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 instrumentation specialty area. It is organized in the following sections: (1) a profile of Augusta Technical Institute (Georgia), the development center that produced these standards and curriculum; (2) an instrumentation and technician competency profile of job duties and tasks; (3) a 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 course crosswalk. Individual syllabi for the following courses are provided: College Algebra; Composition and Rhetoric I; Computer Programming Fundamentals; Engineering Graphics I; College Trigonometry; Technical Communications; Mechanics; DC Circuit Analysis; Differential Calculus; Electricity and Magnetism; AC Circuit Analysis I; Electronic Devices; Fluids, Heat, Sound, and Light; AC Circuit Analysis II; Digital Fundamentals; Electromechanical Devices; Control Systems; Microcomputer Fundamentals; Programmable Controllers; Motor Controls; Introduction to Process Control; Control Systems II; Distributed Control Systems; and Introductory Psychology. Components of each syllabus are as follows: lecture, lab, and credit hours; course description; prerequisites; course objectives; required course materials; method of instruction; course objectives: technical competencies; and course objectives: SCANS competencies. Appendixes contain the individual competency profiles for each company surveyed by the MAST development center and narrative of the pilot program for this occupational specialty. (YLB)
Machine Tool Advanced Skills Technology

COMMON GROUND: TOWARD A STANDARDS-BASED TRAINING SYSTEM FOR THE U.S. MACHINE TOOL AND METAL RELATED INDUSTRIES

VOLUME 12

INSTRUMENTATION

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 12

-- INSTRUMENTATION --

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

September, 1996
<table>
<thead>
<tr>
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<th>Machine Tool Advanced Skills Technology Program</th>
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| **Discrimination:**     | Title VI of the Civil Rights Act of 1964 states: “No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.” Title IX of the Education Amendments of 1972 states: “No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal financial assistance.” Therefore, the Machine Tool Advanced Skills Technology (MAST) project, like every program or activity receiving financial assistance from the U.S. Department of Education, operated in compliance with these laws. |
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 Consortia 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)

VOLUME 15
ADMINISTRATIVE INFORMATION
VOLUME 12
INSTRUMENTATION AND CONTROL TECHNOLOGY

Table of Contents

Foreword ................................................................. 1
Development Center Profile ........................................... 2
Instrumentation and Control Technician Competency Profile .......... 3
Instrumentation and Control Technician Duty/Task/Sub-Task Outline ...... 4
Course Listing/Course Descriptions ..................................... 5
Technical Competency/Course Crosswalk ............................... 6
“SCANS”/Course Crosswalk ........................................... 7
Individual Course Syllabi .............................................. 8
Appendix A - Industry Competency Profiles ............................ 9
Appendix B - Pilot Program Narrative .................................. 10
Under the threat of global competition, shrinking product life cycles, and higher product quality standards, American manufacturing is turning towards electronic sophistication to increase productivity and precision and reduce costs. Robotics, computer controlled systems, and electronic instrumentation have entered the manufacturing workplace at a pace unparalleled in United States industrial history while human workers and the conventional machines they used to operate are departing at the same rate. The machine operator in American factories has become a vulnerable part of the sector and can only hope to survive by obtaining continued training in the new technologies which have revolutionized manufacturing.

Assessment of industry and educational strengths, weaknesses, and opportunities through the year 2000 by Augusta Technical Institute reveals that 95% of future jobs will go to individuals with advanced technical training. The majority of these jobs will require post-secondary education and skills training. Since less than 20% of the population will pursue four-year, post-secondary education, community colleges and similar training institutions will be tasked with training the remaining 80% of the population through technology-based training and literacy curricula.

A case in point is the emerging occupation of Instrumentation and Control Technician. The Instrumentation and Control Technician is the worker in a manufacturing plant who insures that all instrumentation and control components of the manufacturing process operate at maximum efficiency. The work of the Instrumentation and Control Technician blends the science of data acquisition and control of systems with use of electronics and digital computers. Dynamic evaluation, testing, controller tuning, and total system performance are his or her concern. The need for such workers is vital and varied. Instrumentation and Control Technicians can work in field technical sales, field service representation, instrumentation engineering, network systems, computer systems technology, and even some robotics interfacing. Industries such as oil, chemical, petro chemical, power, big manufacturing plants, water utilities, and even large municipalities with large power plants will likely face increasing need for instrumentation workers in the future.

Recognizing the need to increase the supply of new skilled workers in this and other occupations for the metal and metals-related industries, the U.S. Department of Education launched the Cooperative Demonstration Program (Manufacturing Technologies) as part of the National Skills Standards Act of 1994. The goal of the Department initiative was to foster the development and implementation of national skill standards and a training model for certificate and Associate of Science degree programs. In July 1994, a multi-state consortium of community colleges led by Texas State Technical College received a grant awarded by the Department under the initiative. The Machine Tool Advanced Skills Technology (MAST) consortium, which includes six of the nation's leading Advanced Technology Centers (ATCs), was formed to develop, test and disseminate industry-specific skill standards and model curricula for the U.S. machine tool industry over a two year period. As part of the MAST consortium, Augusta Technical Institute in Georgia was tasked with developing and piloting skill standards and model curricula in the technical area of Instrumentation and Control Technician.
After numerous interviews with practitioners from industry (see Appendix A) and discussions with educators, managers, supervisors, and others involved with machine related occupations and specifically instrumentation and control, the MAST consortia partners have agreed to present our definition of a Instrumentation and Control Technician as follows:

**INSTRUMENTATION AND CONTROL TECHNICIAN:** The instrumentation and control technician will be able to troubleshoot, repair, calibrate, specify, and commission as required all instrumentation and control components relating to plant operations.

Augusta Technical College's curricula for instrumentation and control technician is structured as a 24 course, two year course of study. Course diversity ranges from motor control and fluid mechanics to circuit analysis and differential calculus.

This volume contains the justification, documentation, and course syllabi for the courses recommended as minimum training for individuals desiring to become instrumentation and control 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 the Augusta Region
Augusta is the second largest city in Georgia and manufacturing represents the largest sector of the Augusta economy. The region is home to 810 manufacturers employing 89,717 people, an industrial base consisting of about 75% process control and 25% discrete parts production facilities. Major areas of emphasis for industry include technology transfer, factory floor training, and job certification programs. Growth of manufacturing in the region has been driven by Augusta’s high tech development in electronics, process control, telecommunications, computers, medical services and instrumentation.

Augusta Technical Institute and Advanced Manufacturing Technology Center (AMTEC)
Augusta Technical Institute (ATI) is part of Georgia’s Department of Technical and Adult Education system, serving a large percentage of the two-state Central Savannah River area through its main campus and satellite facilities. The student body includes vocational-technical and college prep students, as well as current workers seeking retraining or skills upgrade; ATI has long emphasized outreach and special attention to the needs of low income, rural and disadvantaged residents, as well as displaced workers, single parents, women in non-traditional fields, and the disabled. In 1983, the Institute used the opportunity to host one of Georgia’s new regional advanced technology centers (ATC’s) to streamline its technical programs and thereby help to ensure the future employability of its students. ATI’s Advanced Manufacturing Technology Center (AMTEC) is designed to provide technology research and demonstration, industry assessments, technical consulting, and industry-specific contract training for the many established and emerging high tech companies in the Augusta region.

Development Team
- Project Director: Jim Weaver, PhD., Director of AMTEC, served as program director for the MAST project.
- Subject Matter Expert: Ronnie Lambert, MS, MAST Site Coordinator, had program responsibility for developing skill standards based on the industry skills verification process, as well as developing course curricula and program materials for the MAST pilot program in Industrial Maintenance Mechanic and Instrumentation Technician. Mr. Lambert has taught Industrial Maintenance Mechanic and Instrumentation for 32 years in colleges and industry across the Southeast.
- Subject Matter Expert: Bob Johnson, BS, Project Development, was responsible for developing skill standards for the MAST project. Mr. Johnson has 27 years of experience in process-related industry and training in both technical schools and industry, he is certified in many process-related specialty areas.
THE MAST COMPETENCY PROFILE

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.
BASIC SKILLS AND KNOWLEDGE
Ability to Comprehend Written/Verbal Instructions
Ability to Work as Part of a Team
Communication Skills
Converse in the Technical Language of the Trade
Knowledge of Calibration Procedures
Knowledge of Company Policies/Procedures
Knowledge of Company Quality Assurance Activities
Knowledge of Employee/Employer Responsibilities
Knowledge of Occupational Opportunities
Knowledge of Safety Regulations
Mathematical Skills - Algebra & Trig.
Mechanical Aptitude
Practice Quality-Consciousness in Performance of the Job
Practice Safety in the Workplace
Reading/Writing Skills
Use Inspection Devices
Use Pneumatic & Electronic Measurement Devices

ATTITUDES AND TRAITS
Customer Relations
Dependability
Honesty
Interpersonal Skills
Neatness
Personal Ethics
Physical Ability
Professional
Punctuality
Responsible
Safety Consciousness
Self Motivation
Strong Work Ethics
Trustworthy

EQUIPMENT AND TOOLS
AC Solid State Drives
Air Analyzers
Calibrated Instruments (VOM, Pressure Supply)
Computer
Control Valves/Positioners
Controllers
PI, PI, Single Loop, Multiloop
Dampers
DC Solid State Drives
Digital Training Equipment
Electrical Training Equipment
Gas Analyzers
Gauges (Pressure, Limit, Flow)
Hand Tools
Ice Bath
Instrumentation Lab
Instrumentation Tech's Tools (Lab Calibrated against standard)
Instrumentation Training Equipment
Linear Variable Differential Transformer
Mass Flowmeters
Personal Safety Equipment
pH Analyzers
Programmable Controllers
Recorders/Indicators
Safety Training Equipment
Spectrometer
Strain Gauges
Transducers
Transmitters
Water Analyzers

CONCERNS AND FUTURE TRENDS
Advanced Computer Applications
Automated Material Handling Equipment
Computer Integrated Manufacturing
Distributed Control Systems
Environmental Concerns
Fiber Optic Controls
Robotics
Statistical Process Control

COMPETENCY PROFILE
INSTRUMENTATION TECHNICIAN

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

Machine Tool Advanced Skills Technology Program

AMTEC

14

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15
### INSTRUMENTATION AND CONTROL TECHNICIAN...

will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

**Duties**

<table>
<thead>
<tr>
<th>INSTRUMENTATION AND CONTROL TECHNICIAN</th>
<th>Tasks</th>
</tr>
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<tbody>
<tr>
<td><strong>A</strong> Practice Safety</td>
<td>B-1</td>
</tr>
<tr>
<td><strong>B</strong> Maintain Control Systems</td>
<td>B-2</td>
</tr>
<tr>
<td><strong>C</strong> Maintain Field Instrumentation</td>
<td>B-3</td>
</tr>
<tr>
<td><strong>D</strong> Organize Work Routines</td>
<td>B-4</td>
</tr>
<tr>
<td><strong>E</strong> Collect and File Data</td>
<td>B-5</td>
</tr>
<tr>
<td><strong>F</strong> Participate in Continuing</td>
<td>B-6</td>
</tr>
<tr>
<td><strong>G</strong> Read/interpt diaagrams and</td>
<td>B-7</td>
</tr>
<tr>
<td><strong>H</strong> Sketch diagrams</td>
<td>B-8</td>
</tr>
<tr>
<td><strong>I</strong> Study technical equipment</td>
<td>B-9</td>
</tr>
<tr>
<td><strong>J</strong> Application of ISA/RC standards</td>
<td>B-10</td>
</tr>
<tr>
<td><strong>K</strong> Understand proper use of test</td>
<td>B-11</td>
</tr>
<tr>
<td><strong>L</strong> Utilize manuals</td>
<td>B-12</td>
</tr>
<tr>
<td><strong>M</strong> Attend on-going safety training</td>
<td>B-13</td>
</tr>
<tr>
<td><strong>N</strong> Participate in plant related</td>
<td>B-14</td>
</tr>
<tr>
<td><strong>O</strong> Attend PLC training</td>
<td>B-15</td>
</tr>
<tr>
<td><strong>P</strong> Attend DCS training</td>
<td>B-16</td>
</tr>
</tbody>
</table>

**Tasks**

<p>| <strong>A</strong> Follow safety manuals and all safety regulations/requis  |
| <strong>B</strong> Proper storage of Circuit Boards                       |
| <strong>C</strong> Test and calibrate pressure safety manuals             |
| <strong>D</strong> Coordinate work activities with other crafts/units      |
| <strong>E</strong> Record preventative maintenance data                    |
| <strong>F</strong> Read/interpret diaagrams and drawings                  |
| <strong>G</strong> Sketch diagrams                                         |
| <strong>H</strong> Study technical equipment information                   |
| <strong>I</strong> Application of ISA/RC standards                         |
| <strong>J</strong> Understand proper use of test equipment and tools       |
| <strong>K</strong> Utilize manuals                                         |
| <strong>L</strong> Attend on-going safety training courses                 |
| <strong>M</strong> Participate in plant related training                   |
| <strong>N</strong> Attend PLC training                                     |
| <strong>O</strong> Attend DCS training                                    |</p>
<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>G-1: Learn to review and forecast spare parts inventory</td>
</tr>
<tr>
<td>H</td>
<td>H-1: Troubleshoot, install, maintain, and operate motor starters</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.
INSTRUMENTATION AND CONTROL TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES

INSTRUMENT AND CONTROL TECHNICIAN...will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

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. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Proper Storage of Circuit Boards
   2. Collect and Record Data According to Company Requirements
   3. Test and Calibrate Transducers According to Specs
   4. Perform Preventive Maintenance Procedures for Control Devices
   5. Test and/or Replace Printed Circuit Boards
   6. Function Check Individual Elements Within Loop
   7. Troubleshoot Different Types of System Modules
   8. Test Different Types of System Modules
   9. Configure Software
  10. Repair Different Types of System Modules
  11. Install Control System Hardware
  12. Simulate Control System Check
  13. Loop-Check Control System
  15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES
1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications
9. Perform Basic Algebraic Operations
10. Perform Basic Trigonometric Functions
11. Perform Basic Calculus Operations

E. COLLECT AND FILE DATA
1. Record Test/Calibration Data
2. Record Preventive Maintenance Data
3. Record Equipment Disconnect Data
4. Evaluate Collected Data
5. Review & Revise Procedures if Needed
6. Write Reports Required by Company
7. Specify Equipment for Control Systems
8. Prepare and Update Specification Forms
9. Write Work Orders
10. Prepare and Update Ladder And/Or Logic Diagrams
11. Program PLC’s

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES
1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications
H. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS
1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks
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.
## ELECTROMECHANICAL ENGINEERING TECHNOLOGY
### INSTRUMENTATION OPTION

#### FIRST QUARTER
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**Program Totals**

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26
ELECTROMECHANICAL ENGINEERING TECHNOLOGY
INSTRUMENTATION OPTION

COURSE DESCRIPTIONS

CIS 191 Computer Programming Fundamentals (3-6-5) Emphasizes fundamental concepts of problem solving using computers. Students explore flow charting, control structures, subroutines, arrays, strings manipulation, matrices, and files. A high level source language is used. The laboratory portion of the course is designed to acquaint students with computer facilities and software utilities. Topics include: system fundamentals, concepts of structured programming, arrays, functions and subroutines, data files, engineering applications, graphics, matrices, and program editing. Laboratory work parallels class work.

DDF 191 Engineering Graphics I (1-6-3) Introduces engineering drawing. Topics include: sketching, drafting fundamentals such as use of instruments, linework, lettering, layout, and geometric construction; orthographic projection; pictorial drawing; schematic drawing; descriptive geometry; computer graphics concepts; and engineering drawing conventions. Laboratory work parallels class work.

PHY 191 Mechanics (4-3-5) Introduces the classical theories of mechanics. Topics include: measurements and systems of units; Newton's laws; work, energy, and power; impulse and momentum; linear motion and two-dimensional motion; equilibrium; and elasticity. Laboratory exercises supplement class work. Computer use is an integral part of class and laboratory assignments. Prerequisites: MAT 191, College Algebra, and CIS 191, Computer Programming Fundamentals.

EET 101 DC Circuit Analysis (4-3-5) Emphasizes the knowledge and ability to analyze basic DC circuits. Topics include: units, basic electrical laws, series and parallel circuits, capacitance, an introduction to network analysis and network theorems concepts, and DC instruments. Laboratory work parallels class work. Prerequisites: CIS 191, Computer Programming Fundamentals, and MAT 191, College Algebra.

PHY 192 Electricity and Magnetism (4-3-5) Introduces theories of electricity and magnetism. Topics include: electrostatic forces and fields, magnetism, circuit elements and theory, electromagnetic waves, and modern physics. Laboratory exercises supplement class work. Computer use is an integral part of class and laboratory assignments. Prerequisites: MAT 193, College Trigonometry, and PHY 191, Mechanics.

EET 102 AC Circuit Analysis I (4-3-5) Emphasizes the knowledge and ability to analyze basic AC circuits. Topics include: magnetism, inductance/capacitance, alternating current, AC network theorems, admittance, impedance, phasors, complex power, and applications and use of appropriate instruments. Laboratory work parallels class work. Prerequisites: EET 101, DC Circuit Analysis, and MAT 193, College Trigonometry.)
EET 105 Electronic Devices (4-3-5) Introduces the conduction process in semi-conductor materials. Topics include: semi-conductor physics; diodes; biasing, stability, and graphical analysis of bipolar junction transistors and field effect transistors; introduction to silicon controlled rectifiers; device curve characteristics; and related devices with selected applications. Laboratory work parallels class work. Prerequisites: EET 101, DC Circuit Analysis, ENG 191, Composition and Rhetoric, and MAT 193, College Trigonometry.

PHY 291 Fluids, Heat, Sound, and Light (4-3-5) Introduces classical theories of fluids, heat, sound, and light. Topics include: statics and dynamics of fluids, gas laws, heat transfer, thermodynamics, simple harmonic motion, wave motion, sound, and properties of light. Laboratory exercises supplement class work. Computer use is an integral part of class and laboratory assignments. Prerequisites: MAT 193, College Trigonometry, and PHY 191, Mechanics.

EET 103 AC Circuit Analysis II (4-3-5) Continues the study of AC circuit analysis with emphasis on transient analysis and network theorems. Topics include: analysis of complex networks, resonance, transformers, multiple sources, three-phase systems, an introduction to filters and bode plots, and non-sinusoidal waveforms. Laboratory work parallels class work. Prerequisites: EET 102, AC Circuit Analysis, and MAT 195, Differential Calculus.

EET 201 Digital Fundamentals (4-3-5) Introduces digital electronics. Topics include: fundamentals of digital techniques; integrated logic circuits involving number systems, logic symbols and gates, Boolean algebra, and optimization techniques; flip-flops and registers; combinational and sequential logic circuits; and memory circuits. Laboratory work parallels class work. Prerequisite: EET 102, AC Circuit Analysis I.

EMT 201 Electromechanical Devices (4-3-5) Introduces electromechanical devices which are essential control elements in electrical systems. Topics include: fundamentals of electromechanical devices, control elements in electrical circuits, typical devices such as generators and alternators, DC and AC motors and power factors, and efficiencies in DC, single-phase and three-phase dynamos are stressed. Laboratory work parallels class work. Prerequisite: EET 102, AC Circuit Analysis I.

EMT 202 Control Systems (4-3-5) Introduces control systems components and theory as they relate to controlling industrial processes. Mechanical, fluids, temperatures, and miscellaneous sensors are studied with emphasis on measuring techniques. Topics include: open- and closed-loop control theory, feedback, transducers, signal conditioning, and control hardware and actuators. Laboratory work parallels class work. Prerequisite: EET 201, Digital Fundamentals.

EET 203 Microcomputer Fundamentals (4-3-5) Continues the study of digital electronics. Topics include: computer arithmetic, analog to digital and digital to analog conversion, microcomputer architecture, and machine level and assembly level language programming. Laboratory work parallels class work. Prerequisites: EET 105, Electronic Devices, and EET 201, Digital Fundamentals.
EMT 203 Programmable Controllers (3-3-4) Emphasizes an in-depth study of the programmable controller with programming applications involving controlling industrial processes. Topics include: input and output modules, logic units, memory units, power supplies, ladder diagrams, relay logic timers and counters, control strategy, programming and troubleshooting. Networking is introduced and communications protocol is investigated. Lab work parallels class work. Prerequisites: EET 201, Digital Fundamentals; Corequisite: EMT 201, Electromechanical Devices.

EMT 250 Control Systems II (4-3-5) Emphasizes skills in the area of electronic instrumentation and stresses the use of electronic techniques to control industrial processes. Topics include: control systems, control system design, control system construction, and control system test report of failure analysis. Prerequisite: EMT 202, Control Systems.

EMT 251 Distributed Control Systems (3-3-4) Continues the study of the various applications of distributed control. This course is intended primarily as a survey source of distributed control verses an in-depth study of any single distributed control system. Topics include: historical perspective and systems, basic system wide orientation, sub systems overview, and report generation. Prerequisite: EMT 202, Control Systems.

