This document is intended to help education and training institutions deliver the Machine Tool Advanced Skills Technology (MAST) curriculum to a variety of individuals and organizations. MAST consists of industry-specific skill standards and model curricula for 15 occupational specialty areas within the U.S. machine tool and metals-related industries. This volume provides the MAST standards and curriculum for the manufacturing engineering technician specialty area. (A manufacturing engineering technician is a person who uses special knowledge and skills to recommend and implement solutions for specific manufacturing applications.) This volume is organized in the following sections: (1) a profile of Texas State Technical College, the development center that produced these standards and curriculum; (2) a manufacturing engineering technician competency profile of job duties and tasks; (3) a manufacturing engineering technician duty, task, and subtask outline; (4) a course curriculum outline and course descriptions; (5) a technical workplace competencies and course crosswalk; and (6) a Secretary's Commission on Achieving Necessary Skills (SCANS) proficiencies crosswalk. Individual syllabi for the following courses are provided: Machine Tool Practices I; Drafting Principles; Machine Tool Practices II; Application Software; Engineering Materials; Safety and Accident Prevention; Basic Fluid Power; Electrical Applications; Survey of Welding Processes and Applications; Computer Numerical Control (CNC) Machine Programming; Statics; Manufacturing Processes; Introduction to Computer Drafting; Computer-Assisted Design/Manufacturing (CAD/CAM) I; Tool Design I; Strength of Materials; CAD/CAM II; Computer Integrated Manufacturing; Quality Assurance and Statistical Process Control; and Engineering Technology Project. Each course syllabus includes the following: course hours, course descriptions, prerequisites, required course materials, teaching and evaluation methods, lecture and laboratory outlines, course objectives for technical and SCANS competencies, and suggested references. An appendix contains industry competency profiles. (KC)
COMMON GROUND:
TOWARD A STANDARDS-BASED TRAINING
SYSTEM FOR THE U.S. MACHINE TOOL
AND METAL RELATED INDUSTRIES

VOLUME 4

MANUFACTURING
ENGINEERING
TECHNOLOGY

of
a 15 volume set of Skills Standards
and
Curriculum Training Materials for the
PRECISION MANUFACTURING INDUSTRY

Supported by
the Office of Vocational & Adult Education
U.S. Department of Education
Machine Tool Advanced Skills Technology Program

MAST

VOLUME 4

MANUFACTURING ENGINEERING TECHNOLOGY

Supported by
The Office of Vocational and Adult Education
U.S. Department of Education

September, 1996
GRANT INFORMATION

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ACKNOWLEDGMENTS

This project was made possible by the cooperation and direct support of the following organizations:

- U.S. Department of Education, Office of Vocational & Adult Education
- MAST Consortium of Employers and Educators

MAST DEVELOPMENT CENTERS
Augusta Technical Institute - Itawamba Community College - Moraine Valley Community College - San Diego City College (CACT) - Springfield Technical Community College - Texas State Technical College

INDUSTRIES

COLLEGE AFFILIATES

FEDERAL LABS
Jet Propulsion Lab - Lawrence Livermore National Laboratory - L.B.J. Space Center (NASA) - Los Alamos Laboratory - Oak Ridge National Laboratory - Sandia National Laboratory - Several National Institute of Standards and Technology Centers (NIST) - Tank Automotive Research and Development Center (TARDEC) - Wright Laboratories

SECONDARY SCHOOLS
Aiken Career Center - Chicopee Comprehensive High School - Community High School (Moraine, IL) - Connally ISD - Consolidated High School - Evans High - Greenwood Vocational School - Hoover Sr. High - Killeen ISD - LaVega ISD - Lincoln Sr. High - Marlin ISD - Midway ISD - Moraine Area Career Center - Morse Sr. High - Point Lamar Sr. High - Pontotoc Ridge Area Vocational Center - Putnam Vocational High School - San Diego Sr. High - Tupelo-Lee Vocational Center - Waco ISD - Westfield Vocational High School
ASSOCIATIONS
American Vocational Association (AVA) - Center for Occupational Research and Development (CORD) - CIM in Higher Education (CIMHE) - Heart of Texas Tech-Prep - Midwest (Michigan) Manufacturing Technology Center (MMTC) - National Coalition For Advanced Manufacturing (NACFAM) - National Coalition of Advanced Technology Centers (NCATC) - National Skills Standards Pilot Programs - National Tooling and Machining Association (NTMA) - New York Manufacturing Extension Partnership (NYMEP) - Precision Metalforming Association (PMA) - Society of Manufacturing Engineers (SME) - Southeast Manufacturing Technology Center (SMTC)

MAST PROJECT EVALUATORS
Dr. James Hales, East Tennessee State University and William Ruxton, National Tooling and Machine Association (NTMA)

SPECIAL RECOGNITION
Dr. Hugh Rogers recognized the need for this project, developed the baseline concepts and methodology, and pulled together industrial and academic partners from across the nation into a solid consortium. Special thanks and singular congratulations go to Dr. Rogers for his extraordinary efforts in this endeavor.

This report is primarily based upon information provided by the above companies, schools and labs. We sincerely thank key personnel within these organizations for their commitment and dedication to this project. Including the national survey, more than 3,000 other companies and organizations participated in this project. We commend their efforts in our combined attempt to reach some common ground in precision manufacturing skills standards and curriculum development.

This material may be found on the Internet at http://machinetool.tstc.edu
CATALOG OF 15 VOLUMES

VOLUME 1  EXECUTIVE SUMMARY
STATEMENT OF THE PROBLEM
MACHINE TOOL ADVANCED SKILLS TECHNOLOGY PROJECT
PROJECT GOALS AND DELIVERABLES
PROJECT METHODOLOGY
PROJECT CONCLUSIONS AND RECOMMENDATIONS
APPENDICES

VOLUME 2  CAREER DEVELOPMENT
GENERAL EDUCATION
REMEDICATION

VOLUME 3  MACHINING - CORE COURSES (MAC)

VOLUME 4  MANUFACTURING ENGINEERING TECHNOLOGY (MET)

VOLUME 5  MOLD MAKING (MLD)
VOLUME 6  WELDING (WLD)
VOLUME 7  INDUSTRIAL MAINTENANCE (IMM)
VOLUME 8  SHEET METAL (SML) AND COMPOSITES (COM)
VOLUME 9  TOOL AND DIE (TLD)
VOLUME 10 COMPUTER-AIDED DRAFTING AND DESIGN (CAD)
VOLUME 11 COMPUTER-AIDED MANUFACTURING AND ADVANCED CNC (CNC)
VOLUME 12 INSTRUMENTATION (INT)
VOLUME 13 LASER MACHINING (LSR)
VOLUME 14 AUTOMATED EQUIPMENT TECHNOLOGY (CIM)
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After numerous interviews with practitioners from industry (see Appendix A), and discussions with numerous educators, managers, supervisors, and others involved with machine related occupations and specifically machining, the MAST Consortium Partners have agreed to present our definition of a Manufacturing Engineering Technician as follows:

MANUFACTURING ENGINEERING TECHNICIAN - one who uses special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

MAST has also determined that individuals working as Manufacturing Engineering Technicians will preferably have received at least two years of training and education in both academic and technical courses in the areas of manufacturing methods and processes. This training may have been conducted in a vocational institution or college. Our research indicates that a minimum of two years of vocational training will prepare students with entry level skills necessary to begin work as a Manufacturing Engineering Technician.

In this program, the students progress through a series of courses designed to both educate and train students with skills and knowledge in areas such as manufacturing materials and methods, conventional and CNC machining, computer-aided drafting and design, engineering mechanics and design, computer-aided manufacturing, and robotics. Students receive a wide range of training which enables them to seek jobs in many different manufacturing areas. The Manufacturing Engineering Technology Program at Texas State Technical College has been training Manufacturing Engineering Technicians for many years and works closely with advisory committee members to make sure that the skills being taught are the skills needed in industry. Students who graduate from this course of study receive Associate of Applied Science degrees from TSTC. The MET Department worked closely with the MAST staff, made every effort to assist the MAST staff with research and seek adoption of the recommended MAST materials for their MET students. The MET Department at TSTC is recognized throughout Texas by large and small manufacturing companies as a premier source for entry-level technicians. Upon graduation, students are able to interpret complex drawings, select the correct materials and perform all necessary machining processes. The curriculum has been designed to prepare students to enter the workforce as entry level Manufacturing Engineering Technicians. Laboratory work is emphasized with actual industrial equipment in order to prepare students for interesting, rewarding work in a wide variety of industries. The MET department has a unique blend of theoretical knowledge and practical application which directly corresponds to modern uses in manufacturing. Students may choose from three options of study: Computer-Aided Manufacturing, Machining and Plastics. This volume contains the justification, documentation and course syllabi for the courses which we recommend as minimum training for individuals desiring to become Manufacturing Engineering Technicians.
PARTNER OCCUPATIONAL SPECIALITY ASSIGNMENTS

Although each of the six partner college development centers possessed detailed expertise in each of the MAST 15 occupational specialties, a division of work was still very necessary to ensure completion of the project due to the enormity associated with industrial assessment and complete curriculum revision for each of the areas of investigation.

Each Collegiate Partner was responsible for development of a specialization component of the overall model. Information for the future direction of this specialization area was obtained from NIST Manufacturing Centers and/or national consortia, professional societies, and industrial support groups addressing national manufacturing needs. Each Collegiate Partner tested its specialization model utilizing local campus resources and local industry. Information gained from the local experience was utilized to make model corrections. After testing and modification, components were consolidated into a national model. These events occurred during the first year of the Program. During the second year of the Program, the national model was piloted at each of the Collegiate Partner institutions. Experience gained from the individual pilot programs was consolidated into the final national model.

What follows is a profile of the MAST development center which had primary responsibility for the compilation and preparation of the materials for this occupational specialty area. This college also had the responsibility for conducting the pilot program which was used as one of the means of validation for this program.
Manufacturing in Texas
Economic trends have led Texas officials to recognize the need to better prepare workers for a changing labor market. The downturn in the oil, natural gas, ranching and farming industries during the last decade diminished the supply of high-paying, low-skill jobs. Growth in Texas is occurring in the low paying, low skills service industry and in the high skills, high paying precision manufacturing industry. In Texas, projected increases by the year 2000 include 4,050 jobs for machine mechanics (24% growth rate); 4,700 jobs for machinists (18% growth rate); 3,850 numeric control operators (20% growth rate); and 107,150 general maintenance repair technicians (23% growth rate). The National Center for Manufacturing Sciences (NCMS) identified that of the top twenty manufacturing states, Texas experienced the largest increase in manufacturing employment. Manufacturing will add over 70,000 additional jobs in Texas by the year 2000 with increases in both durable and non-durable goods.

Texas State Technical College (TSTC)
Texas State Technical College System (TSTC) is authorized to serve the State of Texas through excellence in instruction, public service, research, and economic development. The system’s efforts to improve the competitiveness of Texas business and industry include centers of excellence in technical program clusters on the system’s campuses and support of educational research commercialization initiatives. Through close collaboration with business, industry, governmental agencies, and communities, including public and private secondary and postsecondary educational institutions, the system provides an articulated and responsive technical education system.

In developing and offering highly specialized technical programs and related courses, the TSTC system emphasizes the industrial and technological manpower needs of the state. Texas State Technical College is known for its advanced or emerging technical programs not commonly offered by community colleges.

New, high performance manufacturing firms in areas such as plastics, semiconductors and aerospace have driven dynamic change in TSTC’s curriculum. Conventional metal fabrication to support oil and heavy manufacturing remains a cornerstone of the Waco campus and is a primary reason TSTC took the lead in developing new curricula for machining and manufacturing engineering technology in the MAST program.

Development Team
- **Project Director**: Joe K. Penick, Grant Director for Machine Tool Advanced Skills Technology Program (MAST); served as the primary administrator and academic coordinator for the MAST project.
- **Subject Matter Expert**: Wallace Pelton, Site Coordinator, was responsible for developing skill standards and course/program materials for the conventional machining, mold making and manufacturing engineering technology components of the MAST project.
Development of Competency Profiles at each of the MAST sites began with visits to representative companies for the purpose of surveying expert workers within the industry and occupational areas under investigation. Each site began the survey process by asking a subject matter expert in the targeted technical area, generally a member of their faculty, to employ a modified version of the generally-accepted DACUM (Developing A Curriculum) method to categorize the major skills needed to work in the selected occupation. As source materials, the college instructors drew on their professional knowledge and experience of current and future industry requirements. The initial skill standards developed by the subject matter experts underwent numerous internal reviews and revisions within each site, assuming final form as a series of structured survey and interview statements designed to elicit a simple yes or no response.

To determine an appropriate survey sample, each site compiled a database of their region's small and medium-sized manufacturers and searched for companies likely to employ workers in the targeted occupational area. The resulting cross-industry samples were sorted further to achieve a balance of technological capability and workforce size; the sample companies within each region were then asked to participate in the project. Willing respondents were scheduled for interviews.

During the company interviews, MAST staff asked expert workers to identify the primary duties and tasks performed by a typical worker and to consider the special skills and knowledge, traits and attitudes, and industry trends that will have an impact on worker training, employability, and performance both now and in the future. The interview results were analyzed to create individual profiles identifying the most common duties and skills required of workers at each company. Copies of individual company competency profiles are provided in Appendix A of this volume. These individual company Competency Profiles served two purposes. First, they showed, in a format that could be easily understood by both industry and educators, a picture of the occupational specialty at a given company at that particular time. Second, these individual company Competency Profiles furnished the company with a document for which they could claim ownership. This, in effect, made them “real” partners in the work of MAST.

Data for all companies were then aggregated to develop a composite Competency Profile of industry skill standards within the selected occupational specialty area of, as shown in the following pages.

These same duties and tasks were then included in both the Texas and National Surveys for further validation (see Volume 1). As a result of the surveys, additional refinements were made to the Competency Profiles. These changes were then incorporated into the individual course syllabi which were used for the pilot program.

The MAST Competency Profile for this occupational specialty area has been included on the following pages.
SKILLS AND KNOWLEDGE

- Communication Skills
- Use Measurement Tools
- Use Inspection Devices
- Mathematical Skills
- Reading/Writing Skills
- Knowledge of Safety Regulations
- Practice Safety in the Workplace
- Organizational Skills
- Knowledge of Company Policies/Procedures
- Mechanical Aptitude
- Ability to Comprehend Written/Verbal Instructions
- Basic Knowledge of Fasteners
- Ability to Work as Part of a Team
- Converse in the Technical Language of the Trade
- Knowledge of Occupational Opportunities
- Knowledge of Employer/Employer Responsibilities
- Knowledge of Company Quality Assurance Activities
- Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES

- Strong Work Ethic
- Interpersonal Skills
- Punctuality
- Dependability
- Honesty
- Neatness
- Safety Consciousness
- Motivation
- Responsible
- Physical Ability
- Professional
- Trustworthiness
- Customer Relations
- Personal Ethics

TOOLS AND EQUIPMENT

- Machinist's Tools (e.g., calipers, dial indicators, magnetic tool holders, etc.)
- Measuring Tools
- Power Tools
- Metal Lathe with Attachments
- Drill Presses
- Vertical Mill with Attachments
- Power Saws
- Power Drills
- Hydraulic/Arbor Press
- Heat Treatment Equipment
- Hardness Testing Equipment
- Grinding Machines with Attachments
- Welding Equipment (SMAW, GMAW, FCAW, Plasma)
- CNC Machining Center and Turning Center
- Gear Producing Machines with Attachments
- Jig Boring Machines
- Alignment/Calibration Tools
- Coolant Recovery Equipment
- Computer
- Ventilation Equipment
- Forklift
- Personal Safety Equipment
- Ozone Equipment
- Tool Storage Equipment
- Workbenches
- Vises
- Pedestal Grinders
- Welding Equipment
- Optical Comparator
- Coordinate Measurement Machine
- Hydraulic/Pneumatic Testing Equipment
- Electrical Training Equipment
- Safety Training Equipment

FUTURE TRENDS AND CONCERNS

- Statistical Process Control
- Composites
- Laser Machining
- Advanced Computer Applications
- Robotics
- Environmental Concerns
- Fiber Optic Controls
- Automated Material Handling Equipment
- Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing
Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortium Partners
(V.199J40008)

Machine Tool Advanced Skills
Technology Program

MAST
MANUFACTURING ENGINEERING TECHNICIAN.... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
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</thead>
<tbody>
<tr>
<td>Practice Safety</td>
<td>A-1 Follow safety manuals and all safety regulations/requirements</td>
</tr>
<tr>
<td>Apply Mathematical Concepts</td>
<td>B-1 Perform basic arithmetic functions</td>
</tr>
<tr>
<td>Interpret Engineering Drawings and Control Documents</td>
<td>C-1 Review blueprint notes and dimensions</td>
</tr>
<tr>
<td>Recognize Different Manufacturing Materials and Processes</td>
<td>D-1 Identify materials with desired properties</td>
</tr>
<tr>
<td>Demonstrate Measurement/Inspection Techniques</td>
<td>E-1 Identify types of measurement used in manufacturing</td>
</tr>
<tr>
<td>Perform Conventional Machining Operations</td>
<td>F-1 Prepare and plan for machining operations</td>
</tr>
<tr>
<td>Perform Advanced Machining Processes</td>
<td>G-1 Prepare and plan for CNC machining operations</td>
</tr>
<tr>
<td>Perform Gear Generating Operations</td>
<td>H-1 Describe the different types of gears</td>
</tr>
<tr>
<td>Perform Welding Operations</td>
<td>I-1 Weld with Shielded Metal Arc Welding (SMAW) process</td>
</tr>
</tbody>
</table>

<p>| A-2 Use protective equipment | B-2 Interconvert fractions/decimals |
| A-3 Follow safe operating procedures for hand and machine tools | B-3 Interconvert Metric/English measurements |
| A-4 Maintain a clean and safe work environment | B-4 Perform basic algebraic operations |
| A-5 Control fire hazards | B-5 Perform trigonometric functions |
| A-6 Apply American Red Cross First Aid and CPR procedures | B-6 Calculate speeds and feeds for machining |
| A-7 Recommend hazardous waste management techniques | B-7 Locate machining points from a datum point |
| A-8 Apply ergonomic principles to the workplace | B-8 Perform calculations for sine bar and sine plate |
| A-9 Demonstrate knowledge of state and federal EPA regulations | B-9 Calculate for direct, simple, and angular indexing |
| B-10 Perform calculations necessary for turning tapers | B-11 Solve for &quot;h&quot; |
| B-12 Use all functions on a scientific calculator | B-13 Solve engineering equations |
| B-14 Solve static systems for resultant force | B-15 Dertermine strength of materials for various applications |
| C-2 Identify basic layout of drawings | C-3 Identify basic types of drawings |
| C-4 List the purpose of each type of drawing | C-5 Verify drawing elements |
| C-6 Practice Geometric Dimensioning and Tolerancing (GD&amp;T) methodology | C-7 Describe the relationship of engineering drawings to planning |
| C-8 Use standards to verify requirements | C-9 Analyze bill of materials (BOM) |
| C-10 Understand and use quality systems | |
| D-2 Identify materials and processes to produce a product | D-3 Describe heat treating processes |
| D-4 Perform heat treating operations | D-5 Test metal hardness |
| D-6 Describe casting processes | D-7 Describe hot working processes |
| D-7 Describe cold working processes | D-8 Describe alternative manufacturing processes |
| D-9 Evaluate cold working processes | |
| E-2 Select proper measurement tools | E-3 Apply proper measurement techniques |
| E-4 Use Metric and English standards of measurement | E-5 Perform measurements with hand held instruments |
| E-6 Perform measurements on surface plate | E-7 Perform measurements using stationary equipment |
| F-2 Use power saws | F-3 Operate drill presses |
| F-4 Operate vertical milling machines | F-6 Operate horizontal milling machines |
| F-7 Operate metal cutting lathes | F-8 Operate grinding/abrasive machines |
| G-2 Select and use CNC tooling systems | G-3 Program CNC machines |
| G-4 Operate CNC machining centers (mills) | G-5 Operate CNC turning centers (lathes) |
| G-6 Operate electrical discharge machines | G-7 Download programs via network |
| G-8 Program CNC Machines using CAM System | |
| H-2 Understand gear terms | H-3 Use rotary tables and dividing heads |
| H-4 Discuss gear inspection and measurement | |
| I-1 Weld with Shielded Metal Arc Welding (SMAW) process | I-2 Weld/Cut with oxy-arc-lens |
| I-3 Weld with Gas Tungsten Arc Welding (GTAW) (Heluro) | I-4 Weld with Gas Metal Arc Welding (GMAW/Mig) and Flux Core Arc Welding (FCAW) |
| I-5 Perform Plasma Arc Cutting (PAC) | |</p>
<table>
<thead>
<tr>
<th>Duties</th>
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<tbody>
<tr>
<td>J Perform Drafting Tasks</td>
<td>J-1 Demonstrate traditional mechanical drafting skills</td>
</tr>
<tr>
<td></td>
<td>J-2 Use Computer-Aided Drafting (CAD) system</td>
</tr>
<tr>
<td></td>
<td>J-3 Create 3-D solid models</td>
</tr>
<tr>
<td></td>
<td>J-4 Make tool drawings</td>
</tr>
<tr>
<td>K Use Computers</td>
<td>K-1 Use computer operating systems</td>
</tr>
<tr>
<td></td>
<td>K-2 Use computer inquiry systems</td>
</tr>
<tr>
<td></td>
<td>K-3 Use various computer applications</td>
</tr>
<tr>
<td></td>
<td>K-4 Recommend and implement CIM technologies</td>
</tr>
<tr>
<td></td>
<td>K-5 Use computer-aided engineering system</td>
</tr>
<tr>
<td>L Participate in Total Quality and SPC Activities</td>
<td>L-1 Define quality in manufacturing and explain importance</td>
</tr>
<tr>
<td></td>
<td>L-2 Implement concepts of quality in the workplace</td>
</tr>
<tr>
<td></td>
<td>L-3 Apply principles and tools of continuous quality improvement</td>
</tr>
<tr>
<td></td>
<td>L-4 Understand and apply SPC</td>
</tr>
<tr>
<td></td>
<td>L-5 Evaluate data to monitor production</td>
</tr>
<tr>
<td></td>
<td>L-6 Analyze customer problems and recommend solutions</td>
</tr>
<tr>
<td></td>
<td>L-7 Establish methods, plans and procedures to maintain quality</td>
</tr>
<tr>
<td>M Maintain Electrical Devices</td>
<td>M-1 Use electrical test equipment</td>
</tr>
<tr>
<td></td>
<td>M-2 Apply specific terms to electrical circuits</td>
</tr>
<tr>
<td></td>
<td>M-3 Analyze series, parallel and complex DC/AC circuits</td>
</tr>
<tr>
<td></td>
<td>M-4 Check AC and DC motors</td>
</tr>
<tr>
<td></td>
<td>M-5 Inspect transformers and generators</td>
</tr>
<tr>
<td></td>
<td>M-6 Discuss sensors and feedback technology</td>
</tr>
<tr>
<td></td>
<td>M-7 Set up/program PLC</td>
</tr>
<tr>
<td></td>
<td>M-8 Troubleshoot electrical devices</td>
</tr>
<tr>
<td>N Maintain Hydraulic/ Pneumatic Devices</td>
<td>N-1 Use test equipment</td>
</tr>
<tr>
<td></td>
<td>N-2 Describe basic principles of hydraulic systems</td>
</tr>
<tr>
<td></td>
<td>N-3 Identify hydraulic fluids</td>
</tr>
<tr>
<td></td>
<td>N-4 Recommend power distribution and sealing devices</td>
</tr>
<tr>
<td></td>
<td>N-5 Recognize pumps, actuators, and hydraulic control devices</td>
</tr>
<tr>
<td></td>
<td>N-6 Troubleshoot hydraulic/pneumatic systems</td>
</tr>
</tbody>
</table>
The Competency Profiles derived from the industry survey process were returned to industry and faculty members at each MAST partner college for review. Reviewers were asked to identify specific sub-tasks within each block of Duties and Tasks in the Profile; MAST staff at each college broke the sub-tasks down further into the detailed steps required to actually perform the duties and tasks of the manufacturing process. It is these detailed skill standards that were then incorporated into development of the curriculum and piloted as a training program by each of the MAST colleges. All results for the specific occupational specialty area have been organized as an outline of the duties, tasks, and sub-tasks required to demonstrate technical competency in the workplace, as shown in the following pages.

As a result of the Texas and the National Surveys, additional refinements were made to the Competency Outlines. These changes were then incorporated into the individual course syllabi.

The MAST Technical Workplace Competency Outline for this occupational specialty area has been included on the following pages.
MANUFACTURING ENGINEERING TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES

MANUFACTURING ENGINEERING TECHNICIAN—use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

A. PRACTICE SAFETY
   1. Follow Safety Manuals and All Safety Regulations/Requirements
      a. Assume responsibility for the personal safety of oneself and others
      b. Develop a personal attitude towards safety
      c. Interpret safety manual directives
      d. Comply with established company safety practices
      e. Complete forms/paperwork as required
   2. Use Protective Equipment
      a. Wear protective safety clothing as required
      b. Maintain and use protective guards and equipment on machinery
      c. Locate and properly use protective equipment
      d. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Machine Tools
      a. Identify and understand safe machine operation procedures
      b. Demonstrate safe machine operation
   4. Maintain a Clean and Safe Work Environment
      a. Keep work areas clean
      b. Clean machine/hand tools when work is completed
      c. Put tools away when work is finished
      d. Keep aisles clear of equipment and materials
      e. Perform preventative maintenance as required
   5. Control Fire Hazards
      a. Handle/store flammable materials appropriately
      b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
      c. Prevent spontaneous ignition by practicing proper waste disposal habits
      d. Keep marked aisles clear of equipment and materials
      e. Interpret/display MSDS sheets as required
      f. Identify fire exits and fire-fighting equipment
   6. Apply American Red Cross First Aid and CPR Procedures
      a. Notify appropriate personnel of injury
      b. Check and evaluate life-endangering conditions
      c. Determine need for CPR
      d. Apply appropriate first aid techniques
      e. Complete accident report as needed
   7. Recommend Hazardous Waste Management Techniques
      a. Define the types of hazards (e.g., chemical, biological, and physical)
      b. Understand chemical hazards and the use of Material Safety Data Sheets (MSDS)
      d. Describe the proper collection for a variety of hazardous wastes
      e. Respond to emergencies in the appropriate manner
   8. Apply Ergonomic Principles to the Workplace
Define ergonomics
b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

9. Demonstrate Knowledge of State and Federal EPA Regulations
a. Meet health, safety, and legal requirements with regard to process, product and people

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals

2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use decimal equivalent chart for conversions

3. Interconvert Metric/Inch Measurements
   a. Convert inch dimensions to metric
   b. Convert metric dimensions to inch
   c. Use metric/inch conversion chart

4. Perform Basic Algebraic Operations
   a. Express word statements as algebraic equations
   b. Solve word statements as algebraic equations

5. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
   c. Calculate bolt hole patterns

6. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut

7. Locate Machining Points from a Datum Point
   a. Identify points using the Cartesian coordinate system
   b. Identify points using the absolute dimensioning system
   c. Identify points using the incremental dimensioning system
   d. Identify points using the polar coordinate system

8. Perform Calculations for Sine Bar and Sine Plate
   a. Calculate gage block build up for 5" sine bar
   b. Calculate gage block build up for 10" sine plate

9. Calculate for Direct, Simple, and Angular Indexing
   a. Calculate for direct indexing
   b. Calculate for simple indexing (plain)
   c. Calculate for angular indexing
   d. Use Machinery's Handbook for calculations

10. Perform Calculations Necessary for Turning Tapers
    a. Calculate tail stock offset
    b. Determine unknowns (e.g., small and/or large diameters) for taper turning

11. Calculate Depth of Cut on Round Surfaces
    a. Calculate depth of cut for flats to be machined on cylindrical pieces
b. Calculate depth of cut for keyways which are machined on cylindrical pieces

12. Use all Functions on a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
   c. Apply all statistical functions

13. Solve Engineering Equations
   a. Solve linear algebraic equations for an unknown
   b. Solve a system of linear equations with 2 unknowns
   c. Solve right triangles for unknown sides or unknown angles
   d. Use law of sines and cosines to solve obtuse triangles with unknown sides and angles
   e. Operate hand held electronic calculator properly (w/trigonometry keys)
   f. Discuss friction (e.g., coefficient, angle of friction, and angle of repose)

14. Solve Static Systems for Resultant Force
   a. Solve for the following coplanar force systems: parallel, concurrent, and nonconcurrent
   b. Solve for the following noncoplanar force systems: parallel, concurrent, and nonconcurrent

15. Determine Strength of Materials for Various Applications
   a. Discuss stress and deformation
   b. List properties of materials (e.g., strength, elasticity, stiffness, ductility, hardness)
   c. Calculate stresses and designs of joints
   d. Discuss advantages and disadvantages of different fastening technique
   e. Discuss problems relating to torque-twisting moments
   f. Discuss centroids and moments of inertia of areas

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes

2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block

3. Identify Basic Types of Drawings
   a. Identify orthographic views
b. Identify positions of views (top, front, side, and auxiliary)
c. Visualize one or more views from a given view
d. Identify isometric views
e. Identify exploded isometric drawings
f. Identify assembly drawings

4. List the Purpose of Each Type of Drawing
a. Discuss purpose of orthographic (3 views) drawings
b. Discuss purpose of isometric drawing
c. Discuss purpose of exploded isometric drawing
d. Discuss purpose of assembly drawings

5. Verify Drawing Elements
a. Determine the scale of the view or section
b. Check for revisions
c. Recognize out-of-date blueprints

6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
a. Identify the purpose of GD&T
b. Identify symbols for controlling location (or true position) of part features
c. Identify symbols for controlling form (or alignment) of part features
d. Identify symbols for showing datums and basic dimensions on drawings
e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)

7. Describe the Relationship of Engineering Drawings to Planning
a. Discuss production schedule
b. Discuss Material Resource Planning (MRP)
c. Discuss inventory control records
d. Discuss shop floor routing documents

8. Use Standards to Verify Requirements
a. Discuss the purpose of standards
b. Discuss source locations for standards

9. Analyze Bill of Materials (BOM)
a. Discuss components found on BOM
b. Determine materials needed to produce the part
c. Determine quantities necessary to produce the part
d. Submit completed stock request form as required
e. Submit completed tool request form as needed

10. Understand and Use Quality Systems
a. Describe ISO 9000 quality system
b. Document paper trails for document revisions

D. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES
1. Identify Materials With Desired Properties
a. Discuss classification system for metals
b. Discuss general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals
c. List advantages for considering plastic as a viable materials choice
d. List the advantages and disadvantages for each of the following plastic molding processes: blow, injection, vacuum, extrusion, etc.
e. Discuss the advantages for using composites in various manufacturing applications

2. Identify Materials and Processes to Produce a Product
   a. Discuss service requirements (in strength, hardness, etc.)
   b. Discuss fastening processes (i.e., fasteners, welding, bonding, etc.)
   c. Discuss corrosion resistance methods

3. Describe Heat Treating Processes
   a. Discuss the reasons for heat treating
   b. Discuss the time/temperature chart
   c. List the different quenching mediums
   d. Estimate metal heat temperature by color
   e. List reasons for stress relieving workpieces
   f. Discuss surface hardening processes

4. Perform Heat Treating Operations
   a. Harden plain carbon workpiece
   b. Temper plain carbon workpiece
   c. Anneal plain carbon workpiece
   d. Case harden workpiece

5. Test Metal Samples for Hardness
   a. Perform spark test to test for metal hardness
   b. Perform Rockwell hardness tests
   c. Perform Brinell hardness tests
   d. Perform Charpy and/or Izod impact tests
   e. Perform tensile and/or compression tests
   f. Prepare metal samples for viewing under a microscope

6. Describe Casting Processes
   a. Discuss the following casting processes: sand, evaporative, shell molding, permanent mold, centrifugal, investment, and die casting
   b. Discuss pattern and mold design factors for each of the above casting processes
   c. List the advantages and disadvantages of the casting processes

7. Describe Hot Working Processes
   a. Discuss the following hot working processes: rolling, strand casting, forging, drawing, extrusion, spinning, and roll forming
   b. List the advantages and disadvantages of the hot working processes

8. Describe Cold Working Processes
   a. Discuss the following cold working processes: rolling, blanking, pressing, drawing, extruding, wire and bar drawing, bending, shearing, and roll forming
   b. List the advantages and disadvantages of the cold working process

9. Evaluate Alternative Manufacturing Processes
   a. Discuss the powder metallurgy process (PM)
   b. Discuss the following nontraditional machining processes: EDM, Laser machining, Ultrasonic machining, Hydrojet machining, Electron beam machining, and plasma beam machining

E. DEMONSTRATE MEASUREMENT/INSPECTION TECHNIQUES
1. Identify Types of Measurement
a. Discuss the use of metrology in manufacturing
b. Discuss the inch system of measurement
c. Discuss the metric system of measurement
d. Discuss semi-precision and precision measurement
e. Discuss the following: accuracy, precision, reliability, and discrimination

2. Select Proper Measurement Tools
a. Identify basic semi-precision measuring tools
b. Identify precision measuring tools
c. Justify the use of a particular measuring tool based on tool characteristics
d. Identify error possibilities in measurement tool selection
e. Demonstrate proper care of precision measuring tools

3. Apply Proper Measuring Techniques
a. Discuss factors affecting accurate measurement (dirt, temperature, improper measuring tool calibration)
b. Explain calibration requirements of various precision instruments
c. Illustrate measurement differences when taken with calibrated and non-calibrated instruments
d. Calibrate a micrometer type measuring tool

4. Perform Measurements With Hand Held Instruments
a. Measure with steel rules (metric and inch)
b. Measure with micrometers
c. Measure with comparison measuring instruments (e.g., calipers, telescope gages)
d. Measure with direct measuring instruments (e.g., vernier, dial, and digital instruments)
e. Measure with fixed gages (go and not go gages)

5. Perform Measurements on Surface Plate
a. Describe care of surface plate
b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)
c. Check for part squareness
d. Check part dimensions for accuracy
e. Align workpieces using height gage and dial indicators

6. Perform Inspections Using Stationary Equipment
a. Set up and use an Optical Comparator
b. Set up and use a Coordinate Measuring Machine (CMM)

F. PERFORM CONVENTIONAL MACHINING OPERATIONS
1. Prepare and Plan For Machining Operations
a. Read and interpret blueprints
b. Perform basic semi-precision and precision layout as necessary
c. Plan machining operations
d. Understand machinability and chip formation
e. Calculate speeds, feeds, and depth of cut for various machine applications
f. Determine proper cutting fluids/coolants for machining
g. Use carbides and other tool materials to increase productivity
h. Use the Machinery's Handbook as a reference for machine applications

2. Use Proper Hand Tools
a. Use arbor and shop presses
b. Select necessary work-holding devices and hand tools as needed

c. Select and use hand files

d. Identify and use hand reamers

e. Correctly identify and use hand taps as required

f. Follow tapping procedures to produce internal threads

g. Use thread-cutting dies to produce external threads

h. Operate bench and pedestal grinders safely

3. Operate Power Saws

a. Use reciprocating and horizontal band cutoff machines

b. Operate abrasive and cold saws

c. Prepare and use the vertical band saw

d. Weld a bandsaw blade

4. Operate Drill Presses

a. Describe the different types of drill presses found in the machine shop

b. Describe and use standard drilling tools

c. Sharpen a drill bit using a bench or pedestal grinder

d. Setup the drill presses for drilling, countersinking, counterboring, reaming, and tapping operations

e. Drill holes using drill jigs

5. Operate Vertical Milling Machines

a. Demonstrate the use of all controls on the vertical milling machine

b. Align the vertical milling machine head

c. Select, align and use workholding devices

d. Select milling tool holders

e. Select milling cutters

f. Perform all standard vertical milling operations

g. Bore a hole using the offset boring head

h. Machine angles using sine bar and gage blocks

i. Setup and use special vertical mill fixtures

j. Setup and machine dovetails

k. Machine keyways

6. Operate Horizontal Milling Machines

a. Discuss the difference in plain and universal horizontal milling machines

b. Discuss the types of spindles, arbors and adaptors used on the horizontal milling machine

c. List several common work holding methods

d. Use plain milling cutters

e. Use side milling cutters

f. Use face milling cutters

g. Setup and use special horizontal mill fixtures

7. Operate Metal Cutting Lathes

a. Demonstrate the use of all controls on the engine lathe

b. Discuss standard tools and toolholders for the lathe

c. Face and center drill parts correctly

d. Drill, ream and bore on the lathe

e. Turn between centers

f. Discuss alignment of lathe centers
perform advanced machining processes

1. Prepare and plan for CNC machining operations
   a. Read and interpret blueprints
   b. Plan CNC machining operations
   c. Calculate speeds, feeds, and depth of cut for various CNC machine applications
   d. Determine proper cutting fluids/coolants for CNC machining
   e. Use the Machinery's Handbook as a reference for CNC machine applications

2. Select and use CNC tooling systems
   a. Understand machinability and chip formation
   b. Select proper insert materials and geometry
   c. Assemble tooling components
   d. Select correct tooling systems
   e. Identify tooling cost factors

3. Program CNC machines
   a. Identify CNC applications
   b. List various types of CNC machines
   c. Discuss CNC machine control systems
   d. Describe absolute and incremental coordinate systems
   e. Plan and write programs for CNC lathes
   f. Plan and write programs for CNC mills

