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El Camino College
Industry Driven Regional Collaborative
For
Aerospace Manufacturing Engineering

Quality, Design, and Automation

Course Outline; Quality, Design, and Automation

This class is designed to introduce shop floor personnel, CAD designers, estimators, planners, purchasing agents, and low-and-mid level managers to product quality assurance, product design and manufacturing automation. Its' intent is to give basic data so that the individual will recognize the differences, advantages, and limitations of various design parameters, quality programs, and the automation of manufacturing

This course will assist the student in preparation for certification as a Certified Manufacturing Technologist sponsored by the Society of Manufacturing Engineers.

Suggested Time; 24 hours (8 weeks @ 3 hours per week)
Suggested Credit; 1.5 semester units

In addition to the requirement of attending classes each student will be required to submit a 5-7 page paper on a manufacturing process of interest to the individual. The instructor must approve the subject matter. The student will be required to make a five minute presentation to the class on his chosen subject.

This work is supported through a grant from the Chancellors Office of the California Community Colleges to the El Camino Community College District with assistance from the Small Manufacturers Institute.

Course Content:

1. Quality Assurance
2. CAD/CAM/CAM/DNC
3. Engineering Mathematics, Human Factors
4. Units of Measure, Electricity/Hydraulics/Pneumatics
5. Drawing Fundamentals
6. Geometric Tolerancing
7. Automation
8. Review

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Quality, Design, and Automation; Week 1

Quality Assurance

- Total Quality Management
- Cost of Quality
  - Internal Failure Costs
  - External Failure Costs
  - Appraisal Costs
  - Prevention Costs
- Statistical Methods
  - Statistical Process Control
    - Examples
- Control Charting
    - Examples
- Process Capability Analysis
    - Examples
- ISO 9000
- Six Sigma
- Acceptance Sampling
- Inspection Terminology
  - Accuracy
  - Precision
  - Reliability
  - Repeatability
  - Sensitivity
  - Resolution
  - Discrimination

- Inspection Equipment
  - Direct Measurement
  - Comparison Measurement
  - Gauges

- Measurement Errors
  - Instrument
  - Parallax
  - Bias
  - Technique
  - Condition

Quality, Design, Automation; Week 2

CAD/CAM/CIM/DNC

- CAD
  - Wireframe
  - Surface
  - Solids
  - 2-Axis
  - 3-Axis
  - Examples
    - AutoCad
    - ProEngineer
    - Catia
- CIM
- DNC
- Manufacturing Networks
  - Servers
  - Transmission Medium
  - Network Interface
  - Data Transmission
  - Network Operating Systems
    - Open Systems – Interconnect
  - Repeaters, Bridges, Router, and Gateways
  - Topologies
  - Protocols
- CNC Programming
  - Machine Coordinate Axes
  - G and M Codes
- CNC Controllers
  - PLC vs. PC
  - Machine Interfaces
  - Open Loop Control
  - Closed Loop Control
- Rapid Prototyping
  - Advantages
  - Disadvantages
  - Stereo lithography
  - Solid Ground Curing
  - Laminated Object Modeling
  - Fusing-Deposition Modeling
  - Selective Laser Sintering
  - Ballistic Particle Manufacturing
- Design for Manufacture
- Design for Assembly

Quality, Design, Automation; Week 3

Engineering Mathematics, Human Factors

- Statics
  - Force
  - Transmissibility
  - Parallelogram Law
  - Newton's Laws
    - 1^{st}, 2^{nd}, 3^{rd}
  - Rectangular Components of a force
  - Moment of Force
  - Force Couples
  - Newton's First Law and Moments
  - Free Body Diagrams
  - Friction
- Dynamics
  - Rectilinear Motion
  - Angular Motion
  - Newton's Second Law
  - Energy Methods
- Strength of Materials
  - Stress and Strain
  - Axial Loading
  - Torsional Loading
- Thermodynamics
  - Temperature Conversions
  - Thermal Expansion
  - Heat Capacity
  - Thermodynamics
  - Heat Transfer
- Light
  - Electromagnetic Radiation
  - Ray Theory
  - Reflection
  - Refraction
- Sound
  - Wave Nature of Sound
  - Intensity of Sound
  - Frequency of Sound
  - Response of the human ear to sound

Quality, Design, and Automation; Week 4

Units of Measure, Electricity/Hydraulics/Pneumatics

Units of Measure
- SI Base Units
  - Length
  - Time
  - Mass
  - Temperature
  - Electric Current
  - Luminous Intensity
  - Amount of Substance
  - Derived and supplementary Units
- US Customary Units
- Conversions

Electrical Circuits
- Charge
- Current
- Voltage
- Energy
- Power
- Resistance
- Inductance
- Capacitance

Types of Circuit Connections
- Parallel
- Series

Circuit Analysis using Kirchoff's Laws
- Kirchoff's Loop Rule
- Kirchoff's Point Rule

Hydraulics and Pneumatics
- Differences between Hydraulics and Pneumatics
- Properties
- Fluid statics
- Fluid Power
- Fluid Dynamics

Quality, Design, and Automation; Week 5

Drawing Fundamentals

Drawing Standards
Projection systems
Auxiliary and Section Views
Dimensioning
Tolerancing
Fits
    RC- Running and Sliding
    LC- Clearance locational
    LT-Transition location
    LN-Interference location
    FN-Force and Shrink
        Examples
Tolerances for 100% Interchangeability
        Examples
Surface Finish Symbols

Weld Symbols
    Codes

Hydraulic and Pneumatic Symbols
    Difference between Hydraulic and Pneumatic Schematics

Electrical Schematics

Quality, Design, and Automation; Week 6
Geometric Tolerancing

- Introduction
- Basic Dimensions
- Material Condition Modifiers
    - Maximum Material Condition
    - Least Material Condition
    - Regardless of Feature Size
    - Bonus and Additional Tolerance
- Feature Control Frame
- Datum
    - 3-Plane Datum Reference
    - Non-Cylindrical
    - Cylindrical
- Form Control Symbols
    - Straightness
        - Surface
        - Axis
        - Flat Surface
    - Flatness
    - Circularity (Roundness)
    - Cylindricity
- Profile Control Symbols
    - Line
    - Surface
- Orientation Control Symbols
    - Perpendicularity
    - Angularity
    - Parallelism
- Location Control Symbols
    - Position
    - Concentricity
- Runout Control Symbols
    - Circular Runout
    - Total Runout

Quality, Design, and Automation; Week 7

Automation

Programmable Logic Controllers (PLCs)
- Open Loop
- Closed Loop
- Applications
- Components
  - Input Devices
  - Output Devices
  - Digital
  - Analog
- Programming
  - Rails, Rungs, Branches
  - I/O
  - Timers
  - Counters
  - Specialty Programs
    - Motion Control
- PC Based Systems
  - Differences with PLCs

- Robotics
  - Power Systems
    - Electric
    - Pnuematics
    - Hydraulic
  - Control Systems
  - Mechanical Systems
  - Interfacing

- Cell Manufacturing

- Automated Material Handling
  - Storage Systems
  - Movement Systems
  - Identifications Systems
    - Bar Codes
    - Magnetic Strips
    - Voice Recognition
    - Machine Vision

Quality, Design, and Automation; Week 8

Review

Week 1	Quality Assurance
Week 2	CAD/CAM/CAM/DNC
Week 3	Engineering Mathematics, Human Factors
Week 4	Units of Measure, Electricity/Hydraulics/Pneumatics
Week 5	Drawing Fundamentals
Week 6	Geometric Tolerancing
Week 7	Automation

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