics
3.2 Roots of Ethics
3.3 Moral Development
3.4 Levels of Morality
3.5 Ethics and Values at Work
   3.5.1 Honesty; Respect; Service; Excellence; Integrity
   3.5.2 Traditional Definitions of Good
   3.5.3 Leadership and Values
   3.5.4 Personal Values
   3.5.5 Understanding Core Values

Unit 4: Empowerment and Leadership Principles (Duration 17%)

4.1 Leadership Authority
4.2 Participative Leadership Philosophy
4.3 Principles of an Empowered Workplace
   4.3.1 Trust, Invest and Recognize accomplishments in people
   4.3.2 Decentralize Decision Making
   4.3.3 View work as a cooperative effort
4.4 Characteristics of an Empowered Workplace
4.5 Importance of Communication
4.6 Communications Problems and Solutions
   4.6.1 Distance; Distortion; Fear; Trust; Size
4.7 Improving Performance through Quality Initiatives
4.8 Human Relations
   4.8.1 Raising Morale
   4.8.2 Job Design and Work Satisfaction
4.9 Effective Human Relationships
4.10 Trust and Respect
4.11 The Art of Listening
4.12 The Team Concept
   4.12.1 Designing Teams for Success
   4.12.2 Avoiding Groupthink
   4.12.3 Team Building Techniques
4.13 Workplace Motivation
   4.13.1 The Five Motivation Levels

4.14 Employee Engagement
   4.14.1 The Art of Persuasion

4.15 Managing Conflict

4.16 Effective Delegation

4.17 Developing Others

4.18 Managing Through Change

4.19 Managing Performance
   4.19.1 Setting objectives
   4.19.2 Performance reviews

Unit 5: Venture Opportunity and Strategy (Duration 14%)

5.1 The Role and Promise of Entrepreneurship
   5.1.1 Economics – Financial, Intellectual, Human, Organizational and Social capital
   5.1.2 Innovation and Technology
   5.1.3 The Technology Entrepreneur

5.2 Opportunities
   5.2.1 Market Engagement and Design Thinking
   5.2.2 Types and Sources of Innovation
   5.2.3 Opportunity Evaluation

5.3 Vision and the Business Model
   5.3.1 Vision, Mission and Value
   5.3.2 The Business Model
   5.3.3 Business Model Innovation in Challenging Markets

5.4 Competitive Strategy
   5.4.1 Core Competencies
   5.4.2 Industry Analysis
   5.4.3 Strengths, Weaknesses, Opportunities and Threats (SWOT)
   5.4.4 Barriers to Entry
   5.4.5 Achieving a Sustainable Competitive Advantage
   5.4.6 Matching Tactics to Markets
   5.4.7 The Socially Responsible Firm

5.5 Innovation Strategies
   5.5.1 First Movers versus Followers (First to Market)
   5.5.2 Technology and Innovation Strategies
   5.5.3 New Technology Ventures

Unit 6: Concept Development and Venture Formation (Duration 20%)

6.1 The Business Story and Plan
   6.1.1 The Concept Summary and Story
6.1.2 The Business Plan
   6.1.2.1 Executive Summary
   6.1.2.2 Opportunity and Market Analysis
   6.1.2.3 The Solution and Concept
   6.1.2.4 Marketing and Sales
   6.1.2.5 Product Development and Operations
   6.1.2.6 Team and Organization
   6.1.2.7 Risks
   6.1.2.8 Financial Plan and Investment Offering
   6.1.2.9 Detailed Financial Plan

6.1.3 The Elevator Pitch

6.2 Risk and Return
   6.2.1 Risk and Uncertainty
   6.2.2 Scale and Scope
   6.2.3 Risk versus Return
      6.2.3.1 Managing Risk

6.3 Creativity and Product Development
   6.3.1 Creativity and Invention
   6.3.2 Product Design and Development
   6.3.3 Product Prototypes
   6.3.4 Scenarios

6.4 Marketing and Sales
   6.4.1 Marketing Objectives and Customer Target Segments
   6.4.2 Product and Offering Description
   6.4.3 Brand Equality
   6.4.4 The Four Elements of Marketing Mix
   6.4.5 Customer Relationship Management (CRM)
   6.4.6 Personal Selling and the Sales Force

6.5 Types of Ventures
   6.5.1 Independent versus Corporate Ventures
   6.5.2 Nonprofit and Social Ventures
   6.5.3 Incentives for Corporate Entrepreneurs

Unit 7: Intellectual Property, Organizations and Operations (Duration 8%)

7.1 Intellectual Property
   7.1.1 Trade Secrets; Patents; Trademarks; Copyrights
   7.1.2 Licensing

7.2 The New Enterprise Organization
   7.2.1 The New Venture Team
   7.2.2 Organizational Design
   7.2.3 Leadership, Management, Recruiting and Retention

7.3 Acquiring and Organizing Resources
   7.3.1 Influence and Persuasion
   7.3.2 Vertical Integration and Outsourcing
   7.3.3 Innovation
7.4 Management of Operations
   7.4.1 The Value Chain
   7.4.2 Processes and Operations Management
   7.4.3 The Internet and Operations

7.5 Acquisitions and Global Expansion
   7.5.1 Acquisitions as a Growth Strategy
   7.5.2 Global Business

Unit 8: Financing and Leading the Enterprise (Duration 13%)

8.1 Profit and Harvest
   8.1.1 Revenue, Cost and Profit Model
   8.1.2 Managing Revenue Growth
   8.1.3 Managing Harvest (Cash Return)

8.2 The Financial Plan
   8.2.1 Sales Projections and Costs Forecasts
   8.2.2 Financial Statements – Income, Cash Flow and Balance Sheet
   8.2.3 Measures of Profitability and Return on Investment (ROI)

8.3 Sources of Capital

8.4 Deal Presentations and Negotiations

8.5 Leading Ventures to Success
   8.5.1 Execution
   8.5.2 The Adaptive Enterprise
   8.5.3 Ethics

Lab: None – this is a lecture-only course.

18. Methods of Instruction:
   1. Lecture
   2. Demonstration
   3. Active Learning
   4. Discussion
   5. Guest Speakers
   6. Instruction through Examination and Quizzing
   7. Outside Reading and Outside of Class Work
   8. Problem-Solving Assignments and Scenarios
   9. Written Materials (including worksheets, calculation sheets, et. al.)

19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

   Oral Presentations
   Using a grading rubric developed in collaboration with the Communication department, and after the
   criteria and expectations are presented, students will prepare and deliver at least one oral
   presentation for the other students in the course section.
Sample topics:

1) Students will present case analyses, individual project reports, and a team project involving a proposed technological venture. Team project topics will be selected by students in consultation with the instructor.

2) Students will present a comprehensive business plan for a new technology venture in a small group to include an Elevator Pitch.

3) Students will present a comprehensive financial plan for a new technology venture in a small group to include sales projections, costs forecasts, financial statements measures of profitability and return on investment data.

Writing/Research Assignments
The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work. A uniform grading rubric will be provided, and the expectations for the assignment will be covered prior to the assignment.

Sample topics:

1) The paper will analyze your own approach to leadership and strategize an approach that will allow you to integrate best practices into a practical business, community, or family context. Theories and models of leadership should be considered and evaluated.

2) The paper will outlines a plan as to how they can make a significant difference as a leader: at home, at work, and/or in the community.

3) A paper that will demonstrate your mastery of the course content. The application will be specific to a leadership situation in which you are currently involved or have been personally involved in the past.

Application/Problem Solving/Synthesis
These assignments are based upon scenarios, comparisons, or connections between various topics covered in the course.