4. Operate CNC machining centers (mills)
   a. Install and align work holding devices
   b. Load/align materials into the machine
   c. Load tools into machine
   d. Establish tool length offset for each tool
   e. Establish/set machine reference
   f. Load programs into CNC mill
   g. Demonstrate working knowledge of all controls on the MCU
   h. Demonstrate proper operation of CNC machining center to include "dry run" and final production
5. Operate CNC Turning Centers (Lathes)
   a. Install and bore soft jaws as required
   b. Load tools into machine
   c. Establish machine reference
   d. Set initial tool offsets
   e. Monitor/adjust offsets for accurate part production
   f. Load programs into CNC lathe
   g. Demonstrate working knowledge of all controls on the MCU
   h. Demonstrate proper operation of CNC lathe to include "dry run" and final production
   i. Edit CNC programs for optimum part production
   j. Replenish stock in bar feeder as needed

6. Operate Electrical Discharge Machines
   a. Discuss the EDM process
   b. List advantages and disadvantages of the EDM process
   c. Identify electrode materials
   d. Machine EDM electrodes
   e. Setup and operate die sinker EDM machines
   f. Calculate overburn
   g. Identify generator setting of machine
   h. Choose proper techniques for flushing
   i. Estimate number of roughers and finishers
   j. Demonstrate proper electrode mounting techniques
   k. Utilize 3R tooling
   l. Perform touch-off procedures
   m. Recognize optimum machine settings
   n. Perform continuity checks
   o. Determine R-MAX finish required
   p. Setup and operate wire cut EDM machines

7. Download Programs Via Network
   a. Download programs from the network
   b. Upload programs to the network
   c. Perform edit and print functions via network

8. Program CNC Machines Using a CAM System
   a. Create Job Plan for machining operations
   b. Construct part geometry
   c. Program tool path for roughing and finishing operations
   d. Verify tool path
   e. Generate CNC code

H. PERFORM DRAFTING TASKS.
1. Demonstrate Traditional Mechanical Drafting Skills
   a. Form freehand vertical Gothic upper-case letters and numerals of correct shape and space
   b. Execute the alphabet of lines correctly, producing dense black lines of uniform thickness and spacing
c. Demonstrate proficiency with the engineers and metric scales
d. Execute geometric constructions with no mistakes in tangent points, line
   quality or layout work
e. Accurately draw the missing view or line in a multiview drawing
f. Make or complete a sectional instrument drawing, given one or more views
g. Develop satisfactory working drawings of simple machine components to
   include all necessary views and dimensions for complete shape and size
   description of detail parts
h. Discuss the differences in standard engineering drawings and tool drawings
i. Develop satisfactory tool drawings for drill jigs, milling fixture, and
   inspection fixtures

2. Use Computer-Aided Drafting (CAD) System
   a. Demonstrate the start-up and shut-down of a PC based CAD system
   b. Input information through the use of various input devices
   c. Use the SETTINGS menu commands to establish operating parameters in a
      drawing
d. Use the Cartesian coordinate system to correctly enter line and arc
      elements to construct a part
e. Use the DISPLAY menu to manipulate the drawing image
f. Apply basic DRAW menu and EDIT menu commands to create a drawing
g. Use appropriate menu commands to manage files
h. Set up the specifications within the PLOT command for producing a hard
   copy of a drawing
i. Convert to accepted drawing exchanges Formats (i.e., IGES, DXF, etc.)
j. Convert CAD data to a CAM system
k. Use a CAD system for producing tool drawings

3. Create 3-D Solid Models
   a. Construct the required geometrical elements required for the model
   b. Assign necessary properties for the creation of the solid model
   c. Perform engineering tests on the solid model

4. Make Tool Drawings
   a. Discuss the differences in tool drawings verses regular mechanical
      drawings
   b. Design and draw a simple drill jig using accepted practices
   c. Design and draw a simple milling fixture using accepted practices

I. USE COMPUTERS
   1. Use Computer Operating Systems
      a. Use basic computer terminology appropriately and accurately
      b. Boot the computer and recognize the basic components of DOS
      c. Use DOS to perform file management
      d. Use DOS to perform directory management
      e. Install software packages on a PC
   2. Use Computer Inquiry Systems
      a. Log in to a multi-user system
      b. Access system for needed information
      c. Print reports as necessary
   3. Use Various Computer Applications
a. Load word processor, create, save, edit, and print a document
b. Load spreadsheet, create, save, retrieve, erase, edit, and print a worksheet
c. Load database programs, create, edit, delete, and print records in a database file

4. Recommend and Implement CIM Technologies
a. Use automatic storage & retrieval system
b. Use bar coding technology
c. Understand robot applications
d. Program robots
e. Use shop floor control systems
f. Understand machine vision systems

5. Use Computer-Aided Engineering System
a. Perform structural loading tests
b. Perform finite element analysis tasks
c. Perform interference tests

J. PARTICIPATE IN TOTAL QUALITY, TEAMWORK, EMPOWERMENT, QUALITY PROBLEM SOLVING AND STATISTICAL PROCESS CONTROL

1. Discuss the Role of Total Quality Management (TQM) in Manufacturing (TQM²)
   a. Understand the history of Total Quality Management process and its major historical contributors Deming, Juran, and Crosby
   b. State the reason for intensive application of Total Quality Management principles, concepts and constitution parts in the industrial workplaces of America
   c. Identify the parts of the of the Total Quality Management formula (or the major element of TQM) - TQM=(T⁵ + SPC) X CI + E&CS = P&S
   d. Understand the vital interplay of Training, Trust, Teamwork, Total Involvement and Transformation (T⁵) to the successful implementation of TQM²
   e. Understand the need for quantitative tools to base quality decisions on objective measurable information (Statistical Process Control - SPC)
   f. Understand how Continuous Improvement (CI) is a vital philosophy with the power to multiply quality efforts of TQM²
   g. State the importance of Employee and Customer Satisfaction (E&CS) to the successful implementation of TQM²
   h. Understand how the meaning of quality is determined based on the prospective of supplier and customer
   i. Understand that the quality perceptions of the customer are of prime importance
   j. Identify external and internal customers and the importance of both to the successful implementation of TQM²
   k. Know the essential importance of the Total Quality Management formula and its constitution parts to the Profitability and Survivability of a manufacturing enterprise
   l. Understand the importance of National TQM awards

2. Discuss Team Work (Teaming) Concepts
   a. Understand how successful implementation of Teamwork is fundamental to the successful implementation of TQM²
b. Identify the basic theories and concepts that allow for the development of effective teams in a manufacturing setting

c. Identify the stages in building a functioning manufacturing team

d. Identify the roles that must be fulfilled for teams to function effectively

e. Identify the responsibilities of sponsoring manager(s), team leader, recorder, facilitator, and member

f. Be able to function in each of the roles of leader, recorder, facilitator and member

g. Understand how team norms or guidelines are vital to an effective team

h. Identify and practice team building behaviors

i. Identify and be able to counter team subverting or destructive behaviors

j. Understand the dynamic and desirable tension between diversity and conflict on teams

k. Identify and practice methods for containing conflict without retarding creativity within teams

l. Understand the dynamic and desirable tension between consensus and group think

m. Identify the four ways to reach a decision

n. Understand the desirability of reaching a consensus

q. Identify the eight factors that lead to group think and how to negate them

3. Demonstrate Empowerment Techniques

a. Understand how successful implementation of TQM² and Teamwork in the manufacturing environment will inevitably lead to empowerment

b. List the benefits to be gained by both management and labor from the implementation of Empowerment in a manufacturing setting

c. Define Empowerment as a process that helps the right people at the right levels make the right decisions for the right reasons

d. List and explain the two sides (facilitating empowerment in others and self empowerment) and four dimensions of empowerment (time, alignment, capability and trust)

e. Appreciate the need to make it possible for others to be empowered by valuing individuals, establish vision, providing tools, encouraging independent action and building empowerment systems

f. Understand the need for delegation and the dos and don'ts of delegation

g. Be able to empower themselves through recognizing and operating from their own power, creating a personal vision, using the power tools, taking independent action and contributing to the empowerment process

4. Demonstrate Knowledge of Quality Problem Solving (Six-Step Problem Solving Model) Techniques

a. Understand the need in today's fast faced business environment to improve manufacturing processes and efficiency through the diligent use of a problem solving model

b. Be able to identify the six steps of the six-step problem solving model

c. Be able to identify each of the sub-steps of the six-step problem solving model

d. Be able to apply the six-step problem solving model in individual and in team situations within the manufacturing environment
5. Demonstrate Knowledge of Statistical Process Control (SPC) Concepts
   a. Understand basic statistics for manufacturing process control
   b. Be able to define variation and probability
   c. Be able to identify the difference between "natural variation" and "unnatural variation"
   d. Be able to describe the difference between expected occurrence and actual occurrences of an event
   e. Be able to identify a histogram
   f. Recognize and describe the normal distribution curve
   g. Understand the usefulness of the normal or bell curve to SPC
   h. Be able to explain how the area under the normal curve is divided into standard deviations, or sigma (σ) units
   i. Define and calculate mean and range
   j. Apply a formula to estimate standard deviation
   k. Describe the relationship between the distributions of individuals and sample averages
   l. Be able to state the purpose of a control chart
   m. Identify the central line of a control chart
   n. Explain the difference between control limits and engineering specifications or tolerances
   o. Describe why the control chart has so much power
   p. Describe the purpose of a process capability study
   q. Define control chart variables and explain what X"bar" and R charts illustrate about a manufacturing process
   r. Explain the relationship between X"bar" (mean of sample) and R (range) of samples
   s. Define attributes and explain what p charts tell about a manufacturing process
   t. Be able to interpret control charts by identifying the pattern of points that shows the presence of a normal distribution
   u. Be able to recognize the five signs that show a process may be out of control

K. MAINTAIN ELECTRICAL DEVICES
   1. Use Electrical Test Equipment
      a. Measure resistance with an analog volt-ohm-milliamp meter
      b. Measure voltage with volt-ohm-milliamp meter
      c. Measure current with volt-ohm milliamp meter
      d. Use wattmeter to measure power in a simple DC circuit
      e. Use oscilloscope to observe AC signals of various waveshapes and frequencies
   2. Apply Specific Terms to Electrical Circuits
      a. Define voltage, current, and resistance
      b. Discuss power, power factor, and sine waves
c. Define three phase, induction, and capacitance

3. Analyze Series, Parallel and Complex DC/AC Circuits
   a. Define a series circuit
   b. Define a parallel circuit
   c. Define a complex DC circuit
   d. Define an AC circuit
   e. Apply Ohm's law to each of the above circuits
   f. Apply Kirchoff's law to each of the above circuits

4. Check AC and DC Motors
   a. List types of AC and DC motors
   b. List characteristics of AC motors
   c. List characteristics of DC motors
   d. Compare AC motors versus DC motors to job duty

5. Inspect Transformers and Generators
   a. Define transformer construction and the principle of operation
   b. List the different types of transformers
   c. Define electro-magnetic induction
   d. Describe the principle of operation of AC alternators and DC generators

6. Discuss Sensors and Feedback Technology
   a. List the various types of feedback devices used in industrial controls
   b. Apply the use of feedback systems in industrial control circuitry including AC, DC, and servo drive systems
   c. Identify, hardwire, and troubleshoot electro-mechanical devices and electrical switching devices including proximity switches, infra-red, and magnetic sensors

7. Set Up/Program PLC
   a. Describe the function and operation of three basic components of programmable controllers
   b. Revise electrical ladder control diagrams as reference diagrams to be programmed into the user memory of the programmable controller
   c. Use the programming devices to program, monitor, and edit the programmable controller
   d. Design and develop programs using standard functions and special standard functions of the programmable controller
   e. Troubleshoot functional circuits using reference diagram, indication lights, and programming devices

8. Troubleshoot Electrical Devices
   a. Discuss common methods of troubleshooting electrical systems
   b. Follow a logical troubleshooting sequence to trace a problem to its origin

L. MAINTAIN HYDRAULIC/PNEUMATIC DEVICES

1. Use Test Equipment
   a. Monitor hydraulic flow with flow meters
   b. Use temperature gauges to determine hydraulic fluid operating temperature
   c. Use flow control valves, U-tube manometers and pressure gauges to measure operating conditions for the fluid power system

2. Describe Basic Principles of Hydraulic Systems
   a. List advantages of hydraulic systems
b. Identify components of typical hydraulic system
c. State or describe Pascal's law
d. Analyze a hydraulic system to determine its performance

3. Identify Hydraulic Fluids
   a. Name types of hydraulic fluids
   b. List methods of measuring fluid viscosity
   c. List desirable characteristics of hydraulic fluids
   d. Identify safety hazards related to hydraulic fluid use
   e. Discuss heat exchangers, filters, and micron rating of filters

4. Recommend Power Distribution and Sealing Devices
   a. Describe proper identification and selection of lines, hoses, and fittings
   b. Discuss pressure, velocity, and safety factors
   c. List conditions determining selection of sealing devices

5. Recognize Pumps, Actuators, and Hydraulic Control Devices
   a. Name general classifications of pumps
   b. Determine overall pump efficiency
   c. Name types of positive displacement pumps and give advantages and disadvantages of each
   d. Discuss types of variable delivery pumps and describe their operation
   e. Describe linear actuators (cylinders)
   f. Describe how cylinders are rated and sized
   g. Describe rotary actuators and motors
   h. Name two types of hydraulic motors

6. Troubleshoot Hydraulic/Pneumatic Systems
   a. Discuss common methods of troubleshooting hydraulic systems
   b. Follow a logical troubleshooting sequence to trace a problem to its origin
THE MAST PILOT PROGRAM CURRICULUM AND COURSE DESCRIPTIONS

After completing the Competency Profile and Technical Workplace Competency Outline for each occupational specialty area, each MAST partner reviewed their existing curricula against the industry-verified skill standards in order to identify a suitable foundation for new pilot training programs. Because each college had to comply with the requirements of its respective college system and appropriate state agency, the resulting pilot curricula for occupational specialty areas tended to vary in format and academic requirements (e.g., some programs were based on the semester system, others on the quarter system). Despite differences in the curricula developed at the partner colleges, each of the pilot programs was designed to achieve the following two goals mandated in the MAST grant proposal:

- **Pilot Program**: “Conduct a one year pilot program with 25 or more selected applicants at each college or advanced technology center to evaluate laboratory content and effectiveness, as measured by demonstrated competencies and indicators of each program area.”

- **Student Assessment**: “Identify global skills competencies of program applicants both at point of entrance and point of exit for entry level and already-employed technicians.”

(Note: All occupational specialty areas were not pilot tested at all Development Centers; however, all partner colleges conducted one or more pilot programs.)

Included on the following pages is the curriculum listing for the pilot program which was used to validate course syllabi for this occupational specialty area. This curriculum listing included course names and numbers from the college which conducted the pilot program. The curriculum also shows the number of hours assigned to each of the courses (lecture, lab and credit hours). Also included is a description of each of the courses.
# Manufacturing Engineering Technology
## Computer Aided Manufacturing Option
**Curriculum 1995-96**

### First Quarter
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>LEC</th>
<th>LAB</th>
<th>CR</th>
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</thead>
<tbody>
<tr>
<td>PSYC 1100*</td>
<td>College Success Skills</td>
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<tr>
<td>MET 100</td>
<td>Machine Tool Practices I</td>
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<td>9</td>
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<tr>
<td>DDT 104</td>
<td>Drafting Principles</td>
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<td>4</td>
<td>6</td>
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<tr>
<td>MATH 1314*</td>
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<tr>
<td>ENGL 1301*</td>
<td>Composition I</td>
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**Total:** 14 LEC, 13 LAB, 16 CR

### Second Quarter
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<td>MET 200</td>
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<td>ENGL 134*</td>
<td>Interpersonal Communication</td>
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<tr>
<td>MATH 1316*</td>
<td>Plane Trigonometry</td>
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<td>CNS 2060</td>
<td>Application Software</td>
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**Total:** 13 LEC, 13 LAB, 15 CR

### Third Quarter
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<tr>
<td>MET 112</td>
<td>Engineering Materials</td>
<td>2</td>
<td>3</td>
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</tr>
<tr>
<td>OSH 216</td>
<td>Safety and Accident Prevention</td>
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<td>PHY 114</td>
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<td>EST 120</td>
<td>Electrical Applications</td>
<td>3</td>
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<td>WLT 105</td>
<td>Survey of Welding Applications and Processes</td>
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**Total:** 13 LEC, 15 LAB, 18 CR

### Fourth Quarter
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<td>MET 205</td>
<td>CNC Machine Programming</td>
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<td>MET 206</td>
<td>Statics</td>
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<tr>
<td>MET 301</td>
<td>Manufacturing Processes</td>
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<td>4</td>
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<tr>
<td>DDT 128</td>
<td>Introduction to Computer Drafting</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>PSYC 2301*</td>
<td>General Psychology</td>
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**Total:** 14 LEC, 13 LAB, 17 CR

### Fifth Quarter
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<tr>
<td>MET 302</td>
<td>CAD/CAM I</td>
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<td>3</td>
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<tr>
<td>MET 216</td>
<td>Tool Design I</td>
<td>2</td>
<td>6</td>
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<tr>
<td>MET 312</td>
<td>Strength of Materials</td>
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<tr>
<td>PHYS 1310*</td>
<td>Elementary Physics</td>
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**Total:** 14 LEC, 12 LAB, 17 CR
**SIXTH QUARTER**

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<td>MET 318</td>
<td>CAD/CAM II</td>
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<tr>
<td>MET 315</td>
<td>Computer Integrated Manufacturing</td>
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<tr>
<td>MET 324</td>
<td>Quality Assurance and Statistical Process Control</td>
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<tr>
<td>MET 322</td>
<td>Engineering Technology Project</td>
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Program Totals: 79 80 99

* Course Syllabi in Volume 2
MANUFACTURING ENGINEERING TECHNOLOGY
COMPUTER AIDED MANUFACTURING OPTION
COURSE DESCRIPTIONS 1995-1996

MET 100 Machine Tool Practices I (3-9-6) Students will be assigned, specially designed projects that will be machined using the engine lathe, milling, machine, drill press, and various saws. The capability and safe use of the machine tools will be stressed.

MET 112 Engineering Materials (2-3-3) A study of metallic and nonmetallic materials used in design including properties, characteristics, and methods of conducting common tests and interpreting data.

MET 200 Machine Tool Practices II (3-9-6) A course designed to develop additional machine shop skills for those students who were successful in Machine Tool Practices I.

MET 205 CNC Machine Programming (3-3-4) A course in the programming and operation of a computerized numerical control milling machine using manual machine language. Included will be linear and circular interpolation, drilling cycle, and repetitive programming. Prerequisites: MET 100

MET 206 Statics (3-3-4) An introduction to the field of engineering mechanics covering the calculation of forces and moments acting on machine parts, frames and structures. The equilibrium of concurrent and coplanar force systems, centroids and friction are studied. Prerequisite: MATH 1316 or concurrent enrollment

MET 216 Tool Design I (2-6-4) Students will set up and machine work pieces using the lathe, vertical mill, drill press, and surface grinder. Fasteners, surface finish, machining techniques typical of tool and die making will be used. Prerequisites: MET 100 and DDT 104.

MET 301 Manufacturing Processes (3-3-4) Essential studies into the processes and materials for manufacturing, including metal casting, hot and cold forming of steel, powder metallurgy and plastics. Analysis of newer processes such as electrical discharge machining, chemical machining and ultrasonic machining with an emphasis on the economical manufacturing of products.

MET 302 CAD/CAM I (3-3-4) This course will provide an introduction to "Process Modeling" utilizing the CNC graphics programming system; "SMARTCAM". Using engineering drawings, students will program various parts for both CNC mills and CNC lathes. Related topics include: job planning, tool selection, construction of a process model, tool path verification, simulation, quality control, CAD/CAM data transfer, and CNC code generation.
MET 312 **Strength of Materials** (3-3-4) A study of the relationship existing between externally applied forces and internally induced stresses, and the resulting deformations of structural members. Prerequisite: MET 206.

MET 315 **Computer Integrated Manufacturing** (2-2-3) An understanding into the fundamentals of (CIM). This includes the key elements and technologies involved, the typical applications that exist in industry today and the major trends that will affect the future of manufacturing.

MET 318 **CAD/CAM II** (3-3-4) A continuation of MET 302 with advanced utilization of "SMARTCAM". Topics will include the following: 3-D Process Modeling, creation and utilization of different work planes, 4th and 5th axis programming, creation of tool path for surface primitives, swept surfaces, translated surfaces, sculpted surfaces, ruled surfaces, and coons surfaces. Additional topics include: projecting, intersecting, blending, and trimming one surface to another surface. Students will program both a simple punch and die set and a simple injection mold cavity. Prerequisite: MET 302.

MET 322 **Engineering Technology Project** (4-6-6) Different industrial level projects emphasizing manufacturing applications/research in the areas of CAD/CAM, CIM or plastics will be assigned to students utilizing a team concept. Prerequisites: MET 302 and MET 312.

MET 324 **Quality Assurance and Statistical Process Control** (2-3-3) An introduction to the concepts of applied quality control systems. Topics covered include equality responsibility, control chart methods, samplings techniques, reliability applications and computer utilization/programs.
MANUFACTURING ENGINEERING TECHNOLOGY
COMPUTER AIDED MANUFACTURING OPTION
SUPPORT COURSES
1995-1996

PSYC 1100*

**College Success Skills** This course acquaints the students with the policies of the college, services available on and off the campus, and study skills along with other issues that will help them through their college studies. Students are required to take this course in their first quarter at TSTC.

DDT 104

**Drafting Principles** A course consisting of basic exercises in lettering, use of the instruments, technical sketching, geometric construction, orthographic projection, auxiliary views, and dimensioning. Working drawings will be made.

MATH 1314*

**College Algebra** A study of quadratics; polynomial, rational, logarithmic and exponential functions; systems of equations, progressions; sequences and series; matrices and determinants. Prerequisite: MATH 104, Intermediate Algebra, or equivalent as determined by MATH placement test.

ENGL 1301*

**Composition I** Students study the process of composing essays, including prewriting techniques, drafting, and revising and editing. Students write several multi-paragraph essays of various types, in both in-class and out-of-class settings. Students critically analyze sample student and professional essays. Prerequisite: ENGL 020, Writing Skills II, or equivalent as determined by the English placement test.

ENGL 134*

**Interpersonal Communication** Theories and exercises in verbal and nonverbal communication with focus on interpersonal relationships. Students will study internal and external factors that impact communication, communication clarification, and conflict resolution. Various presentations are required. Prerequisite: ENGL 1301, Composition I.

MATH 1316*

**Plane Trigonometry** Topics in trigonometric functions, right triangles, trigonometric identities, radian measure, graphs of periodic functions, and oblique triangles. Prerequisite: MATH 1314, College Algebra.

CNS 2060

**Application Software** This course includes introductory concepts combined with an emphasis on the more predominate computer software including, but not limited to DOS, word processing, electronic spreadsheets, and databases, thus providing non-majors with computer literacy and hands-on experience.
OSH 216 **Safety and Accident Prevention** A course designed to enable the student to recognize hazards and potential hazards which may occur in the workplace and to take corrective action. The course may be directed toward a specific technology as required. Federal safety requirements under the OSHA law will be emphasized. General supervisor safety training course for all technologies.

PHY 114 **Basic Fluid Power** A basic study of hydraulic system components, fluid power theory, problem solving and troubleshooting techniques. Prerequisite: MTH 109, Mathematics for Industrial Technicians, MTH 110, Basic Algebraic Concepts, or equivalent.

EST 120 **Electrical Applications** A survey course designed to present basic concepts in DC and AC circuits, fundamental motor design and applications, and basic motor controls.

WLT 105 **Survey of Welding Processes and Applications** This course is a survey of shielded metal arc, gas tungsten arc, gas metal arc, flux cored arc, and submerged arc welding processes. Metals weldability and weld symbols are considered. Process safety, electrode selection, and process parameters are emphasized. Hard surfacing using shielded metal arc and oxyacetylene processes and techniques are studied. It is recommended that the student have some knowledge of the welding processes before enrollment in this course.

DDT 128 **Introduction to Computer Drafting** This course introduces the student to Computer-Aided Drafting (CAD). This introduction involves equipment software and basic command logic. Graphic images are created using introductory level commands. Recommended for Non-Majors.

PSYC 2301* **General Psychology** A survey of the major topics in psychology, introducing the study of behavior and the factors that determine and affect behavior.

PHYS 1310* **Elementary Physics** An algebra-level problem-oriented course. Presents special topics in classical physics, such as basic mechanics, optics, acoustics, or electricity. Prerequisite: MATH 1314, College Algebra, or above.

* Course syllabi in Volume 2
THE MAST TECHNICAL WORKPLACE COMPETENCY/COURSE CROSSWALK

Upon development of appropriate curricula for the pilot programs, each MAST college began to develop individual course outlines for its assigned specialty area. The skill standards identified in the Competency Profile were cross walked against the technical competencies of the courses in the pilot curriculum. The resulting matrix provided a valuable tool for assessing whether current course content was sufficient or needed to be modified to ensure mastery of entry level technical competencies. Exit proficiency levels for each of the technical competencies were further validated through industry wide surveys both in Texas and across the nation.

The Technical Workplace Competency/Course Crosswalk in the following pages presents the match between industry-identified duties and tasks and the pilot curriculum for . Course titles are shown in columns, duties and tasks in rows. The Exit Level Proficiency Scale, an ascending scale with 5 the highest level of proficiency, includes marked boxes indicating whether the task is covered by the instructor during the course; the numbers 1-5 indicate the degree of attention given to the task and the corresponding proficiency expected on the part of the student. The crosswalk is intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages is the Technical Workplace Competency/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the duties and tasks which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi.
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</thead>
<tbody>
<tr>
<td>A-1 Follow Safety and All Safety Regulations/Requirements</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<td>4</td>
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<tr>
<td>A-2 Use Protective Equipment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>A-3 Follow Safe Operating Procedures for Hand and Machine Tools</td>
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<td>X</td>
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<tr>
<td>A-4 Maintain a Clean and Safe Work Environment</td>
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<tr>
<td>A-5 Control Fire Hazards</td>
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<td>A-6 Apply American Red Cross First Aid and CPR Procedures</td>
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<td>A-7 Recommend Hazardous Waste Management Techniques</td>
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<td>A-9 Demonstrate Knowledge of State and Federal EPA Regulations</td>
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<td>B-2 Interconvert Fractions/Decimals</td>
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<td>B-3 Interconvert Metric/English Measurements</td>
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<td>B-6 Calculate Speeds and Feeds for Machining</td>
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<td>X</td>
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<td>B-8 Perform Calculations for Sine Bar and Sine Plate</td>
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<td>2</td>
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<td>B-9 Calculate for Direct, Simple, and Angular Indexing</td>
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<td>B-11 Solve for Little &quot;L&quot;</td>
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<td>B-13 Solve Engineering Equations</td>
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<td>B-14 Solve Static Systems for Resultant Force</td>
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<td>3</td>
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<td>B-15 Determine Strength of Materials for Various Applications</td>
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<td>X</td>
<td>3</td>
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<td>C-1 Review Blueprint Notes and Dimensions</td>
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<td>C-2 Identify Basic Layout of Drawings</td>
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</table>
### Technical Competency: Manufacturing Engineering Technology - Computer Aided Manufacturing Option

#### C-4 List the Purpose of Each Type of Drawing
- **X**

#### C-5 Verify Drawing Elements
- **X**

#### C-6 Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
- **X**

#### C-7 Describe the Relationship of Engineering Drawings to Planning
- **X**

#### C-8 Use Standards to Verify Requirements
- **X**

#### C-9 Analyze Bill of Materials (BOM)
- **X**

#### C-10 Understand and Use Quality Systems
- **X**

#### D. Recognize Different Manufacturing Materials and Processes

##### D-1 Identify Materials with Desired Properties
- **X**

##### D-2 Identify Materials and Processes to Produce a Product
- **X**

##### D-3 Describe Heat Treating Processes
- **X**

##### D-4 Perform Heat Treating Operations
- **X**

##### D-5 Test Metal Samples for Hardness
- **X**

##### D-6 Describe Casting Processes
- **X**

##### D-7 Describe Hot Working Processes
- **X**

##### D-8 Describe Cold Working Processes
- **X**

##### D-9 Evaluate Alternative Manufacturing Processes
- **X**

#### E. Demonstrate Measurement/Inspection Techniques

##### E-1 Identify Types of Measurement Used in Manufacturing
- **X**

##### E-2 Select Proper Measurement Tools
- **X**

##### E-3 Apply Proper Measuring Techniques
- **X**

##### E-4 Use Metric and English Standards of Measurement
- **X**

##### E-5 Perform Measurements With Hand Held Instruments
- **X**

##### E-6 Perform Measurements on Surface Plate
- **X**

##### E-7 Perform Inspections Using Stationary Equipment
- **X**

#### F. Perform Conventional Machining Operations

##### F-1 Prepare and Plan for Machining Operations
- **X**

##### F-2 Use Proper Hand Tools
- **X**

##### F-3 Operate Power Saws
- **X**

##### F-4 Operate Drill Presses
- **X**

---

Note: The table is incomplete and contains placeholders for some entries. The full context and meaning of the table entries are not provided in the image.
<table>
<thead>
<tr>
<th>Technical Workplace Competencies/Course</th>
<th>CROSSWALK</th>
<th>Technical Competency: Manufacturing Engineering Technology - Computer Aided Manufacturing Option</th>
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<tbody>
<tr>
<td>F-5 Operate Vertical Milling Machines</td>
<td>X</td>
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<tr>
<td>F-6 Operate Horizontal Milling Machines</td>
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<td>F-7 Operate Metal Cutting Lathes</td>
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<td>F-8 Operate Grinding/Abrasive Machines</td>
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<td>G. PERFORM ADVANCED MACHINING PROCESSES</td>
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<td>G-1 Prepare and Plan for CNC Machining Operations</td>
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<td>G-2 Select and Use CNC Tooling Systems</td>
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<td>G-3 Program CNC Machines</td>
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<td>G-4 Operate CNC Machining Centers (Mills)</td>
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<td>G-5 Operate CNC Turning Centers (Lathes)</td>
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<td>G-6 Operate Electrical Discharge Machines</td>
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<td>G-7 Download Programs Via Network</td>
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<td>G-8 Program CNC Machines Using a CAM System</td>
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<td>H. PERFORM GEAR GENERATING OPERATIONS</td>
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<td>H-1 Describe the Different Types of Gears</td>
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<td>H-2 Understand Gear Terms</td>
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<td>H-3 Use Rotary Tables and Dividing Heads</td>
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<td>H-4 Discuss Gear Inspection and Measurement</td>
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<td>I. PERFORM WELDING OPERATIONS</td>
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<td>I-1 Weld With Shielded Metal Arc Welding (SMAW) Process</td>
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<td>I-2 Weld/Cut With Oxyacetylene</td>
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<td>I-3 Weld With Gas Tungsten Arc Welding (GTAW) (Heliarc)</td>
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<td>I-4 Weld With Gas Metal Arc Welding (GMAW)/(MIG) and Flux Core Arc Welding (FCAW)</td>
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<td>I-5 Perform Plasma Arc Cutting (PAC)</td>
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<td>J. PERFORM DRAFTING TASKS</td>
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<tr>
<td>J-1 Demonstrate Traditional Mechanical Drafting Skills</td>
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<td>J-2 Use Computer-Aided Drafting (CAD) System</td>
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<td>J-3 Create 3-D Solid Models</td>
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<td>J-4 Make Tool Drawings</td>
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**USE COMPUTERS**

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<td>K-1 Use Computer Operating Systems</td>
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<td>K-2 Use Computer Inquiry Systems</td>
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<td>K-3 Use Various Computer Applications</td>
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<td>K-4 Recommend and Implement CIM Technologies</td>
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<td>K-5 Use Computer-Aided Engineering System</td>
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**L. PARTICIPATE IN TOTAL QUALITY AND SPC ACTIVITIES**

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<td>L-1 Define Quality in Manufacturing and Explain Importance</td>
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<td>L-2 Implement Concepts of Quality in the Workplace</td>
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<td>L-3 Apply Principles and Tools of Continuous Quality Improvement</td>
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<td>L-4 Understand and Apply SPC</td>
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<td>L-5 Evaluate Data to Monitor Production</td>
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<td>L-6 Analyze Customer Problems and Recommend Solutions</td>
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<td>L-7 Establish Methods, Plans and Procedures to Maintain Quality</td>
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**M. MAINTAIN ELECTRICAL DEVICES**

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<td>M-1 Use Electrical Test Equipment</td>
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<td>M-2 Apply Specific Terms to Electrical Circuits</td>
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<td>M-3 Analyze Series, Parallel and Complex DC/AC Circuits</td>
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<td>M-4 Check AC and DC Motors</td>
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<td>M-5 Inspect Transformers and Generators</td>
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<td>M-6 Discuss Sensors and Feedback Technology</td>
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<td>M-7 Set Up/Program PLC</td>
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<td>M-8 Troubleshoot Electrical Devices</td>
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**N. MAINTAIN HYDRAULIC/PNEUMATIC DEVICES**

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<td>N-3 Identify Hydraulic Fluids</td>
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<td>N-4 Recommend Power Distribution and Sealing Devices</td>
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<td>N-5 Recognize Pumps, Actuators, and Hydraulic Control Devices</td>
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MANUFACTURING ENGINEERING TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES
EXIT LEVEL PROFICIENCY MATRIX

Manufacturing Engineering Technician: use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

The following matrix identifies the five exit levels of technical workplace competencies for the Machinist Certificate at Texas State Technical College Waco.

<table>
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<tr>
<th>Technical Workplace Competency</th>
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<tr>
<td></td>
<td>rarely</td>
<td>routinely with supervision</td>
<td>routinely with limited supervision</td>
<td>routinely without supervision</td>
<td>initiates/improves/modify and supervise others</td>
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47
THE MAST SCANS/COURSE CROSSWALK

The Secretary's Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in its "AMERICA 2000 REPORT" the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:

- Resources: Identifies, organizes, plans, and allocates resources
- Interpersonal: Works with others
- Information: Acquires and uses information
- Systems: Understands complex inter-relationships
- Technology: Works with a variety of technologies

FOUNDATION SKILLS:

- Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks
- Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
- Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty

Recognizing the value of SCANS proficiencies to job performance, as well as the growing mandate in many states to include SCANS activities in course curricula, MAST asked survey respondents to review the SCANS skill sets in the context of the draft skill standards for each occupational specialty area. MAST also incorporated evaluation of SCANS competencies and foundation skills into its assessment of the pilot training curricula. The results were summarized in a crosswalk that allowed MAST staff to modify course content where needed to strengthen achievement of SCANS competencies.

The following pages present the SCANS/Course Crosswalk for the pilot curriculum in Courses are listed along the top and SCANS competencies and foundations are shown along the left side of the matrix. An exit level proficiency matrix for SCANS competencies and foundation skills is provided as well.

As "soft" skills, the SCANS competencies are inherently difficult to quantify. MAST realizes that some faculty will emphasize the SCANS more or less than others. The SCANS/Course Crosswalk matrix has been included with this course documentation to show the importance of these "soft skills" and the importance of their being addressed in the classroom (particularly in technical classes). In time, faculty will learn to make these types of SCANS activities an integral and important part of the teaching process.

Included on the following pages is the SCANS/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the "soft skills" (SCANS) which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi. Also included is a matrix which defines the exit level of proficiency scale (1-5).
### CROSSWALK

#### MANUFACTURING ENGINEERING TECHNICIAN

**COMPUTER AIDED MANUFACTURING OPTION**

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<tbody>
<tr>
<td><strong>(RS) RESOURCES:</strong></td>
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<tr>
<td>A. Allocates time</td>
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<td>B. Allocates money</td>
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<tr>
<td>C. Allocates material and facility resources</td>
<td>X X X X X X X X X X X X X X X</td>
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<td>D. Allocates human resources</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td><strong>(IN) INTERPERSONAL SKILLS:</strong></td>
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<tr>
<td>A. Participates as a member of a team</td>
<td>X X X X X X X X X X X X X X X</td>
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<td>B. Teaches others</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>C. Serves clients/customers</td>
<td>X</td>
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<tr>
<td>D. Exercises leadership</td>
<td>X X X X X X X X X X X X X X X</td>
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<td>E. Negotiates</td>
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<td>F. Works with cultural diversity</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td><strong>(IF) INFORMATION SKILLS:</strong></td>
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<tr>
<td>A. Acquires and evaluates information</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>B. Organizes and maintains information</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>C. Interprets and communicates information</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>D. Uses computers to process information</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td><strong>(SY) SYSTEMS:</strong></td>
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<tr>
<td>A. Understands systems</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>B. Monitors and corrects performance</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>C. Improves and designs systems</td>
<td>X</td>
<td>X X</td>
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<tr>
<td><strong>(TE) TECHNOLOGY:</strong></td>
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<tr>
<td>A. Selects technology</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>B. Applies technology to task</td>
<td>X X X X X X X X X X X X X X X</td>
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<tr>
<td>C. Maintains and troubleshoots technology</td>
<td>X X X X X X X X X X X X X X X</td>
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</tbody>
</table>
## MANUFACTURING ENGINEERING TECHNICIAN
### COMPUTER-AIDED MANUFACTURING OPTION

### FOUNDATION SKILLS

#### (BS) BASIC SKILLS:

| A. Reading | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| B. Writing | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| C. Arithmetic and mathematics | X | X | | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| D. Listening | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| E. Speaking | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

#### (TS) THINKING SKILLS:

| A. Creative thinking | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| B. Decision making | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| C. Problem solving | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| D. Seeing things in the mind's eye | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| E. Knowing how to learn | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| F. Reasoning | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

#### (PQ) PERSONAL QUALITIES:

| A. Responsibility | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| B. Self-esteem | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| C. Social | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| D. Self-management | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| E. Integrity/honesty | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
SCANS
COMPETENCIES AND FOUNDATION SKILLS
EXIT LEVEL PROFICIENCY MATRIX

The Secretary’s Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in it’s “AMERICA 2000 REPORT” the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:
Resources: Identifies, organizes, plans, and allocates resources
Interpersonal: Works with others
Information: Acquires and uses information
Systems: Understands complex inter-relationships
Technology: Works with a variety of technologies

FOUNDATION SKILLS:
Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

The following matrix identifies the five exit levels of proficiency that are needed for solid job performance.

