I1. Define Product and Process Control and Explain the Importance of Each

I1.1. List a variety of process control applications.

Performance Objective: Given an overview of both the human and mechanical dimensions of the manufacturing process and the need to continuously improve and to control these, the student will be able to list a variety of applications, tools, and principles that can improve the process control.

PROCESS CONTROL APPLICATIONS	
Supplier partnerships	Quality improvement principles
Human dimension (teamwork)	Flowcharts/value added
Customer-in design	Statistical Process Control
Design/build teams	Statistical analysis
Labor agreements	Control charts
Employee training	Setting control limits
Master scheduling	Computer Aided Process Planning
Time lines/milestones	Computer-aided operations
	Hardware variability control (HVC)

I1.2. Describe the types of computer-aided process planning systems.

Performance Objective: After studying the use of computers in process planning, the student will be able to identify and describe the basic characteristics of four computer-aided systems and their use in process planning.

COMPUTER PROCESS PLANNING APPLICATIONS	
Computer-aided design (CAD)	Computer-aided manufacturing (CAM)
Computer-aided facilities layout	Computer-aided process planning (CAPP)
Parts Group Technology (GT)	

I1.3. Identify operations and subsystems involved in an automated process planning system.

Performance Objective: Given a manufacturing or production process plan, the student will be able to identify the operations and subsystems that can be automated and controlled with computer applications.

PROCESS PLANNING INCLUDES:	
Raw material retrieval and handling	Sequence of operations
Initial inspection	Timing of operations
Production	Cleaning
Type of operations machinery, tooling, fixtures	Assembly
Number of operations	Final inspection

I1.4. Prepare and distribute production plans.

Performance Objective: Given a product and the basic elements of a production plan, the student will be able to prepare a production plan that is 90% accurate in content and time sequence projections when compared with a benchmark model plan.

PRODUCTION PLAN BASIC ELEMENTS		
Production order	Batch sizes	Product variance
Process planning	Production operations	Timing of operations
Assembly sequence	Milestones charts	Delivery dates

I1.5. Summarize production plans.

Performance Objective: Given a production plan, the student will be able to summarize the plan using a review of the basic elements, their sequence, and timing.

I2. Apply Statistical Techniques to Monitor and Improve Processes

I2.1. Interpret statistical forecasting systems.

Performance Objective: Using a monthly statistical analysis, production data for the past six months, and production goals for the next six months, the student will be able to forecast needs and changes to meet the new production goals.

I2.2. Review master schedule regularly.

Performance Objective: Given a master schedule for a six-month production project, related timelines, and milestone charts, the student will be able to review these and provide a written status report for the first two months.

I2.3. Collect and analyze information to determine and improve work processes.

Performance Objective: After studying the variables that can influence product quality and materials handling, and given a routine process, and the necessary measurement instruments, the student will be able to design a problem-solving study and generate related flowcharts, control charts, and make improvement recommendations to a process/quality improvement team.

MATERIAL AND PROCESS VARIABLES (Data Sources)	
Tool, mold, and die wear	Machine conditions and maintenance
Lubricants and metalworking fluids	Environmental conditions on people and machines
Lead times	Operator skills - fatigue, attention

MATERIAL HANDLING PROCESS	
1. From supplier to storage	4. From machine to assembly
2. From storage to machine	5. From assembly to inventory
3. From machine to machine	6. From inventory to transportation

BASIC ELEMENTS OF STATISTICAL QUALITY CONTROL		
Sample size	Distribution	Lot size
Random sampling	Population	Frequency distribution

ELEMENTS OF STATISTICAL PROCESS CONTROL	
1. Control charts	3. Capability of manufacturing. process
2. Setting control limits	4. Characteristic of machines

I3. Explain Just-in-Time Inventory

I3.1. Explain the advantages and disadvantages of just-in-time inventory.

Performance Objective: After studying the history and purpose of Just-In-Time Production, the student will be able to discuss how JIT Inventory applies to the total production process and state the advantages and disadvantages of a JIT system.

JIT PRODUCTION	
1. materials arrive JIT for use	3. Subassemblies arrive JIT for product assemble
2. parts arrive JIT for subassembly	4. Product arrives JIT for sales

JUST-IN-TIME INVENTORY	
Advantages	Disadvantages
Cut inventory warehouse costs	Poor implementation/line stopper
Quick discovery of raw materials defects	Defects of previous operation/materials stops process
Quick discovery of product defects	Vendor can stop production
Low scrap costs and reduced inspection and rework	
Supplier/customer teamwork	
Improved quality	

I4. Explain Factors that Affect Work in Progress

I4.1. Explain the factors that affect work in progress.

Performance Objective: The student will be able to list and discuss at least ten factors that can affect the work in progress.

MATERIAL AND PROCESS VARIABLES	
Inventory	Setup
Run time	Shop configuration
Training - learning curve	Que
Tool, mold, and die wear	Machine conditions and maintenance
Lubricants and metalworking fluids	Environmental conditions on people and machines
Various lead time considerations	Operator skills - fatigue, attention
Illness and absenteeism	Weather
Inspection	

I5. Design a Flow Diagram for Producing a Product

I5.1. List the steps involved to bring a product from the design stage to production.