Sample topics:

1) Students will analyze, prepare reports, and present information to decide whether to acquire and existing company or expand in-house into a new area of technology related to existing operations. A list of areas to choose from will be provided and selected by small groups with instructor input.

2) Students will be exposed with an ethical dilemma and present problem solving techniques to manage the ethical situation in a leadership setting.

3) Students will analyze an upcoming merger and prepare communications for managing change in their workgroup. Problem solving should include but is not limited to, morale, trust, motivation, and productivity.
20. Methods of Evaluation: Assessment of student performance may include but are not limited to:
1. Exams and Quizzes
2. Written Work (outside of class assignments, worksheets, et. al.)
3. Class Performance
4. Class Presentations

21. Tests, Readings, and Materials:


Assigned Readings: None identified

Manuals: None required

Software: None required

Other: Scientific or Financial Calculator

22. Approvals:

*Curriculum Committee Approval Date:* 3/3/2016
*Board of Trustees Approval Date:* 4/14/2016
*State Approval Date:* 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE
INDA B150 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: INDA B150
2. Course Title: Senior Problem I (Systems Design and Integration)
3. Course Author(s): Sean Caras
4. Course Catalog Description: Students will work in teams to design, plan for production, and integrate various automation technologies into the production of a simple product. A working product prototype, a business plan, a facilities plan, and a production plan will also be developed.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid
8. Instructional Methods: Min Units | Min Hours
   Lecture: 0.5 | 9
   Lab: 2.5 | 135
   Activity: x | x
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:
   1. Develop, determine, or design a solution to a technical problem or challenge posed by the sponsoring company or Industrial Automation program faculty in accordance with the required process of the course.
2. Present and justify the solution to the technical problem or challenge, including: oral, written, and visual documentation and presentations.

3. Create an adequate and successful working prototype or design ready for implementation in the INDA B151 course.

**Course Objectives:**

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. To develop or design a solution or a product according to a design brief or statement of a technical problem/challenge, according to a set of defined processes and considering the required documentation for the problem/project.

2. To determine the required technical research, problem solving methodology, investigation of information, and required evaluation process for successful problem/project completion.

3. To evaluate and justify the initial product, problem solution, or systems design.

4. To document the various processes performed during the problem/project, and present them in written, oral, and visual ways to various audiences associated with the project/problem.

**16. Requisites**

**Prerequisite(s):**
- INDA B132 (Project Management and Budgeting)
- **AND**
- INDA B140 (Quality Management)
- **AND**
- INDA B142 (Facilities Planning and Operations)
- **AND**
- Admission to the Industrial Automation Bachelor of Science degree Program

**Advisory:**
- None

**17. Detailed Topic Outline (including instructional time devoted to each topic):**

**Overview Information for Senior Problem/Project Coursework**

*(Lecture and Lab Topical Outline will be presented following this section.)*

The senior problem/project consists of two semesters of coursework. The first semester is devoted to the planning, research, investigation, and formulation of a plausible solution/design/product that will be implemented in the second semester. Students will regularly communicate their progress to the instructor, and at certain times to the students in the course.

The “lecture” portion of the course will serve as a guide to the various processes, skills, knowledge, and other content specific to the course. Additionally, it will serve as an opportunity for the various project teams to present their progress, discuss common issues and experiences with the other teams,
participate in other coordination efforts that are necessary for this type of course, and to participate in the various assessments and evaluations used for course grading.

The “lab” portion of the course is designed to allow students access to the resources of the Engineering and Industrial Technology program (to the extent possible), to one or more program faculty members for assistance, for time to complete sponsor site visits and meetings, and other activities related to the problem or project for the student teams.

**The goals of the senior problem/project are to:**

1) Provide students with a real-world, realistic, and industry-typical problem to solve or project to implement that will utilize their knowledge and skills developed in the other courses in the program.

2) Allow students the ability to work with others – with their peers in class and with those employed in industrial, business, or educational entities – to come up with a solution or tangible project.

3) Provide a realistic environment where students can work with employed professionals, encouraging them to further develop their “personal effectiveness competencies” of: interpersonal skills, integrity, personal acceptability, initiative, and dependability and reliability, and further develop the “workplace competencies” of: teamwork, adaptability and flexibility, scheduling and coordinating, and to follow personal safety and health requirements.

4) Develop opportunities for students to further develop their critical thinking, problem solving, and creativity skills by being responsible for implementing a solution or tangible product, rather than to be directed through a prescribed process.

5) Provide the opportunity for students to spend time interacting with managers and leaders of technical companies that are serving in positions where our students may ultimately be placed upon completion of the program.

6) Create an environment where students will need to work within specific time constraints, adapt to available resources, adhere to strict deadlines, and develop a project management schedule that is reasonable according to the nature of the problem/project.

7) Provide a memorable opportunity for students to be involved with something that is more significant than any one particular subject area or course in the program. The result should be a strong feeling of accomplishment, and a source of confidence as they continue through their career pathway.

**The specific organization and processes of the senior problem/project require that students/student teams:**

1) Work in project teams of two to four. It is up to the student team to determine its structure (e.g. a project leader with project members, two teams with delegated responsibilities, or some other structure).
2) Participate in the development of the problem to solve or the project to implement. Student teams may propose their own project, solicit local technical companies to participate, or choose from projects developed or coordinated through the College.

3) Work with project sponsor to develop a written proposal for their senior problem/process that meets established guidelines.

4) Follow a prescribed process to develop their projects. This process is as close to actual business and industry practices as possible.

5) Utilize the knowledge and skills they have developed in program classes as they go through their project tasks.

6) Utilize several different forms of communication during their project, such as: memos, technical reports, written summaries, oral presentations to other team members, program faculty members, and sponsoring companies, and comprehensive written documentation of project during key milestones in the project cycle.

7) Develop project management skills, including: budget development and monitoring, procurement and management of materials and resources, allocation of resources, time management, and developing, implementing, and enforcing project tasks and deadlines.

8) Divide the responsibilities for project implementation among the team members, and ensure that each team member performs their delegated tasks.

9) Participate in the problem/project in such a way that each student takes equal responsibility and gives equal time and effort in order for a student to successfully complete the course.

10) Evaluate their product/solution in terms of instructor-defined, sponsor-defined, and self-defined criterion.

The requirements for a suitable senior problem/project are:

1) During the duration of the project, students will be performing complex work, rather than the type of work that may be assigned to interns or project assistants. This is not an opportunity for businesses to “farm out” parts of their operation, such as data collection, data entry, inventory processes, physical installation of equipment, preventative maintenance projects, and similar activities.

2) Projects should have a tangible “product” of the effort that can be seen, demonstrated, and the results of the work should be able to be tested or proven. This can either be a tested and documented solution, an actual (physical) product, a combination of a solution to a proposed problem and physically-implemented items that attempt to solve that problem, or some other instructor-approved tangible result of an activity with the level of challenge, the significant application of program-developed knowledge and skills, and the academic rigor of an upper-division program. The next point defines this expectation further.

3) Projects should be at an academic level and have the complexity of a senior-level technical baccalaureate course. Examples of what may determine a senior-level technical course includes, but is not limited to:
a) Academic skills, such as Mathematical Reasoning (Math B1a, Math B2, Math B6a or higher), Written Communication (English B1a), Oral Communication (CSU Breadth Area A1), and Critical Thinking (CSU Breadth Area A3) would be needed by students to complete the assignment/project.

b) Critical-thinking and problem-solving elements, in both an independent (project team directed) and collaborative (business or faculty member sponsor directed) manner should be part of numerous processes within the assignment/project.

c) The application of the upper-division technical coursework should be a key feature. In other words, a student who has only completed the lower-division work would not be equipped to successfully complete the assignment/project (unless that student has previous management work experience or advanced business or technical education that was completed outside of the Industrial Automation degree).

d) The ability to assess, evaluate, test, and/or research the effectiveness of the assignment/project according to criteria developed internally (for this course, that would be criteria developed by the team) and externally (for this course, that would be criteria developed by the sponsoring company or faculty members).