<table>
<thead>
<tr>
<th>EXIT LEVEL OF PROFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCANS Competencies and Foundation Skills</td>
</tr>
<tr>
<td>rarely</td>
</tr>
</tbody>
</table>

MAST/01/013196
THE MAST COURSE SYLLABI
"PILOT PROGRAM"

MAST has produced a very unique set of course outlines, driven and validated by industry and encompassing the broad range of technologies covered by the MAST grant. The course outlines also include proposed SCANS activities that will be useful to an instructor in preparing students to enter the workforce of the future.

Included in the following pages are final course outlines developed and refined in the process of piloting the MAST training programs. The outlines include a brief course description; required course materials (e.g., textbook, lab manual, and tools, if available); proposed method of instruction; proposed lecture and lab outlines; and detailed course objectives for both Technical Workplace Competencies and SCANS Competencies.

These outlines were completed and revised during the second year of MAST, following completion of the pilot phase. The outlines are intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages are the Course Syllabi for each of the courses which were taught during the pilot program.
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

MACHINE TOOL PRACTICES I
COURSE SYLLABUS

MACHINE TOOL PRACTICES I

Lecture hours/week: 3    Lab hours/week: 9    Credit hours: 6

COURSE DESCRIPTION:

Students will be assigned specifically designed projects that will be machined using the engine lathe, milling machine, drill press, and various saws. The capability and safe use of machine tools will be stressed.

PREREQUISITES:   NONE

REQUIRED COURSE MATERIALS:


Student Tool List

<table>
<thead>
<tr>
<th>Tool</th>
<th>Qty. Req'd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool Box</td>
<td>1</td>
</tr>
<tr>
<td>Safety Glasses</td>
<td>1 pair</td>
</tr>
<tr>
<td>6 inch Ruler</td>
<td>1/8, 1/16, 1/32, and 1/64 inch</td>
</tr>
<tr>
<td>Ball Peen Hammer</td>
<td>1</td>
</tr>
<tr>
<td>10 inch Adjustable Wrench</td>
<td>1</td>
</tr>
<tr>
<td>Center Punch</td>
<td>1</td>
</tr>
<tr>
<td>Magic marker, Jumbo, black.</td>
<td>1</td>
</tr>
<tr>
<td>Aluminum Oxide Cloth, 9&quot; X 11&quot;, 240 Grit</td>
<td>2 sheets</td>
</tr>
<tr>
<td>Aluminum Oxide Cloth, 9&quot; X 11&quot;, 320 Grit</td>
<td>2 sheets</td>
</tr>
<tr>
<td>Tool Steel, 3/8&quot;, H.S.S.</td>
<td>2</td>
</tr>
<tr>
<td>Flat Mill Bastard File, 10 inch.</td>
<td>1</td>
</tr>
<tr>
<td>File Handle</td>
<td>1</td>
</tr>
<tr>
<td>Allen Wrench Set, Long English and Metric</td>
<td>1 each</td>
</tr>
<tr>
<td>Center Drill #3</td>
<td>1</td>
</tr>
<tr>
<td>Scribe</td>
<td>1</td>
</tr>
<tr>
<td>Center Gage</td>
<td>1</td>
</tr>
<tr>
<td>Screw Driver, 8 inch</td>
<td>1</td>
</tr>
<tr>
<td>File Card Brush</td>
<td>1</td>
</tr>
<tr>
<td>0-6 inch Dial Calipers</td>
<td>1</td>
</tr>
<tr>
<td>Shop Apron (blue denim)</td>
<td>1</td>
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<tr>
<td>Shop Towels (1 roll)</td>
<td>1</td>
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</tbody>
</table>
METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" machining process

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments and oral presentations
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to the Course</td>
<td></td>
<td>1</td>
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<tr>
<td>Safety</td>
<td>5-12</td>
<td>1</td>
</tr>
<tr>
<td>Tool Grinding</td>
<td>43-45 (lab book)</td>
<td>1</td>
</tr>
<tr>
<td>The Machine Shop</td>
<td>1-4</td>
<td>1</td>
</tr>
<tr>
<td>The Inch Rule</td>
<td>113-118</td>
<td>1</td>
</tr>
<tr>
<td>The Square</td>
<td>163-166</td>
<td>1</td>
</tr>
<tr>
<td>The Inch Micrometer</td>
<td>140-145</td>
<td>1</td>
</tr>
<tr>
<td>Drawings</td>
<td>28-36</td>
<td>2</td>
</tr>
<tr>
<td>Layout Tools</td>
<td>249-262</td>
<td>2</td>
</tr>
<tr>
<td>QUIZ 1 (over above lectures)</td>
<td>---</td>
<td>1</td>
</tr>
<tr>
<td>Semi-precision Layout</td>
<td>262-266</td>
<td>1</td>
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<tr>
<td>Hand Tools</td>
<td>46-55</td>
<td>1</td>
</tr>
<tr>
<td>Hacksaws</td>
<td>55-58</td>
<td>1</td>
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<tr>
<td>Files</td>
<td>58-63</td>
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<tr>
<td>Verniers</td>
<td>122-125</td>
<td>1</td>
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<tr>
<td>Vernier Micrometers</td>
<td>151-156</td>
<td>1</td>
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<tr>
<td>The Drill Press</td>
<td>365-374</td>
<td>1</td>
</tr>
<tr>
<td>Drilling Tools</td>
<td>375-384</td>
<td>2</td>
</tr>
<tr>
<td>QUIZ 2 (over above lectures)</td>
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<td>1</td>
</tr>
<tr>
<td>Drilling Operations</td>
<td>389-402</td>
<td>2</td>
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<tr>
<td>Taps</td>
<td>68-74</td>
<td>1</td>
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<tr>
<td>Tapping Procedures</td>
<td>74-79</td>
<td>1</td>
</tr>
<tr>
<td>Gage Blocks</td>
<td>178-187</td>
<td>1</td>
</tr>
<tr>
<td>Angular Measuring</td>
<td>187-195</td>
<td>1</td>
</tr>
</tbody>
</table>


Precision Layout 267-280
QUIZ 3 (over above lectures) --- 1
Oral Presentations* --- 5

Total Lecture Hours 36

*(10-15 minute student presentations on assigned machine-related topics. These topics could include future trends or special concerns of the machine tool industry.)

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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</thead>
<tbody>
<tr>
<td>Shop orientation</td>
<td>2</td>
</tr>
<tr>
<td>Use of the cut-off saw</td>
<td>2</td>
</tr>
<tr>
<td>Grinding a lathe tool</td>
<td>3</td>
</tr>
<tr>
<td>Grinding a mill tool</td>
<td>3</td>
</tr>
<tr>
<td>Using the band saw</td>
<td>3</td>
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<tr>
<td>Using the radial drill</td>
<td>3</td>
</tr>
<tr>
<td>Using the sensitive drill</td>
<td>3</td>
</tr>
<tr>
<td>Bench work</td>
<td>27</td>
</tr>
<tr>
<td>Lathe work</td>
<td>27</td>
</tr>
<tr>
<td>Mill work</td>
<td>27</td>
</tr>
<tr>
<td>Leaving the shop in order</td>
<td>3</td>
</tr>
<tr>
<td>Inspecting the finished work</td>
<td>5</td>
</tr>
</tbody>
</table>

Total Lab Hours 108

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Follow Safety Manuals and All Safety Regulations/Requirements
      a. Assume responsibility for the personal safety of oneself and others
      b. Develop a personal attitude towards safety
      c. Comply with established safety practices
   2. Use Protective Equipment
      a. Wear protective safety clothing as required
      b. Maintain and use protective guards and equipment on machinery
      c. Locate and properly use protective equipment
      d. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Machine Tools
      a. Understand and apply safe machine operating procedures
      b. Demonstrate safe machine operation
   4. Maintain a Clean and Safe Work Environment
      a. Keep work areas clean
      b. Clean machine/hand tools when work is completed
      c. Put tools away when work is finished
d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS
1. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS
1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify general note symbols
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings

D. PERFORM MEASUREMENT/INSPECTION
1. Identify Types of Measurement
   a. Discuss the use of metrology in manufacturing
   b. Discuss the inch system of measurement
   c. Discuss the metric system of measurement
   d. Discuss semi-precision and precision measurement
   e. Discuss the following: accuracy, precision, reliability, and discrimination
2. Select Proper Measurement Tools
   a. Identify basic semi-precision measuring tools
   b. Identify precision measuring tools
   c. Justify the use of a particular measuring tool based on tool characteristics
   d. Identify error possibilities in measurement tool selection
   e. Demonstrate proper care of precision measuring tools
3. Apply Proper Measuring Techniques
   a. Discuss factors affecting accurate measurement (dirt, temperature, improper measuring tool calibration)
   b. Explain calibration requirements of various precision instruments
   c. Illustrate measurement differences when taken with calibrated and non-calibrated instruments
   d. Calibrate a micrometer type measuring tool
4. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers
c. Measure with comparison measuring instruments (e.g., calipers, telescope gages)
d. Measure with direct measuring instruments (e.g., vernier, dial, and digital instruments)
e. Measure with fixed gages (go and not go gages)

5. Perform Measurements on Surface Plate
   a. Describe care of surface plate
   b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)
   c. Check for part squareness
   d. Check part dimensions for accuracy
   e. Align workpieces using height gage and dial indicators

E. PERFORM CONVENTIONAL MACHINING OPERATIONS

1. Prepare and Plan For Machining Operations
   a. Read and interpret blueprints
   b. Perform basic semi-precision and precision layout as necessary
   c. Plan machining operations
   d. Calculate speeds, feeds, and depth of cut for various machine applications
   e. Use carbides and other tool materials to increase productivity

2. Use Proper Hand Tools
   a. Use arbor and shop presses
   b. Select necessary work-holding devices and hand tools as needed
   c. Select and use hand files
   d. Identify and use hand reamers
   e. Correctly identify and use hand taps as required
   f. Follow tapping procedures to produce internal threads
   g. Use thread-cutting dies to produce external threads
   h. Operate bench and pedestal grinders safely

3. Operate Power Saws
   a. Use reciprocating and horizontal band cutoff machines
   b. Prepare and use the vertical band saw

4. Operate Drill Presses
   a. Describe the different types of drill presses found in the machine shop
   b. Describe and use standard drilling tools
   c. Setup the drill presses for drilling, countersinking, counterboring, and reaming operations

5. Operate Vertical Milling Machines
   a. Demonstrate the use of all controls on the vertical milling machine
   b. Align the vertical milling machine head
   c. Select, align and use workholding devices
   d. Select milling tool holders
   e. Select milling cutters
   f. Perform all standard vertical milling operations

6. Operate Metal Cutting Lathes
   a. Demonstrate the use of all controls on the engine lathe
   b. Discuss standard tools and toolholders for the lathe
   c. Face and center drill parts correctly
d. Drill, ream and bore on the lathe
e. Make all calculations, lathe adjustments and settings to machine sixty degree external threads
f. Use HSS cutting tools
g. Use carbide cutting tools

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. follows a schedule to maximize laboratory resources
      3. complete a stock request form for required material
   B. Interpersonal: Works with others
      1. complete assigned responsibilities within the shop floor serving as a member of the team
      2. provide individual assistance/direction to peers as requested
   C. Information: Acquires and uses information
      1. read and interpret blueprints
      2. organize and apply theories of machine tool operation
      3. perform basic semi-precision and precision layout as necessary
   D. Systems: Understands complex inter-relationships
      1. demonstrate knowledge of the following systems:
         a. organization of personnel and facilities on the shop floor
         b. systematic approach to the metal removal process
         c. dimensioning and measurement systems
      2. monitors and corrects performance during
         a. the machining process
         b. adjustments of individual laboratory work schedule
         c. constantly evaluating the quality of work to achieve acceptable standards
   E. Technology: Works with a variety of technologies
      1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
   1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. read/studies textbook
   b. studies student laboratory manual
   c. interprets blueprints and technical drawings
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
   2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. determines optimum machining speeds, feeds, and depth of cut
   b. interconverts fractions to decimal expressions
   c. keeps a running computation of individual grade
   d. calculate tap drill size
   4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics
   5. Speaking: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory
   e. plan and deliver a 10-15 minute oral presentation on an assigned machine-related topic

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.
1. **Decision Making**: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. decides upon a job process plan to produce a part to specifications, given constraints of available time, equipment and other resources
   b. prioritizes activities for effective use of time

2. **Problem Solving**: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots machining processes and equipment
   d. recognize problems in machining and selects appropriate corrective or preventive action

3. **Seeing Things In the Mind's Eye**: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. visualize objects in three dimensions from engineering drawings
   b. visualize process during instructor lecture
   c. visualize the relative motions between tool and workpiece to generate desired features in raw stock in order to plan machine setups and sequence of machining operations

4. **Knowing How to Learn**: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge

5. **Reasoning**: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. applies knowledge of principles of machining to troubleshoot process problems
   b. applies knowledge of machining process to develop a logical, sequential process plan
   c. applies knowledge of workpiece machinability, cutter characteristics and machine tool characteristics to adjust speeds and feeds

C. **Personal Qualities**: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility**: Exerts a high level of effort and perseveres towards goal attainment
   a. displays promptness and preparation for the day’s work
   b. plans work to use time efficiently
   c. accepts responsibility for mistakes, and takes corrective and preventive actions
   d. takes initiative when needed to gain resources or assistance to complete assignments

2. **Self-Esteem**: Believes in own self-worth and maintains a positive view of self
   a. takes pride in work through positive reinforcement
b. sees self as a valued member of the group through continued contributions toward common goals

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

DRAFTING PRINCIPLES
MAST PROGRAM
COURSE SYLLABUS
DRAFTING PRINCIPLES

Lecture hours/week: 2  Lab hours/week: 4  Credit hours: 3

COURSE DESCRIPTION:

Students will be assigned basic exercises in lettering, use of instruments, technical sketching, geometric construction, orthographic projection, auxiliary views and dimensioning. Working drawings will be made.

PREREQUISITES:  NONE

REQUIRED COURSE MATERIALS:

Textbook:  Technical Drawing, Spencer, Giesecke, Mitchell, Hill
Workbook:  Technical Drawing Problems, Spencer, Giesecke, Mitchell, Hill

Materials:
Drafting Kit No. 1 or the equivalent:
10" Triangles:
1 - 45°
1 - 30°/60°
Engineer's Scale
Metric Scale
Ames Lettering Guide
Eraser Holder with erasers
Drafting Dots
Circle Template (Combination Imperial and Metric)
Sandpaper Pointer
Erasing Shield
Bow Compass
Dusting Brush
Lead Pointer
Irregular Curve
Mechanical Pencils with refills:
.5mm
.7mm
.9mm
Lead Holder - 2mm
Leads:
.5mm - HB
.7mm - H, HB
.9mm - HB
2mm 4H, H, F
Hard Carrying Case
8½” x 11” vellum (10 sheets)

Additional items not included in kit:
4 - 17 x 22 (C size) vellum
1 - Preprinted 22 x 34 (D size) vellum

METHODS OF INSTRUCTION:

Lecture: Classroom presentations will include lecture, video and demonstrations. Computer aided instruction may be used.

Laboratory: Laboratory will be a "hands-on" drawing process using appropriate tools and media.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all safety regulations as stated in the class policies

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Materials and Tests</td>
<td>Handout</td>
<td></td>
</tr>
<tr>
<td>Class Policies and Safety Concerns</td>
<td>Handout</td>
<td></td>
</tr>
<tr>
<td>Function of Drafting in Design and Production</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Drafting Instruments, Material and Equipment</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Lettering</td>
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</tr>
<tr>
<td>Quiz</td>
<td></td>
<td></td>
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<tr>
<td>Alphabet of Lines</td>
<td></td>
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<tr>
<td>Types of Pencils and Leads</td>
<td></td>
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</tr>
<tr>
<td>Scales - Engineering and Metric</td>
<td></td>
<td>2</td>
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<tr>
<td>Quiz</td>
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<tr>
<td>Geometric Constructions</td>
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<tr>
<td>Angle Measurements</td>
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<tr>
<td>Theory of Third Angle Orthographic Projection</td>
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<tr>
<td>Theory of First Angle Orthographic</td>
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ERIC
LAB OUTLINE:

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<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td>Using Drafting Instruments, Materials and Equipment</td>
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<tr>
<td>Applying Lettering</td>
<td>2</td>
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<tr>
<td>Delineating Alphabet of Lines</td>
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<tr>
<td>Selecting and Using Pencils and Leads</td>
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<tr>
<td>Using Scales</td>
<td>2</td>
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<tr>
<td>Developing Geometric Constructions</td>
<td>12</td>
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<tr>
<td>Using Angle Measurement</td>
<td>12</td>
</tr>
<tr>
<td>Using Third Angle Orthographic Projection</td>
<td>6</td>
</tr>
<tr>
<td>Using First Angle Orthographic Projection</td>
<td>6</td>
</tr>
<tr>
<td>Arranging Views and Common Dimensions</td>
<td>2</td>
</tr>
<tr>
<td>Creating Sectional Planes</td>
<td>2</td>
</tr>
<tr>
<td>Applying Cutting Planes</td>
<td>2</td>
</tr>
<tr>
<td>Determine and Use Conventional Representations</td>
<td>1</td>
</tr>
<tr>
<td>Using Classifications of Sections</td>
<td>1</td>
</tr>
<tr>
<td>Applying Dimensioning</td>
<td>1</td>
</tr>
<tr>
<td>Applying Metric Dimensioning</td>
<td>1</td>
</tr>
<tr>
<td>Final Exam</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Lab Hours</strong></td>
<td>48</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PERFORM DRAFTING TASKS.
   1. Demonstrate Traditional Mechanical Drafting Skills
      a. Form freehand vertical Gothic upper-case letters and numerals of correct shape and space
      b. Execute the alphabet of lines correctly, producing dense black lines of uniform thickness and spacing
      c. Demonstrate proficiency with the engineers and metric scales
d. Execute geometric constructions with no mistakes in tangent points, line quality or layout work

e. Accurately draw the missing view or line in a multiview drawing

f. Make or complete a sectional instrument drawing, given one or more views

g. Develop satisfactory working drawings of simple machine components to include all necessary views and dimensions for complete shape and size description of detail parts

h. Discuss the differences in standard engineering drawings and tool drawings

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the appropriate media and instruments to complete assignments
3. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the course serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce drawings to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret text and handouts
2. organize and apply theories of drafting and design
3. apply lecture concepts to lab techniques

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities in the drafting lab
   c. systematic approach to the drafting and design process
   d. dimensioning and measurement systems
   e. systematic organization of training materials

2. monitors and corrects performance
   a. during the drawing process
   b. making adjustments to individual laboratory work schedules
c. while constantly evaluating the quality of work to achieve acceptable standards
d. though maintaining a record of evaluations
e. to meet individual goals

E. Technology: Works with a variety of technologies
1. chooses procedure, tools and equipment required to produce a drawing
2. applies appropriate procedures and uses appropriate tools and equipment to produce a drawing to acceptable standards
3. maintains and troubleshoots equipment and tools
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. performs clean-up assignments of lab

II. FOUNDATION SKILLS
A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
   1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
      a. studies student laboratory manual and text
      b. interprets blueprints and technical drawings
      c. reads/studies concepts in textbook
      d. follows a daily laboratory schedule to maintain appropriate time-line to meet scheduled deadlines
      e. interprets concepts in lab manual drawings and texts to develop accurate drawings
   2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
      a. outlines the steps necessary to produce a simple drawing
      b. sketches object to produce a final drawing
      c. maintains a schedule of assignments and deadlines (these may take the form of a chart, graph, etc.)
      d. maintains a lecture notebook
      e. submits written responses to chapter question assignments
      f. completes all written assignments
   3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
      a. bisects lines, circles, arcs and angles
      b. divides objects into equal parts
      c. applies tolerances
      d. applies and verify dimensions
      e. uses fraction and decimal values
      f. applies principles of trigonometry and geometry to solve angle calculations, tangencies and to define points
   4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
a. assimilates concepts presented by lecture, video or any multimedia methods
b. observes laboratory demonstrations for technique and safety instructions
c. seeks and receive individualized instruction in the laboratory
d. actively listens and participates in discussions and question/answer sessions

5. Speaking: Organizes ideas and communicates orally
a. participates in classroom discussions
b. organizes ideas and communicates specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicates with peers to ensure the efficient and safe completion of assignments

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reason.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
a. identifies personal goals
b. prioritizes goals
c. identifies specific actions required to accomplish personal goals
d. allows for flexibility in meeting goals as circumstances change

2. Problem Solving: Recognizes problems and devises and implements plan of action
a. makes daily accommodations to stay on schedule
b. seeks additional instruction/clarification for assignment completion
c. balances social and academic life/responsibilities
d. accepts responsibility

3. Seeing Things In the Mind’s Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
a. understands both written and verbal instructions
b. assimilates process during instructor demonstrations
c. interprets technical drawings
d. interprets technical illustrations and symbols
e. interprets and applies geometric construction concepts
f. completes missing orthographic views
g. creates multiview projections from pictorial drawings
h. identifies missing lines in multiview drawings

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
a. demonstrates mastery of the basic skills and techniques
b. uses these sequential skills to support mastery of new skills
c. consistently applies the sequential nature of acquired skills to the subsequent knowledge application of new skills and techniques

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
a. understands that practice will improve the skill of the technician
b. understands that the quality of the product is a function of time spent and the attitude and skill of the technician

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
   a. attends class as scheduled and is well prepared for the day's work
   b. completes assignments independently and on time
   c. works well within a team while completing individual assignments
   d. plans and organizes so time may be used wisely

2. Self-Esteem: Believes in own self-worth and maintains a positive view of self
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. Sociability: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assists classmates in improving technical skills
   b. assists students with special needs as a peer mentor
   c. shares laboratory resources (machines, tools and instructor's individual attention)

4. Self-Management: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. performs in-process quality checks on technical drawings
   b. maintains a record of academic achievement (individual gradebook)
   c. maintains a schedule of deadlines, due dates, and other important dates (calendar)
   d. adjusts calendar to accommodate unexpected circumstances
   e. accepts the responsibility for self management

5. Integrity/Honesty: Chooses ethical courses of action
   a. accepts the responsibility for own actions
   b. exhibits personal honesty at all times
   c. accepts the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understands the consequences of unethical behaviors
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

MACHINE TOOL PRACTICES II
Prerequisite: MACHINE TOOL PRACTICES I
COURSE DESCRIPTION:

This course is designed to develop additional machining skills for those students who have the basic skills that were developed in Machine Tool Practices I.

The student will work from more complex engineering drawings and use the engine lathe and milling machines to produce parts that will assemble into a functioning machine. Precision work and the control of surface finishes will be stressed. The engine lathe will be used to turn, taper, thread, bore, ream and knurl several parts. The milling machine will be used to cut keyways, mill precise angles and bore holes. The safe operation and maintenance of the machine shop will also be an important objective.

PREREQUISITES: Machine Tool Practices I

REQUIRED COURSE MATERIALS:


Student Tool List/Qty. Req'd: The same hand tools required in Machine Tool Practices I are also required for Machine Tool Practices II.

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" machining process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to the Course</td>
<td>---</td>
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<tr>
<td>Safety in the Machine Shop</td>
<td>5</td>
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<tr>
<td>Gages</td>
<td>88</td>
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<tr>
<td>Lathe Parts</td>
<td>414</td>
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<tr>
<td>Lathe Accessories</td>
<td>394</td>
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<tr>
<td>Cutting Speeds and Feeds</td>
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<tr>
<td>Aligning Centers</td>
<td>440</td>
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<tr>
<td>Machining Between Centers</td>
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<tr>
<td>Knurling and Grooving</td>
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<tr>
<td>QUIZ I (over the above units)</td>
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<tr>
<td>Tapers</td>
<td>477</td>
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<tr>
<td>Threads</td>
<td>457</td>
<td>3</td>
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<tr>
<td>Using Chucks</td>
<td>408</td>
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<tr>
<td>Drilling and Boring</td>
<td>443</td>
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<tr>
<td>Milling Machines</td>
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<td>QUIZ 2 (over the above units)</td>
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<td>Milling Cutters</td>
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<td>Cutting Speeds</td>
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<tr>
<td>Milling Operations</td>
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<tr>
<td>Indexing</td>
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<tr>
<td>Gears</td>
<td>607</td>
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<tr>
<td>Gear Cutting</td>
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<tr>
<td>Assembly of Jig Saw</td>
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<tr>
<td>QUIZ 3 (over the above units)</td>
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<tr>
<td>Oral Presentations*</td>
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<td>6</td>
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</table>

Total Lecture Hours 36

*(15-20 minute student presentations on assigned machine-related topics. These topics could include future trends or special concerns of the machine tool industry.)

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
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<tbody>
<tr>
<td>Shop orientation and safety</td>
<td>1</td>
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<tr>
<td>Precision layout</td>
<td>4</td>
</tr>
<tr>
<td>Precision measuring with gage blocks and sine bar</td>
<td>8</td>
</tr>
<tr>
<td>Lathe work</td>
<td>27</td>
</tr>
<tr>
<td>Vertical milling machine work</td>
<td>18</td>
</tr>
<tr>
<td>Horizontal milling machine</td>
<td>6</td>
</tr>
</tbody>
</table>
After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Follow Safe Operating Procedures for Hand and Machine Tools
      a. Identify and understand lathe operating procedures
      b. Demonstrate safe lathe operation
      c. Identify and understand milling machine operating procedures
      d. Demonstrate safe milling machine operation

B. APPLY MATHEMATICAL CONCEPTS
   1. Perform Basic Trigonometric Functions
      a. Solve for unknown angles
      b. Calculate bolt hole patterns
   2. Calculate Speeds and Feeds for Machining
      a. Calculate RPM for various metals and various tools
      b. Calculate feed for various metals, tools, and depths of cut
   3. Locate Machining Points from a Datum Point
      a. Identify points using the absolute dimensioning system
      b. Identify points using the incremental dimensioning system
   4. Perform Calculations for Sine Bar and Sine Plate
      a. Calculate gage block build up for 5" sine bar
   5. Calculate for Direct, Simple, and Angular Indexing
      a. Calculate for direct indexing
      b. Calculate for simple indexing (plain)
      c. Calculate for angular indexing
      d. Use Machinery's Handbook for calculations
   6. Perform Calculations Necessary for Turning Tapers
      a. Calculate tail stock offset
      b. Determine unknowns (e.g., small and/or large diameters) for taper turning
   7. Calculate Depth of Cut on Round Surfaces
      a. Calculate depth of cut for flats to be machined on cylindrical pieces
      b. Calculate depth of cut for keyways which are machined on cylindrical pieces

C. PERFORM CONVENTIONAL MACHINING OPERATIONS
   1. Operate Vertical Milling Machines
      a. Demonstrate the use of all controls on the vertical milling machine
      b. Align the vertical milling machine head
      c. Select, align and use workholding devices
      d. Select milling tool holders
e. Select milling cutters
f. Perform all standard vertical milling operations
g. Bore a hole using the offset boring head
h. Machine angles using sine bar and gage blocks
i. Setup and use special vertical mill fixtures
j. Setup and machine dovetails
k. Machine keyways

2. Operate Horizontal Milling Machines
   a. Discuss the difference in plain and universal horizontal milling machines
   b. Discuss the types of spindles, arbors and adaptors used on the horizontal milling machine
c. List several common work holding methods
d. Use plain milling cutters
e. Use side milling cutters
f. Use face milling cutters

3. Operate Metal Cutting Lathes
   a. Demonstrate the use of all controls on the engine lathe
   b. Discuss standard tools and toolholders for the lathe
c. Face and center drill parts correctly
d. Drill, ream and bore on the lathe
e. Turn between centers
f. Discuss alignment of lathe centers
g. Make all calculations, lathe adjustments and settings to machine UNF and UNC series threads
h. Discuss thread fit classifications
i. Describe the common tapers used in the machine shop
j. Discuss taper cutting and calculations for the lathe
k. Use HSS cutting tools
l. Use carbide cutting tools

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary’s Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its “AMERICA 2000 REPORT” that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. follows a schedule to maximize laboratory resources
3. complete a stock request form for required material

B. **Interpersonal: Works with others**
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested

C. **Information: Acquires and uses information**
1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. **Systems: Understands complex inter-relationships**
1. demonstrate knowledge of the following systems:
   a. organization of personnel and facilities on the shop floor
   b. systematic approach to the metal removal process
   c. dimensioning and measurement systems
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

E. **Technology: Works with a variety of technologies**
1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards

II. **FOUNDATION SKILLS**
A. **Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.**
1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. read/studies textbook
   b. studies student laboratory manual
   c. interprets blueprints and technical drawings
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. prepare job process for lathe and mill assignments
3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
a. determines optimum machining speeds, feeds, and depth of cut
b. interconverts fractions to decimal expressions
c. keeps a running computation of individual grade
d. calculate gage block buildup
e. calculate for turning tapers
f. calculate for indexing problems

4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics

5. Speaking: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory
   e. plan and deliver a 15-20 minute oral presentation on an assigned machine-related topic

6. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.
   1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
      a. decides upon a job process plan to produce a part to specifications, given constraints of available time, equipment and other resources
      b. prioritizes activities for effective use of time
   2. Problem Solving: Recognizes problems and devises and implements plan of action
      a. makes daily accommodations to stay on schedule
      b. seeks additional instruction/clarification for assignment completion
      c. troubleshoots machining processes and equipment
      d. recognize problems in machining and selects appropriate corrective or preventive action
   3. Seeing Things In the Mind’s Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
      a. visualize objects in three dimensions from engineering drawings
      b. visualize process during instructor lecture
      c. visualize the relative motions between tool and workpiece to generate desired features in raw stock in order to plan machine setups and sequence of machining operations
4. **Knowing How to Learn**: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge

5. **Reasoning**: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. applies knowledge of principles of machining to troubleshoot process problems
   b. applies knowledge of machining process to develop a logical, sequential process plan
   c. applies knowledge of workpiece machinability, cutter characteristics and machine tool characteristics to adjust speeds and feeds

### C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility**: Exerts a high level of effort and perseveres towards goal attainment
   a. displays promptness and preparation for the day’s work
   b. plans work to use time efficiently
   c. accepts responsibility for mistakes, and takes corrective and preventive actions
   d. takes initiative when needed to gain resources or assistance to complete assignments

2. **Self-Esteem**: Believes in own self-worth and maintains a positive view of self
   a. takes pride in work through positive reinforcement
   b. sees self as a valued member of the group through continued contributions toward common goals

3. **Sociability**: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management**: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them

5. **Integrity/Honesty**: Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors
Appropriate Reference Materials:

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

APPLICATION SOFTWARE
MAST PROGRAM
COURSE SYLLABUS
APPLICATION SOFTWARE

Lecture hours/week: 1  Lab hours/week: 4  Credit hours: 3

COURSE DESCRIPTION:

This course covers introductory computer concepts combined with an emphasis on the more predominate computer software including, but not limited to DOS, word processing, electronic spreadsheets, and data bases thus providing non-majors with computer literacy and hands-on experience.

PREREQUISITES:  NONE

REQUIRED COURSE MATERIALS:

Textbook:  Microsoft Office Professional for Windows (Illustrated); by Halvorson, Swanson, Reding, Beskeen, and Johnson. Latest edition.

Lab Manual:  None

Supplies/Quantity Required:

2 - High density disks (3 1/2")
6 - Scantron test forms

METHODS OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture, video and demonstrations.

Laboratory:  Laboratory will be a "hands-on" application of computer software.

Method of Evaluation:  A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the computer skills as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy

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LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOS Commands</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Review &amp; Test - DOS Commands</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Microsoft Windows 3.1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>a. Getting started with Windows 3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Creating and managing files</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review &amp; Test - Microsoft Windows 3.1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Microsoft Word 6.0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>a. Getting started with Microsoft Word 6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Creating and editing a document</td>
<td></td>
<td></td>
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<tr>
<td>c. Formatting a document</td>
<td></td>
<td></td>
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<tr>
<td>d. Arranging text and graphics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review &amp; Test - Microsoft Word 6.0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Microsoft Excel 5.0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>a. Getting started with Microsoft Excel 5.0</td>
<td></td>
<td></td>
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<tr>
<td>b. Creating a worksheet</td>
<td></td>
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<tr>
<td>c. Modifying a worksheet</td>
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<tr>
<td>d. Working with charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Integrating Word and Excel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review &amp; Test - Microsoft Excel 5.0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Microsoft Access 2.0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>a. Getting started with Microsoft Access 2.0</td>
<td></td>
<td></td>
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<tr>
<td>b. Creating a database</td>
<td></td>
<td></td>
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<tr>
<td>c. Manipulating data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Creating forms and reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review &amp; Test - Access 2.0 for Windows</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Lecture Hours: 12

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work with DOS Tutor (Sections 2, 4, 5, 6, and 7)</td>
<td>12</td>
</tr>
<tr>
<td>Microsoft Windows 3.1 (Units 1 and 2)</td>
<td>10</td>
</tr>
<tr>
<td>Microsoft Word 6.0 (Units 1, 2, 3, and 4)</td>
<td>10</td>
</tr>
<tr>
<td>Microsoft Excel 5.0 (Units 1, 2, 3, and 4)</td>
<td>8</td>
</tr>
<tr>
<td>Microsoft Access 2.0 (Units 1, 2, 3, and 4)</td>
<td>8</td>
</tr>
</tbody>
</table>

Total Lab Hours: 48

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. USE COMPUTERS

1. Use Computer Operating Systems
   a. Use basic computer terminology appropriately and accurately
   b. Boot the computer and recognize the basic components of DOS
   c. Use DOS to perform file management
   d. Use DOS to perform directory management
2. Use Computer Inquiry Systems
   a. Log in to a multi-user system
   b. Access system for needed information
   c. Print reports as necessary
3. Use Various Computer Applications
   a. Load word processor, create, save, edit, and print a document
   b. Load spreadsheet, create, save, retrieve, erase, edit, and print a worksheet
   c. Load database programs, create, edit, delete, and print records in a database file

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
   B. Interpersonal: Works with others
      1. provide individual assistance/direction to peers as requested
      2. works well with all members of the class
   C. Information: Acquires and uses information
      1. read and interpret textbooks
   D. Systems: Understands complex inter-relationships
      1. demonstrate knowledge of the following systems:
         a. laboratory organization structure: physical and social
         b. systematic organization of training materials
      2. monitors and corrects performance during
         a. operation of computer hardware and software
         b. adjustments of individual laboratory work schedule
         c. constantly evaluating the quality of work to achieve acceptable standards
         d. maintains record of evaluations and sets individual goals
   E. Technology: Works with a variety of technologies
      1. chooses procedure to successfully complete assignments
II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. read/studies textbook
   c. follow a daily laboratory schedule to maintain appropriate time-line

2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. maintain a lecture notebook
   b. submit written responses to chapter question assignments
   c. complete all written assignments

3. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe classroom demonstrations
   d. seek and receive individualized instruction in the laboratory

4. Speaking: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. Problem Solving: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical manuals
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. **Reasoning:** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator

C. **Personal Qualities:** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. **Responsibility:** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. **Self-Esteem:** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving computer skills
   b. assist students with special needs as a peer mentor

4. **Self-Management:** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process checks of work
   b. maintain a record of academic achievement (individual gradebook)
   c. accept the responsibility for self-management

5. **Integrity/Honesty:** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors
Machine Tool Advanced Skills
Technology Program

MAST

COURSE SYLLABUS

ENGINEERING MATERIALS
Prerequisite: MACHINE TOOL PRACTICES II
LECTURE: Didactic presentations will include lecture, video and demonstrations.

LABORATORY: Laboratory will be "hands-on" activities.