EMT 253 Motor Controls (4-3-5) Emphasizes the principles of motor controls from fractional horsepower to large magnetic starters, including starting polyphase induction, synchronous, wound rotor, and direct current motors. Topics include: control pilot devices, control circuits and AC reduces voltage starters, three-phase induction wound rotor and synchronous motor controls, DC motors, and solid state motor controls. Prerequisite: EMT 201, Electromechanical Devices.

EMT 254 Introduction to Process Control (2-6-4) Emphasizes the knowledge and skills required to draw and interpret standard ISA drawings. Topics include: instrumentation symbols, loop identification, open-loop control, closed-loop control, single-loop control and multi-loop control. Prerequisite: DDF 191, Engineering Graphics I; Corequisite: PHY 291, Fluids, Heat, Sound, and Light.
ELECTROMECHANICAL ENGINEERING TECHNOLOGY
INSTRUMENTATION OPTION
SUPPORT COURSES

MAT 191  College Algebra (3-0-5) Emphasizes techniques of problem solving using algebraic concepts. Topics include: algebraic concepts and operations, linear and quadratic equations and functions, simultaneous equations, inequalities, exponents and powers, graphing techniques, and analytic geometry. Prerequisite: Placement by diagnostic testing.

ENG 191  Composition and Rhetoric I (5-0-5) Explores the analysis of literature and articles about issues in the humanities and in society. Students practice various modes of writing, ranging from exposition to argumentation and persuasion. The course includes a review of standard grammatical and stylistic usage in proofreading and editing. An introduction to library resources lays the foundation for research. Topics include writing analysis and practice, revision, and research.

MAT 193  College Trigonometry (5-0-5) Emphasizes techniques of problem solving using trigonometric concepts. Topics include: trigonometric functions, properties of trigonometric functions, vectors and triangles, inverse of trigonometric functions/graphic, logarithmic and exponential functions, and complex numbers. Prerequisite: MAT 191, College Algebra

ENG 195  Technical Communications (5-0-5) Emphasizes practical knowledge of technical communications techniques, procedures, and reporting formats used in industry and business. Topics include: research, device and process description, formal technical report writing, business correspondence, and oral technical report presentation. Prerequisite: ENG 191, Composition and Rhetoric, with “C” or better.

MAT 195  Differential Calculus (5-0-5) Emphasizes the use of differential calculus. Applications of techniques include extreme value problems, motion, graphing, and other topics as time allows. Topics include: derivatives and applications, differentiation of transcendental functions, and an introduction to integration and applications. Prerequisite: MAT 193, College Trigonometry

PSY 191  Introductory Psychology (5-0-5) Emphasizes the basics of psychology. Topics include: science of psychology; social environments; life stages; physiology and behavior; personality; emotions and motives; conflicts, stress and anxiety; abnormal behavior; and perception, learning, and intelligence.
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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<tr>
<th>Technical Workplace Competencies/Course</th>
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<th>INSTRUMENTATION AND CONTROL TECHNICIAN</th>
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### Technical Workplace Competencies/Course Crosswalk

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### D. Organize Work Routines

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# Technical Workplace Competencies/Course Crosswalk
## Technical Competency
### Instrumentation and Control Technician

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<td>F-5 Understand Proper Use of Test Equipment and Tools</td>
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<td>F-6 Learn to Write Technical Reports</td>
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<td>F-11 Participate in Plant Related Training</td>
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<td>F-12 Attend PLC Training</td>
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<td>F-13 Attend DCS Training</td>
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<td>G-1 Learn to Review and Forecast Spare Parts Inventory</td>
<td>X</td>
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<td>G-2 Learn Parts Requests</td>
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<td>G-3 Verify Parts Received</td>
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<td>G-4 Research/Verify Substitute Specifications</td>
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<td>H-1 Troubleshoot, Install, Maintain, and Operate Motor Control Systems</td>
<td>X</td>
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<td>H-2 Troubleshoot, Install, Maintain, and Operate Relays</td>
<td>X</td>
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<td>H-3 Troubleshoot, Install, Maintain, and Operate Pushbuttons</td>
<td>X</td>
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<td>H-4 Troubleshoot, Install, Maintain, and Operate Switches</td>
<td>X</td>
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<td>H-5 Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks</td>
<td>X</td>
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INSTRUMENTATION AND CONTROL TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES
EXIT LEVEL PROFICIENCY MATRIX

Instrumentation and Control Technician:
will be able to troubleshoot, repair, calibrate, specify and commission as required all
instrumentation and control components relating to overall plant operations. This is to
include dynamic evaluation, testing, controller tuning, and total system performance
evaluations.

The following matrix identifies the five exit levels of technical workplace competencies for the
Instrumentation and Control Technician Certificate at Augusta Technical Institute in Augusta,
Georgia.

<table>
<thead>
<tr>
<th>EXIT LEVEL OF PROFICIENCY</th>
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<tbody>
<tr>
<td>Technical Workplace Competency</td>
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<td>rarely</td>
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36
### 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:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Interpersonal</th>
<th>Information</th>
<th>Systems</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifies, organizes, plans, and allocates resources</td>
<td>Works with others</td>
<td>Acquires and uses information</td>
<td>Understands complex inter-relationships</td>
<td>Works with a variety of technologies</td>
</tr>
</tbody>
</table>

#### FOUNDATION SKILLS:

<table>
<thead>
<tr>
<th>Basic Skills</th>
<th>Thinking Skills</th>
<th>Personal Qualities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads, writes, performs arithmetic and mathematical operations, listens and speaks</td>
<td>Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons</td>
<td>Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty</td>
</tr>
</tbody>
</table>

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).
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<td><strong>(RS) RESOURCES:</strong></td>
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<td>A. Allocates time</td>
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<td>B. Allocates money</td>
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<td>C. Allocates material and facility resources</td>
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<td>D. Allocates human resources</td>
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<td><strong>(IN) INTERPERSONAL SKILLS:</strong></td>
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<tr>
<td>A. Participates as a member of a team</td>
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<td>B. Teaches others</td>
<td>X X X X X X X X X X X X X</td>
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<td>C. Serves clients/customers</td>
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<td>D. Exercises leadership</td>
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<td>E. Works with cultural diversity</td>
<td>X X X X X X X X X X X X X</td>
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<td><strong>(IF) INFORMATION SKILLS:</strong></td>
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<tr>
<td>A. Acquires and evaluates information</td>
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<td>B. Organizes and maintains information</td>
<td>X X X X X X X X X X X X X</td>
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<td>C. Interprets and communicates information</td>
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<td>D. Uses computers to process information</td>
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<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</td>
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<td>B. Monitors and corrects performance</td>
<td>X X X X X X X X X X X X X</td>
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<td>C. Improves and designs systems</td>
<td>X X X X X X X X X X X X X</td>
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<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</td>
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<td>B. Applies technology to task</td>
<td>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</td>
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</table>
### FOUNDATION SKILLS

#### (BS) BASIC SKILLS:

| A. Reading | 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 |
| C. Arithmetic and mathematics | 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 |
| E. Speaking | 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 |
| B. Decision making | 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 |
| D. Seeing things in the mind's eye | 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 |
| F. Reasoning | 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 |
| B. Self-esteem | 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 |
| D. Self-management | 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 |
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.

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

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<th>EXIT LEVEL OF PROFICIENCY</th>
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<tbody>
<tr>
<td>SCANS Competencies and Foundation Skills</td>
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MAST/01/012296
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.
MAST PROGRAM
COURSE SYLLABUS
COLLEGE ALGEBRA

Lecture hours/week: 5    Lab hours/week: 0    Credit hours: 5

COURSE DESCRIPTION:

Emphasizes techniques of problem solving using algebraic concepts. Topics include: algebraic concepts and operations, linear and quadratic equations and functions, simultaneous equations, inequalities, exponents and powers, graphing techniques, and analytic geometry.

PREREQUISITE/COREQUISITE: Placement by diagnostic testing

REQUIRED COURSE MATERIALS:

Textbook: Basic Technical Mathematics with Calculus, 6th Ed.

Hand Tools/Quantity Required:
Tools
Scientific Calculator 1
graph paper 1 pack
pencils
straight edge 1

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and discussions.

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. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

<table>
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<tr>
<th>Lecture Topics</th>
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<th>Contact Hrs.</th>
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<tr>
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<tr>
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<td>Equations Involving Fractions</td>
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- Scientific Notation: 5 pages
- Roots and Radicals: 5 pages
- Addition and Subtraction of Algebraic Expressions: 5 pages
- Multiplication of Algebraic Expressions: 5 pages
- Division of Algebraic Expressions: 5 pages
- Solving Equations: 35 pages
- Formulas and Literal Equations: 5 pages
- Applied Verbal Problems: 5 pages
- Properties of Inequalities: 75 pages
- Solving Linear Inequalities: 5 pages
- Introduction of Functions: 5 pages
- More About Functions: 5 pages
- Rectangular Coordinates: 84 pages
- The Graph of a Function: 5 pages
- The Graphing Calculator: 5 pages
- Graphs of Functions by Tables of Data: 5 pages
- Linear Equations: 128 pages
- Graphs of Linear Equations Basic Definitions: 5 pages
- The Straight Line: 5 pages
- The Ellipse: 5 pages
- Solving Systems of Two Linear Equations in Two Unknowns: 135 pages
- Graphically: 5 pages
- Solving Systems of Two Linear Equations in Two Unknowns: 5 pages
- Algebraically: 5 pages
- Solving Systems of Two Linear Equations in Two Unknowns: 5 pages
- by Determinants: 5 pages
- Solving Systems of Three Linear Equations in Three Unknowns: 135 pages
- Algebraically: 5 pages
- Solving Systems of Three Linear Equations in Three Unknowns: 5 pages
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- Multiplication and Division of Fractions: 5 pages
- Addition and Subtraction of Fractions: 5 pages
- Equations Involving Fractions: 191 pages
- Special Products: 5 pages
Quadratic Equations: Solution by
Factoring
Completing the Square
The Quadratic Formula
The Graph of the Quadratic Function
The Circle 547
The Ellipse
The Hyperbola
Review
Final Exam

Total Lecture Hours 50

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:
A. ORGANIZE WORK ROUTINES
   1. Organize Documents and Drawings Required on the Job
   2. Determine Proper Tools/Equipment/Materials to Perform the Job
   3. Perform Basic Algebraic Operations

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 work
      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. perform work 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 mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
b. performs mathematical computations necessary to understand course

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. 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 grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

COMPOSITION AND RHETORIC I
MAST PROGRAM  
COURSE SYLLABUS  
COMPOSITION AND RHETORIC I

Lecture hours/week: 5  Lab hours/week: 0  Credit hours: 5

COURSE DESCRIPTION:

Emphasizes the development and improvement of written and oral communications abilities. Topics include: idea development; vocabulary; spelling; out-lining; sentence elements; revision; unity and coherence in basic paragraph development; re-search; exploration of communication modes including description, exposition, argumentation, and persuasion; and functional writing as applied to reports, abstracts, and technical papers.

PREREQUISITE: NONE

REQUIRED COURSE MATERIALS:

Textbook: From Idea to Essay

COURSE OBJECTIVES:

Students who have successfully completed this course will be able to:
1. Demonstrate through use a knowledge of grammatical structure, as well as punctuation and other mechanics.
2. Demonstrate the ability to write clear, coherent, well-organized paragraphs.
3. Recognize correct spelling in one's own or other's writing.
4. Present oral summaries outside reading.
5. Write descriptions drawing details from observation.
6. Write clear, coherent, well-organized explanations.
7. Demonstrate through writing the ability to successfully employ the various methods of development (including comparison and contrast, cause division, illustration, definition, classification, and division, argumentation, process). And to choose the appropriate form.
8. Articulate clean oral response to reading.
9. Identify the major steps in conducting research.
10. Locate and use appropriate reference materials for written and oral reports.

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

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. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

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<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
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<td>Fundamentals of Grammar and Composition</td>
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<tr>
<td>Sentence elements</td>
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<td>Review of basic parts of speech</td>
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<td>Complete sentence paragraph, placement of modifiers,</td>
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<td>phrases, and clauses</td>
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<td>Paragraph construction</td>
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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. determine the initial cost of materials and "value added" as result of work
   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. perform work 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 mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical 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 perform the task
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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:

Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

COMPUTER PROGRAMMING FUNDAMENTALS
MAST PROGRAM
COURSE SYLLABUS
COMPUTER PROGRAMMING FUNDAMENTALS

Lecture hours/week: 3  Lab hours/week: 6  Credit hours: 5

COURSE DESCRIPTION:
Emphasizes fundamentals concepts of problems solving using computers. Students explore flowcharting control structures, subroutines, arrays, strings manipulation, matrices, and files. A high level source language is used. The laboratory portion of the course is designed to acquaint students with computer facilities and software utilities. Topics include: DOS instructions, word processing (WordPerfect), spreadsheet applications (Lotus), systems fundamentals, concepts of structured programming, functions and subroutines, engineering applications, graphics, and program editing. Laboratory work parallels class work.

PREREQUISITE: NONE

REQUIRED COURSE MATERIALS:

Textbook:  Computer Currents by George Beekman

Supplies:
Flowchart template
Coding forms
In addition it is the responsibility of each student to bring his/her own coding papers, pencil, pen and notebook to class each day.

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
5. contribute to class discussions
6. maintain attendance per current policy
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>DOS Overview</td>
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<tr>
<td>QBASIC Overview</td>
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<tr>
<td>QBASIC Environment</td>
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<tr>
<td>Test 1</td>
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<tr>
<td>Structured QBASIC Programs</td>
<td></td>
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<tr>
<td>Structured Programs (continued)</td>
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<tr>
<td>Test 2</td>
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<tr>
<td>Midterm</td>
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<tr>
<td>Arithmetic Expressions and Output</td>
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<tr>
<td>Interactive Processes and Decisions</td>
<td></td>
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<tr>
<td>Working with Words</td>
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<tr>
<td>Calculation, Visualization, Simulation</td>
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<tr>
<td>Final Exam</td>
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Total Lecture Hours 30

LAB OUTLINE:

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<tr>
<td>Calculation, Visualization, Simulation</td>
<td></td>
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</tbody>
</table>

Total Lab Hours 60

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

B. MAINTAIN CONTROL SYSTEMS
   1. Proper Storage of Circuit Boards
   2. Configure Software
   3. Perform On-Line Testing

C. ORGANIZE WORK ROUTINES
1. Organize Documents and Drawings Required on the Job
2. Follow Specifications

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
1. Understand Personal Computers

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 work
   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. perform work 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 mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course
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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
MAST PROGRAM
COURSE SYLLABUS
ENGINEERING GRAPHICS I

Lecture hours/week: 1  Lab hours/week: 6  Credit hours: 3

COURSE DESCRIPTION:

This course introduces engineering drawing using freehand sketching and computer graphics as the necessary engineering graphics tools for the 1990's. The intent of this course is to provide the student with introductory skills necessary to communicate, Freehand sketching, Computer system fundamentals, Computer-Aided Drafting fundamentals (CAD), and an introduction to making working drawings from solid computer models, 2D entity construction, as well as an introduction to graphical vector analysis.

PREREQUISITE:  NONE

REQUIRED COURSE MATERIALS:


METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all lab 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>3</td>
<td>1</td>
</tr>
</tbody>
</table>

64
Design Process and Graphics 11 1
Computer-Aided Design and Drafting 37 1
Freehand Sketching 59 1
Engineering Geometry 73 1
The Theory of Shape Description 95 1
The Theory of Size Description 108 1
Multiviews 127 1
Auxiliary Views 152 1
Sectional Views 163 1
Pictorial Views 174 1

Total Lecture Hours 10

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
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<tbody>
<tr>
<td>AutoCAD Basics</td>
<td>3</td>
</tr>
<tr>
<td>Object Construction and Manipulation</td>
<td>3</td>
</tr>
<tr>
<td>Geometric Constructions</td>
<td>3</td>
</tr>
<tr>
<td>Shape Description/Multi-View Projection</td>
<td>3</td>
</tr>
<tr>
<td>Dimensioning Techniques</td>
<td>6</td>
</tr>
<tr>
<td>Analyzing 2-D Drawings</td>
<td>6</td>
</tr>
<tr>
<td>Region Modeling Techniques</td>
<td>6</td>
</tr>
<tr>
<td>Section Views</td>
<td>6</td>
</tr>
<tr>
<td>Auxiliary Views</td>
<td>6</td>
</tr>
<tr>
<td>Isometric Drawings</td>
<td>6</td>
</tr>
<tr>
<td>3-D Modeling</td>
<td>6</td>
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<tr>
<td>Solid Modeling</td>
<td>6</td>
</tr>
</tbody>
</table>

Total Lab Hours 60

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. Locate and properly use protective equipment
   c. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Loop-Check Control System

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
   1. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward

D. COLLECT AND FILE DATA
   1. Prepare and Update Ladder And/Or Logic Diagrams

E. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
   1. Read/Interpret Diagrams and Drawings
   2. Sketch Diagrams

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 work
      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. perform work 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 mechanical process
d. dimensioning and measurement systems
e. systematic organization of training materials

2. monitors and corrects performance during
a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course
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
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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 equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

COLLEGE TRIGONOMETRY
MAST PROGRAM
COURSE SYLLABUS
COLLEGE TRIGONOMETRY

Lecture hours/week: 5  Lab hours/week: 0  Credit hours: 5

COURSE DESCRIPTION:

Emphasizes techniques of problem solving using trigonometric concepts. Topics include: trigonometric functions, properties of trigonometric functions, vectors and triangles, inverse of trigonometric functions/graphic, logarithmic and exponential functions, and complex numbers.

PREREQUISITE: College Algebra

REQUIRED COURSE MATERIALS:

Textbook: Basic Technical Mathematics with Calculus, 6th Ed.

Hand Tools/Quantity Required:
Tools
Scientific Calculator 1
Graph paper 1 pack
Pencils
Straight edge 1

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and discussions.

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. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

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<tbody>
<tr>
<td>Trigonometric Functions</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Signs of the Trigonometric Functions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Define the Six Trigonometric Functions</td>
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</tr>
</tbody>
</table>
COURSE OBJECTIVES: TECHNICAL COMPETENCIES

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

A. ORGANIZE WORK ROUTINES
   1. Organize Documents and Drawings Required on the Job
   2. Determine Proper Tools/Equipment/Materials to Perform the Job
   3. Perform Basic Trigonometric 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. determine the initial cost of materials and "value added" as result of work
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. perform work 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 mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

TECHNICAL COMMUNICATIONS
MAST PROGRAM
COURSE SYLLABUS
TECHNICAL COMMUNICATIONS

Lecture hours/week: 5  Lab hours/week: 0  Credit hours: 5

COURSE DESCRIPTION:
Emphasizes practical knowledge of technical communications techniques, procedures, and reporting formats used in industry and business. Topics include: reference use and research, device and process descriptions, formal technical report writing, business correspondence, and oral technical report presentation.

PREREQUISITE: Composition and Rhetoric I

REQUIRED COURSE MATERIALS:


Supplies:
Composition notebook (for students notes)
Loose leaf note paper (for class work submission)
Regulation report cover
Note cards (3x5 and 4x6 or 5x7)
Black or blue pen
Pencil

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, and discussions.

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. satisfactorily perform on written and oral examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
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<tbody>
<tr>
<td>Reference Use and Research</td>
<td>Chapters 3 and 13</td>
<td>5</td>
</tr>
<tr>
<td>Orientation: Process in Technical</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Writing, Technical Research
(groups in class)
Library Orientation
Organizing Information Styles in Technical Writing
Organizing Information, Styles in Technical Writing
Report: Topic Memo Due;
Free-Write on Topic (in class)
Informal Report Writing
Letters and Memos, Informal Reports
Report: Problem Memo (groups in class); Purpose Statement and Informal Outline Due (handwritten drafts);
Reference List Due (APA format in draft form)
Formal Technical Report Writing
Formal Reports and Oral Communication
Report: Abstract of Journal Article for Formal Report (see text page 437, informational)
Patterns of Organization, Process Descriptions and Instructions
Report: Description of Mechanisms (groups in class); Note Cards Due
Page Design, Graphics
Report: Purpose Statement Followed by Formal Outline Due (typed); Two Copies Progress Memo Due (one addressed to oral report)
Drafting, Editing, and Revising
Report: Transmittal Memorandum Due; Rough Draft Due for Final Report
Business Correspondence
The Job Search
Report: Final Drafts Due (two copies; one for advisor)
Oral Technical Report Presentation
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 work
      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. perform work 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 mechanical process
         d. dimensioning and measurement systems
         e. systematic organization of training materials
      2. monitors and corrects performance during
         a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course
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
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   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
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   a. maintain a record of academic achievement (individual grade book)
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   c. accept the responsibility for self-management

5. **Integrity/Honesty:** Chooses ethical courses of action
   a. accept the responsibility for own actions
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   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

MECHANICS
COURSE DESCRIPTION:

The first of three courses in the calculus based physics sequence. This course is an introduction to classical mechanics. Topics include: physical quantities, measurements of physical quantities, system of units, vector algebra, kinematics, Newton's Laws, rotational motion, momentum, energy, angular momentum, conservation laws, impulse, mechanical equilibrium and elasticity. Laboratory exercises supplement class work. Computer use is an integral part of the class and laboratory assignments.