4) The process for completing the project should not be given as a step-by-step series of instructions from the sponsor. Rather, the team should initiate the project planning and project management tasks, with the sponsor providing guidance to help refine those tasks.

5) For “problems,” the sponsor should identify a real and existing issue, limitation, opportunity for improvement, or need within the organization that meets these requirements and allows for a tangible solution to be developed and implemented. The solution should be able to be tested, either in an actual production or business process or perhaps with a limited production run. The solution should not be intended as a theoretical result, in other words. The cost of materials for the solution, if used in a business or industrial plant, should be covered by the project sponsor.

6) For “projects,” the sponsor should identify a real and existing issue, limitation, opportunity for improvement, or need within the organization that meets these requirements and allows for a tangible solution to be developed and implemented. A tangible product should result from the process, and the product should actually be tested in either in an actual production or business process or perhaps with a limited production run. The cost of materials for the product, if used in a business or industrial plant, should be covered by the project sponsor.

7) The selected project or problem should be reasonable in terms of the resources available to students, including:

   a) The amount of time available to students during the semester, and in terms of the number of students on the project team.

   b) The existing resources available to students (technology, software, equipment, supplies, technical expertise of students and assisting instructor(s) of the course).

   c) The ability of the project sponsor to provide time for assisting student project teams and for help in implementing the solution/project/product once it has been
Students will be assessed and the results of the semester’s work will be graded using multiple measures:

1) Assigned “plans,” reports, and presentations will be graded objectively with instructor-developed rubrics and benchmarks.

2) The problem/project sponsor will periodically evaluate the team performance using an evaluation form developed by the instructor.

3) At the end of the semester, the final problem/project presentation will be evaluated by one or more employees of the sponsor who have worked with the student teams. Guest judges from industry and/or professional organizations may also be used.

4) At the end of the semester, the final problem/project presentation will also be evaluated by the course instructor according to a previously-developed and communicated grading rubric.

5) Members of the team will also perform a self-evaluation using their previously-developed evaluation criteria.

Lecture: 9 hours total

It is recommended that students who wish to enroll in this course are able to attend an orientation session prior to the start date of the course. Since the actual problem or project will need to be determined by the beginning of the course, it will be during this orientation session that the students will learn about the process of identifying a company/project that they would like to work on, or can choose from any possible projects that may already be organized through the program faculty.

For the first class meeting, students should have been able to finalize their problem/project, and have obtained a written commitment from the sponsor company, organization, or educational institution.

The “lecture” portion of two class meetings will be devoted to a midterm and a final presentation of the problem/project to the class and instructor(s). (25% of lecture time)

The remaining lecture topics for the course are:

1. Clearly Defining the Project Scope of Work (12.5% of lecture time)

1.1 Examples of previous projects/problems, including the various plans that were developed, and the types of documentation that was created for those examples.
1.2 The process of defining the problem to solve or the product/project to be developed, and anticipating the research that will need to be done in order to become adequately equipped to solve the problem, complete the project, or create the product that is desired, including:

1.2.1 Defining the problem adequately so that the process from planning through implementation will proceed with a minimum of change or re-defining of the desired outcome.

1.2.2 Determining the research that will need to take place regarding the specific technology, industrial process(es), theoretical knowledge, business and/or industry understanding, specific product or production understanding, and other areas in which research may be needed.

1.2.3 Working with the industry/sponsor collaborators and advisors in a way that is productive and least distracting to their job responsibilities and schedule.

1.2.4 Understanding the “best practices” for similar assignments and senior projects that have been effective in other programs, and determining which ones best suit the team’s particular situation.

1.2 Utilizing the project development form and examples

1.3 Developing the scope or work document with the industry partner/sponsor

1.4 Deadlines and benchmarks for the semester

1.5 Defining a schedule of activities and processes

2. Problem/Project Documentation for First Semester (12.5%)

2.1 Documentation required for the various steps of the project

2.1.1 Written documentation

2.1.2 Drawings and renderings

2.1.3 Numeric data, tables, charts, spreadsheets, statistical data requirements

2.1.4 Examples of documentation of research and investigation activities

2.1.5 Verbal presentations, videos, and other performed work

2.2 Format and expectations of the documentation

3. Planning for Evaluation of Problem/Project (12.5%)

3.1 Defining desired outcomes

3.2 Determining the methods of evaluation(s) used

3.3 Creating the evaluation instrument

4. Documentation of Facilities/Production Plan (12.5%)

4.1 Elements of the Facilities Plan

4.2 Elements of the Project Resources Plan
4.3 Elements of the Production Plan

5. Development of Business Plan for Problem/Project (12.5%)

5.1 Business Plan format and examples

5.2 Important considerations for creating the business plan

5.3 Alternatives to the Business Plan for problems or projects not resulting in business improvement

6. Planning for Second Semester Course (INDA B151) (12.5%)

6.1 Benchmarks for items that should be completed before the end of the semester

6.2 Beginning steps for the second semester course

6.3 Managing and adapting to challenges

Lab:

The lab time assigned to this course will be performed through the efforts and processes of the senior project/problem, and will be performed on campus through scheduled lab sessions and possible open lab times. It is possible that some students may be performing their “lab” time in part at the industrial location of their problem/project sponsor.

Examples of the work performed during the “lab” portion of this course include, but is not limited to:

a) Performing the steps of initial planning, development of potential solutions, planning for the implementation phase (the second semester of the senior project class), and the other work required to create a viable solution/product/project.

b) Collaboration with employees of the industry or educational entity project/problem sponsor.

c) Development of the various “plans” such as: facilities, production, project resources, and business plan.

d) Performing research on the industry, business, production process(es), specific technical knowledge required, and/or other information required for a successful project/solution implementation.

e) Performing research on other solutions to similar problems or projects that have been previously done, including any best practices or supporting data that may exist.

f) Development of the various forms of documentation required for the project/problem, as well as the oral presentations to the class and periodic brief progress presentations to the sponsor.

g) Utilization of the equipment, technology, software, and other resources available on campus and/or the sponsor site for testing, prototyping, simulation, or fabrication-related processes.
h) Logging or documenting the work performed by the team members.

i) Meeting with the course instructor for direction, advice, expertise, and/or encouragement.

j) Completing additional tasks as necessary to adequately complete the required benchmarks for the semester.

18. **Methods of Instruction:**

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Outside of Class Research and Investigation
6. Additional/Supplemental Reading Materials
7. Problem/Project Guidelines, Requirements, Organizational Documents, and Other Guiding Materials
8. Group Work During and Outside of Laboratory Time

19. **Outside of Class Assignments:**

Outside of class assignments may include, but are not limited to:

Because this course uses a majority of its time for activities, and because the nature of the course extends beyond the boundaries of the campus (through visits to sponsor site(s), meetings with sponsor’s staff, as well as possible use of technology and resources external to the campus), it is possible that each project team will have differing amounts of time spent outside the class lecture and lab time. However, we still expect that each project team member will devote a significant amount of time preparing and creating the various “plans” and presentations that will be required in the course.

**Oral Presentations**

There will be two oral presentations: a midterm progress report and a final team report that covers the entire process that has been completed up to that time. These presentations will be created using a general outline that each lab team is expected to follow, and will be graded according to the oral presentation criteria used in our Industrial Automation (INDA) courses.