METHODS OF EVALUATION: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual.
LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topic</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extracting Metals from Ores</td>
<td>12-28</td>
<td></td>
</tr>
<tr>
<td>The Manufacture of Steel Products</td>
<td>32-41</td>
<td></td>
</tr>
<tr>
<td>Identification and Selection of Iron &amp; Steels</td>
<td>44-50</td>
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<tr>
<td>Identification on Nonferrous Metals</td>
<td>52-64</td>
<td></td>
</tr>
<tr>
<td>Identification and Selection of Nonmetallic Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Mechanical and Physical Properties of Materials</td>
<td>70-86</td>
<td></td>
</tr>
<tr>
<td>Rockwell and Brinell Hardness Testers</td>
<td>92-98</td>
<td></td>
</tr>
<tr>
<td>The Crystalline Structure of Materials</td>
<td>102-123</td>
<td></td>
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<tr>
<td>Phase Diagrams and the Iron-Carbon Diagram</td>
<td>127-142</td>
<td></td>
</tr>
<tr>
<td>Hardening and Tempering of Carbon Steels</td>
<td>145-151</td>
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</tr>
<tr>
<td>Annealing, Normalizing and Stress Relieving</td>
<td>155-163</td>
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<tr>
<td>I-T Diagrams and Cooling Curves</td>
<td>165-173</td>
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<tr>
<td>Harden ability of Steels and Tempered Martensite</td>
<td>175-183</td>
<td></td>
</tr>
<tr>
<td>Heat-Treatment Equipment and Procedures</td>
<td>185-206</td>
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<tr>
<td>Heat Treatment of Nonferrous Metals</td>
<td>207-207</td>
<td></td>
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Total Lecture Hours 24

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using Hardness Testers</td>
<td>6</td>
</tr>
<tr>
<td>a) Standard Rockwell Hardness Tester</td>
<td></td>
</tr>
<tr>
<td>b) Superficial Rockwell Tester</td>
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</tr>
<tr>
<td>c) Automatic Rockwell Hardness Tester</td>
<td></td>
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<tr>
<td>d) Shores Tester</td>
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<tr>
<td>e) Brinell Tester</td>
<td></td>
</tr>
<tr>
<td>f) Vickers Tester</td>
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</tr>
<tr>
<td>Microscopic Examination of Specimens</td>
<td>12</td>
</tr>
<tr>
<td>Determination of Critical Temperature of Steels</td>
<td>6</td>
</tr>
<tr>
<td>Tempering of Hardened Materials</td>
<td>4</td>
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<tr>
<td>Impact Testing</td>
<td>4</td>
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<tr>
<td>Determining the Harden ability of Steels</td>
<td>4</td>
</tr>
</tbody>
</table>

Total Lab Hours 36

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Follow Safety Manuals and All Safety Regulations/Requirements
      a. Assume responsibility for the personal safety of oneself and others
b. Develop a personal attitude towards safety
c. Interpret safety manual directives
d. Comply with established company safety practices

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
   e. Know the location(s) and type of fire extinguishers
   f. Review procedures for using emergency eye-wash station

3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation

4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS
1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals

2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions

3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart

4. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides

5. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS
1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes
D. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Discuss general characteristics for carbon steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals
   c. List advantages for considering plastic as a viable materials choice
   d. List the advantages and disadvantages for each of the following plastic molding processes: blow, injection, vacuum, and extrusion
   e. Discuss the advantages for using composites in various manufacturing applications

2. Describe Heat Treating Processes
   a. Discuss the reasons for heat treating
   b. Discuss the time/temperature chart
   c. List the different quenching mediums
   d. Estimate metal temperature by color
   e. List reasons for stress relieving work piece
   f. Discuss surface hardening processes

3. Perform Heat Treating Operations
   a. Harden plain carbon steel work pieces
   b. Temper plain carbon steel work pieces
   c. Anneal plain carbon steel work pieces
   d. Case harden mild steel work pieces

4. Test Metal Samples for Hardness
   a. Perform spark test on carbon steels
   b. Perform Rockwell hardness tests
   c. Perform Brinell hardness tests

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. determine the initial cost of materials and "value added" as result of machining
      3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. **Interpersonal: Works with others**
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce machine parts to acceptable levels of quality as required
4. works well with all members of the class

C. **Information: Acquires and uses information**
1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. **Systems: Understands complex inter-relationships**
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. **Technology: Works with a variety of technologies**
1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. **FOUNDATION SKILLS**

A. **Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.**

1. **Reading**: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. taps and threads
   e. keeps a running computation of individual grade
   f. interconverts fractions to decimal expressions
   g. use protractors to lay-out angle machining
   h. use trigonometry to solve angle and taper calculations

4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. **Speaking:** Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. **Thinking Skills:** Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.
   1. **Decision Making:** Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
      a. identifies personal goals
      b. identifies actions required to accomplish personal goals
   2. **Problem Solving:** Recognizes problems and devises and implements plan of action
      a. makes daily accommodations to stay on schedule
      b. seeks additional instruction/clarification for assignment completion
      c. balances social and academic life/responsibilities
      d. accepts responsibility
   3. **Seeing Things In the Mind's Eye:** Organizes, and processes symbols, pictures, graphs, objects, and other information
      a. interprets technical drawings
      b. interprets technical illustrations and symbols
      c. understands both written and verbal instructions
4. **Knowing How to Learn:** Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. **Reasoning:** Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. **Personal Qualities:** Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility:** Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. **Self-Esteem:** Believes in own self-worth and maintains a positive view of self
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
d. accept the responsibility for self-management

5. **Integrity/Honesty: Chooses ethical courses of action**
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

Machine Tool Advanced Skills Technology Program
MAST

COURSE SYLLABUS

SAFETY AND ACCIDENT PREVENTION
COURSE DESCRIPTION:

A course designed to enable the student to recognize hazards and potential hazards which may occur in the workplace and to take corrective action. The course may be directed toward a specific technology as required. Federal safety requirements under the OSHA law will be emphasized. General supervisor safety training course for all technologies.

PREREQUISITES:  NONE

REQUIRED COURSE MATERIALS:

Lab Manual:  NONE

Hand Tools/Quantity Required:  
Notebook paper  
Notebook  
Pencils or pens

METHODS OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture, demonstrations, and the following training materials and visual aids (OSH Film Library):  
"The Convincer" - 45 min. color slide  
"Safety and the Supervisor - 16 mm - color film  
"All About OSHA" - 16 mm - color film  
"Search for Safety" - 16 mm - color film  
"In Search of the Facts" - 16 mm - color film  
"Color of Danger" - 16 mm - color film  
"Six Ways to Lift" - 16 mm - color film  
"MGM Grand Hotel Fire" - 16 mm - color film

Laboratory:  Laboratory assignments will require students to recognize hazards and potential hazards which may occur in the workplace and to take corrective action.

Method of Evaluation:  A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. satisfactorily perform on written, oral, and practical examinations
3. explain all the elements of good communication as it relates to safety
4. apply several human relations concepts as a supervisor to ensure safety in the work place
5. discuss the importance of industrial hygiene and noise control
6. correctly fill out an accident investigation report and a safety inspection form
7. discuss and/or demonstrate the use of personal protective equipment
8. apply the principles of and discuss the benefits of machine safeguarding
9. explain and/or demonstrate the use and safe handling of hand and portable power tools
10. discuss safe electrical procedures
11. discuss the basic principles and causes of fire
12. explain the need for safety training of workers
13. satisfactorily perform on outside assignments including writing assignments
14. contribute to class discussions
15. maintain attendance per current policy
16. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
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<tr>
<td>Course content and text</td>
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<tr>
<td>Attendance and grading</td>
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<tr>
<td>Testing procedures</td>
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<tr>
<td>The origin of the safety movement</td>
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<td>The Williams-Steiger Act</td>
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<td>OSHAct applied to technology</td>
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<tr>
<td>Safety Management</td>
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<tr>
<td>Definition of terms</td>
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<td>Areas of responsibility</td>
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<td>The &quot;old&quot; approach to safety performance</td>
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<tr>
<td>A better approach to safety performance</td>
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<tr>
<td>Summary of Key Points</td>
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<td>Communications</td>
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<tr>
<td>Elements of communication</td>
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<td>Methods of communication</td>
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<tr>
<td>Effective listening</td>
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<td>Summary of key points</td>
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<tr>
<td>Human Relations</td>
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<td>Human relations concepts</td>
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<td>Leadership</td>
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<td>Coping with difficult problems</td>
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<td>Shift work and shift changes</td>
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<td>Stress management</td>
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<td>Alcohol and drug problems</td>
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<tr>
<td>Employee assistance programs</td>
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<tr>
<td>Summary of key points</td>
<td></td>
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<tr>
<td>Employee Safety Training</td>
<td>97</td>
<td>1</td>
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</tbody>
</table>
Orientation training
Job instruction training
Other methods of instruction
Job safety analysis
Summary of key points
Employee Improvement
Promoting safety among workers
Off-the-job accident problems
Summary of key points
EXAM #1
Safety Inspections
Formal inspections
Inspection planning and procedures
Inspecting work practices
Inspection reports
Summary of key points
Accident Investigation
Accident reporting
Finding causes
Emergency procedures
Effective use of witnesses
Accident investigation reports
Summary of key points
EXAM #2
Industrial Hygiene
Chemical stresses
Physical stresses
Ergonomic stresses
Biological stresses
Threshold limit values
Standard Operating Procedures (SOP)
Summary of key points
EXAM #3
Personal Protective Equipment
Controlling hazards
Head protection
Face protection
Eye protection
Ear protection
Respiratory protection
Body protection
Protecting extremities
Summary of key points
EXAM #4
Ergonomics
What are ergonomic problems?
Understanding ergonomics
Materials movement
Work space and body characteristics
Hand work and use of tools
Whole-body vibration
Video display terminals
Lighting, noise, and heat
Summary of key points

EXAM #5
Machine Safeguarding
Principles of guarding
Safeguard design
Safeguarding mechanisms
Automation
Maintenance of safeguards
Summary of key points

Hand Tools and Portable Power Tools
Safe work practices
Use of hand tools
Portable power tools
Supervisory considerations
Maintenance and repair
Summary of key points

Materials Handling and Storage
Materials handling problems
Manual handling methods
Materials handling equipment
Ropes, chains, and slings
Materials storage
Summary of key points

EXAM #6
Electrical Safety
Myths and misconception about electricity
Electrical fundamentals review
Branch circuits and grounding concepts
Plug and cord connected equipment
and extension cords
Branch circuit and equipment testing methods
Ground-fault circuit interrupters
Hazardous locations
Electrical standards most often violated
Inspection guidelines and checklist
Safeguards for portable home electrical appliances
Safety program policy and procedures
Electrical distribution system review
Summary of key points
Fire Safety
Basic principles
Causes of fire
Other hazardous materials
Effective housekeeping for fire safety
Fire prevention inspections
Alarms, equipment, and evacuation
Fire protection education
Protective insurance requirements
Summary of key points

Exams #7

Total Lecture Hours 24

Lab Outline:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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</thead>
<tbody>
<tr>
<td>Students will research each chapter of the Supervisor's Safety Manual and answer questions which cover the main points of the chapter</td>
<td>16</td>
</tr>
<tr>
<td>Students will demonstrate the six steps in proper lifting</td>
<td>4</td>
</tr>
<tr>
<td>Students will demonstrate the proper use of powered hand tools</td>
<td>6</td>
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<tr>
<td>Students will demonstrate the use of different types of fire extinguishers</td>
<td>6</td>
</tr>
<tr>
<td>Students will explain the importance of inspecting electrical extension cords, plugs and cord-connected equipment</td>
<td>4</td>
</tr>
</tbody>
</table>

Total Lab Hours 36

Course Objectives: Technical Competencies

After the successful completion of this course the student will be able to:

A. Practice Safety

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation

4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
e. Perform preventative maintenance as required

5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Interpret/display MSDS sheets as required
   f. Identify fire exits and fire-fighting equipment

6. Apply American Red Cross First Aid and CPR Procedures
   a. Notify appropriate personnel of injury
   b. Check and evaluate life-endangering conditions
   c. Determine need for CPR
   d. Apply appropriate first aid techniques
   e. Complete accident report as needed

7. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Interpret MSDS sheets
   d. Describe the proper collection for a variety of hazardous wastes
   e. Respond to emergencies in the appropriate manner

8. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

9. Demonstrate Knowledge of State and Federal EPA Regulations
   a. Meet health, safety, and legal requirements with regard to process, product and people

COURSE OBJECTIVES: SCANS COMPETENCIES

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The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. provide a self-evaluation of performance based on the time and quality of work
B. **Interpersonal: Works with others**
   1. provide individual assistance/direction to peers as requested
   2. works well with all members of the class

C. **Information: Acquires and uses information**
   1. studies safety materials and completes assignments
   2. makes safety recommendations based on classroom instruction

D. **Systems: Understands complex inter-relationships**
   1. demonstrate knowledge of the following systems
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities in the lab
      c. systematic organization of training materials
   2. monitors and corrects performance during
      a. adjustments of individual laboratory work schedule
      b. maintains record of evaluations and sets individual goals

E. **Technology: Works with a variety of technologies**
   1. apply fire safety principles
   2. apply hazardous material handling principles
   3. apply ergonomic principles to the workplace

II. **FOUNDATION SKILLS**
A. **Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.**
   1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
      a. studies student laboratory manual
      b. read/studies textbook
      c. follow a daily laboratory schedule to maintain appropriate time-line and product completion
   2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
      a. maintain a lecture notebook
      b. submit written responses to chapter question assignments
      c. complete all written assignments
   3. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
      a. assimilate classroom instruction
      b. interpret and assimilate video instruction
      c. observe laboratory demonstrations
      d. seek and receive individualized instruction in the laboratory
   4. **Speaking:** Organizes ideas and communicates orally
      a. participates in classroom discussions
      b. organize ideas and communicate specific questions to the instructor
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      d. communicates with peers to ensure the smooth and safe operation of the laboratory
B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. Problem Solving: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. understands both written and verbal instructions
   b. assimilates process during instructor demonstrations

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the student

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. Self-Esteem: Believes in own self-worth and maintains a positive view of self
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3. Sociability: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
a. assist classmates in improving technical skills  
b. assist students with special needs as a peer mentor  
c. share laboratory resources (machines, tools and instructor's individual attention)  

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control  
a. maintain a record of academic achievement (individual grade book)  
b. make accommodations to laboratory schedules due to broken machines/tools  
c. accept the responsibility for self-management  

5. **Integrity/Honesty:** Chooses ethical courses of action  
a. accept the responsibility for own actions  
b. exhibit personal honesty at all times  
c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments  
d. understand the consequences of unethical behaviors  

**Appropriate Reference Materials:**

OSH216  
01/072396
COURSE SYLLABUS

BASIC FLUID POWER
Prerequisites: MATHEMATICS FOR INDUSTRIAL TECHNICIANS, BASIC ALGEBRAIC CONCEPTS, OR EQUIVALENT
MAST PROGRAM
COURSE SYLLABUS
BASIC FLUID POWER

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:
A basic study of hydraulic system components, fluid power theory, problem solving and troubleshooting techniques.

PREREQUISITES: Mathematics for Industrial Technicians, Basic Algebraic Concepts, or equivalent

REQUIRED COURSE MATERIALS:

Textbook: Industrial Hydraulic Technology, Parker Hannifin Corp.
Lab Manual: NONE

Supplies Required:
- Electronic Pocket Calculator (Texas Instruments Model No. TI-35 or equivalent
- Ruler-plastic, 12-inch, graduated in inches and centimeters
- Notebook
- Ballpoint pen
- #2 Pencil (6)

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual
<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A. Historical background</td>
<td></td>
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<tr>
<td>B. Advantages and application of hydraulic power</td>
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<tr>
<td>1) List five advantages of hydraulic power</td>
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<tr>
<td>2) List five examples of the application of hydraulic power</td>
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<tr>
<td>C. Overview of a typical hydraulic system</td>
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<tr>
<td>1) Identify by name and describe the function of the major components of a basic hydraulic system</td>
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<tr>
<td>2) Sketch or identify the ANSI standard symbol for each major component</td>
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<tr>
<td><strong>Basic Principles of Hydraulics</strong></td>
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<td>8</td>
</tr>
<tr>
<td>A. Pressure and force relationships</td>
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<tr>
<td>1) State or describe the consequences of Pascal's law</td>
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<tr>
<td>2) Knowing the basic mathematical relationship of pressure, force, and area, solve for any one given the other two</td>
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<tr>
<td>B. Principles and Concepts of Fluid Pressure and Flow</td>
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<tr>
<td>1) Given the density or specific gravity of a fluid, calculate the pressure head for a given fluid height</td>
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<tr>
<td>2) State Bernoulli's Theory in terms of velocity and pressure</td>
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<tr>
<td>3) Using the Continuity Equation, solve for hydraulic line size given the flow rate and velocity parameters; determine cylinder extension speed (or time) given flow rate and cylinder size; determine flow</td>
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</table>
velocity in various sized lines
given flow rate
4) State the results of Torricelli’s
Theories in terms of pressure
head and velocity
5) Use the Reynolds Number to
determine laminar or turbulent
flow
6) Given the movement of a load
in a given time interval,
calculate work, power, and
horsepower
7) Analyze a hydraulic system to
determine its performance
given the specifications of the
pump and various actuators
(cylinders, hydraulic motors,
rotary actuators)

Hydraulic Fluids
A. Types, properties, and safety
1) Name three types of hydraulic
fluid
2) List two methods of measuring
fluid viscosity
3) List four desirable characteristics
of a hydraulic fluid
4) Given a hypothetical hydraulic
system configuration, identify
the safety hazards and means
of correction

B. Fluid storage and conditioning
1) List five features of a well-
designed hydraulic reservoir
2) Name two types of heat
exchangers
3) Name two basic types of filter
elements
4) Explain what is meant by the
micron rating of filters
5) List three benefits derived
from proper conditioning of
hydraulic fluid

Power, Distribution and Sealing Devices
A. Lines, hoses and fittings
1) Given the pressures and flow
rates of a system, select the
correct tubing size for a
properly designed hydraulic system

2) Show actual or illustrated hose installations, identify improper installation and recommend an acceptable configuration

3) Show actual or illustrated tubing connectors, properly identify them within the two main classifications

B. Pressure, velocity, and safety factors
   1) Using Barlow’s Formula, or a proper reference chart, determine the allowable maximum pressure of a given conductor
   2) Determine working pressure of a system given the safety factor
   3) Using Darcy’s Formula, calculate the pressure drop of a given length of conductor
   4) Given the Reynold’s Number, determine whether the flow is laminar or turbulent
   5) Using a nomograph, determine the flow rate, conductor size, or flow velocity given any two parameters
   6) Determine hydraulic pump inlet and discharge line size given the flow rate, using the Continuity Equation and accepted industrial velocity parameters

C. Sealing devices
   1) List three conditions affecting the selection of sealing devices
   2) Name the three general categories of sealing materials

Pumps
A. Types and operation
   1) Name the two general classifications of pumps
   2) List the design features, main uses, and describe the operation of each of the two
types of pumps

3) Know why **positive displacement** pumps are preferred for fluid power systems

B. Theory and calculations

1) Calculate the theoretical output flow and input torque of a positive displacement pump

2) Determine overall pump efficiency

3) Determine the **volumetric efficiency** of a pump

4) Determine the **mechanical efficiency** of a pump

5) Calculate the hydraulic horsepower output of a pump

C. Design and selection factors

1) Name three types of positive displacement pumps; list the advantages/disadvantages of each

2) Name two types of variable delivery pumps and describe their operation

3) Using catalog or advertising data, evaluate various pumps for use in specific applications

Hydraulic Actuators

A. Linear actuators (cylinders)

1) Name two of the most common **types** of cylinders

2) Describe how cylinders are rated and sized

3) Using an illustration or actual cylinder, name and identify the parts

4) Given the size of a cylinder and the system flow rate, calculate the cylinder extension speed or extension time

5) Given system flow and pressure, or load, stroke, and extension time, calculate the power output of a cylinder
B. Rotary actuators and motors
1) Name the two general types of hydraulic motors
2) Name the three principle elements of motor ratings
3) Given displacement and flow rate, calculate motor speed (rpm)
4) Given the torque and rpm of a motor, calculate the hydraulic horsepower

Hydraulic Controls
A. Control of hydraulic power
1) Name the three primary ways of controlling pressurized hydraulic fluid
2) Name five types of pressure control valves and describe their use and operation
3) Name at least four types or designs of directional control valves and describe their use
4) Describe the function of flow control valves and name three types or designs

B. Hydraulic circuits
1) Describe the function of pressure controls for sequencing actuators, counterbalances or braking applications, safety or relief operations, pressure reducing and unloading functions
2) Explain the function and proper application of meter-in, meter-out, and bleed-off circuits
3) Explain the function of a three-position directional control valve and name four common center designs
4) Describe the use and limitations of a regenerative circuit
5) Describe the difference
Hydraulic System Troubleshooting

A. Define component relationships
   1) Given a real or hypothetical hydraulic system, trace the flow through the entire system, state the purpose of each component, and describe the action or operation of each component at each control setting.

B. Analyze pressure and flow
   1) Name the three common terms used when referring to pressure within a hydraulic system.
   2) Describe the causes of each of the three kinds of system pressure.
   3) Describe the effect of increased or decreased flow on actuator operation.
   4) Describe the effect of increased or decreased pressure on actuator operation.

C. Troubleshooting sequence
   1) Describe two ways of determining the problem with a malfunctioning hydraulic system.
   2) Given the fault in a malfunctioning hydraulic system, describe the component relationships.
   3) Make a list of possible causes for the malfunctioning of the given system.
   4) Given the specifications of a hydraulic system, compare them to actual or hypothetical measurements.
5) Given a malfunctioning hydraulic system, following a logical troubleshooting sequence, trace the problem to its origin.

**Fluid Power System Maintenance and Safety**

**A. Maintenance**

1) List three general requirements for a good maintenance program.

2) In addition to a proper set of mechanics tools and gauges, list two other factors which are considered “tools” for good maintenance.

3) List at least three types of records used to insure proper preventive maintenance.

**B. Safety**

1) List five safety rules for the operator of fluid power machinery.

2) List five safety rules for the fluid power mechanic.

**Major Exams and Critiques**

Total Lecture Hours 36

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**LAB OUTLINE:**

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td><strong>The Fundamental Hydraulic Circuit</strong></td>
<td>3</td>
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<tr>
<td>This exercise establishes a common base for discussion of hydraulic systems by providing the student the opportunity to:</td>
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<tr>
<td>A. Identify hydraulic components</td>
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<td>B. Assemble components into a hydraulic circuit</td>
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<td>C. Adjust valve settings</td>
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<td>D. Operate a basic circuit</td>
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<td>E. Test circuit operation</td>
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<tr>
<td><strong>Basic Physical Laws</strong></td>
<td>3</td>
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<tr>
<td>Pressure and flow relationships are introduced and demonstrated under flow and non-flow (Pascal's Law) conditions</td>
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<tr>
<td><strong>Pressure and Force</strong></td>
<td>3</td>
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<tr>
<td>Pressure and force relationships are illustrated by:</td>
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<tr>
<td>A. Demonstration of pressure, force, area relationships</td>
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</tbody>
</table>
B. Causes of pressure, units of measurement, measuring instruments
C. Concept of the "hydraulic lever"
D. Cylinder load and working pressure relationships

Flow Rate and Velocity
Relationships between flow rate and actuator speed, creation of flow in the system, calculation and measurement of flow, actuator speed, and cylinder extension times are examined and demonstrated

Work, Power and Horsepower
Definitions of work and power, relationships between pressure and flow to produce power, demonstration and calculations using formulas, and concepts of efficiency are examined

Properties of Hydraulic Fluids and Fluid Storage Conditioning
A combined lab exercise of activity 6 and 9 to illustrate:
A. Effect of temperature change on viscosity
B. Relationship of viscosity and resistance to flow through hydraulic lines, valves, and fitting
C. Characteristics of a well designed reservoir
D. Importance of proper fluid conditioning

Fluid Power Symbols
The introduction of graphic symbols used in industrial diagrams. (Previous introductory labs used pictorial symbols as a training aid.) Basic symbols for components are studied and practiced by interpreting and sketching simple hydraulic circuits

Hydraulic Pumps
The concept of pumps displacement and its relationship to output flow, volumetric efficiency, and the effects of temperature are demonstrated

Fluid Transmission and Introduction to Control Valves
A combined lab of Activity 10 and 11 to illustrate:
A. Hydraulic conductors, terminology, design features, sizing, and selection are demonstrated
B. Pressure, flow, and directional controls are introduced and demonstrated

Pressure Control Valves
Design features and function of pressure controls are discussed. Definition of terms and testing of a pilot-operated relief valve, to include plotting of
test results, demonstrates valve operation
(Activity 12)

**Directional Control Valves**
Design features, terminology, and valve
configurations are demonstrated and discussed
(Activity 13)

**Flow Control Valves**
Valve ratings and concepts of compensation are
discussed and pressure compensation is
demonstrated in the lab exercise (Activity 14)

<table>
<thead>
<tr>
<th>Total Lab Hours</th>
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<tbody>
<tr>
<td>36</td>
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</table>

**COURSE OBJECTIVES: TECHNICAL COMPETENCIES**

After the successful completion of this course the student will be able to:

**A. PRACTICE SAFETY**

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation

4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required

5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Interpret/display MSDS sheets as required
   f. Identify fire exits and fire-fighting equipment

**B. APPLY MATHEMATICAL CONCEPTS**

1. Perform Basic Arithmetic Functions
a. Add, subtract, multiply and divide whole numbers
b. Add, subtract, multiply, and divide fractions
c. Add, subtract, multiply, and divide decimals

2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent

3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English

4. Use all Functions on a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
   c. Apply all statistical functions

C. MAINTAIN HYDRAULIC/PNEUMATIC DEVICES

1. Use Test Equipment
   a. Monitor hydraulic flow with flow meters
   b. Use temperature gauges to determine hydraulic fluid operating temperature
   c. Use flow control valves, U-tube manometers and pressure gauges to measure operating conditions for the fluid power system

2. Describe Basic Principles of Hydraulic Systems
   a. List advantages of hydraulic systems
   b. Identify components of typical hydraulic system
   c. State or describe Pascal's law
   d. Analyze a hydraulic system to determine its performance

3. Identify Hydraulic Fluids
   a. Name types of hydraulic fluids
   b. List methods of measuring fluid viscosity
   c. List desirable characteristics of hydraulic fluids
   d. Identify safety hazards related to hydraulic fluid use
   e. Discuss heat exchangers, filters, and micron rating of filters

4. Recommend Power Distribution and Sealing Devices
   a. Describe proper identification and selection of lines, hoses, and fittings
   b. Discuss pressure, velocity, and safety factors
   c. List conditions determining selection of sealing devices

5. Recognize Pumps, Actuators, and Hydraulic Control Devices
   a. Name general classifications of pumps
   b. Determine overall pump efficiency
   c. Name types of positive displacement pumps and give advantages and disadvantages of each
   d. Discuss types of variable delivery pumps and describe their operation
   e. Describe linear actuators (cylinders)
   f. Describe how cylinders are rated and sized
   g. Describe rotary actuators and motors
   h. Name two types of hydraulic motors

6. Troubleshoot Hydraulic/Pneumatic Systems
   a. Discuss common methods of troubleshooting hydraulic systems
   b. Follow a logical troubleshooting sequence to trace a problem to its origin
COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary’s Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its “AMERICA 2000 REPORT” that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. provide a self-evaluation of performance based on the time and quality of work
   B. Interpersonal: Works with others
      1. complete assigned responsibilities within the lab serving as a member of the team
      2. provide individual assistance/direction to peers as requested
      3. works well with all members of the class
   C. Information: Acquires and uses information
      1. read and interpret schematics and flowcharts
   D. Systems: Understands complex inter-relationships
      1. demonstrate knowledge of the following systems:
         a. laboratory organization structure: physical and social
         b. organization of personnel and facilities in the lab
         c. systematic organization of training materials
      2. monitors and corrects performance during
         a. adjustments of individual laboratory work schedule
         b. constantly evaluating the quality of work to achieve acceptable standards
         c. maintains record of evaluations and sets individual goals
   E. Technology: Works with a variety of technologies
      1. maintains and troubleshoots equipment
         a. applies appropriate preventative maintenance
         b. when operating equipment
         c. reports all malfunctions of equipment to supervisor/instructor
         d. perform clean-up assignments of lab at the end of the class

II. FOUNDATION SKILLS
   A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
1. **Reading**: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. **Writing**: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. maintain a lecture notebook
   b. submit written responses to chapter question assignments
   c. complete all written assignments

3. **Arithmetic/Mathematics**: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. keeps a running computation of individual grade
   b. interconverts fractions to decimal expressions

4. **Listening**: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. **Speaking**: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

**B. Thinking Skills**: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. **Decision Making**: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. **Problem Solving**: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. **Seeing Things In the Mind’s Eye**: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
c. understands both written and verbal instructions
d. assimilates process during instructor demonstrations

4. **Knowing How to Learn:** Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. **Reasoning:** Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the technician

C. **Personal Qualities:** Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility:** Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. **Self-Esteem:** Believes in own self-worth and maintains a positive view of self
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. maintain a record of academic achievement (individual gradebook)
   b. make accommodations to laboratory schedules due to broken machines/tools
   c. accept the responsibility for self-management

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

PHY 114
01/07/2006

120
COURSE SYLLABUS

ELECTRICAL APPLICATIONS

121
MAST PROGRAM
COURSE SYLLABUS
ELECTRICAL APPLICATIONS

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:

A survey course designed to present basic concepts in DC and AC circuits, fundamental motor design and applications, and basic motor controls, including analyzing, calculating, and measuring DC and AC voltage, current, and resistance.

PREREQUISITES: NONE

REQUIRED COURSE MATERIALS:

Lab Manual: NONE

Hand Tools/Quantity Required:
- Notebook paper (50 sheets)
- Binder
- Scientific calculator
- Test leads with alligator clips (12 minimum)
- Screwdriver - 6 inch long, 3/16 inch straight blade
- Screwdriver - #2 Phillips
- Safety glasses

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will include presentation of basic concepts in DC and AC circuits, including analyzing, calculating, and measuring DC and AC voltage, current, and resistance, as well as fundamental motor design, applications and controls.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student’s ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. satisfactorily perform on written, oral, and practical examinations
3. follow safe practices in using electricity
4. analyze atomic structure and the proportionalism that makes an atom a good conductor
5. analyze electrical quantities in circuits, including voltage, current, resistance, and power
6. analyze series and parallel DC circuits using Ohm's law and Kirchoff's voltage and current laws
7. analyze complex DC circuits using Ohm's law and Kirchoff's voltage and current laws
8. relate the principles of magnetism and inductance to electrical circuits
9. satisfactorily perform on outside assignments including writing assignments
10. contribute to class discussions
11. maintain attendance per current policy
12. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

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<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td><strong>Unit 1</strong></td>
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<tr>
<td>1.01 Introduction to Electricity</td>
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<tr>
<td>1.01 Define atoms, protons,</td>
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<td>1.01 electrons, charge, voltage,</td>
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<td>1.01 current, resistance, power,</td>
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<tr>
<td>1.01 electricity, etc.</td>
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<td>1.02 Decode the colors of a</td>
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<td>1.02 carbon resistor</td>
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<td>1.03 Apply Ohm's law</td>
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<td><strong>Unit 2</strong></td>
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<td>2.01 Series Circuits</td>
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<td>2.01 Define a series circuit</td>
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<td>2.02 Apply Ohm's law and</td>
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<td>2.02 Kirchoff's voltage law to</td>
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<td>2.02 a series circuit</td>
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<td>2.03 Evaluate a simple circuit</td>
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<td>2.03 to determine if it is a</td>
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<td>2.03 series circuit</td>
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<td><strong>Unit 3</strong></td>
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<td>3.01 Parallel Circuits</td>
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<td>3.01 Define a parallel circuit</td>
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<td>3.02 Apply Ohm's law and</td>
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<td>3.02 Kirchoff's law to a</td>
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<td>3.02 parallel circuit</td>
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<td><strong>Unit 4</strong></td>
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<tr>
<td>4.01 Complex DC Circuits</td>
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<td>4.01 Analyze a circuit to</td>
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<td>4.01 establish a circuit</td>
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<td>4.01 arrangement</td>
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<tr>
<td>4.01a What is series?</td>
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<td>4.01b What is parallel?</td>
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<td>4.02 Apply series/parallel</td>
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<td>4.02 parameters to circuit</td>
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<td>4.03 Apply Ohm's law and</td>
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<td>4.03 Kirchoff's current</td>
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<td>4.03 voltage law to the circuit</td>
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</table>
### UNIT 5
- **Magnetism and Inductance**
  - 5.01 Define magnetism and inductance
  - 5.02 Relate the effects of magnetism and inductance to AC devices
  - 5.03 Define impedance, inductive reactance and capacitive reactance

### UNIT 6
- **AC Circuits**
  - 6.01 Define alternating current
  - 6.02 List examples of AC signals
  - 6.03 Illustrate the generation of a sinewave
  - 6.04 Define terms relating to AC signals
    - 6.04a Peak values
    - 6.04b RMS values
    - 6.04c Instantaneous values
    - 6.04d Frequency
    - 6.04e Period
    - 6.04f Cycle
    - 6.04g Hertz

### UNIT 7
- **Inductance and Capacitance**
  - 7.01 Define inductance and capacitance
  - 7.02 Relate the effects of inductance and capacitance to AC circuits and motors

### UNIT 8
- **Relays**
  - 8.01 Define relay construction and the principle of operation
  - 8.02 List the different types of relays

### UNIT 9
- **Transformers**
  - 9.01 Define transformer construction and the principle of operation
  - 9.02 List the different types of transformers

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**Total Lecture Hours** 36

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### LAB OUTLINE:

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<tr>
<th>Lab Topics</th>
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<tr>
<td>Safety and Orientation</td>
<td>2</td>
</tr>
<tr>
<td>1.01 Review lab safety</td>
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</tr>
<tr>
<td>1.02 Demonstrate uses of analog volt-ohm-miliamp meter</td>
<td></td>
</tr>
<tr>
<td><strong>Unit 2</strong></td>
<td>3</td>
</tr>
<tr>
<td>Resistance</td>
<td></td>
</tr>
<tr>
<td>2.01 Practice decoding color bands of a carbon resistor</td>
<td></td>
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<tr>
<td>2.02 Demonstrate resistance measuring function of analog</td>
<td></td>
</tr>
</tbody>
</table>
1

2.03 Measure carbon resistors
2.04 Calculate percent error of resistor; coded value versus measured value

Unit 3 Voltage
3.01 Demonstrate voltage measuring function of analog meter
3.02 Measure voltage output of series-aiding, series-opposing, parallel and series-parallel battery groupings
3.03 Compare the advantages and disadvantages of power supplies and battery sources

Unit 4 Current
4.01 Demonstrate the current measuring function of an analog meter
4.02 Measure current in a variety of simple circuits

Unit 5 Power
5.01 Demonstrate the use of a wattmeter to measure power in a simple DC circuit
5.02 Measure power in a circuit
5.03 Confirm the validity of power formulas by measurements of power in a circuit

Unit 6 Series Circuits
6.01 Build a simple series circuit
6.02 Analyze a series circuit

Unit 7 Parallel Circuits
7.01 Build a simple parallel circuit
7.02 Confirm the four parameters that govern a parallel circuit
7.03 Troubleshoot a parallel circuit

Unit 8 Complex (Series/Parallel) Circuits
8.01 Build a complex circuit
8.02 Analyze a complex circuit

Unit 9 Magnetism
9.01 Analyze the properties of permanent magnets
9.02 Observe and analyze the operation and properties of electromagnets

Unit 10 Magnetic Induction
10.01 Analyze the properties of magnetic induction
10.02 Observe magnetic induction in operation

Unit 11 AC Signals
11.01 Observe AC signals of various waveshapes and frequencies on an oscilloscope
11.02 Compare peak values on oscilloscope with RMS values of analog meter
11.03 Measure voltage with analog volt-ohm-milliamp meter

Total Lab Hours 36
COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Follow Safety Manuals and All Safety Regulations/Requirements
      a. Assume responsibility for the personal safety of oneself and others
      b. Develop a personal attitude towards safety
      c. Interpret safety manual directives
      d. Comply with established company safety practices
      e. Complete forms/paperwork as required
   2. Use Protective Equipment
      a. Wear protective safety clothing as required
      b. Maintain and use protective guards and equipment on machinery
      c. Locate and properly use protective equipment
      d. Use lifting aids when necessary
   3. Maintain a Clean and Safe Work Environment
      a. Keep work areas clean
      b. Clean machine/hand tools when work is completed
      c. Put tools away when work is finished
      d. Keep aisles clear of equipment and materials
      e. Perform preventative maintenance as required
   4. Control Fire Hazards
      a. Handle/store flammable materials appropriately
      b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
      c. Keep marked aisles clear of equipment and materials
      d. Interpret/display MSDS sheets as required

B. MAINTAIN ELECTRICAL DEVICES
   1. Use Electrical Test Equipment
      a. Measure resistance with an analog volt-ohm-milliamp meter
      b. Measure voltage with volt-ohm-milliamp meter
      c. Measure current with volt-ohm milliamp meter
      d. Use wattmeter to measure power in a simple DC circuit
      e. Use oscilloscope to observe AC signals of various waveshapes and frequencies
   2. Apply Specific Terms to Electrical Circuits
      a. Define voltage, current, and resistance
      b. Discuss power, power factor, and sine waves
      c. Define three phase, induction, and capacitance
   3. Analyze Series, Parallel and Complex DC/AC Circuits
      a. Define a series circuit
      b. Define a parallel circuit
      c. Define a complex DC circuit
      d. Define an AC circuit
      e. Apply Ohm's law to each of the above circuits
      f. Apply Kirchoff's law to each of the above circuits
4. Check AC and DC Motors  
a. List types of AC and DC motors  
b. List characteristics of AC motors  
c. List characteristics of DC motors  
d. Compare AC motors versus DC motors to job duty  

5. Inspect Transformers and Generators  
a. Define transformer construction and the principle of operation  
b. List the different types of transformers  
c. Define electro-magnetic induction  
d. Describe the principle of operation of AC alternators and DC generators  

6. Troubleshoot Electrical Devices  
a. Discuss common methods of troubleshooting electrical systems  
b. Follow a logical troubleshooting sequence to trace a problem to its origin  

COURSE OBJECTIVES: SCANS COMPETENCIES  

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.  