Performance Objective: Given the elements of the manufacturing process and a flowchart symbols template, the student will be able to draw a flow diagram representing the process of bringing a product from design to delivery with 95% accuracy as compared to a benchmark model.

ELEMENTS OF THE MANUFACTURING PROCESS	
Suppliers	Assembly
Materials acquisition	Delivery
Tooling	Labor and human resources
Planning	Management
Inspection	Training
Design	Units in a production run
Engineering	Duration of the run
Fabrication	Customer variations in the run
Customer input	Vendor input

I5.2. Create a project plan.

Performance Objective: Given the concept of value-added/nonvalue-added activities, a detailed flow diagram, and working on a quality improvement team, the student will be able to create a project plan proposal to study one part of the process flow and present it to the team.

I6. Define Roles of Designers and Engineers in Development of a Product

I6.1. Identify the responsibilities of a designer, engineer, and technician and their individual roles in developing a product.

Performance Objective: After studying the roles and responsibilities of designers, engineers, and technicians, the student will be able to state a) five responsibilities for each, b) how they contribute to a product's development, and c) why they must communicate with each other.

ROLE OF DESIGNER	ROLE OF ENGINEER	ROLE OF TECHNICIAN
Design for:	Apply theories:	Test and verify:
Customer needs	Chemistry	Parts
Manufacturing	Physics	Fits
Process limitations	Electronic metallurgy	Assembly Serviceability
Machinery characteristics	To: Materials	Safety monitoring
Material characteristics	Parts design	Hazardous materials handling
Assembly	Parts assembly	Emergency response teams
Serviceability	Product performance	Industrial hygiene monitoring
Human use		

I6.2. Describe how designers and engineers can interact with others via computer to develop products.

Performance Objective: After studying Computer-Aided Design programs and Local Area Network (LAN), the student will be able to describe how customers, designers, engineers, technicians, and machinists can electronically interact to develop a product.

I7. Explain the Importance of Configuration Control

I7.1. Utilize the most current revision documents.

Performance Objective: Given a revision process for technical drawings and required changes in product and process configurations, the student will be able to prepare a production plan that accommodates all revisions and changes.

I8. List Major Factors in Process Planning

I8.1. Develop a process plan.

Performance Objective: Given a part, a list of machines and skilled workers, the student will be able to develop an effective process plan identifying the major factors of the process as compared to a benchmark model.

GENERAL PROCESS PLANNING ELEMENTS INCLUDE		
Production	Fixture	Sequence of operations
Tooling	Machinery	Assembly

PROCESS PLANNING INCLUDES	
Facilities design	Number of operations
Lead time and setup	Sequence of operations
Raw material retrieval	Timing of operations
Initial inspection	Cleaning
Production (including SPC)	Assembly
Type of operations machinery, tooling, fixtures	Final test

I8.2. Determine line and work station setup.

Performance Objective: After studying different line and workstation setups incorporating different degrees of automation and computerization, and given a production need and particular kinds of equipment, the student will be able to determine the shop layout, line configuration, and workstation setup to produce the product.

LINE SETUP	
Traditional line setup	Cellular setup
Less automated	More automated and computerized
Same machines grouped by same functions	Difference machines with different functions and setup configurations
Straight production line layout (transfer line system)	Cells (group)layout can be L-shaped, U-shaped, loop shaped, or straight

AUTOMATION FACTORS
1. Raw material loaded and/or unloaded at workstation
2. Work pieces loaded and/or unloaded at workstation
3. Tool changing at workstation
4. Movement of tools and work pieces between workstations
5. Scheduling and control total cell operations

I8.3. Obtain and store materials needed to ensure continuity of workflow.

Performance Objective: Given a product, a production process, routing sheets, and a master schedule, the student will be able to identify raw material needs and design a materials handling process flow, including time sequences, that ensures continuity of workflow with 90% accuracy when compared to a benchmark model.

MATERIAL HANDLING PROCESS	
1. From supplier to storage	4. From machine to assembly
2. From storage to machine	5. From assembly to inventory
3. From machine to machine	6. From inventory to transportation

I8.4. Explain bill of materials to include purchasing and resources.

Performance Objective: Given a production process, a production rate, and using JIT inventory, the student will be able to fill out a bill of materials to identify resources and purchases to ensure a continuous flow of the production process with a 90% accuracy when compared to a benchmark master schedule model.

I9. Understand Design for Producibility Concept

I9.1. Identify some of the factors that should be considered when designing products and processes.

Performance Objective: Given an assignment to design a product, the student will be able to identify at least ten factors that must be considered to assure ease of manufacturing, minimum production costs, and meet or exceed customers' criteria.

FACTORS INFLUENCING PRODUCIBILITY	
Knowledge of material quality	Knowledge of operator skills
Knowledge of machine capability	Knowledge of automation
Cost-effective materials and availability	Fewest number of parts
Simplest parts design	Fewest types of materials
Simplest assembly design	Easiest inspection
Simplest maintenance process	Simplest tools and dies
Simplest serviceability (customer)	