**Writing/Research Assignments**

Research on the industry, business, production process(es), specific technical knowledge required, and/or other information required for a successful project/solution implementation will be conducted by the team members as needed. Additionally, research may also be done to explore other solutions to similar problems or projects that have been previously done, including any best practices or supporting data that may exist.

In addition to the various “plans” assigned during the course, a written summary of the work performed during the semester relating to the problem/project/product of the team will also be required. Examples of previous summaries as well as the grading rubric developed by the instructor will be provided to the students in the course.

**Application/Problem Solving/Synthesis**

The very nature of this capstone series of courses (INDA B150 and INDA B151) centers on the application of the technical coursework within the Industrial Automation program, direct problem
solving (such as creating a viable solution to a problem posed by the sponsor, designing a product according to a specific set of expectations/guidelines/constraints, or completing a project to the satisfaction of the sponsor), and performing the cognitive skill of synthesis by connecting the diversity of knowledge and information gained (as a result of study, research, and collaboration) into the solution/problem/project.

During this semester of the senior project, students will be required to develop:

1) A Facilities Plan
2) A Production Plan
3) A Project Resources Plan
4) A Business Plan

Or, depending on the nature of the project/problem/product, these plans will be adapted to suit the situation.

Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide.

20. Methods of Evaluation: Assessment of student performance may include but are not limited to:
1. Team member performance and participation (evaluated by sponsors and instructor)
2. The required documentation (drawings, data, schematics, renderings, projections, work logs, etc.)
3. Class presentations
4. Assessment of progress and accomplished tasks at specific benchmarks during the course
5. Assessment of the end-of-semester “product” for the problem/project (which will most likely be a written report of the accomplishments so far)

21. Texts, Readings, and Materials:

Required Textbook(s): Instructor-created materials will be used in lieu of a textbook, and will cover the content outlined in the lecture portion of this document.

Assigned Readings: None identified

Manuals: None required

Software: None required

Other: None identified

22. Approvals:

Curriculum Committee Approval Date: 3/3/2016
Board of Trustees Approval Date: 4/14/2016
State Approval Date: 5/12/2016
1. Discipline and Course Number: INDA B151
2. Course Title: Senior Problem II (Systems Implementation)
3. Course Author (s): Sean Caras
4. Course Catalog Description: The product and processes designed in by the student teams in INDA B150 will be further refined to create a demonstration production run or simulated production process. The production plan will be refined according to the production run or simulation, and a final plan will be presented. Additionally a simple marketing plan will be included.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:
<table>
<thead>
<tr>
<th>Min Units</th>
<th>Min Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>0.5</td>
</tr>
<tr>
<td>Lab</td>
<td>2.5</td>
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<tr>
<td>Activity</td>
<td>0</td>
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</tbody>
</table>
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable; Career and Technical Education (CTE)
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:
   1. Develop a complete, tested or validated solution to the technical problem, research topic, or desired outcome as determined during the previous Senior Problem/Project course (INDA B150) within the constraints and specifications given, and to at least the minimum level of the success indicators developed for the course.
2. Develop and perform evaluation criteria according to the nature of the problem/product chosen and considering the requirements, expectations, or guidelines of the sponsoring company or entity.

3. Present the full complement of plans developed and processes followed during the activity, as well as the results of the evaluations performed on the product or solution, in written documentation and oral presentations.

Course Objectives: This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. To implement a final “product” of the work performed during both semesters of this course, which may include a: prototype, test production run, solution to a problem posed by a sponsor company, or other final “product” following a design brief or statement of a technical problem/challenge developed at the beginning of the previous course (INDA B150) and according to a set of defined processes and considering the required documentation for the problem/project.

2. To continue to conduct and perform the required technical research, problem solving methodology, investigation of information, and required evaluation process for successful problem/project completion.

3. To evaluate and justify the completed product, problem solution, or systems design according to previously-determined requirements, expectations, specifications, and within the constraints given.

4. To document the various processes performed during the problem/project, and present them in written, oral, and visual ways to various audiences associated with the project/problem.

16. Requisites

Prerequisite(s):
INDA B150
AND
Admission to the Industrial Automation Bachelor of Science degree program

Advisory: None

17. Detailed Topic Outline (including instructional time devoted to each topic):

Overview Information for Senior Problem/Project Coursework
(This section is re-printed from the INDA B150 Course Outline of Record to provide background on the problem/project. The lecture and lab topical outline follows this overview.)

The senior problem/project consists of two semesters of coursework. The first semester is devoted to the planning, research, investigation, and formulation of a plausible solution/design/product that will be
implemented in the second semester. Students will regularly communicate their progress to the instructor, and at certain times to the students in the course.

The “lecture” portion of the course will serve as a guide to the various processes, skills, knowledge, and other content specific to the course. Additionally, it will serve as an opportunity for the various project teams to present their progress, discuss common issues and experiences with the other teams, participate in other coordination efforts that are necessary for this type of course, and to participate in the various assessments and evaluations used for course grading.

The “lab” portion of the course is designed to allow students access to the resources of the Engineering and Industrial Technology program (to the extent possible), to one or more program faculty members for assistance, for time to complete sponsor site visits and meetings, and other activities related to the problem or project for the student teams.

The goals of the senior problem/project are to:

1) Provide students with a real-world, realistic, and industry-typical problem to solve or project to implement that will utilize their knowledge and skills developed in the other courses in the program.

2) Allow students the ability to work with others – with their peers in class and with those employed in industrial, business, or educational entities – to come up with a solution or tangible project.

3) Provide a realistic environment where students can work with employed professionals, encouraging them to further develop their “personal effectiveness competencies” of: interpersonal skills, integrity, personal acceptability, initiative, and dependability and reliability, and further develop the “workplace competencies” of: teamwork, adaptability and flexibility, scheduling and coordinating, and to follow personal safety and health requirements.

4) Develop opportunities for students to further develop their critical thinking, problem solving, and creativity skills by being responsible for implementing a solution or tangible product, rather than to be directed through a prescribed process.

5) Provide the opportunity for students to spend time interacting with managers and leaders of technical companies that are serving in positions where our students may ultimately be placed upon completion of the program.

6) Create an environment where students will need to work within specific time constraints, adapt to available resources, adhere to strict deadlines, and develop a project management schedule that is reasonable according to the nature of the problem/project.

7) Provide a memorable opportunity for students to be involved with something that is more significant than any one particular subject area or course in the program. The result should be a strong feeling of accomplishment, and a source of confidence as they continue through their career pathway.
The specific organization and processes of the senior problem/project require that students/student teams:

1) Work in project teams of two to four. It is up to the student team to determine its structure (e.g. a project leader with project members, two teams with delegated responsibilities, or some other structure).

2) Participate in the development of the problem to solve or the project to implement. Student teams may propose their own project, solicit local technical companies to participate, or choose from projects developed or coordinated through the College.

3) Work with project sponsor to develop a written proposal for their senior problem/process that meets established guidelines.

4) Follow a prescribed process to develop their projects. This process is as close to actual business and industry practices as possible.

5) Utilize the knowledge and skills they have developed in program classes as they go through their project tasks.

6) Utilize several different forms of communication during their project, such as: memos, technical reports, written summaries, oral presentations to other team members, program faculty members, and sponsoring companies, and comprehensive written documentation of project during key milestones in the project cycle.

7) Develop project management skills, including: budget development and monitoring, procurement and management of materials and resources, allocation of resources, time management, and developing, implementing, and enforcing project tasks and deadlines.