The following activities will be performed by each student for successful completion of this course:  

I. COMPETENCIES  
   A. Resources: Identifies, organizes, plans, and allocates resources  
      1. follows a schedule to complete assigned tasks on time  
      2. provide a self-evaluation of performance based on the time and quality of work  
   B. Interpersonal: Works with others  
      1. complete assigned responsibilities within the lab serving as a member of the team  
      2. provide individual assistance/direction to peers as requested  
      3. works well with all members of the class  
   C. Information: Acquires and uses information  
      1. read and interpret schematics  
      2. organize and apply theories of electrical applications  
   D. Systems: Understands complex inter-relationships  
      1. demonstrate knowledge of the following systems:  
         a. laboratory organization structure: physical and social  
         b. organization of personnel and facilities on the shop floor  
         c. systematic organization of training materials
2. monitors and corrects performance during
   a. adjustments of individual laboratory work schedule
   b. constantly evaluating the quality of work to achieve acceptable standards
   c. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies
1. chooses procedure, tools and equipment required to prepare/check a circuit
2. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. perform clean-up assignments of laboratory at the end of the class period

II. FOUNDATION SKILLS
A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
   1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
      a. studies student laboratory assignment sheets
      b. read/studies textbook
      c. follow a daily laboratory schedule to maintain appropriate time-line and project completion
   2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
      a. outline the steps necessary to produce a build/test a simple circuit
      b. maintain a lecture notebook
      c. submit written responses to chapter question assignments
      d. complete all written assignments
   3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
      a. determines appropriate test parameters and variables
      b. calculates voltage, current and resistance
   4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
      a. assimilate classroom instruction
      b. interpret and assimilate video instruction
      c. observe laboratory demonstrations
      d. seek and receive individualized instruction in the laboratory
   5. Speaking: Organizes ideas and communicates orally
      a. participates in classroom discussions
      b. organize ideas and communicate specific questions to the instructor
      c. verbally affirms understanding of a concept, procedure, or required skill
d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. Problem Solving: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the technician
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the technician

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. Self-Esteem: Believes in own self-worth and maintains a positive view of self
a. learns to take pride in his or her work through positive reinforcement
b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (test equipment, tools and instructor's individual attention)

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. maintain a record of academic achievement (individual grade book)
   b. accept the responsibility for self-management

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

EST120
01/072396
Machine Tool Advanced Skills
Technology Program

MAST

COURSE SYLLABUS

SURVEY OF WELDING PROCESSES AND APPLICATIONS
MAST PROGRAM
COURSE SYLLABUS
SURVEY OF WELDING PROCESSES AND
APPLICATIONS

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:

This course is a survey of shielded metal arc, gas tungsten arc, gas metal arc, flux cored arc, and submerged arc welding processes. Metal weldability and weld symbols are considered. Process safety, electrode selection, and process parameters are emphasized. Hard surfacing, using shielded metal arc and oxyacetylene processes and techniques are studied.

PREREQUISITES:  NONE

REQUIRED COURSE MATERIALS:

New Lessons in Arc Welding, by Lincoln Electric, Lincoln Electric Publisher, Latest Edition

Lab Manual:  None Required

Student Tool List
Oxy-acetylene cutting and welding goggles (mono) with #5 filter lens and one clear plastic lens 1 pair
Friction lighter 1
Wire brush 1" wide with long handle 1
Soap stone 2 pieces
Welder's cap 1
Welding gloves, long gauntlet 1 pair
Chipping hammer 1
Safety glasses 1 pair
Slip joint pliers 1 pair

METHODS OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture, video, and demonstrations.
Laboratory: Hands on laboratory activities to enable the students to learn the various aspects of the welding process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
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<tr>
<td>Introduction to the course</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Introduction to oxy-acetylene fusion</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Oxy-acetylene welding and cutting</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Introduction to mechanical and physical properties</td>
<td>77</td>
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<tr>
<td>Non-fusion welding</td>
<td></td>
<td>1</td>
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<tr>
<td>Introduction to the oxy-acetylene cutting processes</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Test #1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>The shielded metal arc welding process</td>
<td>1-7</td>
<td>1</td>
</tr>
<tr>
<td>Running a good quality bead in the flat position</td>
<td>1-21</td>
<td>1</td>
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<tr>
<td>Introduction to shielded metal arc welding electrodes</td>
<td>3-3</td>
<td>2</td>
</tr>
<tr>
<td>Shielded metal arc power sources</td>
<td>2-3</td>
<td>1</td>
</tr>
<tr>
<td>Test #2</td>
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<tr>
<td>Weld joints, weld types and weld positions</td>
<td>1-54</td>
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<tr>
<td>Introduction to fillet welds</td>
<td>1-56</td>
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<tr>
<td>Test #3</td>
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<tr>
<td>Introduction to gas metal arc welding and flux core arc welding</td>
<td>7-37</td>
<td>2</td>
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<tr>
<td>Short circuiting metal transfer</td>
<td></td>
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<tr>
<td>Test #4</td>
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<tr>
<td>Power sources for GMAW and FCAW</td>
<td></td>
<td>1</td>
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<tr>
<td>SMAW and FCAW filler metal transfer modes</td>
<td></td>
<td>1</td>
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<tr>
<td>Test #5</td>
<td></td>
<td>1</td>
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<tr>
<td>Shielding gases used with the GMAW process</td>
<td>7-37</td>
<td>1</td>
</tr>
<tr>
<td>Shielding gases used with the FCAW process</td>
<td></td>
<td>1</td>
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<tr>
<td>Test #6</td>
<td></td>
<td>1</td>
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</tbody>
</table>
Introduction to gas tungsten arc welding | 2
Power sources for GTAW | 1
GTAW electrodes | 1
Test #7 | 1
Introduction to submerged arc welding and techniques | 7-69
Submerged arc welding processes | 1
Test #8 | 1

Total Lecture Hours | 36

LAB OUTLINE:

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<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td><strong>The Oxy-Acetylene Welding and Cutting Process</strong></td>
</tr>
<tr>
<td>Demonstration of setting up and break down of equipment</td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Welding beads on plate</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
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<td>(2)</td>
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<tr>
<td>B.</td>
<td>Square butt joints</td>
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<td>(1)</td>
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<td>(2)</td>
</tr>
<tr>
<td>C.</td>
<td>Brazing beads on plate</td>
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<td>(1)</td>
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<td>(2)</td>
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<tr>
<td>D.</td>
<td>Brazing square butt joint</td>
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<td>(2)</td>
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<tr>
<td>E.</td>
<td>Oxy-acetylene cutting</td>
</tr>
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<td>(1)</td>
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<tr>
<td><strong>2</strong></td>
<td><strong>The Shielded Metal Arc Welding Process (SMAW)</strong></td>
</tr>
<tr>
<td>A.</td>
<td>Welding beads on plate</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
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<tr>
<td></td>
<td>(2)</td>
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<tr>
<td>B.</td>
<td>Welding tee joint</td>
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<tr>
<td></td>
<td>(1)</td>
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<tr>
<td></td>
<td>(2)</td>
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<tr>
<td><strong>3</strong></td>
<td><strong>The Gas Metal Arc Welding and Flux Core Welding Processes (GMAW)</strong></td>
</tr>
<tr>
<td>A.</td>
<td>Set up 3 machines each process</td>
</tr>
<tr>
<td>B.</td>
<td>Welding beads on plate, both processes</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>C.</td>
<td>Demonstration of GMAW spot welder</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td><strong>The Gas Tungsten Arc Welding Process (GTAW)</strong></td>
</tr>
<tr>
<td>A.</td>
<td>Set up machines for welding steel and aluminum (2 or 3 each)</td>
</tr>
<tr>
<td>B.</td>
<td>Welding beads on plate steel</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>C.</td>
<td>Welding bead on plate aluminum</td>
</tr>
</tbody>
</table>
(2) Have hands on with observers

5 The Submerged Arc Welding Process
A. Demonstrate beads on plate
B. Demonstrate running beads roll position
C. Let students have hands on and observation

Total Lab Hours 36

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Use Protective Equipment
      a. Wear protective safety clothing as required when welding
   2. Follow Safe Operating Procedures for Welding/Cutting Machines
      a. Identify and understand safe welding procedures
      b. Demonstrate safe welding procedures

B. PERFORM WELDING OPERATIONS
   1. Weld With Shielded Metal Arc Welding (SMAW) Process
      a. Identify factors for welding electrode selection
      b. Adjust welding amperage setting for each application
      c. Demonstrate proper use of safety equipment
      d. Weld beads on plate (flat and horizontal)
      e. Weld tee joints (flat and horizontal)
      f. Identify weld inspection factors and techniques
   2. Weld/Cut With Oxy-acetylene
      a. Setup and break down the oxy-acetylene welding/cutting station
      b. Properly adjust oxy-acetylene regulators
      c. Identify factors that determine torch welding and cutting tip selection
      d. Demonstrate routine torch maintenance procedures
      e. Weld beads on plate (with and without filler) in the flat and horizontal positions
      f. Weld square groove butt joints in the flat and horizontal positions
      g. Braze weld beads on plate in the flat position
      h. Make square cuts to a straight line with the cutting torch
      i. Demonstrate proper use of safety equipment
   3. Weld With Gas Tungsten Arc Welding (GTAW) (Heliarc)
      a. Set up GTAW welder for welding steel
      b. Set up GTAW welder for welding aluminum
      c. Weld beads on plate (steel) with appropriate filler rod in the flat position
      d. Weld beads on plate (aluminum) with appropriate filler rod in the flat position
      e. Weld lap joints in the horizontal position on steel plate
      f. Weld lap joints in the horizontal position on aluminum plate
   4. Weld With Gas Metal Arc Welding (GMAW)/(MIG)
      a. Set up machine for gas metal arc welding
b. Set up machine for flux cored arc welding

c. Weld beads on plate with gas metal arc welding system in the flat position

d. Weld beads on plate with flux cored welding system in the flat position

e. Weld lap joints on steel plate with the gas metal arc welding system in the horizontal position

f. Weld lap joints on steel plate with the flux cored arc welding system in the horizontal position

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
   1. follows a schedule to complete assigned tasks on time
   2. follows a schedule to maximize laboratory resources
   3. complete a tool crib request form for required materials and supplies

B. Interpersonal: Works with others
   1. complete assigned responsibilities within the welding lab serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. works well with all members of the class

C. Information: Acquires and uses information
   1. read and interpret weld symbols
   2. organize and apply theories of welding and cutting

D. Systems: Understands complex inter-relationships
   1. demonstrate knowledge of the following systems:
      a. organization of personnel and facilities on the shop floor
      b. systematic approach to the cutting and welding processes
      c. welding rod classification and match to various metals
      d. systematic organization of training materials
   2. monitors and corrects performance during
      a. the welding process
      b. adjustments of individual laboratory work schedule
      c. constantly evaluating the quality of work to achieve acceptable standards
E. Technology: Works with a variety of technologies
1. chooses procedure, tools and equipment required to perform the welding process
2. applies appropriate procedures and uses appropriate tools and equipment to produce a weld to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when using equipment
   c. reports all malfunctions of equipment to supervisor/instructor

II. FOUNDATION SKILLS
A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. read/studies textbook
   b. studies student laboratory manual
   c. interprets welding symbols
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to set up, properly adjust and weld/cut using different types of welding equipment
   b. maintain a lecture notebook
3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. keeps a running computation of individual grade
4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics
5. Speaking: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory
B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. analyzes requirements and makes decisions to select appropriate welding process, equipment, materials, fixturing, and protective equipment
   b. prioritizes activities for effective use of time

2. Problem Solving: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots welding problems and makes process adjustments to correct

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. visualize process during instructor lecture
   b. visualize the relative motions between welding rod and workpiece to generate desired weld patterns and weld strength as required

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. applies knowledge of material characteristics, job requirements, and welding processes to perform assignments
   b. applies knowledge of material characteristics, job requirements, and welding processes to troubleshoot and/or improve the welding process

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
   a. displays promptness and preparation for the day's work
   b. plans work to use time efficiently
   c. accepts responsibility for mistakes, and takes corrective and preventive actions
   d. takes initiative when needed to gain resources or assistance to complete assignments

2. Self-Esteem: Believes in own self-worth and maintains a positive view of self
   a. takes pride in work through positive reinforcement
   b. sees self as a valued member of the group through continued contributions toward common goals
3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. share laboratory resources (welding machines, tools and instructor's individual attention)

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process quality checks on weldments
   b. maintain a record of academic achievement (individual grade book)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

4. Hobart Audio - Visual Training Program
5. Miller Audio - Visual Training Program
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

CNC MACHINE PROGRAMMING
COURSE SYLLABUS
CNC MACHINE PROGRAMMING

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:

This course is designed to provide the student with a basic understanding of the programming of CNC machine tools using machine languages to describe machining operations/processes. The course describes the relationship between conventional and CNC machining operations and safety considerations for CNC machining centers. Principles of programming, tooling, setup and machine operations, the Cartesian coordinates system, absolute/incremental modes, word addresses, G & M codes, as well as fixed and canned cycles will be discussed.

PREREQUISITES:  Machine Tool Practices I

REQUIRED COURSE MATERIALS:

Lab Manual:  NONE

Hand Tools/Quantity Required:  Basic tool list for Machine Tool Practices I

METHODS OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture, video and demonstrations.

Laboratory:  Laboratory will include computer based exercises as well as "hands-on" programming of machining processes and setups on the Fadal milling machine center and the Okuma turning center and other machine control simulators.

Method of Evaluation:  A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments involving cnc machine codes, Cartesian coordinate system, G & M codes, fixed and canned cycles, and the basic skills used to produce a cnc program with SMARTCAM's Job Plan and Edit Plus module
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
Lecture Outline:

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7.01 Basic program structure
7.02 Turning, Facing, Boring, Drilling and Threading

Total Lecture Hours 36

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Total Lab Hours 36

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary

3. Follow Safe Operating Procedures for CNC Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation

4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS
1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
4. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut
5. Locate Machining Points from a Datum Point
   a. Identify points using the Cartesian coordinate system
   b. Identify points using the absolute dimensioning system
   c. Identify points using the incremental dimensioning system

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS
1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing
c. Identify the purpose of exploded isometric drawing
d. Identify the purpose of assembly drawings

5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints

6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)

7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records

8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards

D. PERFORM MEASUREMENT/INSPECTION
1. Select Proper Measurement Tools
   a. Match appropriate measurement tools with various types of measurement requirements
   b. Demonstrate proper measurement tool usage

2. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers
   c. Measure with direct measuring instruments (i.e., vernier, dial, and digital instruments)

E. PERFORM ADVANCED MACHINING PROCESSES
1. Prepare and Plan For CNC Machining Operations
   a. Read and interpret blueprints
   b. Plan CNC machining operations
   c. Calculate speeds, feeds, and depth of cut for various CNC machine applications
   d. Determine proper cutting fluids/coolants for CNC machining
   e. Use the Machinery's Handbook as a reference for CNC machine applications

2. Select and Use CNC Tooling Systems
   a. Understand machinability and chip formation
   b. Select proper carbide insert material and geometry needed
   c. Assemble tooling components
   d. Select correct tooling systems
   e. Identify tooling cost factors

3. Program CNC Machines
   a. Identify CNC Applications
b. List various types of CNC machines
c. Discuss CNC machine control systems
d. Describe absolute and incremental coordinate systems
e. Plan and write program for CNC mills and lathes
f. Edit CNC programs

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its “AMERICA 2000 REPORT” that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. provide a self-evaluation of performance based on the time and quality of work
   B. Interpersonal: Works with others
      1. complete assigned responsibilities within the shop floor serving as a member of the team
      2. provide individual assistance/direction to peers as requested
      3. produce machine parts to acceptable levels of quality as required
      4. works well with all members of the class
   C. Information: Acquires and uses information
      1. read and interpret blueprints
      2. organize and apply theories of machine tool operation
   D. Systems: Understands complex inter-relationships
      1. demonstrate knowledge of the following systems:
         a. laboratory organization structure: physical and social
         b. organization of personnel and facilities on the shop floor
         c. systematic approach to the metal removal process
         d. dimensioning and measurement systems
         e. systematic organization of training materials
      2. monitors and corrects performance during
         a. the machining process
         b. adjustments of individual laboratory work schedule
         c. constantly evaluating the quality of work to achieve acceptable standards
         d. maintains record of evaluations and sets individual goals
E. Technology: Works with a variety of technologies
1. chooses procedure, tools and equipment required to produce a part using CNC
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS
A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. taps and threads
   e. keeps a running computation of individual grade
   f. use trigonometry to solve angle and taper calculations
4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. Speaking: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill

d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. Problem Solving: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
2. **Self-Esteem**: Believes in own self-worth and maintains a positive view of self
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability**: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management**: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management

5. **Integrity/Honesty**: Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

Course Syllabus

Statics

150
MAST PROGRAM
COURSE SYLLABUS
STATICS

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:

This is a basic course in applied Statics and Mechanics and will prepare the student for courses in Strength of Materials and Machine Design. The student will acquire a fundamental understanding of concepts and principles which apply in the calculations of such things as: levers, structural members, inclined planes, sheaves, machined parts and structural joints. Other topics will include: coplanar forces, equilibrium of forces, structural analysis, free-body diagrams, laws of friction and the calculation of centroids and centers of gravity.

PREREQUISITES: Plane Trigonometry

REQUIRED COURSE MATERIALS:

Lab Manual: NONE

Required Materials:
Engineering paper, green
Scientific Calculator

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory assignments will require student to solve appropriate static problems.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
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</tr>
<tr>
<td>4.05</td>
<td>Ropes over Sheaves and Pulleys</td>
<td></td>
<td></td>
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<tr>
<td>4.06</td>
<td>Stresses in Trusses; Analytical</td>
<td></td>
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</tbody>
</table>
4.07 Method of Joints
Stresses in Trusses; the Graphical Method of Joints

112-118

4.08 Stresses in Trusses; the Graphical Method of Combined Diagrams

112-118

4.09 Three-force Members

4.10 Graphical Determination of Reactions Using Three-force Principle

Unit 5 Coplanar, Nonconcurrent Force Systems

5.01 Resultant of Coplanar, Nonconcurrent Force Systems

62-119

5.02 Equilibrium of Coplanar, Nonconcurrent Force Systems

62

5.03 Determination of Reactions; Graphical String-polygon Method

93

5.04 Determination of Reactions; Analytical Method

112-118

5.05 Pin Reactions; the Method of Members

5.06 Stresses in Trusses; the Method of Sections

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5.07 Counter Diagonals in Trusses

Unit 6 Noncoplanar, Parallel Force Systems

6.01 Resultant of a Noncoplanar, Parallel Force Systems

75-105

6.02 Equilibrium of Noncoplanar, Parallel Force System

Unit 7 Noncoplanar, Concurrent Force Systems

7.01 Components of a Force in Space

75-105

7.02 Equilibrium of Noncoplanar, Concurrent Force Systems

Unit 8 Noncoplanar, Nonconcurrent Force Systems

8.01 Equilibrium of Noncoplanar, Nonconcurrent Force Systems

75-105

8.02 Equilibrium of Noncoplanar, Nonconcurrent Force Systems

93

Unit 9 Friction

9.01 Coefficient of Friction, Angle of Friction, and Angle of Repose

143-146

9.02 Laws of Friction

144

9.03 Friction Problems

147

9.04 Belt Friction

165

9.05 Rolling Resistance

Total Lecture Hours 36
LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Mechanics</td>
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</tr>
<tr>
<td>Basic Principles of Statics</td>
<td>6</td>
</tr>
<tr>
<td>Coplanar, Parallel Force Systems</td>
<td>3</td>
</tr>
<tr>
<td>Coplanar, Concurrent Force Systems</td>
<td>6</td>
</tr>
<tr>
<td>Coplanar, Nonconcurrent Force Systems</td>
<td>4</td>
</tr>
<tr>
<td>Noncoplanar, Parallel Force Systems</td>
<td>3</td>
</tr>
<tr>
<td>Noncoplanar, Concurrent Force Systems</td>
<td>3</td>
</tr>
<tr>
<td>Noncoplanar, Nonconcurrent Force Systems</td>
<td>3</td>
</tr>
<tr>
<td>Friction</td>
<td>6</td>
</tr>
</tbody>
</table>

Total Lab Hours 36

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals

2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions

3. Interconvert Metric/English measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart

4. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides

5. Solve Static Systems for Resultant Forces
   a. Solve for the following coplanar force systems: parallel, concurrent and nonconcurrent
   b. Solve for the following Noncoplanar force systems: parallel, concurrent and nonconcurrent

6. Solve Engineering Equations
   a. Solve linear algebraic equations for an unknown
   b. Solve a system of linear equations with 2 unknowns
   c. Solve right triangles for unknown sides or angles
   d. Use the law of sines and cosines to solve obtuse triangles with unknown sides and angles
   e. Calculate factors of Friction

7. Use all Functions of a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
C. Apply all statistical functions

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. provide a self-evaluation of performance based on the time and quality of work
   B. Interpersonal: Works with others
      1. complete assigned responsibilities within the class serving as a member of the team
      2. provide individual assistance/direction to peers as requested
   C. Information: Acquires and uses information
      1. read and interpret blueprints
      2. organize and apply theories of mechanics, forces and friction
   D. Systems: Understands complex inter-relationships
      1. demonstrate knowledge of the following systems:
         a. laboratory organization structure: physical and social
         b. systematic organization of training materials
      2. monitors and corrects performance during
         a. adjustments of individual laboratory work schedule
         b. constantly evaluating the quality of work to achieve acceptable standards
         c. maintains record of evaluations and sets individual goals
   E. Technology: Works with a variety of technologies
      1. chooses procedure and formulas necessary for problem solving.

II. FOUNDATION SKILLS
   A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
      1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
         a. studies student laboratory manual
         b. interprets diagrams and technical drawings
         c. read/studies textbook
2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary for problem solving
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. add, subtract, multiply and divide whole numbers
   b. add, subtract, multiply, and divide fractions
   c. add, subtract, multiply, and divide decimals
   d. convert fractions to decimal equivalents
   e. convert decimal values to nearest fractional equivalent
   f. use Decimal Equivalent Chart for conversions
   g. convert English dimensions to Metric
   h. convert Metric dimensions to English
   i. use Metric/English conversion chart
   j. solve for unknown angles
   k. solve for unknown sides
   l. solve for the following coplanar force systems: parallel, concurrent and nonconcurrent
   m. solve for the following noncoplanar force systems: parallel, concurrent and nonconcurrent
   n. solve linear algebraic equations for an unknown
   o. solve a system of linear equations with 2 unknowns
   p. solve right triangles for unknown sides or angles
   q. use the law of sines and cosines to solve obtuse triangles with unknown sides and angles
   r. calculate factors of friction
   s. apply all trigonometric calculator functions
   t. apply all algebraic calculator functions
   u. apply all statistical calculator functions
   v. calculates coplanar, parallel force systems

4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. observe laboratory demonstrations
   c. seek and receive individualized instruction in the laboratory

5. **Speaking:** Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill

**B. Thinking Skills:** Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.
1. **Decision Making:** Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. **Problem Solving:** Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. **Seeing Things In the Mind's Eye:** Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. **Knowing How to Learn:** Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. **Reasoning:** Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the technician

C. **Personal Qualities:** Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.
1. **Responsibility:** Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. **Self-Esteem:** Believes in own self-worth and maintains a positive view of self
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
a. assist classmates in improving technical skills
b. assist students with special needs as a peer mentor

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process checks on calculations
   b. maintain a record of academic achievement (individual gradebook)
   c. accept the responsibility for self-management

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**


MET206
01/072396
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

MANUFACTURING PROCESSES
MAST PROGRAM
COURSE SYLLABUS
MANUFACTURING PROCESSES

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:
Essential studies into the processes and materials for manufacturing, including metal casting, hot and cold forming of steel, powder metallurgy and plastics. Analysis of newer processes such as electrical discharge machining, chemical machining, and ultra-sonic machining; with a emphasis on the economical manufacturing of products.

PREREQUISITES: NONE

REQUIRED COURSE MATERIALS:

Lab Manual: None Required
Student Tool List: Safety glasses

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will consist of "hands-on" activities. Students will operate various conventional metalworking machines to manufacture a product.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual
LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to the Course</td>
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<td></td>
</tr>
<tr>
<td>The Manufacturing Industry</td>
<td>21</td>
<td>3</td>
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<tr>
<td>Material Resource Planning (MRP)</td>
<td>25</td>
<td>2</td>
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<tr>
<td>Processing of Metals: Casting</td>
<td>7</td>
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<tr>
<td>Processing of Metals: Hot Working</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Processing of Metals: Cold Working</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td><strong>QUIZ I</strong></td>
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<tr>
<td>Powder Metallurgy</td>
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<td>2</td>
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<tr>
<td>Non-traditional Machining Processes</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Plastics &amp; Composite Processes</td>
<td>15</td>
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</tr>
<tr>
<td><strong>QUIZ II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joining Processes</td>
<td>14</td>
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</tr>
<tr>
<td>Corrosion &amp; Protection for Materials</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Design, Tooling &amp; Production Lines</td>
<td>18</td>
<td>5</td>
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<tr>
<td><strong>QUIZ III</strong></td>
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<td><strong>Total Lecture Hours</strong></td>
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LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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<tbody>
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</tr>
<tr>
<td>Lab Sheet #1 - Stock preparation; measure (semi-precision), shear and debur</td>
<td>3</td>
</tr>
<tr>
<td>Lab Sheet #2 - Layout, drill, ream and debur holes</td>
<td>3</td>
</tr>
<tr>
<td>Lab Sheet #3 - Metal forming (bending) and countersinking holes</td>
<td>3</td>
</tr>
<tr>
<td>Lab Sheet #4 - Metal joining (welding), stress relieving and sawing</td>
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</tr>
<tr>
<td>Mid-term project evaluation and rework</td>
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</tr>
<tr>
<td>Lab Sheet #5 - Surface preparation (sand blast) and surface finish (paint)</td>
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<tr>
<td>CNC stock preparation</td>
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<tr>
<td>CNC Machining Demonstration and CIM Lab Demonstration</td>
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</tr>
<tr>
<td>Lab Sheet #6 - Component sub-assembly and precision machining activity</td>
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</tr>
<tr>
<td>Lab Sheet #7 - Sub-assembly manufacture (handle)</td>
<td>3</td>
</tr>
<tr>
<td>Lab Sheet #8 - Final assembly and test (final project evaluation)</td>
<td>3</td>
</tr>
<tr>
<td>Lab clean-up</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Lab Hours</strong></td>
<td>36</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. **PRACTICE SAFETY**
   1. Follow Safe Operating Procedures for Hand and Machine Tools
      a. Identify and understand safe machine operating procedures
      b. Demonstrate safe machine operation

B. **INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS**
   1. Describe the Relationship of Engineering Drawings to Planning
a. Discuss production schedule
b. Discuss Material Resource Planning (MRP)
c. Discuss inventory control records
d. Discuss shop floor routing documents

2. Use Standards to Verify Requirements
a. Discuss the purpose of standards
b. Discuss source locations for standards

3. Analyze Bill of Materials (BOM)
a. Discuss components found on BOM
b. Determine materials needed to produce the part
c. Determine quantities necessary to produce the part
d. Submit completed stock request form as required
e. Submit completed tool request form as needed

C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES
1. Identify Materials With Desired Properties
a. Discuss classification system for metals
b. Describe general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary’s Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its “AMERICA 2000 REPORT” that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
   1. follows a schedule to complete assigned tasks on time
   2. follows a schedule to maximize laboratory resources
   3. determine the initial cost of materials and “value added” as result of processing

B. Interpersonal: Works with others
   1. complete assigned responsibilities within the manufacturing lab serving as a member of the team
   2. provide individual assistance/direction to peers as requested

C. Information: Acquires and uses information
   1. read and interpret blueprints
   2. organize and apply theories of manufacturing processes
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. organization of personnel and facilities in the manufacturing lab
   b. systematic approach to the production process
   c. dimensioning and measurement systems
2. monitors and corrects performance during
   a. the manufacturing process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

E. Technology: Works with a variety of technologies
1. chooses procedure, tools and equipment required to fabricate a product
2. applies appropriate procedures and uses appropriate tools and equipment to fabricate a part to referenced engineering standards

II. FOUNDATION SKILLS
A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. read/studies textbook
   b. studies student laboratory exercises
   c. interprets blueprints and technical drawings
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce simple product
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. calculate bend allowances for sheet metal and metal plate
   b. keeps a running computation of individual grade
4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics
5. Speaking: Organizes ideas and communicates orally
   a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor

c. verbally affirms understanding of a concept, procedure, or required skill

d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. applies knowledge of process and materials to select appropriate material and process for safe and economical service in a given application
   b. prioritizes activities for effective use of time

2. Problem Solving: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots manufacturing processes and equipment
   d. recognizes problems in manufacturing and selects appropriate corrective or preventive action

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. visualize objects in three dimensions from engineering drawings
   b. visualize process during instructor lecture
   c. visualize the capabilities of various manufacturing processes and machine tools to generate desired features in raw stock in order to manufacture a simple product

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. apply general understanding of process and material characteristics to determine the process by which a part or piece of stock has been made
   b. applies knowledge of manufacturing materials and processes to develop a logical, sequential process plan
   c. apply broad understanding of processes, materials, product requirements, and manufacturing economics to consider and apply new or alternative techniques to reduce costs, save time and improve quality

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
   a. displays promptness and preparation for the day's work
b. plans work to use time efficiently
c. accepts responsibility for mistakes, and takes corrective and preventive actions
d. takes initiative when needed to gain resources or assistance to complete assignments

2. **Self-Esteem: Believes in own self-worth and maintains a positive view of self**
   a. takes pride in work through positive reinforcement
   b. sees self as a valued member of the group through continued contributions toward common goals

3. **Sociability: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings**
   a. assist classmates in improving technical skills
   b. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control**
   a. perform in-process quality checks on manufactured component parts
   b. maintain a record of academic achievement (individual grade book)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them

5. **Integrity/Honesty: Chooses ethical courses of action**
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

MAST PROGRAM
COURSE SYLLABUS
INTRODUCTION TO COMPUTER DRAFTING

Lecture hours/week: 1  Lab hours/week: 4  Credit hours: 2

COURSE DESCRIPTION:

This course introduces the student to computer-aided drafting (CAD). This introduction involves equipment, software, and basic command logic. Graphic images are created using introductory level commands.

PREREQUISITES:  NONE

REQUIRED COURSE MATERIALS:

Textbook:  AutoCAD and Its Applications, Terence Shumaker/David A. Madsen

Materials:  
2 - HHDS 3 ½" diskettes
1 Ream of plain bond paper (20lb)
Notebook Paper
Felt tip pen
1 Pkg Calcomp Plotter Pens - Assorted Colors

METHODS OF INSTRUCTION:

Lecture:  Classroom presentations will include lecture, video and demonstrations. Computer assisted instruction will be used.

Laboratory:  Laboratory will be a "hands-on" drawing process using computer hardware, software, plotters and printers.

Method of Evaluation:  A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student’s ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
follow all safety regulations as stated in the class policies

**LECTURE OUTLINE:**

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
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<td>Introduction to Course</td>
<td>Handout</td>
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<tr>
<td>Required Materials and Tests</td>
<td>Handout</td>
<td></td>
</tr>
<tr>
<td>Class Policies and Safety Concerns</td>
<td>Appendix B, 1</td>
<td></td>
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<tr>
<td>System Orientation</td>
<td>Chapters 2, 3, 4, 5</td>
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<tr>
<td>Operating Parameters and Drawing Aids</td>
<td>Chapters 6</td>
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<tr>
<td>Cartesian Coordinates</td>
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<tr>
<td>Display Commands</td>
<td>Chapters 6, 7, 8, 13</td>
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<tr>
<td>Draw Commands</td>
<td>Chapters 11, 12</td>
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<tr>
<td>Edit Commands</td>
<td>Chapter 10</td>
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<tr>
<td>Text Commands</td>
<td>Chapter 14</td>
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<tr>
<td>Inquiry Commands</td>
<td>Chapter 15, 35</td>
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<tr>
<td>DOS/Utility Commands</td>
<td>Chapter 27</td>
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<tr>
<td>Plot Specifications</td>
<td>Chapter 17</td>
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<tr>
<td>Layer Command</td>
<td>Chapter 21</td>
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<tr>
<td>Blocks</td>
<td>Chapter 18</td>
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<tr>
<td>Dimensioning</td>
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<tr>
<td>Manufacturing/CAD Project</td>
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Total Lecture Hours 12

**LAB OUTLINE:**

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Orientation</td>
<td>2</td>
</tr>
<tr>
<td>Operating Parameters</td>
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<td>Cartesian Coordinates</td>
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<tr>
<td>Displaying Different Views</td>
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<tr>
<td>Drawing Entities</td>
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<tr>
<td>Editing Existing Entities</td>
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<tr>
<td>Text on the Drawings</td>
<td>2</td>
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<tr>
<td>Inquiry - Obtaining Database Information</td>
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<tr>
<td>DOS/Utility Commands</td>
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</tr>
<tr>
<td>Plotting</td>
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<tr>
<td>Using Layers</td>
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<tr>
<td>Creating Blocks</td>
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<tr>
<td>Dimensioning Drawings</td>
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<tr>
<td>Project</td>
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</tbody>
</table>

Total Lab Hours 48

168
COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Follow Safety Requirements
      a. Assume responsibility for the personal safety of oneself and others
      b. Develop a personal attitude towards safety
      c. Comply with established safety practices
      d. Use special caution with magnetic media
   2. Maintain a Clean and Safe Work Environment
      a. Observe computer lab hygiene
      b. Put equipment and supplies away when work is finished

B. APPLY MATHEMATICAL CONCEPTS
   1. Use Inquiry Commands to Perform Basic Addition and Subtraction
   2. Use Inquiry Commands to Find Area, Length and Distance
   3. Apply Basic Concepts of Geometry Using CAD Software
   4. Convert English Dimensions to Metric

C. APPLY DRAFTING CONCEPTS TO COMPUTER AIDED DRAFTING
   1. Identify the Equipment Used in Computer Aided Drafting
   2. Describe the Methods and Procedures Used to Produce Cad Drawings

D. ESTABLISH AND USE OPERATING PARAMETERS
   1. Use Dos Commands to Manage Drawing Files
   2. Describe and Use Menus and Screen Prompts
   3. Set UNITS
   4. Set LIMITS
   5. Set GRID
   6. Set SNAP
   7. Establish a Prototype Drawing
   8. Open, Close and Save Files
   9. Use ORTHO to Create Lines at Right Angles

E. USE CARTESIAN COORDINATE POINT ENTRY SYSTEMS
   1. Create Drawings Using Absolute Coordinates
   2. Create Drawings Using Relative Coordinates
   3. Create Drawings Using Polar Coordinates
   4. Determine Which System Is Most Efficient for Each Application

F. USE DISPLAY COMMANDS TO VIEW DRAWINGS
   1. Enlarge or Reduce the Amount of Drawing Displayed on the Monitor Using Zoom Options
   2. Redraw the Screen to Clean up Clutter
   3. Specify and Save Certain Views on a Drawing
   4. Manipulate Your View of the Drawing Without Changing the Magnification

G. USE CAD COMMANDS TO CREATE DRAWINGS
   1. Determine Most Efficient Sequence of Commands to Produce Required Object
   2. Use Standard Line Types to Indicate Drawing Features
   3. Use POLYLINES to Show Width And/or Taper
4. Draw Circles Using the CIRCLE Command Options
5. Draw Arcs Using the ARC Command Options
6. Use Ellipses, Polygons and Doughnuts to Represent Drawing Features
7. Use OSNAPS to Create Accurate Geometry
8. Use ARRAY to Create Rectangular and Circular Repetitions

H. USE CAD COMMANDS TO EDIT DRAWINGS
1. Create Angled Corners Using the CHAMFER Command
2. Create Rounded Corners Using the FILLET Command
3. Remove Portions of Entities Using the BREAK Command
4. Change the Location of an Entity
5. Use TRIM and EXTEND to Shorten or Lengthen an Object
6. Use COPY to Create Duplicates of Existing Objects
7. Change Angular Position of Objects
8. Use the STRETCH and SCALE Commands to Change to Size Length and Height of an Object

I. PLACE TEXT ON A DRAWING
1. Use the Text Command to Add Notes and Callouts to a Drawing
2. Set Text Style
3. Draw Special Symbols Using Control Characters
4. Underscore and Overscore Text
5. Edit Existing Text

J. OBTAIN INFORMATION ABOUT A DRAWING
1. Determine the Area of an Object by Adding and Subtracting Entities
2. List Database Information Related to Entities and Drawings
3. Track Time Spent in a Drawing Session

K. USE DOS/UTILITY COMMANDS TO MANAGE FILES
1. Explain the Meaning and Use of DOS File Extensions
2. List Files Using FILE UTILITIES
3. Copy, Rename and Delete Files Using FILE UTILITIES
4. Format, Label and List Contents of Disks Using DOS Commands
5. Copy, Rename, and Delete Files Using DOS Commands

L. PRODUCE PLOTTED COPIES OF DRAWINGS
1. Set up Plotter
   a. Load media
   b. Load pens
2. Set up Parameters Within a Drawing File for Plotting

M. USE LAYERS TO SEPARATE DETAILS OF A DESIGN
1. Name and Create Layers
   a. Select colors
   b. Set linetypes
2. Set Layers
3. Control Visibility of Layers
4. Lock Layers
5. Freeze Layers
6. Rename Layer
The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. **Resources:** Identifies, organizes, plans, and allocates resources
   1. follows a schedule to complete assigned tasks on time
   2. determine the appropriate media and instruments to complete assignments
   3. provide a self-evaluation of performance based on the time and quality of work

B. **Interpersonal:** Works with others
   1. complete assigned responsibilities within the course serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. produce drawings to acceptable levels of quality as required
   4. works well with all members of the class

C. **Information:** Acquires and uses information
   1. reads and interprets text and handouts
   2. organizes and applies theories of drafting and design
   3. applies lecture concepts to lab techniques
D. **Systems:** Understands complex inter-relationships

1. demonstrates knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities in the computer drafting lab
   c. systematic approach to the drafting and design process
   d. dimensioning and measurement systems
   e. systematic organization of training materials

2. monitors and corrects performance
   a. during the drawing process
   b. making adjustments to individual laboratory work schedules
   c. while constantly evaluating the quality of work to achieve acceptable standards
   d. though maintaining a record of evaluations
   e. to meet individual goals

E. **Technology:** Works with a variety of technologies

1. chooses, procedures media and supplies required to produce a drawing
2. applies appropriate procedures and uses appropriate tools and equipment to produce a drawing to acceptable standards
3. maintains and troubleshoots equipment and tools
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. performs clean-up assignments of lab

II. **FOUNDATION SKILLS**

A. **Basic Skills:** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. interprets technical drawings
   b. reads/studies concepts in textbook
   c. follows a daily laboratory schedule to maintain appropriate timeline to meet scheduled deadlines
   d. interprets concepts in texts to develop accurate drawings

2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outlines the steps necessary to produce a simple drawing
   b. sketches object to produce a final drawing
   c. maintains a schedule of assignments and deadlines (these may take the form of a chart, graph, etc.)
   d. maintains a lecture notebook
   e. submits written responses to chapter question assignments
   f. completes all written assignments
3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. bisects lines, circles, arcs and angles
   b. divides objects into equal parts
   c. applies tolerances
   d. applies and verify dimensions
   e. uses fraction and decimal values
   f. applies principles of trigonometry and geometry to solve angle calculations and tangencies and to define points

4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilates concepts presented by lecture, video or any multimedia methods
   b. observes laboratory demonstrations for technique and safety instructions
   c. seeks and receive individualized instruction in the laboratory
   d. actively listens and participates in discussions and question/answer sessions

5. **Speaking:** Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organizes ideas and communicates specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the efficient and safe completion of assignments

B. **Thinking Skills:** Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reason.

1. **Decision Making:** Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. prioritizes goals
   c. identifies specific actions required to accomplish personal goals
   d. allows for flexibility in meeting goals as circumstances change

2. **Problem Solving:** Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. **Seeing Things In the Mind's Eye:** Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. understands both written and verbal instructions
   b. assimilates process during instructor demonstrations
c. interprets technical drawings
d. interprets technical illustrations and symbols
e. interprets and applies geometric construction concepts

4. **Knowing How to Learn:** Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrates mastery of the basic skills and techniques
   b. uses these sequential skills to support mastery of new skills
   c. consistently applies the sequential nature of acquired skills to the subsequent knowledge application of new skills and techniques

5. **Reasoning:** Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice will improve the skill of the technician
   b. understands that the quality of the product is a function of time spent and the attitude and skill of the technician

C. **Personal Qualities:** Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility:** Exerts a high level of effort and perseveres towards goal attainment
   a. attends class as scheduled and is well prepared for the day’s work
   b. completes assignments independently and on time
   c. works well within a team while completing individual assignments

2. **Self-Esteem:** Believes in own self-worth and maintains a positive view of self
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assists classmates in improving technical skills
   b. assists students with special needs as a peer mentor
   c. shares laboratory resources (computers, plotters and instructor’s individual attention)

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. performs in-process quality checks on CAD drawings
   b. maintains a record of academic achievement (individual gradebook)
   c. maintains a schedule of deadlines, due dates, and other important dates (calendar)
   d. adjusts calendar to accommodate unexpected circumstances
   e. accepts the responsibility for self management
5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accepts responsibility for own actions
   b. exhibits personal honesty at all times
   c. accepts the challenge of doing his/her own work in the laboratory, during examination and on outside assignments
   d. understands the consequences of unethical behaviors
MAST PROGRAM
COURSE SYLLABUS
CAD/CAM I

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:

Student will introduced to "Process Modeling" utilizing a CNC graphics programming system called "SMARTCAM". Using engineering drawings, students will program various parts for both CNC mills and CNC lathes. Related topics include: job planning, tool selection, process model construction, tool path verification, machine simulation, quality control, CAD/CAM transfer and CNC code generation.