PREREQUISITE: College Algebra and Computer Programming Fundamentals

REQUIRED COURSE MATERIALS:

Textbook: University Physics, by William P. Crummet and Author B. Western

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
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>Measurements and Systems of Units</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
Scientific Notation
Express and manipulate numbers in scientific notation

Systems of Units
Explain SI, CGS, and FPS unit systems
Change a physical quantity from one set of units to another

Vectors
Explain the difference between vector and scalar quantities
Express vector quantities in polar and component form

Newton's Law
Newton's Laws of Motion
State Newton's laws of motion
Newton's Universal Law of Gravitation
Calculate the gravitational attraction between two bodies

Mass and Weight
Distinguish between force and mass and define the units of each

Application of Newton's Laws
Solve dynamics problems involving constant forces

Work, Energy and Power
Define work, potential energy, kinetic energy and power, and identify the units of each

Conservation of Energy
State the law of conservation and energy

Work
Compute the work done by both constant and varying forces
Use the work-energy theorem in solving problems

Kinetic Energy
Compute the translational kinetic energy of a body

Hooke’s Law
Solve problems with Hooke’s law

Potential Energy
Compute the elastic potential energy stored in a spring
Compute the gravitational potential energy of an object

Power
Compute the power given appropriate parameters

Impulse and Momentum
Momentum
Define the momentum and identify its units
Conservation of Momentum
State the law of conservation of momentum
Elastic and Inelastic Collisions
Solve elastic and inelastic collision problems

One and Two-Dimensional Motion
Displacement
Define displacement and identify its units
Velocity and Speed
Define both velocity and speed and identify their respective units
Acceleration
Define acceleration and identify its units
Motion and Constant Acceleration
Solve problems involving uniformly accelerated motion
Angular Displacement
Define angular displacement, angular velocity
Circular Motion
Define centripetal force and centripetal acceleration
Solve rotational kinematics problems
Calculate the centripetal force exerted on a body the associated centripetal acceleration

**Mechanical Equilibrium**

**Torque**
- Define torque and identify its units
- Compute the torque generated by a force about an axis

**Moments of Inertia**
- Determine the moment of inertia of a rigid body about a given axis

**Mechanical Equilibrium**
- State the conditions of mechanical equilibrium
- Solve problems involving systems in the state of mechanical equilibrium

**Conservation of Angular Momentum**
- State the law of conservation of angular momentum
- Solve problems with conservation of angular momentum

**LAB OUTLINE:**

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
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<tbody>
<tr>
<td>Measurements and Systems of Units</td>
<td>4</td>
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<td>Scientific Notation</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Vectors</td>
<td></td>
</tr>
<tr>
<td>Newton’s Law</td>
<td>7</td>
</tr>
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<td>Newton’s Laws of Motion</td>
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<tr>
<td>Newton’s Universal Law of Gravitation</td>
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<td>Application of Newton’s Laws</td>
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<td>Work, Energy and Power</td>
<td>4</td>
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<tr>
<td>Conservation of Energy</td>
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<tr>
<td>Work</td>
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<tr>
<td>Kinetic Energy</td>
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</table>

Total Lecture Hours 40
Hooke’s Law
Potential Energy
Power
Impulse and Momentum
Momentum
Conservation of Momentum
Elastic and Inelastic Collisions
One and Two-Dimensional Motion
Displacement
Velocity and Speed
Acceleration
Motion and Constant Acceleration
Angular Displacement
Circular Motion
Mechanical Equilibrium
Torque
Moments of Inertia
Mechanical Equilibrium
Conservation of Angular Momentum

Total Lab Hours 30

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. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
1. Install Control System Hardware

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
1. Install/Replace Field Sensing Elements
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

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B. Interpersonal: Works with others
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      b. maintain a lecture notebook
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COURSE SYLLABUS

DC CIRCUIT ANALYSIS
MAST PROGRAM
COURSE SYLLABUS
DC CIRCUIT ANALYSIS

Lecture hours/week: 4  Lab hours/week: 3  Credit hours: 5

COURSE DESCRIPTION:

Emphasizes knowledge and ability to analyze basic DC circuits. Topics include: units, basic electrical laws, series and parallel circuits, capacitance, an introduction to network analysis and network theorem concepts, and DC instruments. Laboratory work parallels class work.

PREREQUISITE: College Algebra and Computer Programming Fundamentals

REQUIRED COURSE MATERIALS:

Textbook: Introductory Circuit Analysis, Boylstad, 5th Edition

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
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5. contribute to class discussions
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7. follow all shop rules and safety regulations as stated in the laboratory manual

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</tr>
</thead>
<tbody>
<tr>
<td>Conversion, Scientific Notation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current and Voltage</td>
<td></td>
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<tr>
<td>Resistance</td>
<td></td>
<td></td>
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<tr>
<td>Test 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ohm's Law, Power, and Energy</td>
<td></td>
<td></td>
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<tr>
<td>Series and Parallel Circuits</td>
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<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Notation</td>
<td>3</td>
</tr>
<tr>
<td>Measure Voltage and Current, Voltmeter and Ammeter</td>
<td>3</td>
</tr>
<tr>
<td>Measure Resistance of Fixed and Variable Resistors</td>
<td>3</td>
</tr>
<tr>
<td>Measure Power, Wattmeter</td>
<td>3</td>
</tr>
<tr>
<td>Construct Series Circuit; Construct Parallel Circuit; Measure Voltage and Currents in Circuits</td>
<td>3</td>
</tr>
<tr>
<td>Construct Series and Parallel Circuits</td>
<td>3</td>
</tr>
<tr>
<td>Mesh Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Norton’s Theorem</td>
<td>3</td>
</tr>
<tr>
<td>Measure Capacitor Leakage Current and Charging Current</td>
<td>3</td>
</tr>
<tr>
<td>Complete All Labs</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Lab Hours 30

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. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
1. Collect and Record Data According to Company Requirements
2. Simulate Control System Check
3. Perform On-Line Testing

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 work
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. perform work 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 mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
      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. keeps a running computation of individual grade
      b. performs mathematical computations necessary to understand course
   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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills
Technology Program

MAST

COURSE SYLLABUS

DIFFERENTIAL CALCULUS
MAST PROGRAM
COURSE SYLLABUS
DIFFERENTIAL CALCULUS

Lecture hours/week: 5          Lab hours/week: 0          Credit hours: 5

COURSE DESCRIPTION:

Emphasizes the use of differential calculus. Application of techniques include extreme value problems, motion, graphing, and other topics as time allows. Topics include: derivatives and applications, differentiation of transcendental functions, and an introductions to integration and applications. Class includes lecture, applications and homework to reinforce learning.

PREREQUISITE:                College Trigonometry

REQUIRED COURSE MATERIALS:

Textbook:                    Basic Technical Mathematics With Calculus, 6th Ed.

Hand Tools/Quantity Required:
Tools                         
Scientific Calculator        1
Graph paper                  1 pack
Pencils                      
Straight edge                1

METHOD OF INSTRUCTION:

Lecture:                    Didactic presentations will include lecture and discussions.

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. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functions (Notations, Range, Domain, Inverse, Operations, Graphing, Continuous)</td>
<td>760</td>
<td>5</td>
</tr>
<tr>
<td>Test 1</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

102
COURSE OBJECTIVES: TECHNICAL COMPETENCIES

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

A. ORGANIZE WORK ROUTINES
   1. Organize Documents and Drawings Required on the Job
   2. Determine Proper Tools/Equipment/Materials to Perform the Job
   3. Perform Basic Calculus Operations
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.

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         a. identifies personal goals
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   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

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   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

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   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

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   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
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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

ELECTRICITY AND MAGNETISM
MAST PROGRAM
COURSE SYLLABUS
ELECTRICITY AND MAGNETISM

Lecture hours/week: 4  Lab hours/week: 3  Credit hours: 5

COURSE DESCRIPTION:

The second of three courses in the calculus based physics sequence. This course is an introduction to the classical theory of magnetism. Topics include: electrostatic forces and fields, basic circuit elements and circuit theory, magnetism, electromagnetic waves and modern physics.

PREREQUISITE: College Trigonometry and Mechanics

REQUIRED COURSE MATERIALS:

Textbook: University Physics, by William P. Crummet and Author B. Western Physics of Everyday Phenomena, by W. Thomas Griffith

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
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>Electrostatic Forces and Fields</td>
<td></td>
<td></td>
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<tr>
<td>Charges</td>
<td></td>
<td></td>
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<tr>
<td>Identify the units of charge</td>
<td></td>
<td></td>
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<tr>
<td>Conservation of Charge</td>
<td></td>
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</tr>
</tbody>
</table>

109
State the law of conservation of charge

Conductors and Insulators
Explain and demonstrate the difference between conductors and insulators

Coulomb's Law
Use Coulomb’s law to calculate the force between point charges

Electric Potential
Compute the potential difference between two points in an electric field

Capacitors
Define capacitance and identify its units
Calculate the capacitance of two parallel plates

Magnetism
Magnetic Fields
Define the concepts of a magnetic field and identify the units of the magnetic field
Determine the magnitude and direction of the magnetic field produced by straight wires, loops and solenoids

Magnetic Forces
Explain the forces related to charge in motion

Manual and Self-Inductance
Calculate the magnitude and direction of an induced EMF using Faraday’s law and Lenz’s law

Generators and Transformers
State the principles associated with the behavior of motors and generators
Explain the principles associated with the behavior of transformers

Circuit Elements and Theory
Direct Current Circuits
Ohm's Law
Calculate the current, EMF, and effective resistance of series and parallel circuits
Kirchoff's Rules
Calculate the current at any point and the potential difference between any two points in a circuit using Kirchoff's rules
Alternating Current Circuits
Resistance
Calculate resistance
Reactance
Calculate the reactance
Inductance
Calculate the inductance
Phase Angles
Calculate the phase angles
Capacitance
Calculate the capacitance
Power
Calculate the reactance, impedance, current, voltage, power factor, power, and phase angle in AC circuits

Electromagnetic Waves
Maxwell's Equations
Recognize Maxwell's equations
Electromagnetic Wave Speed
Explain the relationship between the frequency, wavelength, and speed of electromagnetic waves
Electromagnetic Wave Energy
Explain the transport of energy by electromagnetic waves
Electromagnetic Spectrum
List the various types of electromagnetic waves according to their respective wavelengths

Total Lecture Hours
40
LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
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<tbody>
<tr>
<td>Electrostatic Forces and Fields</td>
<td>9</td>
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<tr>
<td>Charges</td>
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<tr>
<td>Conservation of Charge</td>
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<tr>
<td>Conductors and Insulators</td>
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<tr>
<td>Coulomb’s Law</td>
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<tr>
<td>Electric Potential</td>
<td></td>
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<tr>
<td>Capacitors</td>
<td></td>
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<tr>
<td>Magnetism</td>
<td>6</td>
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<td>Magnetic Fields</td>
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<td>Magnetic Forces</td>
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<td>Manual and Self-Inductance</td>
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<td>Lenz’s law</td>
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<td>Generators and Transformers</td>
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<tr>
<td>Circuit Elements and Theory</td>
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<tr>
<td>Kirchoff’s Rules</td>
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<tr>
<td>Alternating Current Circuits</td>
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<tr>
<td>Resistance</td>
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<td>Reactance</td>
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<td>Inductance</td>
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<td>Capacitance</td>
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<td>Power</td>
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<td>Electromagnetic Waves</td>
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<tr>
<td>Maxwell’s Equations</td>
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<tr>
<td>Electromagnetic Wave Speed</td>
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<tr>
<td>Electromagnetic Wave Energy</td>
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<tr>
<td>Electromagnetic Spectrum</td>
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</tr>
</tbody>
</table>

Total Lab Hours 30

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. Locate and properly use protective equipment
   c. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Collect and Record Data According to Company Requirements
   2. Function Check Individual Elements Within Loop
   3. Test Different Types of System Modules
   4. Simulate Control System Check
   5. Perform On-Line Testing

COURSE OBJECTIVES: SCANS COMPETENCIES

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   B. Interpersonal: Works with others
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   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
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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
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4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
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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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
MAST PROGRAM
COURSE SYLLABUS
AC CIRCUIT ANALYSIS I

Lecture hours/week: 4  Lab hours/week: 3  Credit hours: 5

COURSE DESCRIPTION:

Emphasizes knowledge and ability to analyze AC circuits. Topics include: magnetism, inductance, capacitance, alternating current, AC network theorems, admittance, impedance, phasors, complex power, and applications and use of appropriate instruments. Laboratory work parallels class work.

PREREQUISITE: DC Circuit Analysis and College Trigonometry

REQUIRED COURSE MATERIALS:

Textbook: Introductory Circuit Analysis, Boylston, 5th Edition
Introduction to Electric Circuits, Jackson, H. W.

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
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>AC Network Theorems</td>
<td></td>
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<tr>
<td>Thevenin's Theorem</td>
<td></td>
<td></td>
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<tr>
<td>Analyze complex network</td>
<td></td>
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<tr>
<td>Thevenin's Theorem</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>
Norton's Theorem
Analyze a complex network using Norton's Theorem

Admittance
Admittance Calculations
Calculate the admittance of an AC circuit

Impedance
Impedance Calculations
Calculate the impedance in a complex circuit

Phasors
AC Voltage and Current
Calculate voltage and current calculations in an AC circuit using phasor analysis

Complex Power
Circuit Reduction
Reduce a complex network to an equivalent circuit using analysis technique

Average Power
Calculate the average power in an AC circuit

Reactive Power
Calculate the reactive power in an AC circuit

Apparent Power
Calculate the apparent power in an AC circuit

Applications and Use of Instruments

Voltmeters
Measure AC voltage using a voltmeter

Ammeters
Measure AC current using an ammeter

Oscilloscope
Measure voltage and frequency using an oscilloscope

Total Lecture Hours 40

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
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</tr>
</thead>
<tbody>
<tr>
<td>AC Network Theorems</td>
<td>5</td>
</tr>
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</table>
Thevenin's Theorem
Norton's Theorem
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Admittance Calculations
Impedance
Impedance Calculations
Phasors
AC Voltage and Current
Complex Power
Circuit Reduction
Average Power
Reactive Power
Apparent Power
Applications and Use of Instruments
Voltmeters
Ammeters
Oscilloscope

Total Lab Hours 30

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. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Collect and Record Data According to Company Requirements
   2. Perform Preventive Maintenance Procedures for Control Devices
   3. Test Different Types of System Modules
   4. Simulate Control System Check
   5. Perform On-Line Testing
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 work
      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. perform work 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 mechanical process
         d. dimensioning and measurement systems
         e. systematic organization of training materials
      2. monitors and corrects performance during
         a. the practical 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 perform the task
      2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

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
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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
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   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
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   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

ELECTRONIC DEVICES
MAST PROGRAM
COURSE SYLLABUS
ELECTRONIC DEVICES

Lecture hours/week: 4  Lab hours/week: 3  Credit hours: 5

COURSE DESCRIPTION:
Introduces the conduction process in semi-conductor materials. Topics include: semi-conductor physics; diodes; biasing; stability; and graphical analysis of bipolar junction transistors and field effect transistors; an introduction to silicon controlled rectifiers; device curve characteristics and related devices with selected applications. Laboratory work parallels class work.

PREREQUISITE: DC Circuit Analysis, Composition & Rhetoric I, and College Trigonometry

REQUIRED COURSE MATERIALS:

Textbook: Introduction to Electronic Devices
Lab Manual: Introduction to Electronic Devices

Hand Tools/Quantity Required:
VOM 1
Scope 1
Hand Tools Varies
Calculator 1

METHOD OF INSTRUCTION:

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

Laboratory: Laboratory will be a "hands-on" 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
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
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<tr>
<th>Lecture Topics</th>
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<th>Contact Hrs.</th>
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<tbody>
<tr>
<td><strong>Semi-Conductor Physics</strong></td>
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<td>8</td>
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<tr>
<td>Atomic Theory for Semi- Conductors</td>
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<tr>
<td>Determine the number of</td>
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<td>electrons in each</td>
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<td>shell for copper, silicon</td>
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<td>and germanium</td>
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<td>Silicon and Germanium Conduction</td>
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<tr>
<td>Explain majority and minority</td>
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<td>current</td>
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<tr>
<td><strong>PN Junctions</strong></td>
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<tr>
<td>Explain the depletion region</td>
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<td>in a PN junction</td>
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<td><strong>Diodes</strong></td>
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<tr>
<td><strong>Diode Models</strong></td>
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<tr>
<td>Draw the model for an ideal</td>
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<tr>
<td>and practical diode</td>
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<td><strong>Diode Applications</strong></td>
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<tr>
<td>Identify clipping and clamping circuits</td>
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<td><strong>Bipolar Junction Transistors</strong></td>
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<tr>
<td>PNP and NPN Atomic Characteristics</td>
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<td>8</td>
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<tr>
<td>Draw the forward and reverse</td>
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<td>characteristics for a PN</td>
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<td>junction</td>
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<td><strong>BJT Operation</strong></td>
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<td>Explain the current flow in</td>
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<tr>
<td>a BJT</td>
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<td>Draw the symbols for a PNP</td>
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<td>and a NPN BJT</td>
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<tr>
<td><strong>Amplifying Action</strong></td>
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<td>Explain how gain is achieved</td>
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<td>in a transistor</td>
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<tr>
<td><strong>Circuit Configurations: Common Base (CB),</strong></td>
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<tr>
<td>Common Emitter (CE),</td>
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<td>Common Collector (CC)</td>
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<tr>
<td>Explain the characteristics</td>
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<td>for each transistor</td>
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<tr>
<td>configuration</td>
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<tr>
<td><strong>Specification Sheets</strong></td>
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<tr>
<td>List the maximum ratings</td>
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<tr>
<td>for BJTs</td>
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<tr>
<td><strong>Transistor Biasing</strong></td>
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<tr>
<td>List the four (4) main types of DC biasing</td>
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<td>8</td>
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<tr>
<td>networks</td>
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<tr>
<td><strong>Field Effect Transistors</strong></td>
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<tr>
<td>Junction Field Transistors</td>
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</tbody>
</table>
Explain the operation of the junction field effect transistor

JFET Biasing Circuits
Depletion MOSFET Biasing Circuits
Identify the three (3) main DC biasing networks
Enhancing MOSFET Biasing Circuits

Silicon Controlled Rectifiers
Thyristor Concepts
Zener Diodes
Diacs and Triacs Circuit Applications
Tunnel Diodes and Unijunction Transistors

Explain the operation of
SCRs thyristors, Zener diodes, diacs and triacs, tunnel diodes, and unijunctional transistors

Device Curve Characteristics
Device Characteristics Plotting (Using Curve Tracer and Laboratory Equipment)

Draw the input and/or output characteristics for the following devices: BFT, JFET, depletion MOSFET, enhancement MOSFET, SCR, tracer, Zener diode, and regular diode

Total Lecture Hours 40

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Diodes</td>
<td>15</td>
</tr>
<tr>
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<td></td>
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<tr>
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<td></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. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Proper Storage of Circuit Boards
   2. Collect and Record Data According to Company Requirements
   3. Test and Calibrate Transducers According to Specs
   4. Perform Preventive Maintenance Procedures for Control Devices
   5. Test and/or Replace Printed Circuit Boards
   6. Function Check Individual Elements Within Loop
   7. Troubleshoot Different Types of System Modules
   8. Test Different Types of System Modules
   9. Configure Software
   10. Repair Different Types of System Modules
   11. Install Control System Hardware

Total Lab Hours 30
12. Simulate Control System Check  
13. Loop-Check Control System  
15. Troubleshoot and Maintain PLCs and Motor Control Systems  

C. MAINTAIN FIELD INSTRUMENTATION DEVICES  
1. Test and Clean Video Display Unit  
2. Check and Adjust Video Display Unit  

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  
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      2. determine the initial cost of materials and "value added" as result of work  
      3. complete a stock request form for required material  
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   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  
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   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 mechanical process  
         d. dimensioning and measurement systems  
         e. systematic organization of training materials  
      2. monitors and corrects performance during  
         a. the practical 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 perform the task  
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task  
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      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. keeps a running computation of individual grade  
      b. performs mathematical computations necessary to understand course  
   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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

FLUIDS, HEAT, SOUND AND LIGHT
MAST PROGRAM
COURSE SYLLABUS
FLUIDS, HEAT, SOUND, AND LIGHT

Lecture hours/week: 4 Lab hours/week: 3 Credit hours: 5

COURSE DESCRIPTION:

The third of three courses in the calculus based physics sequence. The course is an introduction to the physics of waves, geometrical optics and thermal physics. Laboratory exercises supplement class work. Computer use is an integral part of the class and laboratory assignments.