8) Divide the responsibilities for project implementation among the team members, and ensure that each team member performs their delegated tasks.

9) Participate in the problem/project in such a way that each student takes equal responsibility and gives equal time and effort in order for a student to successfully complete the course.

10) Evaluate their product/solution in terms of instructor-defined, sponsor-defined, and self-defined criterion.

The requirements for a suitable senior problem/project are:

1) During the duration of the project, students will be performing complex work, rather than the type of work that may be assigned to interns or project assistants. This is not an opportunity for businesses to “farm out” parts of their operation, such as data collection, data entry, inventory processes, physical installation of equipment, preventative maintenance projects, and similar activities.

2) Projects should have a tangible “product” of the effort that can be seen, demonstrated, and the results of the work should be able to be tested or proven. This can either be a tested and documented solution, an actual (physical) product, a combination of a solution to a proposed problem and physically-implemented items that attempt to solve that problem, or some other instructor-approved tangible result of an activity with the level of challenge, the significant
application of program-developed knowledge and skills, and the academic rigor of an upper-
division program. The next point defines this expectation further.

3) Projects should be at an academic level and have the complexity of a senior-level technical
baccalaureate course. Examples of what may determine a senior-level technical course
includes, but is not limited to:

a) Academic skills, such as Mathematical Reasoning (Math B1a, Math B2, Math B6a
or higher), Written Communication (English B1a), Oral Communication (CSU
Breadth Area A1), and Critical Thinking (CSU Breadth Area A3) would be needed
by students to complete the assignment/project.

b) Critical-thinking and problem-solving elements, in both an independent (project
team directed) and collaborative (business or faculty member sponsor directed)
manner should be part of numerous processes within the assignment/project.

c) The application of the upper-division technical coursework should be a key feature.
In other words, a student who has only completed the lower-division work would
not be equipped to successfully complete the assignment/project (unless that
student has previous management work experience or advanced business or
technical education that was completed outside of the Industrial Automation
degree).

d) The ability to assess, evaluate, test, and/or research the effectiveness of the
assignment/project according to criteria developed internally (for this course, that
would be criteria developed by the team) and externally (for this course, that
would be criteria developed by the sponsoring company or faculty members).

4) The process for completing the project should not be given as a step-by-step series of
instructions from the sponsor. Rather, the team should initiate the project planning and
project management tasks, with the sponsor providing guidance to help refine those tasks.

5) For “problems,” the sponsor should identify a real and existing issue, limitation, opportunity
for improvement, or need within the organization that meets these requirements and allows
for a tangible solution to be developed and implemented. The solution should be able to be
tested, either in an actual production or business process or perhaps with a limited production
run. The solution should not be intended as a theoretical result, in other words. The cost of
materials for the solution, if used in a business or industrial plant, should be covered by the
project sponsor.

6) For “projects,” the sponsor should identify a real and existing issue, limitation, opportunity for
improvement, or need within the organization that meets these requirements and allows for a
tangible solution to be developed and implemented. A tangible product should result from
the process, and the product should actually be tested in either in an actual production or
business process or perhaps with a limited production run. The cost of materials for the
product, if used in a business or industrial plant, should be covered by the project sponsor.

7) The selected project or problem should be reasonable in terms of the resources available to
students, including:
a) The amount of time available to students during the semester, and in terms of the number of students on the project team.

b) The existing resources available to students (technology, software, equipment, supplies, technical expertise of students and assisting instructor(s) of the course).

c) The ability of the project sponsor to provide time for assisting student project teams and for help in implementing the solution/project/product once it has been completed.

c) The complexity of the problem or project.

8) The instructor has final approval rights for the selected problem or project. Because of this, it is vital that students meet with the instructor as early as possible in the selection process in order to get approval, in the event the proposed problem/project is determined to not be adequate or suitable.

Students will be assessed and the results of the semester’s work will be graded using multiple measures:

1) Assigned “plans,” reports, and presentations will be graded objectively with instructor-developed rubrics and benchmarks.

2) The problem/project sponsor will periodically evaluate the team performance using an evaluation form developed by the instructor.

3) At the end of the semester, the final problem/project presentation will be evaluated by one or more employees of the sponsor who have worked with the student teams. Guest judges from industry and/or professional organizations may also be used.

4) At the end of the semester, the final problem/project presentation will also be evaluated by the course instructor according to a previously-developed and communicated grading rubric.

5) Members of the team will also perform a self-evaluation using their previously-developed evaluation criteria.

Lecture: 9 hours total

In order to complete the required work in this course, it is essential that the student have completed the work in INDA B150 course during the previous term, and have worked with their project team to design and integrate (perform the steps necessary to prototype, test, or simulate) the product/solution. Therefore, this course is not intended for students who have taken INDA B150 earlier than the previous term and are not part of a current project team.

This course (INDA B151) is focused on students performing the remaining steps and processes in order to have a completed product, project, solution, application, or adequately researched topic as defined in the previous course (INDA B150).

The “lecture” portion of two class meetings will be devoted to a midterm and a final presentation of the problem/project to the class and instructor(s) including business partners or project advisors. (25% of lecture time)
The remaining lecture topics for the course are:

1. Planning for Implementation of Problem/Project (6.25% of lecture time)
   1.1 Resources (equipment and facilities) Available for Student Use; Scheduling of Facilities
   1.2 Documentation of Activities Performed
   1.3 Assembling Materials and Other Resources
   1.4 Communication with Industry Partners, Advisors, or Project Sponsors
   1.5 Time and Resource Management Strategies
   1.6 Dealing with Potential Problems and Challenges

2. Problem/Project Documentation for the Second Semester (6.25% of lecture time)
   2.1 Analyzing and Adapting the Project/Problem Scope of Work
   2.2 Analyzing and Adapting the Facilities/Production Plan (developed during the previous semester)
   2.3 Analyzing and Adapting the Business Plan (developed during the previous semester)
   2.4 Format of the Plans for the Final Report
   2.5 Examples of Plans Written in a Satisfactory Manner

3. Evaluation of Problem/Project (6.25% of lecture time)
   3.1 Analyzing and Adapting the Evaluation Plan (developed during the previous semester)
   3.2 Obtaining Evaluation Data, Benchmarks, and Results
   3.3 Format of Problem/Project Evaluation Report
   3.4 Examples of Evaluations Performed in a Satisfactory Manner

4. Final Problem/Project Reporting and Presentations (6.25% of lecture time)
   4.1 Format of Final Presentations and Presentation Grading Rubric
   4.2 Examples of Final Presentations Performed in a Satisfactory Manner
   4.3 Additional Advice and Guidance for Completing the Problem/Project
**Lab: 135 hours total**

The lab time assigned to this course will be performed through the efforts and processes of the senior project/problem, and will be performed on campus through scheduled lab sessions and possible open lab times. It is possible that some students may be performing their “lab” time in part at the industrial location of their problem/project sponsor. **The possible lab work as listed below may take place for both semesters (in INDA B150 and INDA B151), since two semesters of work are scheduled for the senior problem/project from initiation through completion.**

Examples of the work performed during the “lab” portion of this course include, but is not limited to:

a) Continuing the work performed during the previous semester, and the additional work required to create a viable solution/product/project by the end of the semester.

b) Collaboration with employees of the industry or educational entity project/problem sponsor.

c) Refinement of the various “plans” such as: facilities, production, project resources, and business plan.

d) Performing research on the industry, business, production process(es), specific technical knowledge required, and/or other information required for a successful project/solution implementation.

e) Performing research on other solutions to similar problems or projects that have been previously done, including any best practices or supporting data that may exist.

f) Development of the various forms of documentation required for the project/problem, as well as the oral presentations to the class and periodic brief progress presentations to the sponsor.

g) Utilization of the equipment, technology, software, and other resources available on campus and/or the sponsor site for testing, prototyping, simulation, or fabrication-related processes.

h) Logging or documenting the work performed by the team members.

i) Meeting with the course instructor for direction, advice, expertise, and/or encouragement.

j) Completing additional tasks as necessary to adequately complete the required benchmarks for the semester.