PREREQUISITES: NONE

REQUIRED COURSE MATERIALS:

Textbook: SMARTCAM-2D, Pelton, TSTC Pub., 2nd Ed.
Lab Manual: NONE

Materials and/or Supplies: 2 - double sided, high density 3 ½" floppy diskettes

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, overheads and SMARTCAM and related software demonstrations.

Laboratory: Laboratory will be a "hands-on" (computer based) process modeling using the SMARTCAM System.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. demonstrate the ability to use DOS commands
2. create a basic procedure for machining a part on a machine center and a turning center, including: machine tool selection, tool selection and application, operational sequences, speeds, feeds and depth of cuts and tool length offsets
3. develop job plans using SMARTCAM
4. demonstrate the ability to develop a SHAPE file in the SMARTCAM graphics system
5. demonstrate the ability to manipulate files to successfully complete a graphics project within a CAM system
6. create part profiles and part geometry to produce accurately coded information for both CNC lathes and mills
7. utilize plotters and printers to produce accurate documents
8. perform and demonstrate the ability to transfer CAD files to CAM files and CAM files to CAD files
9. generate a tool path from CAD to CAM files
10. edit a tool path from a CAD file and proof the tool path from a CAD file.
11. satisfactorily perform on written, oral, and practical examinations
12. satisfactorily perform on outside assignments including writing assignments
13. contribute to class discussions
14. maintain attendance per current policy

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topic</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td>Unit 1</td>
<td><strong>CNC/CAD/CAM Overview</strong>&lt;br&gt;1.01 Description of CNC&lt;br&gt;1.02 Computer Systems Review&lt;br&gt;1.03 Job Opportunities in the CAM Field&lt;br&gt;1.04 Employability Skills in CAM</td>
<td></td>
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<tr>
<td>Unit 2</td>
<td><strong>The Structure of a CAM System</strong>&lt;br&gt;2.01 From Print to Part&lt;br&gt;2.02 The Graphical User Interface&lt;br&gt;2.03 Working with SMARTCAM's Display Areas</td>
<td>5-6</td>
</tr>
<tr>
<td>Unit 3</td>
<td><strong>Process Planning (Mill)</strong>&lt;br&gt;3.01 Interpreting a Part Print&lt;br&gt;3.02 Creating a Job Sheet from a Part Print&lt;br&gt;3.03 Entering Tool Information into the Job Plan</td>
<td>11-18</td>
</tr>
<tr>
<td>Unit 4</td>
<td><strong>Working with a CNC Process Model (Mill)</strong>&lt;br&gt;4.01 Starting a CNC Process Model&lt;br&gt;4.02 Roughing and Finishing an Existing Process Model&lt;br&gt;4.03 Modifying Existing Geometry&lt;br&gt;4.04 Methods for Creating Geometry for the Process Model</td>
<td>19-24; 37-42</td>
</tr>
<tr>
<td>Unit 5</td>
<td><strong>Generating CNC Code with a CAM System</strong>&lt;br&gt;5.01 Basic NC Code Structure&lt;br&gt;5.02 Locating the Data Source for Code Generation&lt;br&gt;5.03 How a CAM System Generates CNC Code</td>
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<thead>
<tr>
<th>Unit 6</th>
<th>Additional Modeling Practices</th>
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<td>6.01 Pocketing and Facing with Islands/Notches, etc.</td>
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<tr>
<td>6.02 Re-sequencing Machining Operations</td>
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<td>6.03 Rotate, Move, Copy, Mirror and Scale Commands</td>
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<tr>
<th>Unit 7</th>
<th>Process Planning (Lathe)</th>
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<td>7.01 CNC Lathe Coordinate Systems</td>
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<td>7.02 Carbide Tooling for CNC Lathes</td>
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<tr>
<td>7.03 Entering Tool Information into the Job Plan</td>
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<tr>
<th>Unit 8</th>
<th>Working with a CNC Process Model (Lathe)</th>
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<tbody>
<tr>
<td>8.01 Turning, Facing, Boring and Drilling</td>
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<td></td>
<td>Review for Quiz 3</td>
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<thead>
<tr>
<th>Unit 9</th>
<th>Additional Modeling Practices</th>
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<tbody>
<tr>
<td>9.01 Threading Cycles and Grooving Cycle</td>
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<tr>
<td>9.02 Roughing for Turning and Facing Operations</td>
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<thead>
<tr>
<th>Unit 10</th>
<th>Working with CAD Geometry</th>
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<tr>
<td>10.01 Conventions of CAD Geometry</td>
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<tr>
<td>10.02 Using a CAM System to Transfer CAD Geometry</td>
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<tr>
<td>10.03 Working with CAD Geometry in a CAM System</td>
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<tr>
<td>10.04 Transferring a CNC Process Model to a CAD System</td>
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**LAB OUTLINE:**

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td>Job Plan</td>
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<tr>
<td>“Tryit” Exercises 1 thru 5</td>
<td>2</td>
</tr>
<tr>
<td>Simple Part Profile (Mill 1)</td>
<td>2</td>
</tr>
<tr>
<td>Simple Part Profile (Mill 2)</td>
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<tr>
<td>Profile with Roughing (Mill 3)</td>
<td>2</td>
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<tr>
<td>Using Multiple Tools (Mill 4)</td>
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</tr>
<tr>
<td>Using Multiple Tools and Roughing (Mill 5)</td>
<td>2</td>
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<tr>
<td>Using Layers, Islands and Rough Facing (Mill 6)</td>
<td>3</td>
</tr>
<tr>
<td>Rough Processing (Mill 7)</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Lecture Hours 36
COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS
   1. Perform Basic Arithmetic Functions
      a. Add, subtract, multiply and divide whole numbers
      b. Add, subtract, multiply, and divide fractions
      c. Add, subtract, multiply, and divide decimals
   2. Interconvert Fractions/Decimals
      a. Convert fractions to decimal equivalents
      b. Convert decimal values to nearest fractional equivalent
      c. Use Decimal Equivalent Chart for conversions
   3. Interconvert Metric/English measurements
      a. Convert English dimensions to Metric
      b. Convert Metric dimensions to English
      c. Use Metric/English conversion chart
   4. Utilize Trigonometric Functions
      a. Solve for unknown angles
      b. Solve for unknown sides
   5. Calculate Speeds and Feeds for Machining Using SMARTCAM's Job Plan Module
      a. Calculate RPM for various metals and various tools
      b. Calculate feed for various metals, tools, and depths of cut
   6. Locate Machining Points from a Datum Point
      a. Identify points using the Cartesian coordinate system
      b. Identify points using the absolute dimensioning system
      c. Identify points using the incremental dimensioning system

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS
   1. Review Blueprint Notes and Dimensions
      a. Interpret basic blueprint terminology
      b. Identify the types of dimensions
      c. Identify general note symbols
      d. Locate notes on a print
      e. Interpret commonly used abbreviations and terminology
      f. Determine tolerances associated with dimensions on a drawing
      g. Determine the tolerance for a reference dimension
      h. Determine the surface finish for a given part
      i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Interpret the meaning of lines used within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. Identify the components found in the revision block

3. Identify Basic Types of Drawings
   a. Interpret information found in orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings

4. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints

5. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)

6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records

7. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS & PROCESSES
   1. Identify Materials With Desired Properties
      a. Discuss classification system for metals

D. PERFORM ADVANCED MACHINING PROCESSES
   1. Prepare and Plan For CNC Machining Operations
      a. Read and interpret blueprints
      b. Plan CNC machining operations
      c. Calculate speeds, feeds, and depth of cut for various CNC machine applications
      d. Determine proper cutting fluids/coolants for CNC machining
      e. Use the Machinery's Handbook as a reference for CNC machine applications

2. Select and Use CNC Tooling Systems
a. Understand machinability and chip formation
b. Select proper insert materials and geometry
c. Assemble tooling components
d. Select correct tooling systems
e. Identify tooling cost factors

3. Program CNC Machines
a. Identify CNC applications
b. List various types of CNC machines
c. Discuss CNC machine control systems
d. Describe absolute and incremental coordinate systems
e. Plan and write programs for CNC lathes
f. Plan and write programs for CNC mills

4. Operate CNC Machining Centers (Mills)
a. Install and align work holding devices
b. Load/align materials into the machine
c. Load tools into machine
d. Establish tool length offset for each tool
e. Establish/set machine reference
f. Load programs into CNC mill
g. Demonstrate working knowledge of all controls on the MCU
h. Demonstrate proper operation of CNC machining center to include "dry run" and final production
i. Edit CNC programs for optimum part production
j. Operate machine in DNC mode if that capability exists

5. Download Programs Via Network
a. Download programs from the network
b. Upload programs to the network
c. Perform edit and print functions via network

6. Program CNC Machines using a CAM system
a. Create Job Plan for machining operations
b. Construct part geometry
c. Program tool path for roughing and finishing operations
d. Verify tool path
e. Generate CNC code

E. USE COMPUTERS
1. Use Computer Operating Systems
a. Use basic computer terminology appropriately and accurately
b. Boot the computer and recognize the basic components of DOS
c. Use DOS to perform file management
d. Use DOS to perform directory management

COURSE OBJECTIVES: SCANS COMPETENCIES

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made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of machining
   3. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
   1. complete assigned responsibilities within the shop floor serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. produce machine parts to acceptable levels of quality as required
   4. works well with all members of the class

C. Information: Acquires and uses information
   1. read and interpret blueprints
   2. organize and apply theories of machine tool operation

D. Systems: Understands complex inter-relationships
   1. demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities on the shop floor
      c. systematic approach to the metal removal process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the machining process
      b. adjustments of individual laboratory work schedule
      c. constantly evaluating the quality of work to achieve acceptable standards
      d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies
   1. chooses procedure, tools and equipment required to produce a part
   2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
   3. maintains and troubleshoots equipment
      a. applies appropriate preventative maintenance
      b. when operating machines

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. taps and threads
   d. keeps a running computation of individual grade
   e. interconverts fractions to decimal expressions

4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. **Speaking:** Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. **Thinking Skills:** Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. **Decision Making:** Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. **Problem Solving:** Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. **Seeing Things In the Mind's Eye:** Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. **Knowing How to Learn:** Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. **Reasoning:** Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. **Personal Qualities:** Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility:** Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. **Self-Esteem:** Believes in own self-worth and maintains a positive view of self
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

1. SMARTCAM Advanced 3-D Machining Reference Manual
3. Machine Tool Catalogs
COURSE SYLLABUS

TOOL DESIGN I
Prerequisite: MACHINE TOOL PRACTICES I
MAST PROGRAM
COURSE SYLLABUS
TOOL DESIGN I

Lecture hours/week: 2 Lab hours/week: 3 Credit hours: 3

COURSE DESCRIPTION:

Students will be assigned specific machining problems involving tool and die design concepts. These projects will be machined using the engine lathe, milling machine, drill press, band saws, surface grinders and various hand tools. Design simplification thru utilization of commercially available hardware vs. special non standard items and the safe use of machine tools will be stressed.

PREREQUISITES: Machine Tool Practices I and Drafting Principles

REQUIRED COURSE MATERIALS:


Hand Tools/Quantity Required:
Tool Box
Safety Glasses 1 pair
6 inch Ruler 1/8, 1/16, 1/32, and 1/64 inch
Ball Peen Hammer 1
10 inch Adjustable Wrench 1
Center Punch 1
Magic marker, Jumbo, black. 1
Aluminum Oxide Cloth, 9" X 11", 240 Grit 2 sheets
Aluminum Oxide Cloth, 9" X 11", 320 Grit 2 sheets
Tool Steel, 3/8", H.S.S. 2
Flat Mill Bastard File, 10 inch. 1
File Handle 1
Allen Wrench Set, Long English and Metric 1 each
Center Drill #3 1
Scribe 1
Center Gage 1
Screw Driver, 8 inch 1
File Card Brush 1
0-6 inch Dial Calipers 1
Shop Apron (blue denim) 1
Shop Towels (1 roll) 1
METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theories of design considerations to laboratory assignments involving design and production of jigs, fixtures and other production tooling
3. demonstrate a knowledge of alternate manufacturing processes by selecting processes that reduce or eliminate primary and/or secondary machining operations
4. satisfactorily perform on written, oral, and practical examinations
5. satisfactorily perform on outside assignments including writing assignments
6. contribute to class discussions
7. maintain attendance per current policy
8. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
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</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Introduction to Tool Design</td>
<td>1-5TD</td>
<td></td>
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<tr>
<td>Unit 2</td>
<td>Safety</td>
<td>1-13MTP</td>
<td></td>
</tr>
<tr>
<td>Unit 3</td>
<td>Tool Grinding</td>
<td>436-443MTP</td>
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<tr>
<td>Unit 4</td>
<td>Review Measuring Tools</td>
<td>113-186MTP</td>
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<td>Unit 5</td>
<td>Review Machine Tools and Operations</td>
<td></td>
<td></td>
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<tr>
<td>5.01</td>
<td>The Drill Press</td>
<td>365-402MTP</td>
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<tr>
<td>5.02</td>
<td>Engine Lathes</td>
<td>429-535MTP</td>
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<tr>
<td>5.03</td>
<td>Vertical Milling Machines</td>
<td>553-577MTP</td>
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<tr>
<td>Unit 6</td>
<td>Introduction to Surface Grinding</td>
<td>671-719MTP</td>
<td></td>
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<tr>
<td>Unit 7</td>
<td>Special Tooling</td>
<td>26-112TD</td>
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<tr>
<td>Unit 8</td>
<td>Problems Resulting from Design</td>
<td>3-6TD</td>
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<tr>
<td>Unit 9</td>
<td>Toolmaker Practices</td>
<td>26-128TD</td>
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<tr>
<td>Unit 10</td>
<td>Tooling Materials and Heat Treatment</td>
<td>162-202TD</td>
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<tr>
<td>Unit 11</td>
<td>Location and Clamping Methods</td>
<td>493-515TD</td>
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<tr>
<td>Unit 12</td>
<td>Design of Drill Jigs</td>
<td>540-564TD</td>
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<tr>
<td>Unit 13</td>
<td>Design of Fixtures</td>
<td>573-604TD</td>
<td></td>
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<tr>
<td>Unit 14</td>
<td>Using Standard vs. Non-Standard Parts</td>
<td></td>
<td></td>
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</table>

Total Lecture Hours: 36
LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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</thead>
<tbody>
<tr>
<td>Identifying Design Problems</td>
<td>10</td>
</tr>
<tr>
<td>Solving Manufacturing Problems</td>
<td>24</td>
</tr>
<tr>
<td>Evaluating the Design Considerations</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Lab Hours</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. **PRACTICE SAFETY**

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation

4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required

5. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

B. **INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS**

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block

3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings

4. List the Purpose of Each Type of Drawing
   a. Discuss purpose of orthographic (3 views) drawings
   b. Discuss purpose of isometric drawing
   c. Discuss purpose of exploded isometric drawing
   d. Discuss purpose of assembly drawings

5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints

6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)

7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents

8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards

9. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

10. Understand and Use Quality Systems
    a. Describe ISO 9000 quality system
    b. Document paper trails for document revisions
C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Discuss general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals
   c. List advantages for considering plastic as a viable materials choice
   d. List the advantages and disadvantages for each of the following plastic molding processes: blow, injection, vacuum, extrusion, etc.
   e. Discuss the advantages for using composites in various manufacturing applications

2. Identify Materials and Processes to Produce a Product
   a. Discuss service requirements (in strength, hardness, etc.)
   b. Discuss fastening processes (i.e., fasteners, welding, bonding, etc.)
   c. Discuss corrosion resistance methods

3. Describe Heat Treating Processes
   a. Discuss the reasons for heat treating
   b. Discuss the time/temperature chart
   c. List the different quenching mediums
   d. Estimate metal heat temperature by color
   e. List reasons for stress relieving workpieces
   f. Discuss surface hardening processes

4. Perform Heat Treating Operations
   a. Harden plain carbon workpiece
   b. Temper plain carbon workpiece
   c. Anneal plain carbon workpiece
   d. Case harden workpiece

5. Test Metal Samples for Hardness
   a. Perform spark test to test for metal hardness
   b. Perform Rockwell hardness tests

D. DEMONSTRATE MEASUREMENT/INSPECTION TECHNIQUES

1. Identify Types of Measurement Used in Manufacturing
   a. Distinguish between direct and calculated measurements
   b. Compute calculated measurements
   c. Justify the use of precision measurements in manufacturing
   d. Discuss the following: precision, reliability and accuracy
   e. Demonstrate general measurement techniques
   f. Demonstrate semi-precision measurement techniques
   g. Demonstrate precision measurement techniques
   h. Document results of measurement activities and calculations

2. Select Proper Measurement Tools
   a. Match appropriate measurement tools with various types of measurement requirements
   b. Demonstrate proper measurement tool usage
   c. List steps of proper measurement
   d. Explain rationale for each step
   e. Identify error possibilities in measurement tool selection
f. Identify error possibilities within measurement procedures
g. Identify common conversion error possibilities
h. Discriminate between accepted measurement procedures and improper measurement procedures

3. Apply Proper Measuring Techniques
   a. Explain calibration requirements of various precision instruments
   b. Illustrate measurement differences when taken with calibrated and non-calibrated instruments
c. Justify use of particular measurement tools based on tool characteristics
d. Discuss factors affecting accurate measurement (e.g., dirt, temperature)

4. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers
c. Measure with comparison measuring instruments (e.g., calipers, telescope gages)
d. Measure with direct measuring instruments (e.g., vernier, dial, and digital instruments)

5. Perform Measurements on Surface Plate
   a. Describe care of surface plate
   b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)
c. Check for part squareness
d. Check part dimensions for accuracy
e. Align workpieces using height gage and dial indicators

E. PERFORM CONVENTIONAL MACHINING OPERATIONS
   1. Prepare and Plan For Machining Operations
      a. Read and interpret blueprints
      b. Perform basic semi-precision and precision layout as necessary
c. Plan machining operations
d. Understand machinability and chip formation
e. Calculate speeds, feeds, and depth of cut for various machine applications
f. Determine proper cutting fluids/coolants for machining
g. Use carbides and other tool materials to increase productivity
h. Use the Machinery's Handbook as a reference for machine applications
   2. Use Proper Hand Tools
      a. Use arbor and shop presses
      b. Select necessary work-holding devices and hand tools as needed
c. Select and use hand files
d. Identify and use hand reamers
e. Correctly identify and use hand taps as required
f. Follow tapping procedures to produce internal threads
g. Use thread-cutting dies to produce external threads
h. Operate bench and pedestal grinders safely
   3. Operate Power Saws
      a. Use reciprocating and horizontal band cutoff machines
      b. Operate abrasive and cold saws
c. Prepare and use the vertical band saw
d. Weld a bandsaw blade
4. Operate Drill Presses
   a. Describe the different types of drill presses found in the machine shop
   b. Describe and use standard drilling tools
   c. Sharpen a drill bit using a bench or pedestal grinder
   d. Setup the drill presses for drilling, countersinking, counterboring, reaming, and tapping operations
   e. Drill holes using drill jigs

5. Operate Vertical Milling Machines
   a. Demonstrate the use of all controls on the vertical milling machine
   b. Align the vertical milling machine head
   c. Select, align and use workholding devices
   d. Select milling tool holders
   e. Select milling cutters
   f. Perform all standard vertical milling operations
   g. Bore a hole using the offset boring head
   h. Machine angles using sine bar and gage blocks
   i. Setup and use special vertical mill fixtures
   j. Setup and machine dovetails
   k. Machine keyways

6. Operate Horizontal Milling Machines
   a. Discuss the difference in plain and universal horizontal milling machines
   b. Discuss the types of spindles, arbors and adaptors used on the horizontal milling machine
   c. List several common work holding methods
   d. Use plain milling cutters
   e. Use side milling cutters
   f. Use face milling cutters
   g. Setup and use special horizontal mill fixtures

7. Operate Metal Cutting Lathes
   a. Demonstrate the use of all controls on the engine lathe
   b. Discuss standard tools and toolholders for the lathe
   c. Face and center drill parts correctly
   d. Drill, ream and bore on the lathe
   e. Turn between centers
   f. Discuss alignment of lathe centers
   g. Make all calculations, lathe adjustments and settings to machine sixty-degree internal and external threads
   h. Discuss thread fit classifications
   i. Make all calculations, lathe adjustments and settings to machine an Acme thread
   j. Describe the common tapers used in the machine shop
   k. Discuss taper cutting and calculations for the lathe
   l. Setup and use the taper attachment found on most lathes
   m. Use follower rests and steady rests
   n. Use HSS cutting tools
   o. Use carbide cutting tools
   p. Setup and operate tracer lathes

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8. Operate Grinding/Abrasive Machines
   a. Discuss the selection and identification of grinding wheels
   b. Inspect, mount, true, dress, and balance grinding wheels
   c. Discuss the selection of grinding fluids
   d. Operate horizontal spindle reciprocating table surface grinders
   e. Operate cylindrical grinders
   f. Operate ID and OD grinders
   g. Setup and operate tool and cutter grinders
   h. Discuss common problems and solutions in surface grinding
   i. Operate honing machine
   j. Operate lapping machines

F. PERFORM WELDING OPERATIONS
1. Weld With Shielded Metal Arc Welding (SMAW) Process
   a. Discuss factors for welding electrode selection
   b. Adjust welding amperage setting for each application
   c. Demonstrate proper use of safety equipment
   d. Weld beads on plate (flat, horizontal, and vertical)
   e. Weld tee joints (flat, horizontal, and vertical)
   f. Weld pipe joints
   g. Discuss weld inspection factors and techniques
2. Weld/Cut With Oxyacetylene
   a. Setup and break down the oxyacetylene welding/cutting station
   b. Discuss proper settings for oxyacetylene regulators
   c. Discuss factors that determine torch welding and cutting tip selection
   d. Demonstrate routine torch maintenance procedures
   e. Weld beads on plate (with and without filler) in the flat and horizontal positions
   f. Weld square groove butt joints in the flat and horizontal positions
   g. Braze weld beads on plate in the flat position
   h. Make square cuts to a straight line with the cutting torch
   i. Demonstrate proper use of safety equipment

G. PERFORM DRAFTING TASKS.
1. Demonstrate Traditional Mechanical Drafting Skills
   a. Form freehand vertical Gothic upper-case letters and numerals of correct shape and space
   b. Execute the alphabet of lines correctly, producing dense black lines of uniform thickness and spacing
   c. Demonstrate proficiency with the engineers and metric scales
   d. Execute geometric constructions with no mistakes in tangent points, line quality or layout work
   e. Accurately draw the missing view or line in a multiview drawing
   f. Make or complete a sectional instrument drawing, given one or more views
   g. Develop satisfactory working drawings of simple machine components to include all necessary views and dimensions for complete shape and size description of detail parts
   h. Discuss the differences in standard engineering drawings and tool drawings
i. Develop satisfactory tool drawings for drill jigs, milling fixture, and inspection fixtures

2. Make Tool Drawings
   a. Discuss the differences in tool drawings versus regular mechanical drawings
   b. Design and draw a simple drill jig using accepted practices
   c. Design and draw a simple milling fixture using accepted practices

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. determine the initial cost of materials and "value added" as result of machining
      3. complete a stock request form for required material
      4. provide a self-evaluation of performance based on the time and quality of work
   B. Interpersonal: Works with others
      1. complete assigned responsibilities within the shop floor serving as a member of the team
      2. provide individual assistance/direction to peers as requested
      3. produce tools and fixtures to acceptable levels of quality as required
      4. works well with all members of the class
   C. Information: Acquires and uses information
      1. read and interpret blueprints
      2. organize and apply theories of tool design
      3. perform basic semi-precision and precision layout as necessary
   D. Systems: Understands complex inter-relationships
      1. demonstrate knowledge of the following systems:
         a. laboratory organization structure: physical and social
         b. organization of personnel and facilities on the shop floor
         c. systematic approach to the metal removal process
         d. dimensioning and measurement systems
e. systematic organization of training materials

2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. Technology: *Works with a variety of technologies*
   1. chooses procedure, tools and equipment required to produce a part
   2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
   3. maintains and troubleshoots equipment
      a. applies appropriate preventative maintenance
      b. when operating machines
      c. reports all malfunctions of equipment to supervisor/instructor
      d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS
   A. Basic Skills: *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
      1. Reading: *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
         a. studies student laboratory manual
         b. interprets blueprints and technical drawings
         c. read/studies textbook
         d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
      2. Writing: *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
         a. outline the steps necessary to produce a simple machine part
         b. maintain a lecture notebook
         c. submit written responses to chapter question assignments
         d. complete all written assignments
      3. Arithmetic/Mathematics: *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
         a. determines optimum machining speeds, feeds, and depth of cut
         b. calculates "value added to the part"
         c. aligns machine and/or work holding device
         d. taps and threads
         e. keeps a running computation of individual grade
         f. interconverts fractions to decimal expressions
         g. use protractors to lay-out angle machining
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4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
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   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

STRENGTH OF MATERIALS

200
MAST PROGRAM
COURSE SYLLABUS
STRENGTH OF MATERIALS

Lecture hours/week: 3  Lab hours/week: 3  Credit hours: 4

COURSE DESCRIPTION:

This is a course designed to give the student a basic understanding of the internal stresses and deformation of elastic bodies resulting from the action of external forces. The student should be able to: determine internal stresses due to external loads, make calculations for riveted joints with specified loads, analyze welded joints, determine the centroid and moment of inertia of a built-up section.

PREREQUISITES: Statics

REQUIRED COURSE MATERIALS:

Lab Manual: NONE

Required Materials: Engineering paper, green Scientific Calculator

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory assignments will require student to solve appropriate problems involving the mechanical and physical properties of various materials.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
<table>
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<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
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<td>Total Lab Hours</td>
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COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation

4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals

2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions

3. Interconvert Metric/English measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart

4. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides

5. Solve Static Systems for Resultant Forces
   a. Solve for the following coplanar force systems: parallel, concurrent and nonconcurrent
   b. Solve for the following noncoplanar force systems: parallel, concurrent and nonconcurrent

6. Solve Engineering Equations
   a. Solve linear algebraic equations for an unknown
   b. Solve a system of linear equations with two unknowns
   c. Solve right triangles for unknown sides or angles
   d. Use the law of sines and cosines to solve obtuse triangles with unknown sides and angles
   e. Calculate factors of friction

7. Use All Functions of a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
   c. Apply all statistical functions

8. Determine Strengths of Materials for Various Applications
   a. Discuss stress and deformation
   b. List properties of materials (e.g., strength, elasticity, stiffness, ductility, hardness)
   c. Calculate stresses and design of joints
   d. Discuss advantages and disadvantages of different fastening technique
   e. Discuss problems related to torque-twisting moments
   f. Discuss centroids and moments of inertia of areas

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
Interpret commonly used abbreviations and terminology

Determine tolerances associated with dimensions on a drawing

Determine the tolerance for a reference dimension

Determine the surface finish for a given part

List the essential components found in the general drawing notes

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. **Resources: Identifies, organizes, plans, and allocates resources**
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of machining
   3. complete a stock request form for required material
   4. provide a self-evaluation of performance based on the time and quality of work

B. **Interpersonal: Works with others**
   1. complete assigned responsibilities within the shop floor serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. works well with all members of the class

C. **Information: Acquires and uses information**
   1. read and interpret blueprints
   2. organize and apply theories of machine tool operation

D. **Systems: Understands complex inter-relationships**
   1. demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities on the shop floor
      c. systematic approach to the metal removal process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. application of statics principles and structural analysis
      b. adjustments of individual laboratory work schedule
c. constantly evaluating the quality of work to achieve acceptable standards
d. maintains record of evaluations and sets individual goals

E. **Technology: Works with a variety of technologies**
1. uses a scientific calculator
2. applies appropriate procedures and uses appropriate hardware and software

II. **FOUNDATION SKILLS**
A. **Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.**
   1. **Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules**
      a. studies student laboratory manual
      b. interprets blueprints and technical drawings
      c. read/studies textbook
      d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
   2. **Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts**
      a. outline the steps necessary to produce a simple machine part
      b. maintain a lecture notebook
      c. submit written responses to chapter question assignments
      d. complete all written assignments
   3. **Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques**
      a. determines optimum machining speeds, feeds, and depth of cut
      b. calculates "value added to the part"
      c. aligns machine and/or work holding device
      d. taps and threads
      e. keeps a running computation of individual grade
      f. interconverts fractions to decimal expressions
      g. use protractors to lay-out angle machining
      h. use trigonometry to solve angle and taper calculations
   4. **Listening: Receives, attends to, interprets, and responds to verbal messages and other cues**
      a. assimilate classroom instruction
      b. interpret and assimilate video instruction
      c. observe laboratory demonstrations
      d. seek and receive individualized instruction in the laboratory
   5. **Speaking: Organizes ideas and communicates orally**
      a. participates in classroom discussions
      b. organize ideas and communicate specific questions to the instructor
      c. verbally affirms understanding of a concept, procedure, or required skill
communicates with peers to ensure the smooth and safe operation of the laboratory

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. Problem Solving: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different materials and the principles of statics and mechanics applied to these materials

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. Self-Esteem: Believes in own self-worth and maintains a positive view of self
a. learns to take pride in his or her work through positive reinforcement
b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability:** Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
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   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

CAD/CAM II
Prerequisite: CAD/CAM I
# MAST PROGRAM
## COURSE SYLLABUS
### CAD/CAM II

<table>
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<tr>
<th>Lecture hours/week:</th>
<th>3</th>
<th>Lab hours/week:</th>
<th>3</th>
<th>Credit hours:</th>
<th>4</th>
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## COURSE DESCRIPTION:

A continuation of CAD/CAM I with advanced utilization of "SMARTCAM". Topics will include the following: 3-D Process Modeling, creation and utilization of different work planes, 4th and 5th axis programming, creation of tool path for surface primitives, swept surfaces, translated surfaces; sculpted surfaces, ruled surfaces, and coons surfaces. Additional topics include: projecting, intersecting, blending, and trimming one surface to another surface. Students will program both a simple punch and die set and a simple injection mold cavity.

## PREREQUISITES:

CAD/CAM I

## REQUIRED COURSE MATERIALS:

- **Textbook:** SMARTCAM-3D, Pelton, TSTC Pub., 2nd Ed.
- **Lab Manual:** NONE
- **Materials and/or Supplies:** 2 - double sided, high density 3 ½" floppy diskettes

## METHODS OF INSTRUCTION:

- **Lecture:** Didactic presentations will include lecture, overheads and SMARTCAM and software demonstrations.
- **Laboratory:** Laboratory will be a "hands-on" (computer based) process modeling "SMARTCAM" System.

## Method of Evaluation:

A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. demonstrate the comprehension of Work Plane and Plane Coordinates and the ability to change from one work plane to another work plane to perform work
2. demonstrate the ability to construct surface boundaries on various work planes
3. demonstrate the ability to both identify and create various surfaces which are available in the SMARTCAM 3-D system to include:
   - **Surface Primitives:** Plane, Cone, Cylinder, Sphere, Torus
   - **Composite Surfaces:** Spun, Translated, Ruled, Lofted, Form Patch, Coons
4. generate tool path in both the generator, radial and planar directions
5. develop tool path geometry and part geometry to produce accurately coded information for 3-D CNC mill parts
6. demonstrate the 3-D techniques of projection, intersection, surface trim and blend
7. utilize plotters and printers to produce accurate documents
8. perform and demonstrate the ability to transfer CAD files to CAM files and CAM files to CAD files
9. generate a tool path from CAD to CAM files
10. edit a tool path from a CAD file and proof the tool path from a CAD file
11. satisfactorily perform on written, oral, and practical examinations
12. satisfactorily perform on outside assignments including writing assignments
13. contribute to class discussions
14. maintain attendance per current policy

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<tr>
<td>SMARTCAM's Advanced 3-D Machining</td>
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<td>1.02 Choosing Active Work Planes</td>
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<td>1.03 World vs. Local Coordinate</td>
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<td>Inputs</td>
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<td>5.03 Creating 3-D Surface Tool Paths</td>
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5.04 Creating a Blend Surface
5.05 Planar Cuts
Review for Quiz 2

QUIZ 2

Unit 6 Additional Modeling Practices
6.01 Projection
6.02 Intersection
6.03 Surface Trim and Blend
6.04 Editing Surfaces
Review for Quiz 3

QUIZ 3

Total Lecture Hours 36

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<td>b. Pyramid</td>
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<td>c. Palace</td>
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<td>d. Round Punch</td>
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<td>e. Ruled Block</td>
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<td>f. Cross</td>
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<td>g. Round Die</td>
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<tr>
<td>h. Shift Boot</td>
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<tr>
<td>i. Fin</td>
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<tr>
<td>j. Knobmold</td>
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<tr>
<td>Final Project</td>
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</tbody>
</table>

Total Lab Hours 36

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS
   1. Perform Basic Arithmetic Functions
      a. Add, subtract, multiply and divide whole numbers
      b. Add, subtract, multiply, and divide fractions
      c. Add, subtract, multiply, and divide decimals
   2. Interconvert Fractions/Decimals
      a. Convert fractions to decimal equivalents
      b. Convert decimal values to nearest fractional equivalent
      c. Use Decimal Equivalent Chart for conversions
   3. Interconvert Metric/English measurements
a. Convert English dimensions to Metric
b. Convert Metric dimensions to English
c. Use Metric/English conversion chart

4. Utilize Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides

5. Calculate Speeds and Feeds for Machining Using SMARTCAM's Job Plan Module
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut

6. Locate Machining Points from a Datum Point
   a. Identify points using the Cartesian coordinate system
   b. Identify points using the absolute dimensioning system
   c. Identify points using the incremental dimensioning system
   d. Identify points using both world and local coordinate values

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes

2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. Identify the components found in the revision block

3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings

4. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints

5. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)

6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Utilize "SMARTCAM's" Job Plan to determine machine operations sequences

7. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES
   1. Determine Operations to be performed
      a. Identify workpiece material requirements
      b. Identify cutting tool material requirements speeds, feeds, depth of cuts
      c. Identify setup parameters, strength and rigidity of setup, strength and rigidity of the workpiece, power requirements, finish and tolerances, use of coolants
   2. Sequence Machine Operations
      a. Utilize "SMARTCAM's" 3-D Modeling Tool
      b. Verify toolpath

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. provide a self-evaluation of performance based on the time and quality of work
   B. Interpersonal: Works with others
      1. complete assigned responsibilities within the laboratory serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. systematic approach to the metal removal process
   c. dimensioning and measurement systems
   d. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies
1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards

II. FOUNDATION SKILLS
A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. Speaking: Organizes ideas and communicates orally
a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. Decision Making: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
a. identifies personal goals
b. identifies actions required to accomplish personal goals

2. Problem Solving: Recognizes problems and devises and implements plan of action
a. makes daily accommodations to stay on schedule
b. seeks additional instruction/clarification for assignment completion
c. balances social and academic life/responsibilities
d. accepts responsibility

3. Seeing Things In the Mind's Eye: Organizes, and processes symbols, pictures, graphs, objects, and other information
a. interprets technical drawings
b. interprets technical illustrations and symbols
c. understands both written and verbal instructions
d. assimilates process during instructor demonstrations

4. Knowing How to Learn: Use efficient learning techniques to acquire and apply new knowledge and skills
a. demonstrate mastery of the basic skills and techniques
b. use these sequential skills to support mastery of new skills
c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. Reasoning: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
a. understands that practice may not make it perfect but it certainly will improve the skill of the technician
b. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. Responsibility: Exerts a high level of effort and perseveres towards goal attainment
a. develops an understanding that in order to be successful you must be a "good" student
b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
c. develops an understanding good students know what they are going
to do in class and does not waste time
d. develops a fine work-ethic

2. **Self-Esteem: Believes in own self-worth and maintains a positive view of self**
   a. learns to take pride in his or her work through positive
      reinforcement
   b. sees himself or herself as an asset to the class through continued
      contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief
      in their own abilities will systematically seek solutions and be a
      valuable employee

3. **Sociability: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings**
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's
      individual attention)

4. **Self-Management: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control**
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. make accommodations to laboratory schedules due to broken
      machines/tools
   d. accept the responsibility for self-management

5. **Integrity/Honesty: Chooses ethical courses of action**
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory,
      during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

1. SMARTCAM Advanced 3-D Machining Reference Manual
3. Machine Tool Catalogs
Machine Tool Advanced Skills
Technology Program

COURSE SYLLABUS

COMPUTER INTEGRATED
MANUFACTURING
MAST PROGRAM
COURSE SYLLABUS
COMPUTER INTEGRATED MANUFACTURING

Lecture hours/week: 2  Lab hours/week: 2  Credit hours: 3

COURSE DESCRIPTION:

An introduction to fundamentals of Computer Integrated Manufacturing (CIM). This includes the key elements and technologies involved, the typical applications that exist in industry today and the major trends that will affect the future of manufacturing.