PREREQUISITE: Mechanics

REQUIRED COURSE MATERIALS:

Textbook: University Physics, by William Crummet and Author B. Western

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
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>Statics and Dynamics of Fluids</td>
<td>13.i</td>
<td>5</td>
</tr>
<tr>
<td>States of Matter</td>
<td>13.i</td>
<td></td>
</tr>
<tr>
<td>Define the three states of matter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Define density and identify</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pressure
   Define pressure and identify its units
   Determine the pressure in a fluid column of known density
Archimedes’ Principle
   Determine the buoyant force of an object
Bernoulli’s Equation
   Solve problems with Bernoulli’s equation

Heat Transfer
Quantity of Heat
   Explain the difference between the terms of heat energy and internal energy
   Identify the units of heat energy
Calorimetry
   Solve calorimetry problems
Thermal Expansion
   Solve problems on thermal expansion with the expansion coefficients
Heat Transfer
   Explain the three basic avenues of heat transfer

Thermodynamics
State Variables
   Explain the concept of a state variable
First Law of Thermodynamics
   Solve problems using the first law of thermodynamics
Typical Processes in Gases
   Explain the four basic thermodynamic processes and the concept of a cyclic thermodynamic process
   Demonstrate the use of P-V diagrams
Heat Engines
   Define the thermal efficiency
   Determine the efficiency of a heat engine
Second Law of Thermodynamics
Explain the second law of thermodynamics

**Harmonic Motion**

**Stress**
- Define stress and identify its units
- Calculate stress

**Strain**
- Define strain and identify its units

**Moduli of Elasticity**
- Calculate the moduli of elasticity

**Simple Harmonic Motion**
- Solve problems involving simple harmonic motion

**Wave Motion**

**Mechanical Waves**
- Define the terms used to describe the properties of waves

**Reflection of Waves**
- Explain wave reflection and the principle of superposition
- Explain standing waves
- Compute wavelength, frequency, and speed of various types of waves
- Explain the difference between transverse and longitudinal waves

**Sound**

**Sound Waves**
- Explain the nature of sound as a compressional wave

**Intensity**
- Explain the concepts of intensity and intensity level

**Beats**
- Explain the phenomenon of beats

**Resonance**
- Compute the resonant frequency of a system given appropriate data

**Doppler Effect**
- Explain the Doppler effect and compute frequency shift
given appropriate data

**Properties of Light**

**Speed of Light**
Determine the speed of light in various media

**Wave-Particle Duality**
Demonstrate knowledge of dual nature of light

**Reflection**
Explain reflection and image formation by plane and spherical mirrors

**Refraction**
Explain refraction and image formation by lenses
Solve problems using Snell's law

**Interface and Diffraction**
Explain double slit interference patterns
Explain the behavior of diffraction gratings

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**LAB OUTLINE:**

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquids</td>
<td>3</td>
</tr>
<tr>
<td>Temperature and Heat</td>
<td>6</td>
</tr>
<tr>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>Momentum</td>
<td>4</td>
</tr>
<tr>
<td>One Dimensional Waves</td>
<td>4</td>
</tr>
<tr>
<td>Sound</td>
<td>4</td>
</tr>
<tr>
<td>Reflection, Refraction and Polarization of Light</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total Lab Hours** 30

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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. Locate and properly use protective equipment
c. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Test and Calibrate Indicators and Gauges
4. Troubleshoot and Repair Indicators
5. Test and Calibrate Transmitters
6. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
7. Check and Test Vibration Sensing Elements
8. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves

D. ORGANIZE WORK ROUTINES
1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons

E. COLLECT AND FILE DATA
1. Record Test/Calibration Data
2. Evaluate Collected Data

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Learn to Write Technical Reports
4. Utilize Technical Manuals
5. Understand Personal Computers
6. Attend On-Going Safety Training 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.

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 work
      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. perform work 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 mechanical process
         d. dimensioning and measurement systems
         e. systematic organization of training materials
      2. monitors and corrects performance during
         a. the practical 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 task
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
         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. keeps a running computation of individual grade
         b. performs mathematical computations necessary to understand course
      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

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   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 equipment/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

Additional Resources:

MAST PROGRAM
COURSE SYLLABUS
AC CIRCUIT ANALYSIS II

Lecture hours/week: 4  Lab hours/week: 3  Credit hours: 5

COURSE DESCRIPTION:
Continues study of AC circuit analysis which emphasizes transient analysis and network theorems. Topics include: analysis of complex networks, resonance, transformers, multiple sources, three-phase systems, an introduction to filters and bode plots, nonsinusoidal waveforms, and P-Spice.

PREREQUISITE: AC Circuit Analysis I and Differential Calculus

REQUIRED COURSE MATERIALS:
Textbook: Introductory Circuit Analysis, Boylstad, 7th Edition
Supplemental Text: Principles of Electric Circuits, T.L. Floyd
Fundamentals of Electric Circuits, David Bell
Introduction to Electric Circuits, Jackson, H.W.

METHOD OF INSTRUCTION:
Lecture: Didactic presentations will include lecture and demonstrations.
Laboratory: Laboratory will be a "hands-on" 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
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>Series-Parallel AC Networks</td>
<td>Chapter 16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sections 2, 4, 5, 7, 9, 11, 13</td>
<td></td>
</tr>
<tr>
<td>Methods of Analysis and Selected</td>
<td>Chapter 17</td>
<td>145</td>
</tr>
</tbody>
</table>
Topics (Mesh and Nodal)
Network Theorem Norton,
Thevenin, and Superposition
Sections 3, 5, 7, 8, 11, 17, 22, 27, 28
Chapter 18
Sections 3, 5, 7, 10, 11, 13, 27, 37, 38, 44, 46
EXAM 1
Power (AC) Resistive and Apparent
Inductive and Reactive
Chapter 19
Chapter 19, Sections 1, 3, 4, 6, 8, 12, 15, 18, 20
Series-Parallel Resonance Quality Factor Curve
Chapter 20
Sections 1, 3, 7, 13, 16, 18, 21, 23, 26
Selectivity Series-Parallel
EXAM 2
Attenuation and Bode Plots Low
Pass, High Pass, Band Pass
and Band-Stop
Chapter 21
Sections 6, 13, 18, 22, 26, 30, 33, 35, 39, 42, 47, 49
Polyphase System Y-Delta
Generators
Chapter 23
Sections 4, 7, 9, 13, 17
Non-Sinusoidal Circuits
Chapter 24, Sections 1, 2, 5, 7, 10, 14, 17
Transformers
Chapter 25, Sections 1, 6, 8, 12, 17, 22, 23, 25, 27
FINAL EXAM

LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct AC Ladder Series - Parallel Circuit</td>
<td>3</td>
</tr>
<tr>
<td>Construct AC Mesh and Nodal Circuit</td>
<td>3</td>
</tr>
<tr>
<td>Construct Norton Network Theorem</td>
<td>3</td>
</tr>
<tr>
<td>Construct Thevenin Theorem</td>
<td>3</td>
</tr>
<tr>
<td>Measure Apparent, Resistant and Reacting Power</td>
<td>3</td>
</tr>
<tr>
<td>Build Resonance Circuits; Measure Quality Factor</td>
<td>3</td>
</tr>
<tr>
<td>Build Filters - Low Pass, High Pass, Band Pass, and Band Shop</td>
<td>3</td>
</tr>
<tr>
<td>Wire Delta 1 Y-Generators, Measure Voltages</td>
<td>3</td>
</tr>
<tr>
<td>Computer Addition of Non-Sinesoidal Waveforms</td>
<td>3</td>
</tr>
<tr>
<td>Wire Transformers, Measure Voltage and Impedance</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Lab Hours</strong></td>
<td><strong>30</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
Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary

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

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. MAINTAIN CONTROL SYSTEMS**
1. Collect and Record Data according to company requirements
2. Perform Preventive Maintenance Procedures for Control Devices
3. Function Check Individual Elements Within Loop
4. Troubleshoot Different Types of System Modules
5. Test Different Types of System Modules
6. Configure Software
7. Simulate Control System Check
8. Perform On-Line Testing

**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
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   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. perform work to acceptable levels of quality as required
4. works well with all members of the class

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   1. read and interpret blueprints
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   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 mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical 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 perform the task
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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
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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
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   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 perform a mechanical task
      b. maintain a lecture notebook
      c. submit written responses to chapter question assignments
      d. complete all written assignments

148
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. performs mathematical computations necessary to understand course

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
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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
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   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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

DIGITAL FUNDAMENTALS
MAST PROGRAM
COURSE SYLLABUS
DIGITAL FUNDAMENTALS

Lecture hours/week: 4  Lab hours/week: 3  Credit hours: 5

COURSE DESCRIPTION:

Introduces digital electronics. Topics include: fundamental of digital techniques, integrated logic circuits involving number systems, logic symbols and gates. Boolean algebra, and optimization techniques, flip-flops and registers, combinational and sequential logic circuits, and memory circuits. Laboratory work parallels class work.

PREREQUISITE: AC Circuit Analysis I

REQUIRED COURSE MATERIALS:


METHOD OF INSTRUCTION:

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

Laboratory: Laboratory will be a "hands-on" 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
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>Numbering System</td>
<td>Chapter 1, Sections 2, 3, 6</td>
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<tr>
<td>Parallel and Serial Transmission</td>
<td>Chapter 2, Sections 1 (b, c), 2 (f), 10,</td>
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<tr>
<td>Numbering System Conversion</td>
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LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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<tr>
<td>Numbering System</td>
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<td>Parallel and Serial Transmission</td>
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<td>Numbering System Conversion</td>
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<td>BCD Code</td>
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<td>Parity Method for Error Detection</td>
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<tr>
<td>Boolean Constants and Variables</td>
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<td>Truth Tables</td>
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<td>Combination Logic Circuits</td>
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<td>Sum-Of Product</td>
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<td>Product-Of-Sum</td>
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<tr>
<td>Karnaugh Map</td>
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<td>EX-OR and Not Exclusive OR Gate</td>
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<tr>
<td>Flip-Flops and Related Topics</td>
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<tr>
<td>Clocked S-C, J-K, D Flip Flop</td>
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<td>Asynchronous Inputs</td>
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<td>EXAM 2</td>
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<tr>
<td>Add, Subtract, Divide, and Multiply in Numbering Systems</td>
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<tr>
<td>BCD Addition</td>
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<tr>
<td>1’s and 2’s Complement System</td>
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<tr>
<td>Async. And Sync. Counters</td>
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<tr>
<td>Up and Down Counters</td>
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<tr>
<td>Decoding a Counter</td>
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<tr>
<td>Registers and Memory</td>
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<tr>
<td>FINAL</td>
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</tbody>
</table>

Total Lecture Hours 40
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. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Proper Storage of Circuit Boards
   2. Collect and Record Data According to Company Requirements
   3. Test and Calibrate Transducers According to Specs
   4. Perform Preventive Maintenance Procedures for Control Devices
   5. Test and/or Replace Printed Circuit Boards
   6. Function Check Individual Elements Within Loop
   7. Troubleshoot Different Types of System Modules
   8. Test Different Types of System Modules
   9. Configure Software
   10. Repair Different Types of System Modules
   11. Install Control System Hardware
   12. Simulate Control System Check
   13. Loop-Check Control System
   15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
   1. Troubleshoot and Repair Electronic Computing Relays
   2. Test and Clean Video Display Unit
   3. Check and Adjust Video Display Unit
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 work
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. perform work 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 mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

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
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   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
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   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
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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 equipment/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
COURSE SYLLABUS

ELECTROMECHANICAL DEVICES
MAST PROGRAM
COURSE SYLLABUS
ELECTROMECHANICAL DEVICES

Lecture hours/week: 4 Lab hours/week: 3 Credit hours: 5

COURSE DESCRIPTION:
Introduces electromechanical devices which are essential control elements in electrical systems. Topics include: fundamentals of electromechanical devices, control elements in electrical circuits, typical devices such as generators and alternators, DC and AC motors and controls, transformers and synchromechanisms. Quantitative analysis of power losses, power factors and efficiencies in DC, single-phase and three phase dynamos are stressed. Laboratory work parallels class work.

PREREQUISITE: AC Circuit Analysis I

REQUIRED COURSE MATERIALS:

Textbook: Electric Circuits and DC Machines, by E.C. Lister

Hand Tools/Quantity Required:
Calculator
Screwdrivers (flathead and phillips head)
Diagonal pliers

METHOD OF INSTRUCTION:

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

Laboratory: Laboratory will be a "hands-on" 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
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

160
**LECTURE OUTLINE:**

<table>
<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switches, Fuses, Relays and Circuit Breakers</td>
<td></td>
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<tr>
<td>Test on Switches, Fuses, Relays and Circuit Breakers</td>
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<tr>
<td>Magnetism and Electromagnetism</td>
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<tr>
<td>Test on Magnetism and Electromagnetism</td>
<td>Pages 72-90</td>
<td></td>
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<tr>
<td>Transformers - Principle of Operation, Voltage Ration, Turns Ration, Current Ration, Losses, Efficiency</td>
<td>Pages 210-237</td>
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<tr>
<td>Solve Problems From Handout</td>
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<tr>
<td>Test on transformers</td>
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<tr>
<td>DC Generators - Principles of Operation, Different Types, Characteristics</td>
<td>Pages 91-113</td>
<td></td>
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<tr>
<td>Solve Problems</td>
<td>Pages 114-116</td>
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<tr>
<td>Field Trip (near end of quarter)</td>
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<tr>
<td>Alternators - Principle of Operation, Characteristics, Operating in Parallel (Synchronizing)</td>
<td>Pages 242-257</td>
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<tr>
<td>Solve Problems From Handout</td>
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<tr>
<td>Test on Generators and Alternators</td>
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<tr>
<td>Review of Weeks 1-5</td>
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<tr>
<td>Midterm</td>
<td></td>
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<tr>
<td>DC Motors - Principle of Operation, Types, Characteristics, Basic Motor Control Methods</td>
<td>Pages 117-144</td>
<td></td>
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<tr>
<td>Solve Problems</td>
<td>Pages 146-147</td>
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<tr>
<td>AC Motors (3-Phase) - Principle of Operation, Types, Power Factor, Slip</td>
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<td>NEMA Classification and Class of Insulation</td>
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<tr>
<td>Test on DC Motors and 3-Phase AC Motors</td>
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<tr>
<td>Single-Phase AC Motors - Principle of Operation, Types, Characteristics</td>
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<tr>
<td>Synchronomechanism Systems - Synchrotransmitter, Synchro Receiver</td>
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<td>Simplified Circuits on Synchro Systems</td>
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<tr>
<td>Test on Single Phase AC Motors and Synchro Systems</td>
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<tr>
<td>Review</td>
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<tr>
<td>Final Exam</td>
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</tbody>
</table>

**Total Lecture Hours** 40
LAB OUTLINE:

Lab Topics | Contact Hrs.
--- | ---
Switches Used in Common Control Circuits | 
Transformers | 
Single Phase AC Motors | 
3-Phase Motors | 3-Phase Motors | 
Total Lab Hours | 30

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. Locate and properly use protective equipment
   c. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

E. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES
1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

F. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS
1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

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 work
      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
provide individual assistance/direction to peers as requested
perform work to acceptable levels of quality as required
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 mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
MAST PROGRAM
COURSE SYLLABUS
CONTROL SYSTEMS

Lecture hours/week: 4          Lab hours/week: 3          Credit hours: 5

COURSE DESCRIPTION:

Introduces control system components and theory as they relate to controlling industrial processes. Mechanical, fluidics, temperature, and miscellaneous sensors are studied with emphasis on measuring techniques. Topics include: signal conditioning, and control hardware and actuators. Laboratory work parallel class work.

PREREQUISITE: Digital Fundamentals

REQUIRED COURSE MATERIALS:

Textbook: Instrumentation, Kirk & Rimboi, American Technical Publishers
Automated Process Control Systems, Hunter, Ronald P.


Hand Tools/Quantity Required:
Plastic Tool Box
Screwdriver
Pliers
Wrench

COURSE OBJECTIVE:

Upon successful completion of this course, the student will:
1. Describe the advantages and disadvantages of open and closed loop theory in conjunction with level, pressure, flow, temperature and density
2. Describe the features of negative and positive feedback
3. Describe various transducers, i.e., mechanical, electrical
4. Describe various actuators control hardware, i.e., mechanical, electrical

METHOD OF INSTRUCTION:

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

Laboratory: Laboratory will be a "hands-on" 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
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 Process Control and</td>
<td>Chapters 1 and 4, Appendix A</td>
<td>4</td>
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<tr>
<td>Level ISA Symbols</td>
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<td></td>
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<tr>
<td>Flow</td>
<td>Chapter 5</td>
<td>4</td>
</tr>
<tr>
<td>Measurement and Temperature</td>
<td>Chapter 2</td>
<td>4</td>
</tr>
<tr>
<td>Measurements Pressure</td>
<td>Chapter 3</td>
<td>4</td>
</tr>
<tr>
<td>Analysis</td>
<td>Chapter 13</td>
<td>4</td>
</tr>
<tr>
<td>Analysis Control</td>
<td>Chapter 8</td>
<td>4</td>
</tr>
<tr>
<td>Analysis Control, continued</td>
<td>Chapter 14</td>
<td>4</td>
</tr>
<tr>
<td>Control</td>
<td>Chapter 14 continued</td>
<td>4</td>
</tr>
<tr>
<td>(On - Off) - Proportional - + Reset</td>
<td>Chapter 14 continued</td>
<td>4</td>
</tr>
<tr>
<td>+ Derivative,</td>
<td></td>
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<tr>
<td>Review and Final Exam</td>
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</table>

LAB OUTLINE:

<table>
<thead>
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<th>Contact Hrs.</th>
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</thead>
<tbody>
<tr>
<td>Draw a level control loop</td>
<td>3</td>
</tr>
<tr>
<td>Draw a flow control loop</td>
<td>3</td>
</tr>
<tr>
<td>Draw a temperature control loop</td>
<td>3</td>
</tr>
<tr>
<td>Draw a pressure control loop</td>
<td>3</td>
</tr>
<tr>
<td>Draw a density control loop</td>
<td>3</td>
</tr>
<tr>
<td>Draw a multi-loop control</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Total Lab Hours</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

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

3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES
1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications

E. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend on-going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training
F. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES
1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

G. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS
1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

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 work
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. perform work 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 mechanical process
d. dimensioning and measurement systems
e. systematic organization of training materials

2. monitors and corrects performance during
   a. the practical 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 perform the task
   2. applies appropriate procedures and uses appropriate tools and equipment
ten perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
      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. keeps a running computation of individual grade
      b. performs mathematical computations necessary to understand course
   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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills
Technology Program

MAST

COURSE SYLLABUS

MICROCOMPUTER FUNDAMENTALS
MAST PROGRAM
COURSE SYLLABUS
MICROCOMPUTER FUNDAMENTALS

Lecture hours/week: 4     Lab hours/week: 3     Credit hours: 5

COURSE DESCRIPTION:

Continues the study of digital electronics. Topics include: computer arithmetic, analog to digital and digital to analog conversion, microcomputer architecture and machine level and assembly level language programming. Laboratory work parallels class work.

PREREQUISITE: Electronic Devices and Digital Fundamentals

REQUIRED COURSE MATERIALS:

Textbook: The 6800 Microprocessor

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
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>Arithmetic and Logic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adder Circuits</td>
<td>Explain the operation of full and half adder circuits</td>
<td></td>
</tr>
<tr>
<td>Encoder/Decoder Circuits</td>
<td>Explain the operation of</td>
<td></td>
</tr>
</tbody>
</table>
encoder/decoder circuitry

Conversions
Digital to Analog
  Construct digital/analog
correctors using
  operational-amplifier
  summing circuits
  Analyze the operation of current
  DACs
  Determine the resolution and
  accuracy of a DAC
Analog to Digital
  Construct an A/D converter using
  comparators, D/A
  convertors, binary
  counters, and logic gates
  Analyze the operation of a
  successive approximation
  ADC

Microcomputer Architecture
Tri-State Bus
  Explain how data is transferred
  between registers connected
  by a tri-state bus
System Layout
  Draw a block diagram showing the
  relationship between system
  components linked by address, data
  and control busses

Machine Level Language Programming
Machine Code
  Analyze instruction words, data and
  address words
  Explain how control words activate
  memory and other registers
  Analyze the operation of program
  counters, stack registers,
  instruction registers, and
  memory address registers
  Analyze read and write operations
Assembly Level Language Programming
Assembly Language Codes
  Identify assembly language operation
  codes
  Write assembly language programs to
  store and retrieve data

Total Lecture Hours 40
LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td>Arithmetic and Logic</td>
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<td>Adder Circuits</td>
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<td>Encoder/Decoder Circuits</td>
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<td>Conversions</td>
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<td>Digital to Analog</td>
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<tr>
<td>Analog to Digital</td>
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<tr>
<td>Microcomputer Architecture</td>
<td>6</td>
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<tr>
<td>Tri-State Bus</td>
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<tr>
<td>System Layout</td>
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<tr>
<td>Machine Level Language Programming</td>
<td>6</td>
</tr>
<tr>
<td>Machine Code</td>
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<tr>
<td>Assembly Level Language Programming</td>
<td>6</td>
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<tr>
<td>Assembly Language Codes</td>
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</table>

Total Lab Hours 30

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. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Configure Software
   2. Troubleshoot and Maintain PLCs and Motor Control Systems

C. COLLECT AND FILE DATA
   1. Program PLCs

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
   1. Understand Personal Computers
   2. Attend PLC Training
E. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS

1. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

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 work
   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. perform work 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 mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course
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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills
Technology Program

MAST

COURSE SYLLABUS

PROGRAMMABLE CONTROLLERS
MAST PROGRAM
COURSE SYLLABUS
PROGRAMMABLE CONTROLLERS

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

COURSE DESCRIPTION:

Emphasizes an in-depth study of the programmable controller with programming applications involving controlling industrial processes. Topics include: supplies, ladder diagrams, relay logic timers, and counters; Networking is introduced and communications protocol is investigated. Lab work parallels class work.