**18. Methods of Instruction:**

1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Outside of Class Research and Investigation
6. Additional/Supplemental Reading Materials
7. Problem/Project Guidelines, Requirements, Organizational Documents, and Other Guiding Materials
8. Group Work During and Outside of Laboratory Time
19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

Because this course uses a majority of its time for activities, and because the nature of the course extends beyond the boundaries of the campus (through visits to sponsor site(s), meetings with sponsor’s staff, as well as possible use of technology and resources external to the campus), it is possible that each project team will have differing amounts of time spent outside the class lecture and lab time. However, we still expect that each project team member will devote a significant amount of time preparing and creating the various “plans” and presentations that will be required in the course.

Oral Presentations

There will be two oral presentations: a midterm progress report and a final team report that covers the entire process that has been completed up to that time. These presentations will be created using a general outline that each lab team is expected to follow, and will be graded according to the oral presentation criteria used in our Industrial Automation (INDA) courses.

Writing/Research Assignments

Research on the industry, business, production process(es), specific technical knowledge required, and/or other information required for a successful project/solution implementation will be conducted by the team members as needed. Additionally, research may also be done to explore other solutions to similar problems or projects that have been previously done, including any best practices or supporting data that may exist.

In addition to the various “plans” assigned during the course, a written summary of the work performed during the semester relating to the problem/project/product of the team will also be required. Examples of previous summaries as well as the grading rubric developed by the instructor will be provided to the students in the course.

Application/Problem Solving/Synthesis

The very nature of this capstone series of courses (INDA B150 and INDA B151) centers on the application of the technical coursework within the Industrial Automation program, direct problem solving (such as creating a viable solution to a problem posed by the sponsor, designing a product according to a specific set of expectations/guidelines/constraints, or completing a project to the satisfaction of the sponsor), and performing the cognitive skill of synthesis by connecting the diversity of knowledge and information gained (as a result of study, research, and collaboration) into the solution/problem/project.

During this semester of the senior project, students will be required to develop a final version of the following documents:

1) A Facilities Plan
2) A Production Plan
3) A Project Resources Plan
4) A Business Plan
5) An Evaluation Plan
6) A Final Report on the problem/project
Or, depending on the nature of the project/problem/product, these plans will be adapted to suit the situation.

Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be standardized program-wide.

20. Methods of Evaluation:  
Assessment of student performance may include but are not limited to:  
1. Team member performance and participation (evaluated by sponsors and instructor)  
2. The required documentation (drawings, data, schematics, renderings, projections, work logs, etc.)  
3. Class presentations  
4. Assessment of progress and accomplished tasks at specific benchmarks during the course  
5. Assessment of the end-of-semester “product” for the problem/project (which will most likely be a written report of the accomplishments so far)

21. Texts, Readings, and Materials:  
 Required Textbook(s):  Instructor-created materials will be used in lieu of a textbook, and will cover the content outlined in the lecture portion of this document.  
 Assigned Readings: None identified  
 Manuals: None required  
 Software: None required  
 Other: None identified

22. Approvals:  
 Curriculum Committee Approval Date: 3/3/2016  
 Board of Trustees Approval Date: 4/14/2016  
 State Approval Date: 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT – BAKERSFIELD COLLEGE

English B100 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: ENGL B100
2. Course Title: Technical Writing
3. Course Author (s): Ed Barton
4. Course Catalog Description: Study of the process of technical writing and written communication. Students review various formats and writing purposes and produce technical and business-related documents.
5. Grading Method: S = Standard Letter
   Optional: none
6. Total Units: 3
7. Method of Delivery: Face-to-Face; Hybrid; Online.
   (face-to-face, hybrid, and/or online)
8. Instructional Methods:
   | Min | Min |
   | Units | Hours |
   | Lecture | 3 | 54 |
   | Lab | x | x |
   | Activity | x | x |
9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:
   1. Evaluate needs and write effective business letters and memoranda.
   2. Analyze situations and write effective instructions and procedural documents.
   4. Synthesize materials for a formal proposal
Course Objectives: This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Develop rhetorical acumen and composing skills need to prepare a variety of documents required in common business and technical writing contexts.

2. Acquire teamwork, collaborative authorship, and real world problem-solving skills.

3. Develop techniques for adapting written work to the demands of audience-driven, context-sensitive field.

4. Understand approaches for giving effective business presentations to individuals and groups.

5. Appreciate internationally and culturally diverse styles of business communication.

16. Requisites
   Prerequisite(s): Admissions to the Bachelor of Science, Industrial Automation Program
   List prerequisites here; include (AND) or (OR)

   Advisory: None

17. Detailed Topic Outline (including instructional time devoted to each topic):

Lecture:
Weeks 1&2: 10%
Unit I: Technical Writing: Email
   Compose a company-wide email addressing six ethical guidelines for work:
   • Sexual harassment
   • Dress code
   • Vacation policy
   • Discrimination
   • Compensation
   • Alcohol and drug use

Weeks 3&4: 10%
Unit II: Letter Revising
   Edit letters for audience and purpose:
   • Diction
   • Objectivity
   • Accuracy
   • Professional tone
   • Concision
   • Clarity

Weeks 5&6: 20%
Unit III: Letter of Transmittal
   Compose letters for a formal proposal:
   • Identifying problems
   • Researching issues
• Addressing specifics
• Following guidelines
• Offering solutions

Weeks 7&8: 10%
Unit IV: Write Messages in Various Formats and Media Review
• Emails
• Memoranda
• Letters
• Online writing
• Power point presentations

Weeks 9&10: 10%
Unit V: Directions and Instructions
• Writing about Processes
• Using Analysis
• Writing a Report

Weeks 11&12: 10%
Unit VI: Resume and Cover Letter
• Chronological format
• Functional format
• Letter of application
• Follow-up letter
• Interview strategies

Weeks 13&14: 20%
Unit VII: Formal Proposal
• Cover or Title Page
• Letter or Memo of Transmittal
• Executive Summary
• Introduction
• Discussion Sections
• Conclusion
• Appendices

Weeks 15&16: 10%
Unit VIII: Selling Yourself
• Who you are
• What you can do
• Why you will be beneficial to potential employers
• Mock interviews

Lab: None

18. Methods of Instruction: 1. Lecture
2. Demonstration
3. Active Learning
4. Discussion
5. Guest Speakers
6. Instruction through Examination and Quizzing
7. Outside Reading and Outside of Class Work
19. Outside of Class Assignments:
Outside of class assignments may include, but are not limited to:

- Business email
- Business letter
- Letter of Transmittal
- Power-point presentations
- Process writing
- Analysis report
- Resume
- Cover letter
- Formal report

Sample topics:

1) As a human resources director, write a memorandum about six ethical guidelines for the workplace.

2) Perform a job search for a position at a company and draft a resume and cover letter.

3) Write a formal proposal offering solutions to a problem in the community. Include a letter of transmittal, executive summary, discussion sections, and a conclusion.

Writing/Research Assignments

Students can be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. Research papers can be the product of single writers or collaborative groups/teams. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work, and a grading rubric will be used for evaluation of student papers. It is expected that the rubric, criteria, and explanations will be standardized among the upper-division coursework. Examples of sample topics are presented below to illustrate assignment depth and connection to course topics and objectives.