PREREQUISITES:  NONE

REQUIRED COURSE MATERIALS:

Lab Manual:  NONE

Hand Tools/Quantity Required:
- Safety Glasses
- 6 inch Ruler
- 0-6 inch Dial Calipers
- Pencil
- Scientific Calculator
- 3½ high density disk

METHODS OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture, video and demonstrations.

Laboratory:  Laboratory will be "hands-on" activities.

Method of Evaluation:  A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual
# LECTURE OUTLINE:

<table>
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<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td><strong>Introduction to Computer-Automated Manufacturing</strong></td>
<td></td>
<td>4</td>
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<tr>
<td>What is Computer-Automated Manufacturing</td>
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<td>Why Do We Use Computers in Manufacturing</td>
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<td>Computer Control</td>
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<td>Computer Applications in Manufacturing</td>
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<td><strong>Computer Technologies</strong></td>
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<td>Computer Graphics Technology</td>
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<td>Computer Automated Design</td>
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<td>Computer Tools for Engineering Analysis</td>
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<td><strong>Robotics</strong></td>
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<td>Basic Robotic Technology</td>
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<td>Intelligent Robotics Systems</td>
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<td>Robot Application</td>
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<td>Implementing Robotics in Manufacturing</td>
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<td><strong>Manufacturing Systems</strong></td>
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<td>System Architecture</td>
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<td>Management Systems</td>
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<td>Integrated Manufacturing Systems</td>
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<td><strong>Computer Automated Manufacturing</strong></td>
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<td>Automated Manufacturing</td>
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<td>Implementing CAM</td>
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# LAB OUTLINE:

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<th>Lab Topics</th>
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<tr>
<td>CIM Lab Safety</td>
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<tr>
<td>CIM System Components</td>
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<tr>
<td>a) Conveyor Systems</td>
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<td>b) Automated Storage and Retrieval Systems</td>
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<tr>
<td>c) PUMA 562 Robot</td>
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<tr>
<td>d) IBM 7576 Robot</td>
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<tr>
<td>e) CNC Vertical Milling Center</td>
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<td>f) CNC Turning Center</td>
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<tr>
<td>g) Vision Systems</td>
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<tr>
<td>Total Lecture Hours</td>
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</table>
COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Follow Safety Manuals and All Safety Regulations/Requirements
      a. Assume responsibility for the personal safety of oneself and others
      b. Develop a personal attitude towards safety
      c. Interpret safety manual directives
      d. Comply with established company safety practices
      e. Complete forms/paperwork as required
   2. Use Protective Equipment
      a. Wear protective safety clothing as required
      b. Maintain and use protective guards and equipment on machinery
      c. Locate and properly use protective equipment
      d. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Machine Tools
      a. Identify and understand safe machine operating procedures
      b. Demonstrate safe machine operation
   4. Maintain a Clean and Safe Work Environment
      a. Keep work areas clean
      b. Clean machine/hand tools when work is completed
      c. Put tools away when work is finished
      d. Keep aisles clear of equipment and materials
      e. Perform preventative maintenance as required
   5. Apply Ergonomic Principles to the Workplace
      a. Define ergonomics
      b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS
   1. Describe the Relationship of Engineering Drawings to Planning
      a. Discuss production schedule
      b. Discuss Material Resource Planning (MRP)
      c. Discuss inventory control records
      d. Discuss shop floor routing documents
   2. Analyze Bill of Materials (BOM)
      a. Discuss components found on BOM
      b. Determine materials needed to produce the part
      c. Determine quantities necessary to produce the part
      d. Submit completed stock request form as required
      e. Submit completed tool request form as needed
3. Understand and Use Quality Systems
   a. Describe ISO 9000 quality system
   b. Document paper trails for document revisions

C. USE COMPUTERS
1. Use Computer Operating Systems
   a. Use basic computer terminology appropriately and accurately
   b. Boot the computer and recognize the basic components of DOS
   c. Use DOS to perform file management
   d. Use DOS to perform directory management
   e. Install software packages on a PC
2. Use Computer Inquiry Systems
   a. Log in to a multi-user system
   b. Access system for needed information
   c. Print reports as necessary
3. Use Various Computer Applications
   a. Load word processor, create, save, edit, and print a document
   b. Load spreadsheet, create, save, retrieve, erase, edit, and print a worksheet
   c. Load database programs, create, edit, delete, and print records in a database file
4. Recommend and Implement CIM Technologies
   a. Use automatic storage & retrieval system
   b. Use bar coding technology
   c. Understand robot applications
   d. Program robots
   e. Use shop floor control systems
   f. Understand machine vision systems

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      1. follows a schedule to complete assigned tasks on time
      2. determine the initial cost of materials and "value added" as result of machining
      3. provide a self-evaluation of performance based on the time and quality of work
B. **Interpersonal: Works with others**
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. **Information: Acquires and uses information**
1. understand and recommend CIM related technologies

D. **Systems: Understands complex inter-relationships**
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic organization of training materials
2. monitors and corrects performance during
   a. adjustments of individual laboratory work schedule
   b. constantly evaluating the quality of work to achieve acceptable standards
   c. maintains record of evaluations and sets individual goals

E. **Technology: Works with a variety of technologies**
1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

**II. FOUNDATION SKILLS**

A. **Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.**

1. **Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules**
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. **Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts**
   a. maintain a lecture notebook
   b. submit written responses to chapter question assignments
   c. complete all written assignments

3. **Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques**
   a. calculates "value added to the part"
b. keeps a running computation of individual grade

4. **Listening**: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. **Speaking**: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

**B. Thinking Skills**: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. **Decision Making**: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. **Problem Solving**: Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. **Seeing Things In the Mind’s Eye**: Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. **Knowing How to Learn**: Use efficient learning techniques to acquire and apply new knowledge and skills
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. **Reasoning**: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly
C. **Personal Qualities**: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility**: Exerts a high level of effort and perseveres towards goal attainment
   - develops an understanding that in order to be successful you must be a "good" student
   - develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   - develops an understanding good students know what they are going to do in class and does not waste time
   - develops a fine work-ethic

2. **Self-Esteem**: Believes in own self-worth and maintains a positive view of self
   - learns to take pride in his or her work through positive reinforcement
   - sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   - understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability**: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   - assist classmates in improving technical skills
   - assist students with special needs as a peer mentor
   - share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management**: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
   - maintain a record of academic achievement (individual grade book)
   - make accommodations to laboratory schedules due to broken machines/tools
   - accept the responsibility for self-management

5. **Integrity/Honesty**: Chooses ethical courses of action
   - accept the responsibility for own actions
   - exhibit personal honesty at all times
   - accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   - understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

1. **Machinery's Handbook**, Industrial Press
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

QUALITY ASSURANCE AND STATISTICAL PROCESS CONTROL
MAST PROGRAM
COURSE SYLLABUS
QUALITY ASSURANCE AND
STATISTICAL PROCESS CONTROL

Lecture hours/week: 2  Lab hours/week: 3  Credit hours: 3

COURSE DESCRIPTION:
An introduction to the concepts of applied quality control systems. Topics covered include: quality responsibility, control chart methods, sampling techniques, reliability applications and computer utilization/programs.

PREREQUISITES:  NONE

REQUIRED COURSE MATERIALS:

Lab Manual:  Quality Control Laboratory Manual, TSTC

Hand Tools/Quantity Required:
- Safety Glasses
- 6 inch Ruler
- 0-6 inch Dial Calipers
- Pencil
- Scientific Calculator with statistical functions to solve for: means and standard deviation
- 3½" high density disk

METHODS OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture, video and demonstrations.

Laboratory:  Laboratory will be "hands-on" activities.

Method of Evaluation:  A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student’s ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

### LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
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</thead>
<tbody>
<tr>
<td><strong>Introduction to Statistical Process Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
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Total Lab Hours 36

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY
   1. Follow Safety Manuals and All Safety Regulations/Requirements
      a. Assume responsibility for the personal safety of oneself and others
      b. Develop a personal attitude towards safety
      c. Interpret safety manual directives
      d. Comply with established company safety practices
   2. Use Protective Equipment
      a. Wear protective safety clothing as required
      b. Maintain and use protective guards and equipment on machinery
      c. Locate and properly use protective equipment
      d. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Machine Tools
      a. Identify and understand safe machine operating procedures
      b. Demonstrate safe machine operation
   4. Maintain a Clean and Safe Work Environment
      a. Keep work areas clean
      b. Clean machine/hand tools when work is completed
c. Put tools away when work is finished
d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS
1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart
4. Perform Basic Algebraic Operations
   a. Express word statements as algebraic equations
   b. Solve word statements as algebraic equations
5. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
6. Use all Functions on a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
   c. Apply all statistical functions

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS
1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
d. Identify isometric views
e. Identify exploded isometric drawings
f. Identify assembly drawings

4. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints

5. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)

6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records

7. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards

8. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

D. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES
1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Discuss classification systems for non-metals

E. PERFORM MEASUREMENT/INSPECTION
1. Identify Types of Measurement Used in the Machine Shop
   a. Distinguish between direct and calculated measurements
   b. Compute calculated measurements
   c. Justify the use of precision measurements in manufacturing
   d. Discuss the following: precision, reliability, and accuracy
   e. Demonstrate general measurement techniques
   f. Demonstrate semi-precision measurement techniques
   g. Demonstrate precision measurement techniques
   h. Document results of measurement activities and calculations

2. Select Proper Measurement Tools
   a. Match appropriate measurement tools with various types of measurement requirements
   b. Demonstrate proper measurement tool usage
   c. List steps of proper measurement
d. Explain rationale for each step

e. Identify error possibilities in measurement tool selection

f. Identify error possibilities within measurement procedures

g. Identify common conversion error possibilities

h. Discriminate between accepted measurement procedures and improper measurement procedures

3. Apply Proper Measuring Techniques

a. Explain calibration requirements of various precision instruments

b. Illustrate measurement differences when taken with calibrated and non-calibrated instruments

c. Justify use of particular measurement tools based on tool characteristics

d. Discuss factors affecting accurate measurement (dirt, temperature, etc.)

4. Perform Measurements With Hand Held Instruments

a. Measure with steel rules (metric and inch)

b. Measure with micrometers

c. Measure with comparison measuring instruments (i.e., calipers, telescope gages)

d. Measure with direct measuring instruments (i.e., vernier, dial, and digital instruments)

e. Measure with fixed gages (go and not go gages)

5. Perform Measurements on Surface Plate

a. Describe care of surface plate

b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)

c. Check for part squareness

d. Check part dimensions for accuracy

e. Align workpieces using height gage and dial indicators

F. USE COMPUTERS

1. Use Computer Operating Systems

a. Use basic computer terminology appropriately and accurately

b. Boot the computer and recognize the basic components of DOS

c. Use DOS to perform file management

d. Use DOS to perform directory management

e. Install software packages on a PC

2. Use Computer Inquiry Systems

a. Login to a multi-user system

b. Access system for needed information

c. Print reports as necessary

3. Use Various Computer Applications

a. Load word processor, create, save, edit and print a document

b. Load spreadsheet, create, save, retrieve, erase, edit and print a worksheet

c. Load database programs, create, edit, delete, and print records in a database file

G. PARTICIPATE IN TOTAL QUALITY AND SPC ACTIVITIES

1. Define Quality in Manufacturing and Explain Importance

a. Justify the use of quality in manufacturing systems

b. Identify impact of quality on specific manufacturing processes

2. Implement Concepts of Quality in the Workplace
a. Explain how profit is generated
b. Explain how manufacturing costs are determined
c. Explain the effect of quality in profit
d. Explain the cost incurred by scrapping parts or correcting parts with defects

3. Apply Principles and Tools of Continuous Quality Improvement
   a. Identify the effect of continuous quality improvement
   b. Demonstrate the ability to apply continuous quality improvement to the manufacturing process

4. Understand and Apply SPC
   a. Define SPC
   b. Identify the relationship between SPC steps and specific production
   c. Apply SPC to specific production processes
   d. Recognize a standard deviation

5. Evaluate Data to Monitor Production
   a. Understand process variation
   b. Understand probability
   c. Create a Histogram
   d. Set up and use X-bar, R Charts
   e. Calculate process capability index
   f. Calculate gauge capability

6. Analyze Customer Problems and Recommend Solutions
   a. Analyze production specific processes
   b. Analyze and interpret test data for compliance to specifications
   c. Correct production process (if indicated by data)
   d. Maintain production according to instructions

7. Establish Methods, Plans and Procedures to Maintain Quality
   a. Develop a plan utilizing a selected quality control system
   b. Evaluate a process selected verse desired goals

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary’s Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its “AMERICA 2000 REPORT” that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of machining
3. provide a self-evaluation of performance based on the time and quality of work

B. **Interpersonal: Works with others**
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. **Information: Acquires and uses information**
1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. **Systems: Understands complex inter-relationships**
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. adjustments of individual laboratory work schedule
   b. constantly evaluating the quality of work to achieve acceptable standards
   c. maintains record of evaluations and sets individual goals

E. **Technology: Works with a variety of technologies**
1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. **FOUNDATION SKILLS**
A. **Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.**

1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. keeps a running computation of individual grade
   e. interconverts fractions to decimal expressions

4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. **Speaking:** Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

**B. Thinking Skills:** Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. **Decision Making:** Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. **Problem Solving:** Recognizes problems and devises and implements plan of action
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. **Seeing Things In the Mind’s Eye:** Organizes, and processes symbols, pictures, graphs, objects, and other information
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. **Knowing How to Learn**: Use efficient learning techniques to acquire and apply new knowledge and skills  
a. demonstrate mastery of the basic skills and techniques  
b. use these sequential skills to support mastery of new skills  
c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. **Reasoning**: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem  
a. understands that practice may not make it perfect but it certainly will improve the skill of the operator  
b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist  
c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. **Personal Qualities**: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility**: Exerts a high level of effort and perseveres towards goal attainment  
a. develops an understanding that in order to be successful you must be a "good" student  
b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work  
c. develops an understanding good students know what they are going to do in class and does not waste time  
d. develops a fine work-ethic

2. **Self-Esteem**: Believes in own self-worth and maintains a positive view of self  
a. learns to take pride in his or her work through positive reinforcement  
b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal  
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. **Sociability**: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings  
a. assist classmates in improving technical skills  
b. assist students with special needs as a peer mentor  
c. share laboratory resources (machines, tools and instructor's individual attention)

4. **Self-Management**: Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control  
a. perform in-process quality checks on machined parts  
b. maintain a record of academic achievement (individual gradebook)  
c. make accommodations to laboratory schedules due to broken machines/tools
d. accept the responsibility for self-management

5. **Integrity/Honesty: Chooses ethical courses of action**
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

**Appropriate Reference Materials:**

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

ENGINEERING TECHNOLOGY PROJECT
MAST PROGRAM
COURSE SYLLABUS
ENGINEERING TECHNOLOGY PROJECT

Lecture hours/week: 4            Lab hours/week: 6            Credit hours: 6

COURSE DESCRIPTION:

Different industrial level projects emphasizing manufacturing applications/research in the areas of CNC, CAD/CAM, CIM, or Plastic Mold Making will be assigned to students utilizing a team concept.

PREREQUISITES: NONE

REQUIRED COURSE MATERIALS:

Textbook: NONE
Lab Manual: NONE

Hand Tools/Quantity Required: See basic tool list for Machine Tool Practices I

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" manufacturing assignments which will require the use of problem solving skills by the students.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student’s ability to:
1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual
LECTURE OUTLINE:

Lecture content will be determined by the instructor based on the manufacturing-related exercise(s) which have been selected for the students.

Total Lecture Hours 48

LAB OUTLINE:

Lab activities will be determined by the instructor based on the manufacturing-related exercise(s) which have been selected for the students.

Total Lab Hours 72

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

Technical competencies will be determined for each individual class. The instructor will select certain manufacturing-related problem solving/troubleshooting exercises which will simulate problems in “the real world.” Students will work in teams to solve these problems. This may require machine maintenance, tool/fixture building, or any other activities which will lead to the successful completion of the required assignment. Technical competencies will be covered which will reinforce or strengthen the training/education the students have received in prior courses.

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary’s Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its “AMERICA 2000 REPORT” that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

***** THIS COURSE CAN BE CONSIDERED TO BE SCANS INTENSIVE DUE TO THE NATURE AND STRUCTURE OF THE COURSE.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   A. Resources: Identifies, organizes, plans, and allocates resources
      Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems.
B. **Interpersonal:** Works with others
Emphasis will be on working in teams to identify, solve and document solutions to assigned manufacturing-related problems.

C. **Information:** Acquires and uses information
Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems.

D. **Systems:** Understands complex inter-relationships
Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems.

E. **Technology:** Works with a variety of technologies
Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems. Students will be teamed up with students from other disciplines and expected to communicate and work with a variety of technologies to complete the course assignments.

II. **FOUNDATION SKILLS**

A. **Basic Skills:** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   Students will be expected to use research techniques to find solutions to assigned work. This may include using machinery manuals and charts to troubleshoot equipment.

2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   Students will be expected to document the steps required to complete the assigned work. Students will also be expected to write a final summary of the work performed in class.

3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   Students may be expected to perform any computations necessary for the completion of their tasks.

4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues
   Students will have to communicate with the instructor and the other team members to successfully complete their tasks. Listening skills will be of paramount importance in this class.

5. **Speaking:** Organizes ideas and communicates orally
   Students will be expected to communicate effectively with the instructor and the other team members to successfully complete their tasks. Each
student will be required to give a short (5-10 minute) final oral presentation of their findings/observations taken from the course.

B. **Thinking Skills**: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. **Decision Making**: Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
   Students will be required to determine goals and constraints, generate alternative solutions, consider risks/costs, and evaluate and choose the best alternative to satisfy the requirements of the course.

2. **Problem Solving**: Recognizes problems and devises and implements plan of action
   Students will be expected to recognize problems, devise, and implement a plan of action.

3. **Seeing Things In the Mind's Eye**: Organizes, and processes symbols, pictures, graphs, objects, and other information
   Students will be encouraged to organize, and process symbols, pictures, graphs, objects, and other information in order to solve specific manufacturing-related problems.

4. **Knowing How to Learn**: Use efficient learning techniques to acquire and apply new knowledge and skills
   Student learning will be accomplished through problem solving techniques and team learning.

5. **Reasoning**: Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem
   The format of this class is such that students will be working more with abstract concepts rather than absolute facts. This will help students to develop thinking and reasoning skills.

C. **Personal Qualities**: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. **Responsibility**: Exerts a high level of effort and perseveres towards goal attainment
   Successful completion of the course will come only after students have spent sufficient time and efforts in identifying problems, organizing and planning work, and allocating resources necessary to solve assigned manufacturing-related problems.

2. **Self-Esteem**: Believes in own self-worth and maintains a positive view of self
   Students will be encouraged to use the information learned in their other classes to solve practical assignments. Successful completion of this course helps students achieve more of a positive view of their self.

3. **Sociability**: Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
   Group problem solving activities will develop understanding, friendliness, adaptability, empathy, and politeness towards other team members.
4. **Self-Management:** Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
Each team will be self managed. Team members will be expected to set goals, assess progress accurately, monitor their progress, and exhibit self-control.

5. **Integrity/Honesty:** Chooses ethical courses of action
Students will be expected to make reasonable contributions to team efforts and choose to do things the "right" way.
APPENDIX A - INDUSTRY COMPETENCY PROFILES

The following pages contain the individual Competency Profiles for each of the companies surveyed by the MAST development center for the occupational specialty area of . These Competency Profiles/skill standards were used to develop the curriculum for the pilot program.

The participation of the companies as partners in the MAST effort is greatly appreciated. Each company has approved the use of its logo in MAST materials. None of the participating companies shall be held responsible or liable for any of the findings of the project.
SKILLS AND KNOWLEDGE
Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Arithmetic Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converses in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES
Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Consciousness
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT
Machinist's Tools (e.g., calipers, dial indicators, magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS
Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing
**Duties**

<table>
<thead>
<tr>
<th>A</th>
<th>Practice Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Apply Mathematical Concepts</td>
</tr>
<tr>
<td></td>
<td>B-1 Perform basic arithmetic functions</td>
</tr>
<tr>
<td></td>
<td>B-2 Interconvert fractions/decimals</td>
</tr>
<tr>
<td></td>
<td>B-3 Interconvert Metric/English measurements</td>
</tr>
<tr>
<td></td>
<td>B-4 Perform basic algebraic operations</td>
</tr>
<tr>
<td></td>
<td>B-5 Perform trigonometric functions</td>
</tr>
<tr>
<td></td>
<td>B-6 Calculate speeds and feeds for machining</td>
</tr>
<tr>
<td></td>
<td>B-7 Locate machining points from a datum point</td>
</tr>
<tr>
<td></td>
<td>B-8 Perform calculations for size bar and size plate</td>
</tr>
<tr>
<td></td>
<td>B-9 Calculate for direct, simple, and angular indexing</td>
</tr>
<tr>
<td></td>
<td>B-10 Perform calculations necessary for turning tapers</td>
</tr>
<tr>
<td></td>
<td>B-11 Solve for little &quot;h&quot;</td>
</tr>
<tr>
<td></td>
<td>B-12 Use all scientific calculator equations</td>
</tr>
<tr>
<td></td>
<td>B-13 Solve engineering equations</td>
</tr>
</tbody>
</table>

**Tasks**

| A-1 Follow safety manuals and all safety regulations/requirements |
| A-2 Use protective equipment |
| A-3 Follow safe operating procedures for hand and machine tools |
| A-4 Maintain a clean and safe environment |
| A-5 Control fire hazards |
| A-6 Apply ergonomic principles to the workplace |

| B-1 | Follow safety manuals |
| B-2 | Use protective equipment |
| B-3 | Follow safe operating procedures for hand and machine tools |
| B-4 | Maintain a clean and safe environment |
| B-5 | Control fire hazards |
| B-6 | Apply ergonomic principles to the workplace |

**Perform Computer Aided Drafting (CAD)**

| C-1 | Understand PC basics |
| C-2 | Discuss CAD basics and file management |
| C-3 | Use drawing settings |
| C-4 | Perform basic editing commands |
| C-5 | Create drawings with accuracy |
| C-6 | Organize drawing information |
| C-7 | Control the display of drawings |
| C-8 | Use intermediate drawing commands |
| C-9 | Perform intermediate editing commands |
| C-10 | Create multiview drawings |
| C-11 | Create sectioned drawings |
| C-12 | Investigate basic dimensioning |
| C-13 | Perform advanced dimensioning |

**Perform Conventional Machining Operations**

| D-1 | Identify materials with desired properties |
| D-2 | Describe heat treating processes |
| D-3 | Perform heat treating operations |
| D-4 | Test metal for hardness |
| D-5 | Describe cold working processes |
| D-6 | Describe hot working processes |
| D-7 | Evaluate alternative manufacturing processes |

**Perform Measurement & Inspection**

| E-1 | Study basics of metrology |
| E-2 | Select instruments used for measurement |
| E-3 | Interpret limits and tolerances |
| E-4 | Select gaging tools |
| E-5 | Use CMM for location of features |
| E-6 | Perform surface metrology |
| E-7 | Perform measurement by comparison |
| E-8 | Perform circularity, cylindricity, profile of a line, and round measurements |
| E-9 | Investigate advanced metrology topics |

**Perform CNC Programming**

| G-1 | Apply machine specific (rolling and laser) nomenclature and terminology |
| G-2 | Investigate the Cartesian coordinate system as applied to milling and laser machines |
| G-3 | Apply CNC programming language |
| G-4 | Perform start up, tool changing, and ending of programs |
| G-5 | Perform advanced editing of part profiles |
| G-6 | Perform advanced editing of part profiles |
| G-7 | Use positioning and fixed cycles |
| G-8 | Perform contouring |
| G-9 | Apply tool radius compensation (cutter comp) |
| G-10 | Perform programming preparation |
| G-11 | Apply special laser coding parameters |

**Perform Computer Aided Manufacturing (CAM)**

<p>| H-1 | Understand the basics of a PC based CAM system |
| H-2 | Discuss basic CAM operations |
| H-3 | Set up cutting tools |
| H-4 | Create part profiles |
| H-5 | Edit part profiles |
| H-6 | Perform advanced editing of part profiles |
| H-7 | Edit tool paths |
| H-8 | Perform drilling and counterboring |
| H-9 | Use construction layers in SmartCAM |
| H-10 | Perform use commands and machine events |
| H-11 | Create families of parts |
| H-12 | Perform CAD/CAM integration |
| H-13 | Perform code generation |</p>
<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
</table>
| I      | I-1 Define quality in manufacturing and explain importance. 
I-2 Implement concepts of quality in the workplace. 
I-3 Apply principles and tools of continuous quality improvement. 
I-4 Understand and apply SPC. 
I-5 Evaluate data to monitor production. 
I-6 Analyze customer problems and recommend solutions. 
I-7 Establish methods, plans and procedures to maintain quality. |
| J      | J-1 Use electrical test equipment. 
J-2 Apply specific terms to electrical circuits. 
J-3 Analyze series, parallel and complex DC/AC circuits. 
J-4 Check AC and DC motors. 
J-5 Inspect transformers and generators. 
J-6 Discuss sensors and feedback technology. 
J-7 Set up and program PLC. 
J-8 Troubleshoot electrical devices. |
| K      | K-1 Use test equipment. 
K-2 Describe basic principles of hydraulic systems. 
K-3 Identify hydraulic fluids. 
K-4 Recommend power distribution and sealing devices. 
K-5 Recognize pumps, actuators, and hydraulic control devices. 
K-6 Troubleshoot hydraulic/pneumatic systems. |
| L      | L-1 Investigate the concepts of product design. |
| M      | M-1 Study manufacturing cells. 
M-2 Identify automation sensors. 
M-3 Perform robot programming. 
M-4 Use vision systems. |
COMPETENCY PROFILE
Manufacturing Engineering Technician

Conducted By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199540008)

Bell Helicopter
TEXTRON
MANUFACTURING ENGINEERING TECHNICIAN ... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1 Review engineering drawings and dimensions</td>
<td>A-2 Identify basic layout of drawings</td>
</tr>
<tr>
<td>A-3 Identify basic types of drawings</td>
<td>A-4 List the purpose of each type of drawing</td>
</tr>
<tr>
<td>A-5 Verify drawing elements</td>
<td>A-6 Identify lines and symbols (ID&amp;T)</td>
</tr>
<tr>
<td>A-7 Understand the relationship of engineering drawings to planning</td>
<td>A-8 Use standards to verify requirements</td>
</tr>
<tr>
<td>A-9 Analyze bill of materials</td>
<td></td>
</tr>
<tr>
<td>B-1 Select materials with desired properties</td>
<td>B-2 Identify heat treating processes</td>
</tr>
<tr>
<td>B-3 Determine materials and processes to produce a product</td>
<td>B-4 Determine advanced manufacturing processes</td>
</tr>
<tr>
<td>B-5 Test metal samples</td>
<td>B-6 Discuss casting processes</td>
</tr>
<tr>
<td>B-7 Discuss hot working processes</td>
<td>B-8 Discuss cold working processes</td>
</tr>
<tr>
<td>B-9 Evaluate alternative manufacturing processes</td>
<td></td>
</tr>
<tr>
<td>C-1 Identify types of measurements</td>
<td>C-2 Practice using measurement tools</td>
</tr>
<tr>
<td>C-3 Select proper measurement tools</td>
<td>C-4 Use metric and English standards of measurement</td>
</tr>
<tr>
<td>C-5 Perform measurements with hand held instruments</td>
<td>C-6 Perform measurements on surface plate</td>
</tr>
<tr>
<td>C-7 Perform inspections using stationary equipment</td>
<td></td>
</tr>
<tr>
<td>D-1 Prepare and plan for machining operations</td>
<td>D-2 Use proper hand tools</td>
</tr>
<tr>
<td>D-3 Operate power saws</td>
<td>D-4 Operate drill presses</td>
</tr>
<tr>
<td>D-5 Operate vertical milling machines</td>
<td>D-6 Operate horizontal milling machines</td>
</tr>
<tr>
<td>D-7 Operate metal cutting lathes</td>
<td>D-8 Operate grinding machines</td>
</tr>
<tr>
<td>E-1 Program CNC machine</td>
<td>E-2 Operate CNC machining centers and turning centers</td>
</tr>
<tr>
<td>E-3 Operate CNC machining centers and turning centers</td>
<td>E-4 Operate CNC grinders</td>
</tr>
<tr>
<td>E-5 Operate CNC grinding machines</td>
<td>E-6 Download programs via network</td>
</tr>
<tr>
<td>F-1 Describe the different types of gears</td>
<td>F-2 Understand gear terms and calculations</td>
</tr>
<tr>
<td>F-3 Calculate for direct, simple, and arithmetical indexing</td>
<td>F-4 Use rotary tables and dividing heads</td>
</tr>
<tr>
<td>F-5 Make calculations for gear cutting</td>
<td>F-6 Discuss gear inspection</td>
</tr>
<tr>
<td>G-1 Weld with SMAW process</td>
<td>G-2 Weld with Oxyfue gas cutting (Oxyfuel)</td>
</tr>
<tr>
<td>G-3 Weld with GTA (TIG)</td>
<td>G-4 Weld with GMAW (Mig) FCAW</td>
</tr>
<tr>
<td>G-5 Perform Plasma Arc Cutting (PAC)</td>
<td></td>
</tr>
<tr>
<td>H-1 Demonstrate traditional drafting skills</td>
<td>H-2 Interpret and apply ID&amp;T methodology</td>
</tr>
<tr>
<td>H-3 Use CAD systems</td>
<td>H-4 Create 3-D solid models</td>
</tr>
<tr>
<td>H-5 Make tool drawings</td>
<td></td>
</tr>
<tr>
<td>I-1 Use computer operating systems</td>
<td>I-2 Use computer inquiry systems</td>
</tr>
<tr>
<td>I-3 Use various computer applications</td>
<td>I-4 Recommend and implement CIM technologies</td>
</tr>
<tr>
<td>I-5 Evaluate data to monitor production</td>
<td>I-6 Analyze customer problems and recommend solutions</td>
</tr>
<tr>
<td>I-7 Establish methods, plans and procedures to maintain quality</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>K - Maintain Electrical Devices</td>
<td>K-1 Use electrical test equipment</td>
</tr>
<tr>
<td>L - Perform Engineering Calculations</td>
<td>L-1 Use all functions on scientific calculator</td>
</tr>
<tr>
<td>M - Maintain Hydraulics and Pneumatic Systems</td>
<td>M-1 Use test equipment</td>
</tr>
<tr>
<td>N - Interpret Safety Regulations</td>
<td>N-1 Apply safety manual directives</td>
</tr>
<tr>
<td></td>
<td>K-2 Apply specific terms to electrical circuits</td>
</tr>
<tr>
<td></td>
<td>K-4 Check AC and DC motors</td>
</tr>
<tr>
<td></td>
<td>K-6 Discuss AC and DC motors sensors and feedback concepts</td>
</tr>
<tr>
<td></td>
<td>K-7 Setup/program Programmable Logic Controller</td>
</tr>
<tr>
<td></td>
<td>K-8 Troubleshoot electrical devices</td>
</tr>
<tr>
<td></td>
<td>L-3 Perform trigonometric functions</td>
</tr>
<tr>
<td></td>
<td>L-4 Solve engineering equations</td>
</tr>
<tr>
<td></td>
<td>L-5 Solve static systems for resultant force</td>
</tr>
<tr>
<td></td>
<td>L-6 Determine strength of materials</td>
</tr>
<tr>
<td></td>
<td>L-7 Use Computer Aided Engineering system</td>
</tr>
<tr>
<td></td>
<td>M-3 Identify hydraulic fluids</td>
</tr>
<tr>
<td></td>
<td>M-4 Recommend power distribution and sealing devices</td>
</tr>
<tr>
<td></td>
<td>M-5 Recognize pumps, actuators, and control devices</td>
</tr>
<tr>
<td></td>
<td>M-6 Troubleshoot hydraulic/pneumatic systems</td>
</tr>
<tr>
<td></td>
<td>N-3 Apply American Red Cross First Aid and CPR procedures</td>
</tr>
<tr>
<td></td>
<td>N-4 Recommend hazardous waste management techniques</td>
</tr>
<tr>
<td></td>
<td>N-5 Apply ergonomic principles to the workplace</td>
</tr>
<tr>
<td></td>
<td>N-6 Demonstrate knowledge of state and federal EPA regulations</td>
</tr>
</tbody>
</table>

Bell Helicopter TEXTRON
DACUM Pest Members

LUCIEN ROUZE
Department of Employee Training and Development

DAVE PEARL
Administrator of Human Resource Development

ROBERT D. SWANSON
Administrator of Human Resource Development

JOHN P. DAVIS
International Training Program Manager

MILTON R. SIEMS
Senior Consultant of Human Resource Development

JAMES R. HELMICK, JR.
Manufacturing Engineer
SKILLS AND KNOWLEDGE
Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
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Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE
Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College
Waco

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MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

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</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>B</strong></td>
</tr>
<tr>
<td>Practice Safety</td>
<td>Apply Mathematical Concepts</td>
</tr>
<tr>
<td><strong>B-1</strong></td>
<td><strong>B-4</strong></td>
</tr>
<tr>
<td>Perform basic arithmetic functions</td>
<td>Use decimals</td>
</tr>
<tr>
<td><strong>B-14</strong></td>
<td><strong>B-15</strong></td>
</tr>
<tr>
<td>Solve static systems for resultant forces</td>
<td>Perform cold working processes</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td><strong>D</strong></td>
</tr>
<tr>
<td>Interpret Engineering Drawings and Control Documents</td>
<td>Recognize casting materials and processes</td>
</tr>
<tr>
<td><strong>C-1</strong></td>
<td><strong>D-1</strong></td>
</tr>
<tr>
<td>Review blueprint notes and dimensions</td>
<td>Identify materials with desired properties</td>
</tr>
<tr>
<td><strong>D-14</strong></td>
<td><strong>D-15</strong></td>
</tr>
<tr>
<td>Deter mine strength of materials for various applications</td>
<td>Determine measurement used in manufacturing processes</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td><strong>F</strong></td>
</tr>
<tr>
<td>Demonstrate Measurement/Inspection Techniques</td>
<td>Perform conventional machining operations</td>
</tr>
<tr>
<td><strong>E-1</strong></td>
<td><strong>F-1</strong></td>
</tr>
<tr>
<td>Identify types of measurement used in manufacturing</td>
<td>Prepare and plan for machining operations</td>
</tr>
<tr>
<td><strong>F-14</strong></td>
<td><strong>F-15</strong></td>
</tr>
<tr>
<td><strong>G</strong></td>
<td><strong>H</strong></td>
</tr>
<tr>
<td>Perform Advanced Machining Processes</td>
<td>Perform gear generating operations</td>
</tr>
<tr>
<td><strong>G-1</strong></td>
<td><strong>I-1</strong></td>
</tr>
<tr>
<td>Prepare and plan for CNC machining processes</td>
<td>Weld with Shielded Metal Arc Welding (SMAW) process</td>
</tr>
<tr>
<td><strong>H-1</strong></td>
<td><strong>I-2</strong></td>
</tr>
<tr>
<td>Describe the different types of gears</td>
<td>Weld with Tungsten Arc Welding (TIG) process</td>
</tr>
<tr>
<td><strong>I-13</strong></td>
<td><strong>I-15</strong></td>
</tr>
<tr>
<td><strong>J</strong></td>
<td><strong>K</strong></td>
</tr>
<tr>
<td><strong>J-1</strong></td>
<td><strong>K-1</strong></td>
</tr>
<tr>
<td><strong>L</strong></td>
<td><strong>M</strong></td>
</tr>
<tr>
<td><strong>L-1</strong></td>
<td><strong>M-1</strong></td>
</tr>
<tr>
<td><strong>N</strong></td>
<td><strong>O</strong></td>
</tr>
<tr>
<td><strong>N-1</strong></td>
<td><strong>O-1</strong></td>
</tr>
<tr>
<td><strong>O-14</strong></td>
<td><strong>O-15</strong></td>
</tr>
<tr>
<td>Perform Welding Operations</td>
<td>Perform flame and plasma cutting operations</td>
</tr>
</tbody>
</table>