PREREQUISITE:  Digital Fundamentals
COREQUISITE:  Electromechanical Devices

REQUIRED COURSE MATERIALS:

Textbook:  Technician's Guide to Programmable Logic Controllers, by Cox

METHOD OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture and demonstrations.

Laboratory:  Laboratory will be a "hands-on" 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
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 and Hardware</td>
<td>Chapters 1 and 2</td>
<td></td>
</tr>
<tr>
<td>Basic Concepts</td>
<td>Chapters 3 and 4</td>
<td></td>
</tr>
<tr>
<td>Test 1</td>
<td></td>
<td></td>
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<tr>
<td>Program Panels and Relay</td>
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</tbody>
</table>

186
LAB OUTLINE:

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify and List Functions of the Various Sections of a Programmable Controller System, Chapters 1 and 2</td>
<td></td>
</tr>
<tr>
<td>Locate and Identify the Functions of the Various Diagnostic Indicators, Chapters 3 and 4 to page 49</td>
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</tr>
<tr>
<td>Assign an Address to Designated Terminals, Chapters 5, 7, 8 and 9</td>
<td></td>
</tr>
<tr>
<td>Identify the Address of Words in Memory, Chapters 10, 11, 12, 13, 14</td>
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<tr>
<td>Enter Various Rungs Using PC Equipment</td>
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<tr>
<td>Identify the Various Types of Instructions Using PC Equipment</td>
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<tr>
<td>Troubleshoot the PC System, MSQD and AB 5/10</td>
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</tr>
<tr>
<td><strong>Total Lab Hours</strong></td>
<td>30</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

2. **Use Protective Equipment**
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary

3. **Follow Safe Operating Procedures for Hand and Power 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. **MAINTAIN CONTROL SYSTEMS**
1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. **MAINTAIN FIELD INSTRUMENTATION DEVICES**
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend on-going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

E. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES
1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

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 work
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. perform work 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 mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

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
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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. 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

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   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 equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

MOTOR CONTROLS
MAST PROGRAM
COURSE SYLLABUS
MOTOR CONTROLS

Lecture hours/week: 4          Lab hours/week: 3          Credit hours: 5

COURSE DESCRIPTION:

Emphasizes the principles of motor controls from fractional horse-power to large magnetic starters, including starting polyphase induction, synchronous, wound rotor and direct current motors. Topics includes: Control pilot devices, control circuits and AC reduced voltage starters, three-phase induction, wound rotor and synchronous motor controls, DC motors and solid state motor controls.

PREREQUISITE:  Electromechanical Devices

REQUIRED COURSE MATERIALS:

Textbook:  Industrial Motor Controls, W. Alerich

Hand Tools/Quantity Required:
VOM                      1
Hand Tools                varies

METHOD OF INSTRUCTION:

Lecture:  Didactic presentations will include lecture, video and demonstrations.
Laboratory:  Laboratory will be a "hands-on" 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
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>Three-Phase Circuits Review</td>
<td></td>
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<tr>
<td>General Principles of Motor Control</td>
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<tr>
<td>Fractional Horse-Power</td>
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<td>Starters</td>
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<tr>
<td>Magnetic Line Voltage Starters, Control Stations</td>
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<td>Relays and Contactors</td>
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<td>Test #1</td>
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<td>Timing Devices, Pilot Devices</td>
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<tr>
<td>Control Circuits and Symbols, Schematic and Wiring</td>
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<td>Diagrams, Conversion From Wiring to Schematic</td>
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<td>Test #2</td>
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<tr>
<td>Diagrams and Basic Control Circuits, Three-Phase</td>
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<tr>
<td>Induction Motor</td>
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<td>Midterm</td>
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<tr>
<td>Single-Phase Induction Motor, Interlocking Methods,</td>
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<td>Various Reduced Voltage Starting Multi Speed</td>
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<td>Induction Motors and Their Controls</td>
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<tr>
<td>Wound Rotor Motor Theory and Operation</td>
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<td>Manual and Automatic Acceleration of Wound Rotor</td>
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<tr>
<td>Motor</td>
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<td>Test #3</td>
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<tr>
<td>Synchronous Motor Theory and Operations</td>
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<td>Synchronous Motor Controls</td>
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<tr>
<td>DC Motor Theory and Operations</td>
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<td>DC Motor Controls</td>
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<td>Test #4</td>
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<tr>
<td>Introduction to Solid State Motor Control, Variable</td>
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<tr>
<td>Speed DC Drives</td>
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<td>Test #5</td>
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<tr>
<td>Variable Frequency Speed Control, Static Logic</td>
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<tr>
<td>Control, Review for Final Exam</td>
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Total Lecture Hours 40

**LAB OUTLINE:**

<table>
<thead>
<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect a Push-Button Station to Operate a Relay and</td>
<td></td>
</tr>
<tr>
<td>a Motor</td>
<td>196</td>
</tr>
</tbody>
</table>
(Three-wire Control)
(Two Wire Control)
Connect a Selector Switch (Hands-on Automatic) and Pressure Switch
(Substitute Toggle Switch to Operate a Relay and Load)
Connect a Motor Starter with a Start-Stop and a Jog Control Circuit
Using a Control Relay
Connect Two Forward and Two Reverse Control Stations with
Push-button and Auxiliary Contact Interlock
Dismantle a Three Phase Line Starter, Identifying All Parts and
State the Purpose of Each and Reassemble
Speed Control of a DC Motor and Study of its Characteristics
Connect a Diac-SCR Variable Speed DC Drive and Study its
Characteristics
Connect a Diac-Triac Variable Speed DC Drive and Study its
Characteristics
Study the Characteristics of Various Static Logic Control Elements
and Connect Different Control Schemes Using These Schemes
Open Laboratory

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. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop  
7. Troubleshoot Different Types of System Modules  
8. Test Different Types of System Modules  
9. Configure Software  
10. Repair Different Types of System Modules  
11. Install Control System Hardware  
12. Simulate Control System Check  
13. Loop-Check Control System  
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES  
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches  
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches  
3. Adjust Dampers and Positioners  
4. Troubleshoot and Adjust Control Drive (Damper)  
5. Test and Calibrate Indicators and Gauges  
6. Troubleshoot and Repair Indicators  
7. Test and Calibrate Transmitters  
8. Test and Calibrate Recorders  
9. Troubleshoot and Repair Recorders  
10. Troubleshoot Linear Variable Differential Transformers  
11. Troubleshoot, Repair, and Calibrate Transmitters  
12. Test Different Field Sensing Elements  
   a. flow  
   b. temperature  
   c. pressure  
   d. level  
13. Install/Replace Field Sensing Elements  
14. Troubleshoot and Repair Transmitters  
15. Tune Controllers: Pneumatic and Electronic  
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls  
17. Troubleshoot and Repair Solenoid Valves  
18. Perform Preventive Maintenance Procedures for Field Devices  
19. Test and Repair Thermocouples  
20. Check and Test Vibration Sensing Elements  
21. Inspect and Troubleshoot Power Supplies and Converters  
22. Test and Calibrate Control Valve Actuators  
23. Troubleshoot and Repair Control Valves/Positioners  
24. Test and Calibrate Controllers  
25. Troubleshoot and Repair Local Controllers  
26. Troubleshoot and Repair Electronic Computing Relays  
27. Troubleshoot and Repair Analyzers  
28. Test and Calibrate Air Analyzers  
29. Test and Calibrate Water Analyzers  
30. Troubleshoot Servo Valves  
31. Calibrate Servo Valves  
32. Test and Clean Video Display Unit  
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

E. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES
1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

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 work
      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. perform work 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 mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical 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 perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
   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. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills Technology Program

MAST

COURSE SYLLABUS

INTRODUCTION TO PROCESS CONTROL
MAST PROGRAM  
COURSE SYLLABUS  
INTRODUCTION TO PROCESS CONTROL

Lecture hours/week: 2  
Lab hours/week: 6  
Credit hours: 4

COURSE DESCRIPTION:
Emphasizes the knowledge and skills required to draw and interpret standard ISA drawings. Topics include: instrumentation symbols, loop identification, open-loop control, closed-loop control, single-loop control and multi-loop control.

PREREQUISITE:  
Engineering Graphics I

COREQUISITE:  
Fluids, Heat, Sound and Light

REQUIRED COURSE MATERIALS:
Textbook: Instrumentation, by Kirk and Rimboi  
Lab Manual: Instrumentation, by Kirk and Rimboi

Hand Tools/Quantity Required:  
Hand Tools  
Safety Glasses  
Test Equipment  
Calibration Equipment

METHOD OF INSTRUCTION:
Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" 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
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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<td>Loop Identification</td>
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<td>Test #1</td>
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<td>Closed Loop</td>
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<td>Single Loop</td>
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<td>Test #3</td>
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<tr>
<td>Multiloop</td>
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LAB OUTLINE:

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<td>Draw a Level Control Loop</td>
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<tr>
<td>Draw a Flow Control Loop</td>
<td>6</td>
</tr>
<tr>
<td>Draw a Temperature Control Loop</td>
<td>6</td>
</tr>
<tr>
<td>Draw a Pressure Control Loop</td>
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</tr>
<tr>
<td>Draw a Density Control Loop</td>
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<tr>
<td>Draw a Multi-Loop Control</td>
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</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
   2. Use Protective Equipment
      a. Wear protective safety clothing as required
      b. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
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21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves  
31. Calibrate Servo Valves  
32. Test and Clean Video Display Unit  
33. Check and Adjust Video Display Unit  
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves  
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward  
36. Test and Calibrate Gas Analyzers  

D. ORGANIZE WORK ROUTINES  
1. Organize Documents and Drawings Required on the Job  
2. Determine Proper Tools/Equipment/Materials to Perform the Job  
3. Coordinate Work Activities with Other Crafts/Units  
4. Coordinate Preventive Maintenance Schedule with Planning Group  
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons  
6. Report Abnormal Equipment Problems to Supervisor  
7. Write New Calibration Procedures if Needed  
8. Follow Specifications  

E. COLLECT AND FILE DATA  
1. Record Test/Calibration Data  
2. Record Preventive Maintenance Data  
3. Record Equipment Disconnect Data  
4. Evaluate Collected Data  
5. Review & Revise Procedures if Needed  
6. Write Reports Required by Company  
7. Specify Equipment for Control Systems  
8. Prepare and Update Specification Forms  
9. Write Work Orders  
10. Prepare and Update Ladder And/Or Logic Diagrams  
11. Program PLCs  

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES  
1. Read/Interpret Diagrams and Drawings  
2. Sketch Diagrams  
3. Study Technical Equipment Information  
4. Application of ISA/JIC Standards  
5. Understand Proper Use of Test Equipment and Tools  
6. Learn to Write Technical Reports  
7. Acquire Safe Practices for Handling Hydraulic and Special Tools  
8. Utilize Technical Manuals  
9. Understand Personal Computers  
10. Attend On-Going Safety Training Courses  
11. Participate in Plant Related Training  
12. Attend PLC Training  
13. Attend DCS Training  

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES  
1. Learn to Review and Forecast Spare Parts Inventory  
2. Prepare Parts Request  
3. Verify Parts Received
4. Research/Verify Substitute Specifications

H. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS
1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

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
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   1. read and interpret blueprints
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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 mechanical process
      d. dimensioning and measurement systems
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   a. applies appropriate preventative maintenance
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II. FOUNDATION SKILLS
A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
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   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
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   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
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   a. learns to take pride in his or her work through positive reinforcement
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   c. share laboratory resources (machines, tools and instructor's individual attention)

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   a. maintain a record of academic achievement (individual grade book)
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   c. accept the responsibility for self-management

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   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

CONTROL SYSTEMS II
MAST PROGRAM
COURSE SYLLABUS
CONTROL SYSTEMS II

Lecture hours/week: 4 Lab hours/week: 3 Credit hours: 5

COURSE DESCRIPTION:

This course is designed to develop the skill of the student in the area of Electronic Instrumentation. The course stresses the use of electronic techniques to control industrial processes. The student will develop the skills required to maintain electronic transmitters, recorders, and controllers.

PREREQUISITE: Control Systems

REQUIRED COURSE MATERIALS:

Textbook: Automated Process Control Electronic, by Harrington, John

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

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

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<th>Lecture Topics</th>
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<th>Contact Hrs.</th>
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<tr>
<td>Safety</td>
<td>Chapters 2, 3, 8, 9</td>
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<td>Industrial Electronics</td>
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<td>Auxiliary Electrical Devices and</td>
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<td>Miscellaneous Sensors -</td>
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<td>Time Measurement</td>
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<td>Temperature Control - Bridge</td>
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Networks
Review and Midterm
Pressure Flow
Level
Analytical Instruments and Controllers
Radiation and Transmission
Review and Final Exam

Chapters 2, 11
Chapters 5, 7
Chapter 6
Section 5
Chapters 10, 17

Total Lecture Hours 40

LAB OUTLINE:

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<td>Review Solid State Power Supplies</td>
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<td>Position Sensors - Strain Gauge</td>
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<td>RTD</td>
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<tr>
<td>PID Controller</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Lab Hours 30

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. Locate and properly use protective equipment
      c. Use lifting aids when necessary
   3. Follow Safe Operating Procedures for Hand and Power 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. MAINTAIN CONTROL SYSTEMS
   1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot Linear Variable Differential Transformers
10. Troubleshoot, Repair, and Calibrate Transmitters
11. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
12. Install/Replace Field Sensing Elements
13. Troubleshoot and Repair Transmitters
14. Tune Controllers: Pneumatic and Electronic
15. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
16. Troubleshoot and Repair Solenoid Valves
17. Perform Preventive Maintenance Procedures for Field Devices
18. Test and Repair Thermocouples
19. Check and Test Vibration Sensing Elements
20. Inspect and Troubleshoot Power Supplies and Converters
21. Test and Calibrate Control Valve Actuators
22. Troubleshoot and Repair Control Valves/Positioners
23. Test and Calibrate Controllers
24. Troubleshoot and Repair Local Controllers
25. Troubleshoot and Repair Electronic Computing Relays
26. Troubleshoot and Repair Analyzers
27. Test and Calibrate Air Analyzers
28. Test and Calibrate Water Analyzers
29. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES
1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications

E. COLLECT AND FILE DATA
1. Record Test/Calibration Data
2. Record Preventive Maintenance Data
3. Record Equipment Disconnect Data
4. Evaluate Collected Data
5. Review & Revise Procedures if Needed
6. Write Reports Required by Company
7. Specify Equipment for Control Systems
8. Prepare and Update Specification Forms
9. Write Work Orders
10. Prepare and Update Ladder And/Or Logic Diagrams
11. Program PLCs

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES
1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications
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 work
   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. perform work 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 mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical 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 perform the task
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
         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. keeps a running computation of individual grade
         b. performs mathematical computations necessary to understand course
      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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
Machine Tool Advanced Skills
Technology Program

MAST

COURSE SYLLABUS

DISTRIBUTED CONTROL SYSTEMS
COURSE DESCRIPTION:

Continues the study of the various applications of distributed control. This course is intended primarily as a survey source of distributed control versus an in-depth study of any single distributed control system. Topics include: historical perspective and systems, basic system wide orientation, sub systems overview, and report generation.

PREREQUISITE:  Control Systems

REQUIRED COURSE MATERIALS:

Textbook: Process Control Technician

Hand Tools/Quantity Required:
Tools
Safety Glasses 1 pair
Classroom Supplies 1
Calculator 1

METHOD OF INSTRUCTION:

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

Laboratory: Laboratory will be a "hands-on" 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
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>Control Systems Feedback</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Complex Variable Concepts, Diff. Equations</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Laplace and Z Transforms</td>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td>Signal Flow Graphics</td>
<td>67</td>
<td>3</td>
</tr>
<tr>
<td>Modeling Electrical and Mechanical Systems Overview</td>
<td>123</td>
<td>3</td>
</tr>
<tr>
<td>Time Domain Analysis of Control Systems</td>
<td>307</td>
<td>3</td>
</tr>
<tr>
<td>Root-Locus Technique-LAN</td>
<td>398</td>
<td>3</td>
</tr>
<tr>
<td>Single Loop, WAN, Distribution Control System</td>
<td>Handouts</td>
<td>3</td>
</tr>
<tr>
<td>Multi Loop</td>
<td>Handouts</td>
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<td>Total Lecture Hours</td>
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LAB OUTLINE:

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<tr>
<th>Lab Topics</th>
<th>Contact Hrs.</th>
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<tbody>
<tr>
<td>Feedback Lab</td>
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<tr>
<td>Variable Concept Problem</td>
<td>4</td>
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<tr>
<td>Laplace Problem</td>
<td>4</td>
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<tr>
<td>Signal Flow Graph Lab</td>
<td>4</td>
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<tr>
<td>Model Electrical System</td>
<td>4</td>
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<tr>
<td>Stability Problem</td>
<td>4</td>
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<tr>
<td>Control System Exercise</td>
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<tr>
<td>LAN Lab</td>
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<tr>
<td>WAN Lab</td>
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<td>Multi Loop lab</td>
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<td>Total Lab Hours</td>
<td>40</td>
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</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

2. Use Protective Equipment
   a. Wear protective safety clothing as required
b. Locate and properly use protective equipment

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

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1. Proper Storage of Circuit Boards
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3. Test and Calibrate Transducers According to Specs
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5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES
1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
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16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
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22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
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D. ORGANIZE WORK ROUTINES
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F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES
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9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES
   1. Learn to Review and Forecast Spare Parts Inventory
   2. Prepare Parts Request
   3. Verify Parts Received
   4. Research/Verify Substitute Specifications

H. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS
   1. Troubleshoot, Install, Maintain, and Operate Motor Starters
   2. Troubleshoot, Install, Maintain, and Operate Relays
   3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
   4. Troubleshoot, Install, Maintain, and Operate Switches
   5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

COURSE OBJECTIVES: SCANS COMPETENCIES

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

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   c. balances social and academic life/responsibilities
   d. accepts responsibility

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   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
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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
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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
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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

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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 equipment/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
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<thead>
<tr>
<th>Lecture Topics</th>
<th>Text Reference Page</th>
<th>Contact Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science of Psychology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definitions</td>
<td></td>
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</tr>
<tr>
<td>Define psychology</td>
<td></td>
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<tr>
<td>History and Methods</td>
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<tr>
<td>Identify the founders of the</td>
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<tr>
<td>major schools of psychology</td>
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<tr>
<td>Careers in Psychology</td>
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<tr>
<td>Describe methods used in</td>
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<tr>
<td>psychological research</td>
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<tr>
<td>Identify career options in</td>
<td></td>
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</tr>
</tbody>
</table>
Social Environments
Definitions
Define social psychology and attitude
Attitudes
Differentiate between types of conformity to social norms
Attribution Theory
Relate attitudes, reputations, and stereotypes to personal perceptions
Identify career options in psychology
Attraction
Describe factors that link attraction and liking
Conformity, Compliance, Obedience, Altruism, and Individualism
Describe how the attribution theory explains behavior and some of its errors
Communications
Identify the four main factors in the communication process
Group Processes
Differentiate between verbal and nonverbal communication
Provide examples of the use of effective and ineffective communications
Practice active listening and nonjudgmental paraphrasing of statements
Define personal space and tell how it affects behavior
List factors in group effectiveness
List stages of group performance
Life Stages
Physical Development
Identify stages of growth and development throughout life span
Moral Development
Identify theories of moral
development
Cognitive Development
Identify theories of cognitive development

Physiology and Behavior
Nervous and Endocrine Systems
Define roles of the nervous and endocrine systems of behavior

Altered States of Consciousness
Identify altered states of consciousness

Personality
Definitions
Define personality

Theories
Match major theorists with their schools of psychology

Careers in Psychology
Describe methods used in psychological research
Identify career options in psychology

Total Lecture Hours 50

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 work
      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. perform work 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 mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical 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 perform the task
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task 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 equipment 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 task 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 perform a mechanical task
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. keeps a running computation of individual grade

b. performs mathematical computations necessary to understand course

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. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/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
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/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
Knowledge of Cutting Fluids/Lubricants
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

TWITTERS 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
Electrician's Tools (lineman pliers, wire strippers, screwdrivers, etc.)
Electric Drills and Saws
Conduit Threading Equipment
Measuring Tools
Volt-Ohm-Meters
Amp Meters (Clamp On)
Tachometers
Amp Meters (Clamp On)
Power Supplies
Oscilloscopes
Sighal Generators
Power Distribution Center
Computers
Basic Drafting Tools
Electrical Lighting Equipment
Electrical Switches
Electro-Mechanical Devices (Control Relays, Timers, Contactors, Motor Starters, etc.)
Manual and Hydraulic Conduit Benders
Electrical Panelboards
Hazardous Location Equipment
Wire Pulling Equipment
AC Motors
DC Motors
Servo Motors
Alternators and Generators
Motor/Generator Logic Controllers
Transit
Transformer Test Sets
Motor Control Center
Motor Control Troubleshooting Trainers
Switchgear
Protective Metering and Relaying Test Equipment
AC Drives
DC Drives
Servo Drives

FUTURE TRENDS AND CONCERNS
Advanced Computer Applications
Fiber Optic Controls
Advanced Test Equipment
Robotics
Advanced Metering Control

COMPETENCY PROFILE
Electrician/Instrument

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

Texas State Technical College
Waco

ALCOA REPRESENTATIVES
MICHAEL L. VIDRINE, P.E.
Central Engineering & Maintenance Service Superintendent
JIM FOSTER
Electrician

BEST COPY AVAILABLE
ELECTRICIAN/INSTRUMENT...uses knowledge and skills to install, maintain, and troubleshoot electrical/electronic equipment in residential, commercial, and industrial environments.