Sample topics (these topics are applicable both to single writers and collaborative groups):

1) Planned construction of roads, shopping centers, etc.

2) Pensions for public employees.

3) Improvements in public education.

Application/Problem Solving/Synthesis

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses, the process and expectations of which will be
standardized program-wide. An example of sample assignment(s) is/are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Employment opportunities for graduates with Industrial Automation certificates.

2) Engineering school admissions.

3) Real world managerial duties.

**20. Methods of Evaluation:** Assessment of student performance may include but are not limited to:
- Exams and Quizzes
- Written Work (outside of class assignments)
- Class Performance
- Class Presentations
- Formal Proposal

**21. Texts, Readings, and Materials:**

**Required Textbook(s):**  

**Assigned Readings:**  

**Manuals:**  
None required

**Software:**  
None required

**Other:**  
List other materials here

**22. Approvals:**

Curriculum Committee Approval Date: 3/3/2016  
Board of Trustees Approval Date: 4/14/2016  
State Approval Date: 5/12/2016
PHIL B100 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: PHIL B100
2. Course Title: Industry Ethics
3. Course Author(s): Reginald Williams and Michael McNellis
4. Course Catalog Description: The main objective of this course is to stress analytical reasoning and emphasize clear thinking regarding the application of major ethical theories to specific workplace, organizational, and global business and technological issues that students are most likely to encounter once in the workforce. An examination of the responsibilities of the employee, manager, and organization within an industry context will take place, highlighting such issues such as whistleblowing, environment (e.g., asset disposal program), discrimination and harassment, risk, and safety. A key component of the class will also discuss the ethical importance of emerging technologies and their impact on society.

5. Grading Method: S = Standard Letter
   Optional: none

6. Total Units: 3

7. Method of Delivery: Face-to-Face; Hybrid; Online
   (face-to-face, hybrid, and/or online)

8. Instructional Methods: Min Units Min Hours
   \[\text{Lecture} \quad 3 \quad 54\]
   \[\text{Lab} \quad x \quad x\]
   \[\text{Activity} \quad x \quad x\]

9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable
13. Stand Alone: No
14. Program Applicability
   \[\text{Required:} \quad \text{Industrial Automation Bachelor of Science degree}\]
   \[\text{Restricted Elective:} \quad \text{None}\]
   \[\text{Elective:} \quad \text{None}\]
15. Student Learning Outcomes: Upon completion of the course, the student will be able:
   
   1. To elucidate and examine the moral issues within specific workplace, organizational, and global business and technological contexts that
Course Objectives:

This course has as its objectives to develop the following knowledge, skills, and abilities of the enrolled students:

1. Understand the relevance of ethical thought and why it is essential for their professional careers to take ethics seriously.
2. Expose the foundations of ethical theory, the major theories that are used, and critical thinking tools for solving problems with moral dilemmas.
3. Understand the common rights and responsibilities of employees and managers.
4. Understand the concepts of risk and safety, because industry has many areas where uncertainty abounds, especially in the design and operations arenas.
5. Understand the concept of a person, its connection with emotion, interpersonal experience, and emerging technologies.
6. Understand the history and ethical dimensions of war and how emerging technologies, such as robotics and artificial intelligence, affect the nature and pursuit of war.
7. Understand the history and ethical dimensions of medicine and how emerging technologies, such as robotics and artificial intelligence, affect the nature and practice of medicine.
8. Understand the history and ethical dimensions of human sexuality and how emerging technologies, such as robotics and artificial intelligence, affect the nature and expression of sexuality.

16. Requisites

Prerequisite(s): Admissions to the Bachelor of Science, Industrial Automation Program

List prerequisites here; include (AND) or (OR)

Advisory: None

17. Detailed Topic Outline (including instructional time devoted to each topic):

Lecture:

A. Ethics and Responsibility in the Workplace, Organization, or Global Context – Introduction (2 weeks)
   a. Introduction to ethics and why it’s important to professional life
   b. NSPE Code of Ethics for Engineers and other codes of ethics within the professions
   c. Historical perspective of technology and industrial society
B. What is Moral Reasoning - Explain Major Ethical Theories (3 weeks)
   a. Utilitarianism
   b. Deontology
   c. Virtue Ethics
   d. Egoism
e. Toward a synthesis of ethical theories

C. Ethical Case Studies related to the areas of Industry, Engineering, or Technology (5 weeks)
   a. Ethics of Employees
      i. Employee rights
      ii. Whistleblowing
      iii. Risk and safety
      iv. Sexual harassment or discrimination in the workplace
   b. Ethics of Management
      i. Environment (asset disposal)
      ii. Hiring Practices and legal consequences
      iii. Treatment of employees
      iv. Obligations to various stakeholders: employees, customers, shareholders, and community
   c. Other employee, management or related cases
      i. Advertising
      ii. Downsizing
      iii. Comparable worth (equitable pay)

D. Introduction to Emerging Technology and Its Ethical Impact on Industry and Society (2 weeks)
   a. The fact/value distinction
   b. Deontology vs. consequentialist ethics, principles vs. outcomes
   c. Personal identity
   d. The concept of responsibility

E. Emerging Technologies in War (1 week)
   a. The ethics of killing
   b. Agency and responsibility
   c. Governments, combatants, and civilians
   d. Reasons for engaging in war
   e. Means of engaging in war
   f. Applications of emerging technologies in War

F. Emerging Technologies in Medicine (1 week)
   a. The Purpose of Medicine
   b. The history of medicine
   c. The cost of medicine
   d. Research in medicine
   e. Applications of emerging technologies in medicine

G. Emerging Technologies and Human Sexuality (1 week)
   a. The concept of sex
   b. The purpose of sex
   c. The concept of person
   d. Interpersonal relationships
   e. Emotion
   f. Applications of emerging technologies to human sexuality

18. Methods of Instruction: The instructional methods may include but are not limited to the following:

   1. Lecture
   2. Demonstration
   3. Active Learning
   4. Discussion
   5. Guest Speakers
   6. Instruction through Examination and Quizzing
   7. Outside Reading and Outside of Class Work
8. Problem-Solving Assignments and Scenarios
9. Written Materials (including worksheets, calculation sheets, et. al.)

19. Outside of Class Assignments: Outside of class assignments may include, but are not limited to:

**Oral Presentations**
Students may be assigned an oral presentation to be delivered to the other students in the course. The presentation will use a grading rubric developed in collaboration with the Communication department, and the criteria and expectations will be presented to the students prior to starting the assignment. Sample topics are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Identify and describe, in detail, a specific technology that has been developed or newly applied in the past ten years, explaining the interpersonal ethical issues that it raises in industry settings.

2) Identify and describe, in detail, a specific use of artificial intelligence that has been developed or newly applied in the past ten years, explaining the global ethical issues that it raises for society.

**Writing/Research Assignments**

Students will be assigned a research paper to provide practice in researching, organizing information, communicating in a clear and accurate manner, and following proper styles and citation methods. The research papers in the program courses will follow guidelines developed through collaboration with the English department and Librarians that meet the expectations of upper-division student work. Sample topics are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**

1) Compare and contrast the use of a specific current technology in military, healthcare, and/or interpersonal/sexual contexts, highlighting the interpersonal ethical issues that it raises.

2) Compare and contrast the use of a specific current technology in military, healthcare, and/or interpersonal/sexual contexts, highlighting the global ethical issues that it raises for society.