**BEST COPY AVAILABLE**
### Duties

| J | Task 1: Demonstrate traditional mechanical drafting skills |
| K | Task 2: Use Computer-aided Drafting (CAD) system |
| L | Task 3: Create 3-D solid models |
| M | Task 4: Make tool drawings |
| N | Task 5: Recommend tool design |

### Tasks

| J | Task 1: Demonstrate traditional mechanical drafting skills |
| K | Task 2: Use Computer-aided Drafting (CAD) system |
| L | Task 3: Create 3-D solid models |
| M | Task 4: Make tool drawings |
| N | Task 5: Recommend tool design |

**Tasks:**

- Demonstrate traditional mechanical drafting skills
- Use Computer-aided Drafting (CAD) system
- Create 3-D solid models
- Make tool drawings
- Recommend tool design
SKILLS AND KNOWLEDGE
Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
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Coordinate Measurement Machine
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Electrical Training Equipment
Safety Training Equipment

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Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE
Manufacturing Engineering Technician
Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)

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Manufacturing Engineer

PREPARED BY
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Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)
MANUFACTURING ENGINEERING TECHNICIAN... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Tasks</td>
<td>A-1 Follow safety manuals and all safety regulations/requirements</td>
<td>B-1 Perform basic arithmetic functions</td>
<td>C-1 Understand CAD basics and file management</td>
<td>D-1 Identify materials with desired properties</td>
<td>E-1 Study basics of metrology</td>
<td>F-1 Prepare and plan for machining operations</td>
<td>G-1 Apply machine specific (milling and lasing) nomenclature and terminology</td>
<td>H-1 Understand the basics of a PC based CAM system</td>
</tr>
<tr>
<td></td>
<td>A-2 Use protective equipment</td>
<td>B-2 Inter-convert fractions/decimals</td>
<td>C-2 Discuss CAD basics and file management</td>
<td>D-2 Describe heat treating processes</td>
<td>E-2 Select instruments used for measurement</td>
<td>F-2 Use proper hand tools</td>
<td>G-2 Investigate the Cartesian coordinate system as applied to milling and laser machines</td>
<td>H-2 Discuss basic CAM operations</td>
</tr>
<tr>
<td></td>
<td>A-3 Follow safe operating procedures for hand and machine tools</td>
<td>B-3 Inter-convert Metric/English measurements</td>
<td>C-3 Use drawing settings</td>
<td>D-3 Perform heat treating operations</td>
<td>E-3 Interpret limits and tolerances</td>
<td>F-3 Operate power saws</td>
<td>G-3 Apply CNC programming language</td>
<td>H-3 Setup cutting tools</td>
</tr>
<tr>
<td></td>
<td>A-4 Maintain a clean and safe work environment</td>
<td>B-4 Perform basic algebraic operations</td>
<td>C-4 Perform basic editing commands</td>
<td>D-4 Test metal samples for hardness</td>
<td>E-4 Select gaging tools</td>
<td>F-4 Operate drill presses</td>
<td>G-4 Perform start-up, tool changing, and ending of programs</td>
<td>H-4 Create part profiles</td>
</tr>
<tr>
<td></td>
<td>A-5 Control fire hazards</td>
<td>B-5 Perform trigonometric functions</td>
<td>C-5 Create drawings with accuracy</td>
<td>D-5 Describe casting processes</td>
<td>E-5 Use G-M for location of features</td>
<td>F-5 Operate vertical milling machines</td>
<td>G-5 Perform positioning and basic drilling</td>
<td>H-5 Edit part profiles</td>
</tr>
<tr>
<td></td>
<td>A-6 Apply American Red Cross First Aid and CPR procedures</td>
<td>B-6 Calculate speeds and feeds for machining</td>
<td>C-6 Organize drawing information</td>
<td>D-6 Describe hot working processes</td>
<td>E-6 Perform surface metrology</td>
<td>F-6 Operate horizontal milling machines</td>
<td>G-6 Create a sub-program</td>
<td>H-6 Perform advanced editing of part profiles</td>
</tr>
<tr>
<td></td>
<td>A-7 Recommend hazard avoidance policies to the workplace</td>
<td>B-7 Locate machining points from a datum point</td>
<td>C-7 Control the display of drawings</td>
<td>D-7 Describe cold working processes</td>
<td>E-7 Perform measurement by comparison</td>
<td>F-7 Operate grinding abrasive machines</td>
<td>G-7 Use position and feed cycles</td>
<td>H-7 Edit tool paths</td>
</tr>
<tr>
<td></td>
<td>A-8 Apply ergonomic principles to the workplace</td>
<td>B-8 Use intermediate drawing commands</td>
<td>C-8 Use intermediate drawing commands</td>
<td>D-8 Evaluate alternative manufacturing processes</td>
<td>E-8 Perform cylindrical, conical, and planar profiles of a line, and runout measurements</td>
<td>F-8 Operate abrasive machines</td>
<td>G-8 Perform contouring</td>
<td>H-8 Perform drilling and countersinking</td>
</tr>
<tr>
<td></td>
<td>A-9 Demonstrate knowledge of state and federal EPA regulations</td>
<td>B-9 Calculate for direct, simple, and angular indexing</td>
<td>C-9 Perform intermediate drawing commands</td>
<td>D-9 Perform calculations for size bar and size plate</td>
<td>E-9 Investigate advanced technology topics</td>
<td>F-9 Operate abrasive machines</td>
<td>G-9 Apply tool radius compensation (cutout comp)</td>
<td>H-9 Use construction layers in SmartCAM</td>
</tr>
<tr>
<td></td>
<td>A-10 Perform calculations necessary for turning taps</td>
<td>B-10 Solve for little &quot;h&quot;</td>
<td>C-10 Create multiview drawings</td>
<td>D-10 Perform calculations for turning taps</td>
<td>E-10 Investigate advanced technology topics</td>
<td>F-10 Operate abrasive machines</td>
<td>G-10 Perform programming preparation</td>
<td>H-10 Perform user commands and machine events</td>
</tr>
<tr>
<td></td>
<td>A-11 Perform user commands and machine events</td>
<td>B-11 Use all functions on a scientific calculator</td>
<td>C-11 Create sectional drawings</td>
<td>D-11 Perform CAD/CAM integration</td>
<td>E-11 Investigate advanced technology topics</td>
<td>F-11 Operate abrasive machines</td>
<td>G-11 Apply special laser cutting parameters</td>
<td>H-11 Create families of parts</td>
</tr>
<tr>
<td></td>
<td>A-12 Perform CAD/CAM integration</td>
<td>B-12 Use all functions on a scientific calculator</td>
<td>C-12 Investigate advanced technology topics</td>
<td>D-12 Investigate advanced technology topics</td>
<td>E-12 Investigate advanced technology topics</td>
<td>F-12 Operate abrasive machines</td>
<td>G-12 Apply special laser cutting parameters</td>
<td>H-12 Perform CAD/CAM integration</td>
</tr>
<tr>
<td></td>
<td>A-13 Solve engineering equations</td>
<td>B-13 Solve engineering equations</td>
<td>C-13 Perform advanced dimensioning</td>
<td>D-13 Perform advanced dimensioning</td>
<td>E-13 Investigate advanced technology topics</td>
<td>F-13 Operate abrasive machines</td>
<td>G-13 Apply special laser cutting parameters</td>
<td>H-13 Perform CAD/CAM integration</td>
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**BEST COPY AVAILABLE**
<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1-1 Define quality in manufacturing and explain importance</td>
</tr>
<tr>
<td>J</td>
<td>1-2 Implement concepts of quality in the workplace</td>
</tr>
<tr>
<td>K</td>
<td>1-3 Apply principles and tools of continuous quality improvement</td>
</tr>
<tr>
<td>L</td>
<td>1-4 Understand and apply SPC</td>
</tr>
<tr>
<td>M</td>
<td>1-5 Evaluate data to monitor production</td>
</tr>
<tr>
<td></td>
<td>1-6 Analyze customer problems and recommend solutions</td>
</tr>
<tr>
<td></td>
<td>1-7 Establish methods, plans and procedures to maintain quality</td>
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<tr>
<td></td>
<td>1-8 Troubleshoot electrical devices</td>
</tr>
<tr>
<td></td>
<td>1-9 Use vision systems</td>
</tr>
<tr>
<td></td>
<td>1-10 Design production and service facility</td>
</tr>
<tr>
<td></td>
<td>1-11 Use test equipment</td>
</tr>
<tr>
<td></td>
<td>1-12 Describe basic principles of hydraulic systems</td>
</tr>
<tr>
<td></td>
<td>1-13 Identify hydraulic fluids</td>
</tr>
<tr>
<td></td>
<td>1-14 Recommend power distribution and sealing devices</td>
</tr>
<tr>
<td></td>
<td>1-15 Troubleshoot hydraulic/pneumatic systems</td>
</tr>
<tr>
<td></td>
<td>1-16 Investigate the concepts of product design</td>
</tr>
<tr>
<td></td>
<td>1-17 Perform production and inventory planning and control (IPPC)</td>
</tr>
<tr>
<td></td>
<td>1-18 Perform forecasting demand for finished products and services</td>
</tr>
<tr>
<td></td>
<td>1-19 Perform capacity requirements planning and master production scheduling</td>
</tr>
<tr>
<td></td>
<td>1-20 Study production volume job shop scheduling and control</td>
</tr>
<tr>
<td></td>
<td>1-21 Study setup and set-up time production scheduling and control</td>
</tr>
<tr>
<td></td>
<td>1-22 Study purchasing and vendor management</td>
</tr>
<tr>
<td></td>
<td>1-23 Study design production and service facility</td>
</tr>
</tbody>
</table>

BEST COPY AVAILABLE
SKILLS AND KNOWLEDGE
- Communication Skills
- Use Measurement Tools
- Use Inspection Devices
- Mathematical Skills
- Reading/Writing Skills
- Knowledge of Safety Regulations
- Practice Safety in the Workplace
- Organizational Skills
- Mechanical Aptitude
- Ability to Comprehend Written/Verbal Instructions
- Basic Knowledge of Fasteners
- Ability to Work as Part of a Team
- Converse in the Technical Language of the Trade
- Knowledge of Occupational Opportunities
- Knowledge of Employee/Employer Responsibilities
- Knowledge of Company Quality Improvement Activities
- Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES
- Strong Work Ethic
- Interpersonal Skills
- Punctuality
- Dependability
- Honesty
- Neatness
- Safety Awareness
- Motivation
- Responsibility
- Physical Ability
- Professional
- Trustworthiness
- Customer Relations
- Personal Ethics

CENTRAL FLORIDA COMMUNITY COLLEGE
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- IBM WHITE, Vice President/Mfguring
- BILL RICHARDS, Production Manager/Body Plant
- RON STEPHENS, Human Resources Manager
- ELAINE SWOGART, Human Resources Supervisor
- DONNA TACKETT, Health & Safety Supervisor
- JEFF OSTEEN, Supervisor
- JEFF HOUROGOAN, Supervisor

TOOLS AND EQUIPMENT
- Safety Glasses
- Hearing Protection
- Safety Shoes
- Required Clothing
- Computer Terminal System
- Microcomputer
- Drill Motors
- Screw Guns
- Rivet Guns
- Impact Guns
- Sanders
- Grinders
- Power Saws
- Torque Wrenches
- Combination Square
- General Tools (taps, dies, wrenches, etc.)

FUTURE TRENDS AND CONCERNS
- Assembly of Composite Materials
- Advanced Computer Applications
- Environmental Concerns
- Use of Automated Handling Equipment

COMPETENCY PROFILE
Manufacturing/Assembly Technician
Prepared by
Central Florida Community College

and
Emergency One, Inc.

E-ONE®

December 1995
### Duties

<table>
<thead>
<tr>
<th>A-1</th>
<th>Demonstrate understanding of safety rules</th>
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<tbody>
<tr>
<td>A-2</td>
<td>Assume personal safety standards for self and others</td>
</tr>
<tr>
<td>A-3</td>
<td>Support all safety practices and use protective equipment</td>
</tr>
<tr>
<td>A-4</td>
<td>Demonstrate an understanding of proper hazardous material handling</td>
</tr>
<tr>
<td>A-5</td>
<td>Know first aid and CPR</td>
</tr>
<tr>
<td>A-6</td>
<td>Practice safety in the use of tools</td>
</tr>
<tr>
<td>B-1</td>
<td>Apply principles and tools of continuous quality improvement</td>
</tr>
<tr>
<td>B-2</td>
<td>Understand the importance of quality in the manufacturing process</td>
</tr>
<tr>
<td>B-3</td>
<td>Implement concepts of quality in the workplace</td>
</tr>
<tr>
<td>B-4</td>
<td>Follow the Quality Plan and recommended improvements in work methods or processes</td>
</tr>
<tr>
<td>B-5</td>
<td>Establish methods, plans and procedures to maintain quality</td>
</tr>
<tr>
<td>C-1</td>
<td>Be prompt and on time in accordance with work schedule</td>
</tr>
<tr>
<td>C-2</td>
<td>Value honest work, ethics, dedication, and responsibility in the workplace</td>
</tr>
<tr>
<td>C-3</td>
<td>Display a neat and clean workplace</td>
</tr>
<tr>
<td>C-4</td>
<td>Practice cleanliness and maintenance of tools and equipment</td>
</tr>
<tr>
<td>C-5</td>
<td>Be committed to excellence and quality</td>
</tr>
<tr>
<td>C-6</td>
<td>Support a positive work environment</td>
</tr>
<tr>
<td>C-7</td>
<td>Practice a positive attitude</td>
</tr>
<tr>
<td>D-1</td>
<td>Be an active listener</td>
</tr>
<tr>
<td>D-2</td>
<td>Demonstrate good reading, comprehension, and writing skills</td>
</tr>
<tr>
<td>D-3</td>
<td>Be able to document manufacturing procedures</td>
</tr>
<tr>
<td>D-4</td>
<td>Be able to prepare recommendations for continuous improvement</td>
</tr>
<tr>
<td>D-5</td>
<td>Summarize and prioritize work responsibilities</td>
</tr>
<tr>
<td>D-6</td>
<td>Be able to give and follow directions and accept constructive criticism</td>
</tr>
<tr>
<td>D-7</td>
<td>Be able to verbally communicate with co-workers and management</td>
</tr>
<tr>
<td>E-1</td>
<td>Understand the role of the co-worker</td>
</tr>
<tr>
<td>E-2</td>
<td>Value honest work, ethics, dedication, and responsibility in the workplace</td>
</tr>
<tr>
<td>E-3</td>
<td>Demonstrate high moral values</td>
</tr>
<tr>
<td>E-4</td>
<td>Display a neat and clean workplace</td>
</tr>
<tr>
<td>E-5</td>
<td>Practice cleanliness and maintenance of tools and equipment</td>
</tr>
<tr>
<td>E-6</td>
<td>Be committed to excellence and quality</td>
</tr>
<tr>
<td>E-7</td>
<td>Support a positive attitude</td>
</tr>
<tr>
<td>E-8</td>
<td>Encourage good feelings and morale</td>
</tr>
<tr>
<td>E-9</td>
<td>Understand purpose and goals of the organization</td>
</tr>
<tr>
<td>E-10</td>
<td>Plan and organize work as a team</td>
</tr>
<tr>
<td>E-11</td>
<td>Be willing to lead in areas of knowledge and expertise</td>
</tr>
<tr>
<td>E-12</td>
<td>Demonstrate willingness to learn new methods and skills</td>
</tr>
<tr>
<td>E-13</td>
<td>Demonstrate good working relationships with others</td>
</tr>
</tbody>
</table>

### Skills

| F-1 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| F-2 | Demonstrate ability to comprehend and understand fractions and decimals |
| F-3 | Demonstrate ability to comprehend and understand basic understanding of converting equations |
| F-4 | Demonstrate ability to comprehend and understand basic mathematics in the use of measurement tools |
| F-5 | Demonstrate ability to comprehend and understand basic mathematics in the use of measurement tools |
| F-6 | Demonstrate ability to comprehend and understand basic mathematics in the use of measurement tools |
| G-1 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| G-2 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| G-3 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| G-4 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| H-1 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| H-2 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| H-3 | Demonstrate ability to comprehend and understand basic arithmetic functions |
| H-4 | Demonstrate ability to comprehend and understand basic arithmetic functions |

### Tools and Equipment

| I-1 | Demonstrate ability to identify, match, and properly use electrical tools |
| I-2 | Demonstrate ability to identify, match, and properly use electrical tools |
| I-3 | Demonstrate ability to identify, match, and properly use electrical tools |
| I-4 | Demonstrate ability to identify, match, and properly use electrical tools |
| I-5 | Demonstrate ability to identify, match, and properly use electrical tools |

### Emergency Vehicle Terminology

| J-1 | Demonstrate ability to identify, match, and properly use emergency vehicle equipment |
| J-2 | Demonstrate ability to identify, match, and properly use emergency vehicle equipment |
| J-3 | Demonstrate ability to identify, match, and properly use emergency vehicle equipment |

### BEST COPY AVAILABLE
<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
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<tbody>
<tr>
<td><strong>K</strong></td>
<td><strong>L</strong></td>
</tr>
<tr>
<td><strong>Manufacturing Materials and Processes</strong></td>
<td><strong>Duties</strong></td>
</tr>
<tr>
<td>K-1 Identify materials with desired properties and strengths</td>
<td>L-1 Demonstrate ability to lift 50 pounds</td>
</tr>
<tr>
<td>K-2 Identify materials and assembly operations needed</td>
<td>L-2 Demonstrate ability to tolerate heights up to 100 feet</td>
</tr>
<tr>
<td>K-3 Understand the importance of proper fit and torque values</td>
<td>L-3 Ability to work from various positions while standing on concrete for extended periods</td>
</tr>
<tr>
<td>K-4 Understand the capability and use of cutters and grinders</td>
<td>L-4 Display ability to work in hot/dusty environment for 8-10 hours</td>
</tr>
<tr>
<td>K-5 Identify and use corrosion control procedures and materials</td>
<td>L-5 Present a history of documented regular attendance at work</td>
</tr>
<tr>
<td><strong>Wellness/Physical Abilities</strong></td>
<td><strong>L-6 Apply wellness information to lifestyle to maintain health</strong></td>
</tr>
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**Continued**
SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Consciousness
Motivation
Responsibility
Physical Ability
Professional
Trustworthiness
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machine Tooling (e.g., calipers, dial indicators, magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathes with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Fibering Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing Engineering Technician

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TEXAS STATE TECHNICAL COLLEGE WACO
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Inst Coordinator

ROSE MARY TIMMONS
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Furnished By:

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Senior Manager/Systems Design Engineer

MICHAEL KON
Manufacturing Engineer and
CNC Systems/Program Engineer

TEXAS STATE TECHNICAL COLLEGE WACO

LOCKHEED MARTIN
MANUFACTURING ENGINEERING TECHNICIAN... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

### Tasks

| Tasks | Duties | A-1 Follow safe operating procedures and machine tool instructions | A-2 Use protective equipment and clothing | B-1 Prepare and plan for machining operations | B-2 Use proper hand tools | B-3 Select and use CNC turning systems (lathes) | B-4 Use machining centers (mills) | B-5 Use CNC lathes | B-6 Use CNC grinders | B-7 Use CNC vertical grinding machines | C-1 Use and interpret drawings | C-2 Identify heat treating processes | C-3 Identify basic types of metal cutting processes | D-1 Write and understand quality systems requirements | E-1 Perform and plan for machining operations | E-2 Select and use CNC turning systems (lathes) | E-3 Apply basic trigonometric functions | E-4 Use basic machining measurement techniques | E-5 Use basic geometric dimensioning and tolerancing (GD&T) methods | E-6 Use basic quality measurement techniques | E-7 Use basic plastic welding machines | E-8 Use basic rubber and plastic welding machines | E-9 Understand and use cutting speeds | E-10 Understand and use feed rates | F-1 Perform basic machining measurement processes | F-2 Perform basic geometric dimensioning and tolerancing (GD&T) methods | F-3 Test metal using standard instruments | F-4 Test metal using stationary equipment | F-5 Test metal using portable instruments | F-6 Use basic plastic welding machines | F-7 Use basic rubber and plastic welding machines | F-8 Use basic grinding machines | F-9 Use basic metal-cutting machines | F-10 Use basic electrical machine tools | F-11 Use basic welding machines | F-12 Use basic adhesive bonding machine tools | G-1 Perform basic machining measurement processes | G-2 Perform basic geometric dimensioning and tolerancing (GD&T) methods | G-3 Test metal using standard instruments | G-4 Test metal using stationary equipment | G-5 Test metal using portable instruments | G-6 Use basic plastic welding machines | G-7 Use basic rubber and plastic welding machines | G-8 Use basic grinding machines | G-9 Use basic metal-cutting machines | G-10 Use basic electrical machine tools | G-11 Use basic welding machines | G-12 Use basic adhesive bonding machine tools | H-1 Perform basic metal-cutting processes | H-2 Perform basic welding processes | H-3 Use basic machining centers (mills) | H-4 Use basic grinding machines | H-5 Use basic metal-cutting machines | H-6 Use basic electrical machine tools | H-7 Use basic welding machines | H-8 Use basic adhesive bonding machine tools | I-1 Demonstrate basic mechanical drawing skills | I-2 Use AutoCAD (CAD) system | I-3 Use Inventor (3D) software | J-1 Use and interpret drawings | J-2 Use proper hand tools | J-3 Use the proper measuring techniques | J-4 Use basic machining measurement processes | J-5 Use basic geometric dimensioning and tolerancing (GD&T) methods | J-6 Use basic quality measurement techniques | J-7 Use basic plastic welding machines | J-8 Use basic rubber and plastic welding machines | J-9 Use basic grinding machines | J-10 Use basic metal-cutting machines 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Use basic welding machines | Z-13 Use basic adhesive bonding machine tools |
### Duties

<table>
<thead>
<tr>
<th>J</th>
<th>Participate in Total Quality and SPC Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Maintain Electrical Devices</td>
</tr>
<tr>
<td>L</td>
<td>Maintain Hydraulics/Pneumatic Devices</td>
</tr>
</tbody>
</table>

### Tasks

<table>
<thead>
<tr>
<th>J-1 Use computer operating systems</th>
<th>J-2 Use computer inquiry systems</th>
<th>J-3 Use various computer applications</th>
<th>J-4 Recommend and implement CIM technologies</th>
<th>J-5 Use computer-aided engineering system</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-1 Define quality and importance</td>
<td>K-2 Implement quality in the workplace</td>
<td>K-3 Apply continuous quality improvement</td>
<td>K-4 Understand and apply SPC</td>
<td>K-5 Evaluate data to monitor production</td>
</tr>
<tr>
<td>K-6 Analyze customer problems and recommend solutions</td>
<td>K-7 Establish methods, plans, and procedures to maintain quality</td>
<td></td>
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</tr>
<tr>
<td>L-1 Use electrical test equipment</td>
<td>L-2 Apply specific terms to electrical circuits</td>
<td>L-3 Analyze series, parallel, and complex DC/AC circuits</td>
<td>L-4 Check AC and DC motors</td>
<td>L-5 Inspect transformers and generators</td>
</tr>
<tr>
<td>L-6 Discuss sensors and feedback technology</td>
<td>L-7 Set up and program PLC</td>
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</tr>
<tr>
<td>M-1 Use test equipment</td>
<td>M-2 Describe basic principles of hydraulic systems</td>
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SKILLS AND KNOWLEDGE
Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Pr巡回 Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES
Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Consciousness
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT
Machinist's Tools (e.g., calipers, dial indicators, magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gearing Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Computer
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Vises
Pedestal Grinders
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS
Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications/Networking
Robotics/Vision Systems
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing
Digital Measuring Tools
Advanced Materials/Super Plastic Forming
Computer Simulation
MANUFACTURING ENGINEERING TECHNICIAN use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

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<td><strong>A</strong> Practice Safety</td>
<td><strong>A-1</strong> Follow safety manuals and all safety regulations/requirements</td>
</tr>
<tr>
<td><strong>B</strong> Apply Mathematical Concepts</td>
<td><strong>A-2</strong> Use protective equipment</td>
</tr>
<tr>
<td><strong>C</strong> Interpret Engineering Drawings and Control Documents</td>
<td><strong>A-3</strong> Recommend and understand safe operating procedures for hand and machine tools</td>
</tr>
<tr>
<td><strong>D</strong> Recognize Different Manufacturing Materials and Processes</td>
<td><strong>A-4</strong> Maintain a clean and safe work environment</td>
</tr>
<tr>
<td><strong>E</strong> Demonstrate Measurement/Inspection Techniques</td>
<td><strong>A-5</strong> Control fire hazards</td>
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<td><strong>F</strong> Perform Conventional Machining Operations</td>
<td><strong>A-6</strong> Apply American Red Cross First Aid and CPR procedures</td>
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<tr>
<td><strong>G</strong> Perform Advanced Machining Processes</td>
<td><strong>A-7</strong> Follow ergonomic principles to the workplace</td>
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<tr>
<td><strong>H</strong> Perform Welding Operations</td>
<td><strong>A-8</strong> Apply hazardous waste management techniques</td>
</tr>
<tr>
<td><strong>I</strong> Perform Drafting Tasks</td>
<td><strong>A-9</strong> Demonstrate knowledge of state and federal EPA regulations</td>
</tr>
<tr>
<td><strong>J</strong> Use Computers</td>
<td><strong>A-10</strong> Perform calculations necessary for turning taper</td>
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<td>N</td>
<td>Production Control and Scheduling</td>
</tr>
<tr>
<td></td>
<td>N-1 Analyze standard tooling and work order repair schedules</td>
</tr>
<tr>
<td></td>
<td>N-2 Forecast work order repair times and methods</td>
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<tr>
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<td>N-3 Expedite repair processes</td>
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<td>N-4 Analyze cost/time efficiencies (make vs. buy decisions)</td>
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Forklift
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Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE
Manufacturing Engineering Technician
Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)
MANUFACTURING ENGINEERING TECHNICIAN... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

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<td>B</td>
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<tr>
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<td>B-1 Perform arithmetic functions</td>
</tr>
<tr>
<td></td>
<td>B-2 Inter-convert fractions/decimals</td>
</tr>
<tr>
<td></td>
<td>B-3 Inter-convert metric/English measurements</td>
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<td>B-4 Perform basic algebraic operations</td>
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<td>B-5 Perform trigonometric functions</td>
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<tr>
<td></td>
<td>B-6 Calculate speeds and feeds for machining</td>
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<tr>
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<td>B-7 Locate machining points from a datum point</td>
</tr>
<tr>
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<td>B-8 Perform calculations for size bar and size plate</td>
</tr>
<tr>
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<td>B-9 Calculate for direct, simple, and angular indexing</td>
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<tr>
<td>C</td>
<td>Perform Computer Aided Drafting (CAD)</td>
</tr>
<tr>
<td></td>
<td>C-1 Understand CAD basics</td>
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<tr>
<td></td>
<td>C-2 Discuss CAD basics and file management</td>
</tr>
<tr>
<td></td>
<td>C-3 Use drawing settings</td>
</tr>
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<td>C-4 Perform basic editing commands</td>
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<td>C-5 Create drawings with accuracy</td>
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<td>C-6 Organize drawing information</td>
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<td>C-7 Control the display of drawings</td>
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<td>C-8 Use intermediate editing commands</td>
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<td>C-9 Perform intermediate editing commands</td>
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<td>C-10 Create multiview drawings</td>
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<td>C-11 Create sectioned drawings</td>
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<tr>
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<td>C-12 Investigate basic dimensioning</td>
</tr>
<tr>
<td></td>
<td>C-13 Perform advanced dimensioning</td>
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<tr>
<td>D</td>
<td>Recognize Different Manufacturing Materials and Processes</td>
</tr>
<tr>
<td></td>
<td>D-1 Identify materials with desired properties</td>
</tr>
<tr>
<td></td>
<td>D-2 Describe heat treatment processes</td>
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<td>D-3 Perform heat treatment operations</td>
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<tr>
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<td>D-4 Test metal samples for hardness</td>
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<td>D-5 Describe casting processes</td>
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<td>D-6 Describe hot working processes</td>
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<td>D-7 Describe cold working processes</td>
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<td>D-8 Evaluate alternative manufacturing processes</td>
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<tr>
<td>E</td>
<td>Perform Measurement and Inspection</td>
</tr>
<tr>
<td></td>
<td>E-1 Study basics of metrology</td>
</tr>
<tr>
<td></td>
<td>E-2 Select instruments used for measurement</td>
</tr>
<tr>
<td></td>
<td>E-3 Interpret limits and tolerances</td>
</tr>
<tr>
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<td>E-4 Select gaging tools</td>
</tr>
<tr>
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<td>E-5 Use CMM for location of features</td>
</tr>
<tr>
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<td>E-6 Perform surface metrology</td>
</tr>
<tr>
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<td>E-7 Perform measurement by comparison</td>
</tr>
<tr>
<td></td>
<td>E-8 Perform roundness, cylindricity, profile of a line, and nanoscale measurements</td>
</tr>
<tr>
<td></td>
<td>E-9 Investigate advanced metrology topics</td>
</tr>
<tr>
<td>F</td>
<td>Perform Conventional Machining Operations</td>
</tr>
<tr>
<td></td>
<td>F-1 Prepare and plan for machining operations</td>
</tr>
<tr>
<td></td>
<td>F-2 Use proper hand tools</td>
</tr>
<tr>
<td></td>
<td>F-3 Operate power tools</td>
</tr>
<tr>
<td></td>
<td>F-4 Operate drill presses</td>
</tr>
<tr>
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<td>F-5 Operate vertical milling machines</td>
</tr>
<tr>
<td></td>
<td>F-6 Operate horizontal milling machines</td>
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<tr>
<td></td>
<td>F-7 Operate grinding/facing machines</td>
</tr>
<tr>
<td>G</td>
<td>Perform CNC Programming</td>
</tr>
<tr>
<td></td>
<td>G-1 Apply machine specific coordinate system as applied to milling and laser machines</td>
</tr>
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<td>G-2 Investigate the Cartesian coordinate system as applied to milling and laser machines</td>
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<td>G-3 Apply CNC programming language</td>
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<td>G-4 Perform start up, tool changing, and ending of programs</td>
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<td>G-9 Apply tool radius compensation (tool comp)</td>
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<td>G-10 Perform programming preparation</td>
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<td>G-11 Apply special laser coding parameters</td>
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<td>H-1 Understand the basics of a PC based CAM system</td>
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<td>H-2 Discuss basic CAM operations</td>
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SKILLS AND KNOWLEDGE
Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES
Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT
Machinist's Tools (e.g., calipers, dial indicators, magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxymetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS
Statistical Process Control
Computers
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Machining

COMPETENCY PROFILE
Manufacturing Engineering Technician
Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)
MANUFACTURING ENGINEERING TECHNICIAN... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

### Duties

**A**
- **Practice Safety**
  - A-1 Follow safety manuals and all safety regulations/requirements

**B**
- **Apply Mathematical Concepts**
  - B-1 Perform basic arithmetic functions
  - B-2 Interconvert fractions/decimals
  - B-3 Interconvert Metric/English measurements

**C**
- **Perform Conventional Machining Operations**
  - C-1 Understand CAD basics and CAM management

**D**
- **Recognize Different Manufacturing Materials and Processes**
  - D-1 Identify materials with desired properties
  - D-2 Describe heat treating processes

**E**
- **Perform Measurement and Inspection**
  - E-1 Study basics of metrology
  - E-2 Select instruments used for measurement

**F**
- **Perform CNC Programming**
  - F-1 Prepare and plan for machining operations
  - F-2 Use proper hand tools

**G**
- **Perform Computer Aided Drafting (CAD)**
  - G-1 Apply machine specific (milling and laser) nomenclature and terminology

**H**
- **Perform Computer Aided Manufacturing (CAM)**
  - H-1 Understand the basics of a PC based CAM system

### Tasks

#### B
- B-1 Follows safety manuals and all safety regulations/requirements
- B-2 Interconvert fractions/decimals
- B-3 Interconvert Metric/English measurements
- B-4 Perform basic arithmetic operations
- B-5 Perform basic trigonometric functions
- B-6 Calculate speeds and feeds for machining
- B-7 Locate machining points from a datum point
- B-8 Perform calculations for size bar and size plate
- B-9 Calculate for direct, simple, and angular indexing
- B-10 Perform calculations necessary for turning tapers
- B-11 Solve for little "h"
- B-12 Use all functions on a scientific calculator
- B-13 Solve engineering equations

#### C
- C-1 Use and manipulate blocks
- C-2 Discuss CAD basics and CAM management
- C-3 Use drawing settings
- C-4 Perform basic editing commands
- C-5 Create drawings with accuracy
- C-6 Organize drawing information
- C-7 Control the display of drawings
- C-8 Use intermediate drawing commands
- C-9 Perform intermediate editing commands
- C-10 Create multiview drawings
- C-11 Create sectioned drawings
- C-12 Investigate basic dimensioning
- C-13 Perform advanced dimensioning

#### D
- D-1 Identify materials with desired properties
- D-2 Describe heat treating processes
- D-3 Perform heat treating operations
- D-4 Test metal samples for hardness
- D-5 Describe casting processes
- D-6 Describe cold working processes
- D-7 Describe hot working processes
- D-8 Evaluate alternative manufacturing processes

#### E
- E-1 Study basics of metrology
- E-2 Select instruments used for measurement
- E-3 Interpret limits and tolerances
- E-4 Select gaging tools
- E-5 Use Ch 04 for location of features
- E-6 Perform surface metrology
- E-7 Perform measurement by comparison
- E-8 Perform miscellaneous, cylinder, and miscellaneous measurements
- E-9 Investigate advanced metrology topics

#### F
- F-1 Prepare and plan for machining operations
- F-2 Use proper hand tools
- F-3 Operate power saws
- F-4 Operate drill presses
- F-5 Operate vertical milling machines
- F-6 Operate horizontal milling machines
- F-7 Operate metal cutting lathes
- F-8 Operate grinding/abrasive machines

#### G
- G-1 Apply machine specific (milling and laser) nomenclature and terminology
- G-2 Investigate the Cartesian coordinate system of an applied milling and laser machine
- G-3 Apply CNC programming language
- G-4 Perform start up, tool changing, and ending of programs
- G-5 Perform positioning and basic drilling
- G-6 Create a sub-program
- G-7 Use position and fixed cycles
- G-8 Perform contouring
- G-9 Apply tool radius compensation (outer comp)
- G-10 Perform programming preparation
- G-11 Apply special laser coding parameters

#### H
- H-1 Understand the basics of a PC based CAM system
- H-2 Discuss basic CAM operations
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<td>I-1 Define quality in manufacturing and explain importance</td>
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<td>I-2 Implement concepts of quality in the workplace</td>
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<td>I-3 Apply principles and tools of continuous quality improvement</td>
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<td>I-4 Understand data to monitor production</td>
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<td>I-5 Evaluate customer problems and recommend solutions</td>
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<td>I-6 Establish methods, plans and procedures to maintain quality</td>
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<td>I-7 Set up and program PLC</td>
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<td>I-8 Troubleshoot electrical devices</td>
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<td>J-1 Use electrical test equipment</td>
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<td>J-2 Apply specific terms to electrical circuits</td>
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<td>J-3 Analyze series, parallel and complex DC/AC circuits</td>
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<td>J-4 Inspect transformers and generators</td>
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<td>J-5 Diagnose sensors and feedback technology</td>
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<td>K-2 Describe basic principles of hydraulic systems</td>
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<td>K-3 Identify hydraulic fluids</td>
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<td>K-4 Recommend power distribution and sealing devices</td>
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<td>K-5 Recognize pumps, actuators, and hydraulic control devices</td>
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<td>L-1 Investigate the concepts of product design</td>
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<td>L-5 Perform Material Requirements Planning (MRP) and Manufacturing Resource Planning (MRP II)</td>
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<td>L-6 Study reorder point and re-order quantity methods</td>
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<td>L-7 Study low-volume job shop scheduling and control</td>
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<td>L-8 Study repetitive and just-in-time production scheduling and control</td>
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<td>L-10 Design production and service facility</td>
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<td>M-1 Study manufacturing cells</td>
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<td>M-2 Describe group technology</td>
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<td>M-3 Study automated material movement and storage systems</td>
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<td>M-4 Discuss robotics classification and automation</td>
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<td>M-5 Study end-of-arm tooling</td>
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<td>M-6 Identify automation sensors</td>
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<td>M-7 Implement computer integrated manufacturing with robots</td>
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<td>M-9 Use vision systems</td>
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For more information:

MAST Program Director
Texas State Technical College
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Waco, TX 76705

(817) 867-4849
FAX (817) 867-3380
1-800-792-8784
http://machinetool.tstc.edu
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