<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
</table>
| A | A-1 Keep one hand free when possible  
A-2 Wear designated safety equipment  
A-3 Use tag, lock and key procedures  
A-4 Maintain CPR certification  
A-5 When possible, turn off power when testing devices  
A-6 Keep metal tools from high voltage areas  
A-7 Work with a partner on high voltage jobs  
A-8 Practice ladder safety |
| B | B-1 Add, subtract, multiply and divide numbers  
B-2 Calculate perimeters, areas and volumes  
B-3 Use measurement conversion tables  
B-4 Solve basic algebraic equations  
B-5 Measure power factor in AC circuits  
B-6 Keep metal equipment as high voltage possible  
B-7 Practice hand free when lock and try possible, turn off power |
| C | C-1 Measure/ calculate DC resistance, current and voltages  
C-2 Measure/ calculate power in DC circuits  
C-3 Read wire tables and find impedance/resistance  
C-4 Measure/ calculate AC currents, voltages and impedance  
C-5 Measure power factor in AC circuits  
C-6 Use full protection equipment as requested  
C-7 Perform Basic Electrical Functions |
| D | D-1 Measure with inch and metric rulers  
D-2 Use screwdrivers, regular and ball peen hammers  
D-3 Use crescent wrench, socket drivers, lineman piers  
D-4 Use hammers, wire strippers, try square, nut driver  
D-5 Use tie wrap gun, hex wrenches, channel lock pliers  
D-6 Use diagonal cutting pliers, sheet metal snips  
D-7 Use hole cutters  
D-8 Use drills and reamers |
| E | E-1 Use a tachometer to check speed  
E-2 Understand difference between series, shunt & compound connect DC motors  
E-3 Inspect motor for signs of damage and wear  
E-4 Inspect brushes and replace if necessary  
E-5 Trouble-shoot motors using name plate data  
E-6 Disconnect and re-connect motors to the power source  
E-7 Identify frame type  
E-8 Repair and maintain motor controls |
| F | F-1 Use a tachometer to check speed  
F-2 Understand types of induction motors, i.e., split phase  
F-3 Understand types of induction motors, i.e., capacitor start  
F-4 Understand types of induction motors, i.e., shunted pole  
F-5 Understand types of induction motors, i.e., squirrel cage  
F-6 Understand synchronous motor operation  
F-7 Inspect motor for signs of damage and wear  
F-8 Inspect motor for signs of damage and wear  
F-9 Repair and maintain motor controls |
| G | G-1 Recognize the Wye and Delta configurations  
G-2 Trouble-shoot motors using name plate data  
G-3 Connect and disconnect motors, including dual voltage nine lead machines  
G-4 Identify frame type  
G-5 Repair and maintain variable speed drives  
G-6 Repair and maintain motor controls  
G-7 Identify frame type  
G-8 Repair and maintain motor controls |
| H | H-1 Read circuit diagram schematics  
H-2 Read wiring diagrams, including single line diagrams  
H-3 Read ladder logic diagrams  
H-4 Read digital logic diagrams  |
| I | I-1 Use digital and analog ammeters  
I-2 Use clamp on ammeters  
I-3 Use digital and analog voltmeters or read wattimeters  
I-4 Use megger and insulation testers  
I-5 Calibrate and repair electronic scales, loadcells  
I-6 Use variable power supplies |
| J | J-1 Test and replace single and three phase contactors  
J-2 Test and replace motor starters  
J-3 Test and replace overload devices  
J-4 Test and replace relays and timers  
J-5 Test and replace switches, i.e., SPST/SPDT/DPST/DUP limit  
J-6 Test and replace switches, i.e., micro, push button, cam, rotary  
J-7 Test and replace switches, i.e., level and flow transformers  
J-8 Test and replace relays, coils, control transformers  
J-9 Test and replace starting resistors, wire runs, lights, and switch gear  
J-10 Test and replace fuses, circuit breakers and disconnects  
J-11 Test and replace diodes, transistors, SCRs |
<p>| 24h | 24h |</p>
<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>K</strong> Maintain Transformers</td>
<td>K-1 Understand basic transformer operation</td>
</tr>
<tr>
<td></td>
<td>K-2 Measure transformer voltages and currents</td>
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<td></td>
<td>K-3 Test and change transformer oil</td>
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<td></td>
<td>K-4 Replace/repair transformer coils and taps</td>
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<tr>
<td></td>
<td>K-5 Disconnect and connect transformers from the line</td>
</tr>
<tr>
<td><strong>L</strong> Troubleshoot PLCs</td>
<td>L-1 Understand PLC status indicators</td>
</tr>
<tr>
<td></td>
<td>L-2 Use PLCs to test input contacts and sensors</td>
</tr>
<tr>
<td></td>
<td>L-3 Read PLC line inputs and output conditions</td>
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<tr>
<td></td>
<td>L-4 Read PLC timer, counter information</td>
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<tr>
<td></td>
<td>L-5 Test input and output modules and replace if necessary</td>
</tr>
<tr>
<td><strong>M</strong> Test/Repair Communication Systems</td>
<td>M-1 Test/repair various types of microphones, amplifiers, speakers</td>
</tr>
<tr>
<td></td>
<td>M-2 Maintain RF devices</td>
</tr>
<tr>
<td></td>
<td>M-3 Install fiber optic cable</td>
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<td></td>
<td>M-4 Install twisted pair cable</td>
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<td>M-5 Install coaxial cable</td>
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<td></td>
<td>M-6 Maintain video monitor equipment</td>
</tr>
<tr>
<td><strong>N</strong> Understand Basic Troubleshooting Techniques</td>
<td>N-1 Follow power source to final device operation</td>
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<td>N-2 Use ohmmeter for continuity checks</td>
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<td></td>
<td>N-3 Check voltage/current levels against specification</td>
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<td></td>
<td>N-4 Check wiring against diagram</td>
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<tr>
<td></td>
<td>N-5 Analyze possible causes of problem using schematic diagram</td>
</tr>
<tr>
<td></td>
<td>N-6 Use isolation to identify problem area</td>
</tr>
<tr>
<td><strong>O</strong> Use Computer</td>
<td>O-1 Calibrate metal sensors</td>
</tr>
<tr>
<td></td>
<td>O-2 Operate power system via P.C.</td>
</tr>
<tr>
<td></td>
<td>O-3 Print out data report</td>
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<tr>
<td></td>
<td>O-4 Input data</td>
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<tr>
<td></td>
<td>O-5 Make inquiry via P.C.</td>
</tr>
<tr>
<td></td>
<td>O-6 Search/clear alarms</td>
</tr>
<tr>
<td></td>
<td>O-7 Use E-mail</td>
</tr>
<tr>
<td><strong>P</strong> Install Conduit</td>
<td>P-1 Determine conduit size for the circuit</td>
</tr>
<tr>
<td></td>
<td>P-2 Use hand benders to make 90 degree offsets, etc.</td>
</tr>
<tr>
<td></td>
<td>P-3 Identify/use conduit fittings</td>
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<td></td>
<td>P-4 Hang and strap conduit</td>
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<tr>
<td></td>
<td>P-5 Make wire pulls in conduit</td>
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</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
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 Improvement Activities
Practice Quality-Consciousness in Performance of the Job

CENTRAL FLORIDA COMMUNITY COLLEGE
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RICK CUNNINGHAM
Instructor, Electrical Wiring

EMERGENCY ONE, INC.
MANAGEMENT TEAM AND EXPERT WORKERS

DAN WOMBOLD, Vice President Human Resources
JIM WHITE, Vice President/Manufacturing
BILL RHOADES, Production Manager/Body Plant
RON STEPHENS, Human Resources Manager
ELAINE SWIOART, Human Resources Supervisor
DONNA TACKETT, Health & Safety Supervisor
SCOTT FLINN, Supervisor
JM OLMSTEAD, Supervisor

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Awareness
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Electrician's Tools (lineman pliers, wire strippers, screwdrivers, wrenches, etc.)
Electric Drills and Saws
Soldering Ovens
Measuring Tools
Volt-Ohm-Meters
Amplifiers (Clamp On)/Power Supplies
Caulking Ovens
Wire Cutters
Wire Wrap Devices
Computers
Basic Drafting Tools
Electrical Lighting Equipment
Electrical Switches
Electro-Mechanical Devices (Controllers, Timers, Contactors, Motor Starters, etc.)
Electrical Panelboards
AC Motors
DC Motors
Alternators and Generators
Motor Generator Logic Controllers
Motor Control Center
Motor Control Troubleshooting Trainers
Switchgear
Protective Metering and Relaying Test Equipment
General Tools (Hacksaws, Sheet Metal Snips, Digonal Cutting Pliers, etc.)

FUTURE TRENDS AND CONCERNS

Advanced Computer Applications
Fiber Optic Controls
Advanced Test Equipment
Robotics
Advanced Metering Control
Reamers
Socket Drives

COMPETENCY PROFILE
Electrician/Instrument Technician

Prepared by
Central Florida Community College

and
Emergency One, Inc.

E-ONE®
ELECTRICIAN/INSTRUMENT TECHNICIAN...Uses knowledge and skills to install, maintain, and troubleshoot electrical/electronic equipment in residential, commercial, and industrial environments.

### Duties

<table>
<thead>
<tr>
<th>A-1 Demonstrate understanding of safety rules</th>
<th>A-2 Assume personal safety standards for self and others</th>
<th>A-3 Support use of protective equipment and use protective material</th>
<th>A-4 Demonstrate understanding of proper hazard controls in the workplace</th>
<th>A-5 Know fire protection and CPR</th>
<th>A-6 Practice safety in the use of tools</th>
<th>A-7 Wear designated safety equipment (e.g., hard hat, safety glasses)</th>
<th>A-8 Use tag, lock and try procedures on power sources</th>
<th>A-9 Practice ladder safety</th>
<th>A-10 Practice buddy system (i.e., monitoring fellow employees' safety)</th>
<th>A-11 Observe precautions during HIPOT measurements</th>
<th>A-12 Observe precautions when handling and servicing lead-acid batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice Electrical Safety</td>
<td>Practice Total Quality</td>
<td>Work Ethics</td>
<td>Demonstrate Communication Skills</td>
<td>Work as a Team</td>
<td>Electrical and Mechanical Problem Solving</td>
<td>Perform Basic Electrical Measurements Including</td>
<td>Use Basic Hand and Power Tools</td>
<td>Connect and Install Wiring</td>
<td>Install and Maintain Motors</td>
<td>24/7</td>
<td>BEST COPY AVAILABLE</td>
</tr>
</tbody>
</table>
# ELECTRICIAN/INSTRUMENT TECHNICIAN...continued

## Duties

| K | K-1 Mechanical drawings, sketches and blueprints |
| L | L-1 Use digital and analog meters (e.g., milliamp, ohmmeter, watt) |
| M | M-1 Single and three-phase conductors |
| N | N-1 Understand PLC status indicators |
| O | O-1 Amplifier systems |
| P | P-1 Follow power source to load devices |
| Q | Q-1 Input data |
| R | R-1 Determine conduit size for circuit |
| S | S-1 Understand precautions to take when handling, installing and servicing batteries |
| T | T-1 Reference and comprehend appropriate Wire Tables |

## Tasks

| K-2 Electrical block diagrams |
| K-3 Electrical wiring diagrams, including single-line diagrams |
| K-4 Electronic schematics containing analog and/or digital devices |
| K-5 Understand E.S.D. and E.M.I. warnings on documents |
| L-2 Use clamp on ammeters |
| L-3 Use megger and insulation testers |
| L-4 Use power supply (voltage and current) |
| L-5 Use automated engine/transmission diagnostic tool |
| M-2 Pumps, circuit breakers, overload devices and disconnects |
| M-3 Relays and timers |
| M-4 Switches, i.e., SPDT, DPDT, SPST, DPST, push, micro, selector, etc., and changeover switches |
| M-5 Capacitors |
| M-6 Code, control transformers |
| N-2 Use PLCs to test input contacts and sensors |
| N-3 Read PLC line input/output conditions |
| N-4 Read PLC timers, counters and information |
| N-5 Test input/output modules and replace if necessary |
| O-2 Microphones and speakers |
| O-3 RF communication devices (e.g., transceiver) |
| O-4 Coaxial cables and systems |
| O-5 Video monitor equipment |
| O-6 Fiber-optic cable (as used in distributive lighting terminations) |
| P-2 Use ohmmeter for continuity checks |
| P-3 Check voltage/current levels against specification |
| P-4 Check actual wiring against diagram |
| P-5 Analyze possible causes of problem using schematic diagram |
| P-6 Use wire insulation to localize problem area |
| Q-2 Print out data report |
| Q-3 Make data base inquiry |
| Q-4 Conduct problem search and clear alarms |
| R-2 Hang and strap conduit |
| R-3 Make wire pulls in conduit |
| R-4 Identify proper sizing and use of tie-wraps |
| S-2 Check and maintain batteries |
| S-3 Understand importance of good conductivity of terminals |
| S-4 Understand series and parallel connections of batteries |
| S-5 Understand importance of grounds on fixtures |
| S-6 Understand charging and discharging cycles of batteries |
| S-7 Understand reserve minutes |
| T-2 Reference and comprehend impedance/resistance ratings |
| T-3 Reference and comprehend NEC Code Book |
| T-4 Reference and comprehend NFPA Code Book |
| T-5 Read and comprehend work order specifications |
| T-6 Read and comprehend forms used to document work completed |
### ELECTRICIAN/INSTRUMENT TECHNICIAN...continued

#### Duties

<table>
<thead>
<tr>
<th>U</th>
<th>Emergency Vehicle Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Wellness/Physical Abilities</td>
</tr>
</tbody>
</table>

#### Tasks

| U-1 | Display a general understanding of emergency vehicle terminology |
| U-2 | Understand the functions of equipment being assembled |
| U-3 | Understand how components related to a total system |
| V-1 | Demonstrate ability to lift 50 pounds |
| V-2 | Demonstrate ability to tolerate heights up to 100 feet |
| V-3 | Ability to work from various positions while standing on concrete for extended periods |
| V-4 | Display ability to work in hot/cold environment for 8-10 hours |
| V-5 | Present a history of documented attendance at work |
| V-6 | Apply wellness information to lifestyle to maintain health |

- 252
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
Knowledge of Cutting Fluids/Lubricants
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
Trusting
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT
Electrician's Tools (lineman pliers, wire strippers, screwdrivers, etc.)
Electric Drills and Saws
Conduit Threading Equipment
Measuring Tools
Volt-Ohm-Meters
Technometers
Amp Meters (Clamp On)
Power Supplies
Oscilloscopes
Signal Generators
Power Distribution Center
Computers
Basic Drafting Tools
Electrical Lighting Equipment
Electrical Switches
Electro-Mechanical Devices (Control Relays, Timers, Contactors, Motor Starters, etc.)
Manual and Hydraulic Conduit Benders
Electrical Panelboards
Hazardous Location Equipment
Wire Pulling Equipment
AC Motors
DC Motors
Servo Motors
Alternators and Generators
Motor/Generator Logic Controllers
Transits
Transformers
Transformer Test Sets
Motor Control Center
Motor Control Troubleshooting Trainers
Switchgear
Protective Metering and Relaying Test Equipment
AC Drives
DC Drives
Servo Drives

FUTURE TRENDS AND CONCERNS
Advanced Computer Applications
Fiber Optic Controls
Advanced Test Equipment
Robotics
Advanced Metering Control
**ELECTRICIAN/INSTRUMENT**...uses knowledge and skills to install, maintain, and troubleshoot electrical/electronic equipment in residential, commercial, and industrial environments.

### Duties

<table>
<thead>
<tr>
<th>A</th>
<th>Practice Electrical Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Perform Basic Mathematical Skills</td>
</tr>
<tr>
<td>C</td>
<td>Perform Basic Electrical Functions</td>
</tr>
<tr>
<td>D</td>
<td>Use Basic Hand and Power Tools</td>
</tr>
<tr>
<td>E</td>
<td>Maintain DC Motors</td>
</tr>
<tr>
<td>F</td>
<td>Maintain Single Phase Motors</td>
</tr>
<tr>
<td>G</td>
<td>Maintain Three Phase Motors</td>
</tr>
<tr>
<td>H</td>
<td>Read Basic Blueprints, Drawings and Schematics</td>
</tr>
<tr>
<td>I</td>
<td>Use Basic Electrical Metering Equipment</td>
</tr>
<tr>
<td>J</td>
<td>Test Common Parts and Replace If Necessary</td>
</tr>
</tbody>
</table>

### Tasks

| A-1 | Keep one hand free when possible |
| A-2 | Wear designated safety equipment |
| A-3 | Use tag, lock and try procedures |
| A-4 | Maintain CPR certification |
| A-5 | When off power when testing devices |
| A-6 | Keep metal tools from high voltage areas |
| A-7 | Work with tools from high voltage areas |
| A-8 | Use full protection equipment as requested |
| A-9 | Use hand free when possible |
| B-1 | Add, subtract, multiply and divide numbers |
| B-2 | MEASURE CONVERSION TABLES |
| B-3 | Read wire tables and find amperage/resistance |
| B-4 | Solve basic algebraic equations |
| B-5 | When off power when testing devices |
| B-6 | Use tie wrap gun, hex wrenches, channel lock pliers |
| B-7 | Work with tools from high voltage areas |
| B-8 | Use drills and reamers |
| C-1 | Measure/ calculate DC resistance, current and voltages |
| C-2 | Measure/ calculate power in DC circuits |
| C-3 | Read wire tables and find amperage/resistance |
| C-4 | Measure/ calculate AC currents, voltages and impedance |
| C-5 | Measure power factor in AC circuits |
| C-6 | Use tie wrap gun, hex wrenches, channel lock pliers |
| C-7 | Use drills and reamers |
| C-8 | Measure/ calculate AC power factor in AC circuits |
| C-9 | Use drills and reamers |
| D-1 | Measure/ calculate AC power factor in AC circuits |
| D-2 | Use screwdrivers, regular and ball peen hammers |
| D-3 | Use crescent wrench, socket drivers, lineman pliers |
| D-4 | Use hacksaws, wire strippers, try driver |
| D-5 | Use tie wrap gun, hex wrenches, channel lock pliers |
| D-6 | Use drills and reamers |
| D-7 | Use hand free when possible |
| D-8 | Use drills and reamers |
| E-1 | Add, subtract, multiply and divide numbers |
| E-2 | Inspect motors for signs of damage and wear |
| E-3 | Inspect brushes and replace if necessary |
| E-4 | Troubleshoot motors using name plate data |
| E-5 | Disconnect and reconnect motors to the power source |
| E-6 | Identify frame type |
| E-7 | Identify frame type |
| F-1 | Use a tachometer to check speed |
| F-2 | Understand types of induction motors, i.e., split phase |
| F-3 | Understand types of induction motors, i.e., capacitor start |
| F-4 | Understand types of induction motors, i.e., capacitor run |
| F-5 | Understand types of induction motors, i.e., shaded pole |
| F-6 | Understand types of induction motors, i.e., wound rotor |
| F-7 | Use a tachometer to check speed |
| F-8 | Use a tachometer to check speed |
| F-9 | Test and replace single phase motors |
| F-10 | Test and replace three phase motors |
| F-11 | Test and replace single phase motors |
| F-12 | Test and replace single phase motors |
| F-13 | Test and replace single phase motors |