**Application/Problem Solving/Synthesis**

Students in each upper-division technical course for this degree program will be given at least one assignment that calls upon them to apply the higher-level thinking skills of: application, analysis, synthesis, and evaluation. Additional emphasis on critical thinking and problem-solving skills will be employed for these types of assignments. They will be based upon scenarios, comparisons, or connections between various topics covered in the course. Grading will be accomplished through similar methods among upper-division technical courses. Sample assignments are presented below to illustrate assignment depth and connection to course topics and objectives.

**Sample topics:**
1) Compose a clear, concise, and organized 5-page paper (1500-words) that defends a specific account of whether a military should deploy deadly force with drone technology on a target that houses 10 opposing military combatants and 20 civilians, sacrificing the lives of the latter to kill for the former.

2) Compose a clear, concise, and organized 5-page paper (1500-words) that defends a specific account of whether it is acceptable to conduct biomedical research on artificially intelligent robots that articulate opposition to being so used.

3) Compose a clear, concise, and organized 5-page paper (1500-words) that defends a specific account of whether it is appropriate for an adult human being to engage in sexual relations with an artificially intelligent sex doll.

20. Methods of Evaluation:

Assessments of student performance may include but are not limited to: Essay Exams and Quizzes; Written Work (outside of class assignments, worksheets, et. al.); Class Performance; Class Presentations

21. Texts, Readings, and Materials:

**Textbook(s):**

**Assigned Readings:** Various articles related to emerging technologies that raise ethical dilemmas.

**Manuals:** None required

**Software:** None required

**Other:** List other materials here

22. Approvals:

**Curriculum Committee Approval Date:** 4/13/2016

**Board of Trustees Approval Date:** 5/5/2016

**State Approval Date:** 5/12/2016
KERN COMMUNITY COLLEGE DISTRICT - BAKERSFIELD COLLEGE
PSYC B100 COURSE OUTLINE OF RECORD

1. Discipline and Course Number: PSYC B100
2. Course Title: Industrial and Organizational Psychology
3. Course Author(s): Billie Jo Rice

4. Course Catalog Description: The application of psychological principles and theories to the workplace: This includes an introduction to the methods, practices, research, and theories necessary to the scientific study of the attitudes and behaviors of employees and employers; interpersonal relationships in the workplace; the structure of organizations and organizational policies; the complex processes of motivation and leadership; individual and organizational performance; and the match between people and jobs.

5. Grading Method: S = Standard

Optional:

6. Total Units: 3

7. Method of Delivery: Face-to-Face; Hybrid; Online

8. Instructional Methods:

<table>
<thead>
<tr>
<th>Method</th>
<th>Min Units</th>
<th>Min Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>3</td>
<td>54</td>
</tr>
<tr>
<td>Lab</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Activity</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

9. Repeatability: Non-Repeatable Credit
10. Materials Fee: None
11. Credit by Examination: No
12. Core Mission Applicability: Bachelor’s Degree Applicable;
13. Stand Alone: No
14. Program Applicability
   Required: Industrial Automation Bachelor’s of Science degree
   Restricted Elective: None
   Elective: None
15. Student Learning Outcomes: Upon completion of the course, the student will be able to:

   1. Demonstrate knowledge of the major concepts, models and issues of industrial and organizational psychology.
2. Assess social phenomena using observation, hypothesis development, experimentation, and both mathematical and interpretative analysis.

3. Demonstrate an understanding and application of Industrial and Organization Psychology theories and concepts as applied to real world settings.

**Course Objectives:**

1. To develop an awareness of the history and major perspectives underlying and driving the field of Industrial and Organizational Psychology.

2. To develop an understanding of how theory and research in Industrial and Organization Psychology is applied in work settings.

3. To demonstrate an understanding of the kinds of questions industrial/organization psychologists ask and how those questions are answered.

4. To understand and demonstrate the difference between rigorous systematic thinking and uncritical conjecture about social phenomena.

5. To develop an understanding for the potential Industrial and Organization Psychology has for society and organizations now and in the future.

**16. Requisites**

*Prerequisite(s):* Admission to Industrial Automation Bachelor’s Degree Program

*Advisory:* None

**17. Detailed Topic Outline (including instructional time devoted to each topic):**

**Lecture: 54 hours**

**Unit 1: History and Research Methods of Industrial and Organization Psychology**

1:1 Historical Development (1 week)

1.1.1 Defining I/O psychology
1.1.2 Historical development
1.1.3 Current issues

1:2 Research Methods (2 weeks)

1.2.1 Scientific method
1.2.2 Research designs
1.2.3 Data collection
1.2.4 Statistics
1.2.5 Ethics

**Unit 2: Industrial Psychology**
2.1 Job Analysis (1 week)
   2.1.1 Purpose of job analysis
   2.1.2 Approaches to job analysis
   2.1.3 Job evaluation

2.2 Criterion Measurement (1 week)
   2.2.1 Defining criterion
   2.2.2 The criterion problem
   2.2.3 Distinction among performance criterion

2.3 Performance Appraisal (1 week)
   2.3.1 The use of performance appraisal
   2.3.2 The role of Industrial and Organizational Psychology

2.4 Predictors (1 week)
   2.4.1 Types of predictors
   2.4.2 Classification of tests

2.5 Selection Decisions (1 week)
   2.5.1 Recruitment
   2.5.2 Legal issues

2.6 Training and Development (1 week)
   2.6.1 Assessing training needs
   2.6.2 Instructional design
   2.6.3 Training delivery
   2.6.4 Training evaluation
   2.6.5 Issues related to diversity

Unit 3: Organizational Psychology

3.1 Motivation (1 week)
   3.1.1 Theoretical perspectives
   3.1.2 Application of motivational theories
   3.1.3 Organizational problems

3.2 Job Attitudes (1 week)
   3.2.1 Attitudes, intentions and behaviors
   3.2.2 Job satisfaction
   3.3.3 Organizational commitment

3.3 Stress and well-being (1 week)
3.3.1 Stress and strains
3.3.2 Environmental determinants
3.3.3 Work and family conflicts
3.3.4 Job loss

3.4 Group Processes (1 week)

3.4.1 Groups verses teams
3.4.2 Social influence
3.4.3 Group decision making
3.4.4 Current trends

3.5 Leadership (1 week)

3.5.1 Defining leadership
3.5.2 Theories of leadership
3.5.3 Leadership research

3.6 Organizational Theory and Development (1 week)

3.6.1 Organizational theory
3.6.2 Organizational development

**Lab:**

There is no lab component for this course

18. Methods of Instruction

1. Audiovisual
2. Case Studies
3. Demonstration
4. Discussion
5. Group work
6. In-class writing
7. Instruction through examination and quizzing
8. Lecture
9. Outside reading
10. Presentations (by students)
11. Problem solving
12. Written work

19. Outside of Class Assignments:

**Outside Reading**

Outside reading of required materials for class discussion and in-class work

**Research Project**

Research related to the completion of papers and in-class presentations that demonstrate the ability to employ rigorous systematic thinking as a means to objectively analyze social phenomena related to the experiences of individuals within organizations.

20. Methods of Evaluation:

Assessment of student performance may include but are not limited to:

1. Multiple choice, essay, and short answer exams
2. Research papers
3. Oral presentations
4. In-class discussions
5. Poster presentations
6. Cooperative learning experiences
7. Homework problem solving exercises

21. Text, Readings, and Materials: Instructional materials may include but are not limited to:

   **Textbook(s):**


   **Assigned Readings:** None identified

   **Manuals:** None identified

   **Software:** None identified

   **Other:** None identified

22. Approvals:
   *Curriculum Committee Approval Date:* 3/3/2016
   *Board of Trustees Approval Date:* 4/14/2016
   *State Approval Date:* 5/12/2016