### Additional Information

- **Electrical Safety:** Practice electrical safety at all times.
- **Mathematical Skills:** Perform basic mathematical calculations.
- **Electrical Functions:** Understand basic electrical functions and their applications.
- **Hand and Power Tools:** Use hand and power tools safely and effectively.
- **DC Motors:** Maintain and repair DC motors.
- **Single Phase Motors:** Maintain and repair single phase motors.
- **Three Phase Motors:** Maintain and repair three phase motors.
- **Blueprints, Drawings and Schematics:** Read and interpret blueprints, drawings, and schematics.
- **Electrical Metering Equipment:** Use basic electrical metering equipment.
- **Common Parts and Replace If Necessary:** Test and replace common parts as necessary.
<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>K - Maintain Transformers</td>
<td>K-1 Understand basic transformer operation</td>
</tr>
<tr>
<td></td>
<td>K-2 Measure transformer voltages and currents</td>
</tr>
<tr>
<td></td>
<td>K-3 Test and change transformer oil</td>
</tr>
<tr>
<td></td>
<td>K-4 Replace/repair transformer coils and taps</td>
</tr>
<tr>
<td></td>
<td>K-5 Disconnect and connect transformers from the line</td>
</tr>
<tr>
<td>L - Troubleshoot PLCs</td>
<td>L-1 Understand PLC status indicators</td>
</tr>
<tr>
<td></td>
<td>L-2 Use PLCs to test input contacts and sensors</td>
</tr>
<tr>
<td></td>
<td>L-3 Read PLC line inputs and output conditions</td>
</tr>
<tr>
<td></td>
<td>L-4 Read PLC timer, counter information</td>
</tr>
<tr>
<td></td>
<td>L-5 Test input and output modules and replace if necessary</td>
</tr>
<tr>
<td>M - Test/Repair Communication Systems</td>
<td>M-1 Test/repair various types of microphones, amplifiers/speakers</td>
</tr>
<tr>
<td></td>
<td>M-2 Maintain RF devices</td>
</tr>
<tr>
<td></td>
<td>M-3 Install fiber optic cable</td>
</tr>
<tr>
<td></td>
<td>M-4 Install twisted pair cable</td>
</tr>
<tr>
<td></td>
<td>M-5 Install coaxial cable</td>
</tr>
<tr>
<td></td>
<td>M-6 Maintain video monitor equipment</td>
</tr>
<tr>
<td>N - Understand Basic Troubleshooting Techniques</td>
<td>N-1 Follow power source to final device operation</td>
</tr>
<tr>
<td></td>
<td>N-2 Use ohmmeter for continuity checks</td>
</tr>
<tr>
<td></td>
<td>N-3 Check voltage/current levels against specification</td>
</tr>
<tr>
<td></td>
<td>N-4 Check wiring against diagram</td>
</tr>
<tr>
<td></td>
<td>N-5 Analyze possible causes of problem using schematic diagram</td>
</tr>
<tr>
<td></td>
<td>N-6 Use isolation to identify problem area</td>
</tr>
<tr>
<td>O - Use Computer</td>
<td>O-1 Calibrate metal sensors</td>
</tr>
<tr>
<td></td>
<td>O-2 Operate power system via P.C.</td>
</tr>
<tr>
<td></td>
<td>O-3 Print out data report</td>
</tr>
<tr>
<td></td>
<td>O-4 Input data</td>
</tr>
<tr>
<td></td>
<td>O-5 Make inquiry via P.C.</td>
</tr>
<tr>
<td></td>
<td>O-6 Search/clear alarms</td>
</tr>
<tr>
<td></td>
<td>O-7 Use E-mail</td>
</tr>
<tr>
<td>P - Install Conduit</td>
<td>P-1 Determine conduit size for the circuit</td>
</tr>
<tr>
<td></td>
<td>P-2 Use hand benders to make 90 degree offsets, etc.</td>
</tr>
<tr>
<td></td>
<td>P-3 Identify/use conduit fittings</td>
</tr>
<tr>
<td></td>
<td>P-4 Hang and strap conduit</td>
</tr>
<tr>
<td></td>
<td>P-5 Make wire pulls in conduit</td>
</tr>
<tr>
<td></td>
<td>P-6 Machine bend conduit up to four inches</td>
</tr>
</tbody>
</table>

BEST COPY AVAILABLE
BASIC SKILLS AND KNOWLEDGE
- Ability to Comprehend Written/Verbal Instructions
- Ability to Work as Part of a Team
- Communication Skills
- Conversational Language of the Trade
- Knowledge of Calibration Procedures
- Knowledge of Company Policies/Procedures
- Knowledge of Company Quality Assurance Activities
- Knowledge of Employee/employer Responsibilities
- Knowledge of Occupational Opportunities
- Knowledge of Safety Regulations
- Mathematical Skills - Algebra & Trig.
- Mechanical Aptitude
- Organizational Skills
- Practice Quality-Consciousness in Performance of the Job
- Practice Safety in the Workplace
- Reading/Writing Skills
- Use of Pneumatic & Electronic Measurement Devices

ATTITUDES AND TRAITS
- Customer Relations
- Dependability
- Honesty
- Interpersonal Skills
- Neatness
- Personal Ethics
- Physical Ability
- Professional
- Punctuality
- Responsible
- Safety Consciousness
- Self-Motivation
- Strong Work Ethic
- Trustworthy

EQUIPMENT AND TOOLS
- AC Solid State Drives
- Air Analyzers
- Calibrated Instruments (VOM, Pressure Supply)
- Computer
- Control Valves/Positioners
- Controllers
  - P/I, VP, Single Loop, Multiloop
  - Dampers
  - DC Solid State Drives
  - Digital Training Equipment
  - Electrical Testing Equipment
  - Gas Analyzers
  - Gauges (Pressure, Limit, Flow)
  - Hand Tools
  - Ice Bath
  - Instrument Lab
  - Instrumentation Tech's Tools (Lab calibrated against standard)
  - Instrumentation Training Equipment
  - Linear Variable Differential Transformer
  - Mass Flowmeters
  - Personal Safety Equipment
  - pH Analyzer
  - Programmable Controllers
  - Recorders/Indicators
  - Safety Training Equipment
  - Spectrometer
  - Strain Gauges
  - Transmitters
  - Transducers
  - Water Analyzers

CONCERNS AND FUTURE TRENDS
- Advanced Computer Applications
- Automated Material Handling Equipment
- Computer Integrated Manufacturing
- Distributed Control Systems
- Environmental Concerns
- Fiber Optic Controls
- Robotics
- Statistical Process Control
INSTRUMENTATION AND CONTROL TECHNICIAN...will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

<table>
<thead>
<tr>
<th>Duties</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Practice Safety</td>
</tr>
<tr>
<td>B</td>
<td>Maintain Control Systems</td>
</tr>
<tr>
<td>C</td>
<td>Maintain Field Instrumentation Devices</td>
</tr>
<tr>
<td>D</td>
<td>Organize Work Routines</td>
</tr>
<tr>
<td>E</td>
<td>Collect and File Data</td>
</tr>
<tr>
<td>F</td>
<td>Participate in Continuing Education Activities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A-1</th>
<th>B-1</th>
<th>C-1</th>
<th>D-1</th>
<th>E-1</th>
<th>F-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow safety manuals and all safety regulations/requirements</td>
<td>Perform on-line testing</td>
<td>Test and calibrate</td>
<td>Organize documents and drawings required on the job</td>
<td>Record test/calibration data</td>
<td>Read/interpret diagram and drawings</td>
</tr>
<tr>
<td>A-2</td>
<td>B-2</td>
<td>C-2</td>
<td>D-2</td>
<td>E-2</td>
<td>F-2</td>
</tr>
<tr>
<td>Use protective equipment</td>
<td>Collect and record data according to company requirements</td>
<td>Troubleshoot and repair transducers</td>
<td>Determine proper tools/equipment to perform the job</td>
<td>Record preventive maintenance data</td>
<td>Sketch diagrams</td>
</tr>
<tr>
<td>A-3</td>
<td>B-3</td>
<td>C-3</td>
<td>D-3</td>
<td>E-3</td>
<td>F-3</td>
</tr>
<tr>
<td>Follow safe operating procedures for hand and power tools</td>
<td>Test and calibrate maintenance procedures for control devices</td>
<td>Adjust dampers and positioners</td>
<td>Coordinate work activities with other crafts/units</td>
<td>Record equipment disconnect data</td>
<td>Study technical equipment information</td>
</tr>
<tr>
<td>A-4</td>
<td>B-4</td>
<td>C-4</td>
<td>D-4</td>
<td>E-4</td>
<td>F-4</td>
</tr>
<tr>
<td>Maintain a clean and safe work environment</td>
<td>Function check individual elements within loop</td>
<td>Troubleshoot and repair dampers and gauges</td>
<td>Coordinate preventive maintenance schedule with planning group</td>
<td>Evaluate review procedures if needed</td>
<td>Application of ISA/RIC technical equipment standards</td>
</tr>
<tr>
<td>A-5</td>
<td>B-5</td>
<td>C-5</td>
<td>D-5</td>
<td>E-5</td>
<td>F-5</td>
</tr>
<tr>
<td>Test and/or Replace Circuit Boards</td>
<td>Function check individual elements within loop</td>
<td>Test and calibrate indicators and gauges</td>
<td>Verify equipment isolation prior to performance of work for safety reasons</td>
<td>Review revision procedures if needed</td>
<td>Underuse proper use of test equipment and tools</td>
</tr>
<tr>
<td>A-6</td>
<td>B-6</td>
<td>C-6</td>
<td>D-6</td>
<td>E-6</td>
<td>F-6</td>
</tr>
<tr>
<td>Troubleshoot different types of system modules</td>
<td>Troubleshoot and repair indicators</td>
<td>Troubleshoot and repair dampers and gauges</td>
<td>Write new calibration procedures if needed</td>
<td>Write reports required by company</td>
<td>Learn to write technical reports</td>
</tr>
<tr>
<td>A-7</td>
<td>B-7</td>
<td>C-7</td>
<td>D-7</td>
<td>E-7</td>
<td>F-7</td>
</tr>
<tr>
<td>Troubleshoot different types of system modules</td>
<td>Test and calibrate transmitters</td>
<td>Troubleshoot and repair indicators</td>
<td>Complete follow-up work if needed</td>
<td>Specify equipment for control systems</td>
<td>Acquire safe practices for handling hydraulic and special tools</td>
</tr>
<tr>
<td>A-8</td>
<td>B-8</td>
<td>C-8</td>
<td>D-8</td>
<td>E-8</td>
<td>F-8</td>
</tr>
<tr>
<td>Test different types of system modules</td>
<td>Test and calibrate transmitters</td>
<td>Troubleshoot and repair transmitters</td>
<td>Perform specifications</td>
<td>Prepare update specification forms</td>
<td>Utilize technical manuals</td>
</tr>
<tr>
<td>A-9</td>
<td>B-9</td>
<td>C-9</td>
<td>D-9</td>
<td>E-9</td>
<td>F-9</td>
</tr>
<tr>
<td>Configure Software</td>
<td>Troubleshoot linear variable differential transmitters</td>
<td>Troubleshoot and repair transmitters</td>
<td>Perform Algebraic Operations</td>
<td>Write work orders</td>
<td>Understand personal computers</td>
</tr>
<tr>
<td>A-10</td>
<td>B-10</td>
<td>C-10</td>
<td>D-10</td>
<td>E-10</td>
<td>F-10</td>
</tr>
<tr>
<td>Repair different types of system modules</td>
<td>Troubleshoot, repair, and calibrate transmitters</td>
<td>Test and calibrate transmitters</td>
<td>Perform Trigonometric Functions</td>
<td>Program PLCs</td>
<td>Attend on-going safety training courses</td>
</tr>
<tr>
<td>A-11</td>
<td>B-11</td>
<td>C-11</td>
<td>D-11</td>
<td>E-11</td>
<td>F-11</td>
</tr>
<tr>
<td>Install control system hardware</td>
<td>Troubleshoot linear variable differential transmitters</td>
<td>Troubleshoot linear variable differential transmitters</td>
<td>Perform Trigonometric Functions</td>
<td>Program PLCs</td>
<td>Participate in plant related training</td>
</tr>
<tr>
<td>A-12</td>
<td>B-12</td>
<td>C-12</td>
<td>D-12</td>
<td>E-12</td>
<td>F-12</td>
</tr>
<tr>
<td>Simulate control system checkout</td>
<td>Troubleshoot linear variable differential transmitters</td>
<td>Troubleshoot linear variable differential transmitters</td>
<td>Perform Trigonometric Functions</td>
<td>Program PLCs</td>
<td>Attend PLC training</td>
</tr>
<tr>
<td>A-13</td>
<td>B-13</td>
<td>C-13</td>
<td>D-13</td>
<td>E-13</td>
<td>F-13</td>
</tr>
<tr>
<td>Loop-check control system</td>
<td>Troubleshoot linear variable differential transmitters</td>
<td>Troubleshoot linear variable differential transmitters</td>
<td>Perform Trigonometric Functions</td>
<td>Program PLCs</td>
<td>Attend DCS training</td>
</tr>
<tr>
<td>Duties</td>
<td>Tasks</td>
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<td>----------------------------------------------------------------------</td>
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</tr>
<tr>
<td>G Maintain and Control Inventory</td>
<td>O-1 Learn to review and forecast spare parts inventory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H Troubleshoot, Install, Maintain and Operate Motor Control Systems</td>
<td>O-2 Prepare parts request</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>O-3 Verify parts received</td>
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<tr>
<td></td>
<td>O-4 Research/verify substitute specifications</td>
<td></td>
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<tr>
<td></td>
<td>H-1 Troubleshoot, install, maintain, and operate motor starters</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>H-2 Troubleshoot, install, maintain, and operate relays</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>H-3 Troubleshoot, install, maintain, and operate pushbuttons</td>
<td></td>
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<tr>
<td></td>
<td>H-4 Troubleshoot, install, maintain, and operate switches</td>
<td></td>
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<tr>
<td></td>
<td>H-5 Troubleshoot, install, maintain, and operate PLC systems, etc.</td>
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</tr>
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</table>
SKILLS AND KNOWLEDGE
Communication Skills
Use Measurement Tools
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Knowledge of Safety Regulations
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Neatness
Safety-Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

FUTURE TRENDS AND CONCERNS

COMPETENCY PROFILE
Instrumentation and Control Technician

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

Furnished By:
MARTY SCHMIDT
Senior Manufacturing Engineer
and Systems Design Engineer

MICHAEL KON
Manufacturing Engineer and
CNC Systems/Program Engineer

Texas State Technical College
Waco

LOCKHEED MARTIN
INSTRUMENTATION AND CONTROL TECHNICIAN will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

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<tr>
<td>A</td>
<td>B-1 Test and calibrate switches &lt;br&gt; B-2 Troubleshoot and repair switches &lt;br&gt; B-3 Adjust dampers and positioners &lt;br&gt; B-4 Troubleshoot and adjust control drive (damper) &lt;br&gt; B-5 Test and calibrate indicators &lt;br&gt; B-6 Troubleshoot and repair indicators &lt;br&gt; B-7 Test and calibrate transmitters &lt;br&gt; B-8 Test and calibrate recorders &lt;br&gt; B-9 Troubleshoot linear variable differential transformers &lt;br&gt; B-10 Troubleshoot and repair recorders &lt;br&gt; B-11 Calibrate linear variable differential transformers &lt;br&gt; B-12 Test different field sensing elements &lt;br&gt; B-13 Install/replace field sensors</td>
</tr>
<tr>
<td>B</td>
<td>C-1 Organize documents and drawings required on the job &lt;br&gt; C-3 Coordinate work activities with other crafts/units &lt;br&gt; C-4 Verify equipment isolation prior to performance of work &lt;br&gt; C-5 Report abnormal equipment problems to supervisor &lt;br&gt; C-6 Write new procedures</td>
</tr>
<tr>
<td>C</td>
<td>D-1 Record test/calibration data &lt;br&gt; D-2 Record preventive maintenance data &lt;br&gt; D-3 Record equipment disconnect data &lt;br&gt; D-4 Evaluate collected data &lt;br&gt; D-5 Review/reset procedures</td>
</tr>
<tr>
<td>D</td>
<td>E-1 Read/interpret diagrams and drawings &lt;br&gt; E-2 Sketch diagrams &lt;br&gt; E-3 Study technical equipment information &lt;br&gt; E-4 Application of ISA/RS standards &lt;br&gt; E-5 Understand proper use of test equipment and tools &lt;br&gt; E-6 Learn to write reports &lt;br&gt; E-7 Know safe practices for handling hydraulic and special tools &lt;br&gt; E-8 Utilize technical manuals &lt;br&gt; E-9 Understand personal computers (PC's) &lt;br&gt; E-10 Understand basics of fiber optics &lt;br&gt; E-11 Attend in-going safety training courses &lt;br&gt; E-12 Participate in power plant related training</td>
</tr>
<tr>
<td>E</td>
<td>F-1 Review and forecast spare parts inventory &lt;br&gt; F-2 Prepare parts request &lt;br&gt; F-3 Verify parts received &lt;br&gt; F-4 Research/verify substitute specifications</td>
</tr>
<tr>
<td>F</td>
<td>A-1 Clean printed circuit boards &lt;br&gt; A-2 Collect and record data &lt;br&gt; A-3 Test and calibrate I/P module &lt;br&gt; A-4 Perform preventive maintenance procedures for control devices &lt;br&gt; A-5 Calibrate printed circuit boards &lt;br&gt; A-6 Repair printed circuit boards &lt;br&gt; A-7 Function check individual elements within loop &lt;br&gt; A-8 Troubleshoot different types of system modules &lt;br&gt; A-9 Troubleshoot different types of system modules &lt;br&gt; A-10 Configure/modify software &lt;br&gt; A-11 Repair different types of system modules &lt;br&gt; A-12 Install control system hardware &lt;br&gt; A-13 Simulate control system check</td>
</tr>
</tbody>
</table>

BEST COPY AVAILABLE
BASIC SKILLS AND KNOWLEDGE
Ability to Comprehend Written/Verbal Instructions
Ability to Work as Part of a Team
Communication Skills
Converse in the Technical Language of the Trade
Knowledge of Calibration Procedures
Knowledge of Company Policies/Procedures
Knowledge of Company Quality Assurance Activities
Knowledge of Employee/Employer Responsibilities
Knowledge of Occupational Opportunities
Knowledge of Safety Regulations
Mathematical Skills - Algebra & Trig.
Mechanical Aptitude
Organizational Skills
Practice Quality-Consciousness in Performance of the Job
Practice Safety in the Workplace
Reading/Writing Skills
Use Inspection Devices
Use Pneumatic & Electronic Measurement Devices

ATTITUDES AND TRAITS
Customer Relations
Dependability
Honesty
Interpersonal Skills
Neatness
Personal Ethics
Physical Ability
Professional
Punctuality
Reasonable
Safety Consciousness
SelfMotivation
Strong Work Ethic
Trustworthy

EQUIPMENT AND TOOLS
AC Solid State Drives
Air Analyzers
Calibrated Instruments (VOM, Pressure Supply)
Computer
Control Valves/Positioners
Controllers
FV/IV, Single Loop, Multiloop
Dampers
DC Solid State Drives
Digital Training Equipment
Electrical Training Equipment
Gas Analyzers
Gauges (Pressure, Limit, Flow)
Hand Tools
Ice Bath
Instrument Lab
Instrumentation Tech's Tools (Lab Calibrated against standard)
Instrumentation Training Equipment
Linear Variable Differential Transformer
Level
Mass Flowmeters
Personal Safety Equipment
pH Analyzer
Programmable Controllers
Recorders/Indicators
Safety Training Equipment
Spectrometer
Strain Gauges
Transducers
Transmitters
Water Analyzers

CONCERNS AND FUTURE TRENDS
Advanced Computer Applications
Automated Material Handling Equipment
Computer Integrated Manufacturing
Distributed Control Systems
Environmental Concerns
Fiber Optic Controls
Robotics
Statistical Process Control
INSTRUMENTATION AND CONTROL TECHNICIAN... will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

### Duties

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<tr>
<th>Task</th>
<th>Sub-task</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>Proper storage of Circuit Boards</td>
</tr>
<tr>
<td>B-2</td>
<td>Collect and record data according to company requirements</td>
</tr>
<tr>
<td>B-3</td>
<td>Test and calibrate Transducers according to Spec</td>
</tr>
<tr>
<td>B-4</td>
<td>Perform preventive maintenance procedures for control devices</td>
</tr>
<tr>
<td>B-5</td>
<td>Test and/or Replace Printed Circuit Boards</td>
</tr>
<tr>
<td>B-6</td>
<td>Function check individual elements within loop</td>
</tr>
<tr>
<td>B-7</td>
<td>Troubleshoot different types of system modules</td>
</tr>
<tr>
<td>B-8</td>
<td>Test different types of system modules</td>
</tr>
<tr>
<td>B-9</td>
<td>Configure Software</td>
</tr>
<tr>
<td>B-10</td>
<td>Repair different types of system modules</td>
</tr>
<tr>
<td>B-11</td>
<td>Install control system hardware</td>
</tr>
<tr>
<td>B-12</td>
<td>Simulate control system check</td>
</tr>
<tr>
<td>B-13</td>
<td>Loop control system</td>
</tr>
<tr>
<td>B-14</td>
<td>Perform on-line testing</td>
</tr>
<tr>
<td>B-15</td>
<td>Troubleshoot and maintain PLCs and motor control systems</td>
</tr>
<tr>
<td>C-1</td>
<td>Test and calibrate pressure, flow, and temperature transducers</td>
</tr>
<tr>
<td>C-2</td>
<td>Troubleshoot and repair pneumatic and electronic controllers</td>
</tr>
<tr>
<td>C-3</td>
<td>Adjust dampers and positioners</td>
</tr>
<tr>
<td>C-4</td>
<td>Troubleshoot and adjust control drive (damper)</td>
</tr>
<tr>
<td>C-5</td>
<td>Test and calibrate indicators and gauges</td>
</tr>
<tr>
<td>C-6</td>
<td>Troubleshoot and repair solenoid valves</td>
</tr>
<tr>
<td>C-7</td>
<td>Test and calibrate transmitters</td>
</tr>
<tr>
<td>C-8</td>
<td>Test and calibrate recorders</td>
</tr>
<tr>
<td>C-9</td>
<td>Troubleshoot and repair recorders</td>
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<tr>
<td>C-10</td>
<td>Troubleshoot linear variable differential transformers</td>
</tr>
<tr>
<td>C-11</td>
<td>Test different field sensing elements</td>
</tr>
<tr>
<td>C-12</td>
<td>Install/replace field sensing elements</td>
</tr>
<tr>
<td>C-13</td>
<td>Troubleshoot and repair electronic computing relay</td>
</tr>
<tr>
<td>C-14</td>
<td>Troubleshoot and repair transmitters</td>
</tr>
<tr>
<td>C-15</td>
<td>Tune control systems: pneumatic and electronic</td>
</tr>
<tr>
<td>C-16</td>
<td>Troubleshoot and repair solenoid valves</td>
</tr>
<tr>
<td>C-17</td>
<td>Test and repair thermocouples</td>
</tr>
<tr>
<td>C-18</td>
<td>Perform preventive maintenance procedures for field devices</td>
</tr>
<tr>
<td>C-19</td>
<td>Test and repair transducers</td>
</tr>
<tr>
<td>C-20</td>
<td>Check and test vibration sensing elements</td>
</tr>
<tr>
<td>C-21</td>
<td>Inspect and test: power supplies and converters</td>
</tr>
<tr>
<td>C-22</td>
<td>Test and calibrate control valve actuators</td>
</tr>
<tr>
<td>C-23</td>
<td>Troubleshoot and repair control valves/positioners</td>
</tr>
<tr>
<td>C-24</td>
<td>Test and calibrate controllers</td>
</tr>
<tr>
<td>C-25</td>
<td>Troubleshoot and repair local controllers</td>
</tr>
<tr>
<td>C-26</td>
<td>Troubleshoot and repair electronic computing relay</td>
</tr>
</tbody>
</table>

### Tasks

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<thead>
<tr>
<th>Task</th>
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</tr>
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<tr>
<td>A-1</td>
<td>Follow safety manuals and all safety regulations/requirements</td>
</tr>
<tr>
<td>A-2</td>
<td>Use protective equipment</td>
</tr>
<tr>
<td>A-3</td>
<td>Follow safe operating procedures for hand and power tools</td>
</tr>
<tr>
<td>A-4</td>
<td>Maintain a clean and safe work environment</td>
</tr>
<tr>
<td>A-5</td>
<td>Function check individual elements within loop</td>
</tr>
<tr>
<td>A-6</td>
<td>Troubleshoot different types of system modules</td>
</tr>
<tr>
<td>A-7</td>
<td>Test different types of system modules</td>
</tr>
<tr>
<td>A-8</td>
<td>Configure Software</td>
</tr>
<tr>
<td>A-9</td>
<td>Troubleshoot linear variable differential transformers</td>
</tr>
<tr>
<td>A-10</td>
<td>Install control system hardware</td>
</tr>
<tr>
<td>A-11</td>
<td>Simulate control system check</td>
</tr>
<tr>
<td>A-12</td>
<td>Loop control system</td>
</tr>
<tr>
<td>A-13</td>
<td>Perform on-line testing</td>
</tr>
<tr>
<td>A-14</td>
<td>Troubleshoot and maintain PLCs and motor control systems</td>
</tr>
<tr>
<td>B-15</td>
<td>Test and calibrate pressure, flow, and temperature transducers</td>
</tr>
<tr>
<td>B-16</td>
<td>Troubleshoot and repair pneumatic and electronic controllers</td>
</tr>
<tr>
<td>B-17</td>
<td>Adjust dampers and positioners</td>
</tr>
<tr>
<td>B-18</td>
<td>Troubleshoot and adjust control drive (damper)</td>
</tr>
<tr>
<td>B-19</td>
<td>Test and calibrate indicators and gauges</td>
</tr>
<tr>
<td>B-20</td>
<td>Troubleshoot and repair solenoid valves</td>
</tr>
<tr>
<td>B-21</td>
<td>Test and calibrate transmitters</td>
</tr>
<tr>
<td>B-22</td>
<td>Test and calibrate recorders</td>
</tr>
<tr>
<td>B-23</td>
<td>Troubleshoot and repair recorders</td>
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<tr>
<td>B-24</td>
<td>Troubleshoot linear variable differential transformers</td>
</tr>
<tr>
<td>B-25</td>
<td>Install/replace field sensing elements</td>
</tr>
<tr>
<td>B-26</td>
<td>Troubleshoot and repair electronic computing relay</td>
</tr>
<tr>
<td>C-27</td>
<td>Troubleshoot and repair transmitters</td>
</tr>
<tr>
<td>C-28</td>
<td>Test and calibrate air analyzers</td>
</tr>
<tr>
<td>C-29</td>
<td>Test and calibrate water analyzers</td>
</tr>
<tr>
<td>C-30</td>
<td>Troubleshoot servo valves</td>
</tr>
<tr>
<td>C-31</td>
<td>Calibrate servo valves</td>
</tr>
<tr>
<td>C-32</td>
<td>Test and adjust video display unit</td>
</tr>
<tr>
<td>C-33</td>
<td>Check and adjust video display unit</td>
</tr>
<tr>
<td>C-34</td>
<td>Design, specify and configure smart field devices, i.e., transmitters and valves</td>
</tr>
<tr>
<td>C-35</td>
<td>Operate control systems including single element, cascade, ratio, and feedback</td>
</tr>
<tr>
<td>C-36</td>
<td>Test and calibrate gas analyzers</td>
</tr>
</tbody>
</table>

### Education Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Sub-activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-2</td>
<td>Determine proper tools/equipment/plans to perform the job</td>
</tr>
<tr>
<td>D-3</td>
<td>Coordinate work activities with other crafts/units</td>
</tr>
<tr>
<td>D-4</td>
<td>Coordinate preventive maintenance schedule with planning groups</td>
</tr>
<tr>
<td>D-5</td>
<td>Verify equipment isolation prior to performance of work for safety reasons</td>
</tr>
<tr>
<td>D-6</td>
<td>Report abnormal equipment problems to supervisor</td>
</tr>
<tr>
<td>D-7</td>
<td>Write new calibration procedures if needed</td>
</tr>
<tr>
<td>D-8</td>
<td>Follow Specifications</td>
</tr>
<tr>
<td>D-9</td>
<td>Perform Algebraic Operations</td>
</tr>
<tr>
<td>D-10</td>
<td>Perform Trigonometric Functions</td>
</tr>
<tr>
<td>D-11</td>
<td>Perform Calculus Operations</td>
</tr>
<tr>
<td>E-1</td>
<td>Record test/calibration data</td>
</tr>
<tr>
<td>E-2</td>
<td>Record preventive maintenance data</td>
</tr>
<tr>
<td>E-3</td>
<td>Record equipment disconnect data</td>
</tr>
<tr>
<td>E-4</td>
<td>Evaluate collected data</td>
</tr>
<tr>
<td>E-5</td>
<td>Review/revised procedures if needed</td>
</tr>
<tr>
<td>E-6</td>
<td>Write reports required by company</td>
</tr>
<tr>
<td>E-7</td>
<td>Specify equipment for control systems</td>
</tr>
<tr>
<td>E-8</td>
<td>Prepare and update specifications forms</td>
</tr>
<tr>
<td>E-9</td>
<td>Write work orders</td>
</tr>
<tr>
<td>E-10</td>
<td>Prepare and update ladder and/ or logic diagrams</td>
</tr>
<tr>
<td>E-11</td>
<td>Program PLCs</td>
</tr>
<tr>
<td>E-12</td>
<td>Attend technical training courses</td>
</tr>
<tr>
<td>E-13</td>
<td>Attend technical training courses</td>
</tr>
<tr>
<td>E-14</td>
<td>Attend plant related training courses</td>
</tr>
<tr>
<td>E-15</td>
<td>Attend DCS training</td>
</tr>
</tbody>
</table>

### Additional Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Sub-activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-1</td>
<td>Read/interpret diagrams and drawings</td>
</tr>
<tr>
<td>F-2</td>
<td>Sketch diagrams</td>
</tr>
<tr>
<td>F-3</td>
<td>Study technical equipment information</td>
</tr>
<tr>
<td>F-4</td>
<td>Application of ISA/ASME standards</td>
</tr>
<tr>
<td>F-5</td>
<td>Understand proper use of test equipment and tools</td>
</tr>
<tr>
<td>F-6</td>
<td>Learn to write technical reports</td>
</tr>
<tr>
<td>F-7</td>
<td>Acquire safe practices for handling hydraulic and special tools</td>
</tr>
<tr>
<td>F-8</td>
<td>Utilize technical manuals</td>
</tr>
<tr>
<td>F-9</td>
<td>Understand personal computers</td>
</tr>
<tr>
<td>F-10</td>
<td>Attend on-going safety training courses</td>
</tr>
<tr>
<td>F-11</td>
<td>Participate in plant related training</td>
</tr>
<tr>
<td>F-12</td>
<td>Attend PLC training</td>
</tr>
<tr>
<td>F-13</td>
<td>Attend DCS training</td>
</tr>
</tbody>
</table>
## Duties

<table>
<thead>
<tr>
<th>G</th>
<th>Maintain and Control Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Troubleshoot, Install, Maintain and Operate Motor Control Systems</td>
</tr>
</tbody>
</table>

## Tasks

<table>
<thead>
<tr>
<th>G-1 Learn to review and forecast spare parts inventory</th>
<th>G-2 Prepare parts request</th>
<th>G-3 Verify parts received</th>
<th>G-4 Research/verify substitute specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1 Troubleshoot, install, maintain, and operate motor starters</td>
<td>H-2 Troubleshoot, install, maintain, and operate relays</td>
<td>H-3 Troubleshoot, install, maintain, and operate pushbuttons</td>
<td>H-4 Troubleshoot, install, maintain, and operate switches</td>
</tr>
<tr>
<td>H-5 Troubleshoot, install, maintain, and operate PLC Systems, i.e. PLC and DCS Networks</td>
<td></td>
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<td></td>
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</tbody>
</table>
COMPETENCY PROFILE

INSTRUMENTATION TECHNICIAN

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

AMTEC

AUGUSTA TECHNICAL INSTITUTE

SEARLE

BASIC SKILLS AND KNOWLEDGE
Ability to Comprehend Written/Verbal Instructions
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Communication Skills
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Knowledge of Calibration Procedures
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Knowledge of Company Quality Assurance Activities
Knowledge of Employee/Employee Responsibilities
Knowledge of Occupational Opportunities
Knowledge of Safety Regulations
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<tr>
<td>A</td>
<td>Practice Safety</td>
</tr>
<tr>
<td>A-1</td>
<td>Follow safety manuals and all safety regulations/requirements</td>
</tr>
<tr>
<td>A-2</td>
<td>Use protective equipment</td>
</tr>
<tr>
<td>A-3</td>
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<td>A-4</td>
<td>Maintain safe working environment</td>
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<td>Function check individual elements within loop</td>
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<td>A-9</td>
<td>Configure Software</td>
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<td>B</td>
<td>Maintain Control Systems</td>
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<td>Loop control system</td>
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<tr>
<td>C</td>
<td>Maintain Field Instrumentation Devices</td>
</tr>
<tr>
<td>C-1</td>
<td>Test and calibrate pressure, level, flow and temperature equipment</td>
</tr>
<tr>
<td>C-2</td>
<td>Calibrate transmitters and control devices</td>
</tr>
<tr>
<td>C-3</td>
<td>Test and calibrate positioners and pneumatic equipment</td>
</tr>
<tr>
<td>C-4</td>
<td>Verify preventive maintenance work performed by other crafts/units</td>
</tr>
<tr>
<td>C-5</td>
<td>Verify equipment isolation prior to performance of work for safety reasons</td>
</tr>
<tr>
<td>C-6</td>
<td>Report abnormal operating conditions</td>
</tr>
<tr>
<td>C-7</td>
<td>Troubleshoot control systems</td>
</tr>
<tr>
<td>C-8</td>
<td>Calibrate control systems</td>
</tr>
<tr>
<td>C-9</td>
<td>Troubleshoot control systems</td>
</tr>
<tr>
<td>C-10</td>
<td>Troubleshoot linear variable differential transformers</td>
</tr>
<tr>
<td>C-11</td>
<td>Troubleshoot, repair, and calibrate transmitters</td>
</tr>
<tr>
<td>C-12</td>
<td>Test different field sensing elements</td>
</tr>
<tr>
<td>C-13</td>
<td>Install and repair electronic computing elements</td>
</tr>
<tr>
<td>D</td>
<td>Organize Work Routines</td>
</tr>
<tr>
<td>D-1</td>
<td>Organize documents and drawings required on the job</td>
</tr>
<tr>
<td>D-2</td>
<td>Organize equipment/units to perform the job</td>
</tr>
<tr>
<td>D-3</td>
<td>Coordinate equipment with other crafts/units</td>
</tr>
<tr>
<td>D-4</td>
<td>Coordinate preventive maintenance activities with other crafts/units</td>
</tr>
<tr>
<td>D-5</td>
<td>Verify equipment isolation prior to performance of work for safety reasons</td>
</tr>
<tr>
<td>D-6</td>
<td>Report abnormal operating conditions</td>
</tr>
<tr>
<td>D-7</td>
<td>Troubleshoot control systems</td>
</tr>
<tr>
<td>D-8</td>
<td>Troubleshoot electronic computing systems</td>
</tr>
<tr>
<td>D-9</td>
<td>Perform logical operations</td>
</tr>
<tr>
<td>D-10</td>
<td>Perform trigonometric functions</td>
</tr>
<tr>
<td>D-11</td>
<td>Perform control system computing systems</td>
</tr>
<tr>
<td>E</td>
<td>Collect and File Data</td>
</tr>
<tr>
<td>E-1</td>
<td>Troubleshoot and repair controls</td>
</tr>
<tr>
<td>E-2</td>
<td>Record test/calibration data</td>
</tr>
<tr>
<td>E-3</td>
<td>Record preventive maintenance data</td>
</tr>
<tr>
<td>E-4</td>
<td>Evaluate equipment connected to control data</td>
</tr>
<tr>
<td>E-5</td>
<td>Review and update specifications</td>
</tr>
<tr>
<td>E-6</td>
<td>Write reports as needed</td>
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<tr>
<td>E-7</td>
<td>Specify equipment for control systems</td>
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<tr>
<td>E-8</td>
<td>Prepare and update specifications</td>
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<tr>
<td>E-9</td>
<td>Write work orders</td>
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<tr>
<td>E-10</td>
<td>Prepare and update logic diagrams</td>
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<tr>
<td>E-11</td>
<td>Program PLCs</td>
</tr>
<tr>
<td>F</td>
<td>Participate in Continuing Education Activities</td>
</tr>
<tr>
<td>F-1</td>
<td>Read/interpret diagrams and drawings</td>
</tr>
<tr>
<td>F-2</td>
<td>Sketch diagrams</td>
</tr>
<tr>
<td>F-3</td>
<td>Study technical equipment information</td>
</tr>
<tr>
<td>F-4</td>
<td>Application of ISA/ASME standards</td>
</tr>
<tr>
<td>F-5</td>
<td>Troubleshoot use of test equipment and tools</td>
</tr>
<tr>
<td>F-6</td>
<td>Troubleshoot use of test equipment and tools</td>
</tr>
<tr>
<td>F-7</td>
<td>Troubleshoot use of test equipment and tools</td>
</tr>
<tr>
<td>F-8</td>
<td>Utilize technical manuals</td>
</tr>
<tr>
<td>F-9</td>
<td>Troubleshoot local controllers</td>
</tr>
<tr>
<td>F-10</td>
<td>Troubleshoot local controllers</td>
</tr>
<tr>
<td>F-11</td>
<td>Troubleshoot local controllers</td>
</tr>
<tr>
<td>F-12</td>
<td>Attend PLC training</td>
</tr>
<tr>
<td>F-13</td>
<td>Attend DCS training</td>
</tr>
</tbody>
</table>

**BEST COPY AVAILABLE**
### Duties

<table>
<thead>
<tr>
<th>G</th>
<th>Maintain and Control Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Troubleshoot, Install, Maintain and Operate Motor Control Systems</td>
</tr>
</tbody>
</table>

### Tasks

<table>
<thead>
<tr>
<th>G-1 Learn to review and forecast spare parts inventory</th>
<th>G-2 Prepare parts request</th>
<th>G-3 Verify parts received</th>
<th>G-4 Research/verify substitute specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1 Troubleshoot, install, maintain, and operate motor starters</td>
<td>H-2 Troubleshoot, install, maintain, and operate relays</td>
<td>H-3 Troubleshoot, install, maintain, and operate pushbuttons</td>
<td>H-4 Troubleshoot, install, maintain, and operate switches</td>
</tr>
<tr>
<td>H-5 Troubleshoot, install, maintain, and operate PLC systems, i.e., PLC and DCs Networks</td>
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</tbody>
</table>

*Note: Table continues with other duties and tasks.*

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279 280
APPENDIX B - PILOT PROGRAM NARRATIVE

What follows is a narrative of the pilot program which was conducted for this particular occupational specialty.
September 16, 1996

Mr. Wallace Pelton  
Site Coordinator  
Texas State Technical College  
3801 Campus Drive  
Waco, TX 76705

Dear Wallace:

Every effort was and is being made to fulfill the expectations of the Machine Tool Advanced Skills Technology (MAST) Program with respect to the pilot program. After reviewing the parameters needed to meet the requirements for the MAST program, the following areas were addressed: 1) need of conducting a year pilot program during the school year 1995-1996; 2) need of using two pilot programs at this partnering location; and 3) need for 25 students. The original expectation from Augusta Technical Institute was to conduct industrial assessment, curriculum development, pilot program, student assessment and project deliverables in CADD and CNC technical specialty area. However, after consulting with related curriculum areas at Tech here, local industry, and other MAST partners, it was decided to change our emphasis at Augusta Technical Institute to the Instrumentation and Industrial Maintenance Mechanic technical specialty areas.

We have spent many hours conducting the initial phases of the project for the CNC and CADD technical specialty areas. This change caused us to start the five-step process for Instrumentation and Industrial Maintenance Mechanic this year. This resulted in insufficient time to conduct a high quality pilot program with 25 students for one year (between 1995 and 1996) in Instrumentation and Industrial Maintenance Mechanic specialty areas.

Plans have been implemented to conduct the pilot program during the 1996-1997 school year. Recruiting has begun. The pilot program will be conducted in both Instrumentation and Industrial Maintenance Mechanic curriculum areas. The $6,000 scholarship from MAST will be distributed with $3,000 distributed among 15 Instrumentation students and $3,000 distributed among 15 Industrial Maintenance Mechanic students. Students are applying for the MAST pilot programs now. Industrial assessment and industrial validation have taken place for both Instrumentation and Industrial Maintenance Mechanic areas. Curriculum development is actively under way. Student assessment is written and planned with great care. Project deliverables are being prepared. There is a lot of enthusiasm about the two pilot programs. Augusta Technical Institute is excited about these ventures.

Industrial Maintenance Mechanic is a one-year diploma program; and the pilot program will cover the entire year. The Instrumentation program is a two-year associate degree program. Our emphasis for the pilot program for the Instrumentation curriculum will be on the second year students with a GPA of 2.5 or higher.
Enclosed are an information sheet and application for both the instrumentation and Industrial Maintenance Mechanic pilot programs. Please feel free to call me if you require further information.

Sincerely,

Ronnie Lambert
MAST Site Coordinator - Augusta Technical Institute
The Machine Tool Advanced Skills Technology (MAST) Program, a U.S. Department of Education sponsored grant funded through the Office of Vocational and Adult Education (award #V199J40008) includes funds for student scholarships. The money will be available for tuition, fees, and books for students. Students applying for scholarships will need to meet our normal entrance requirements as outlined in the Augusta Technical Institute (ATI) catalog. As part of the terms of the scholarship, achievements of each student will be followed as they progress through the curriculum and into the workplace.

We can fund 15 students in Industrial Maintenance Mechanic and 15 students in Instrumentation Technology. The monetary amount available for each curriculum is $3,000 to be distributed among 15 students. The funds need to be distributed evenly among the 15 students from each curriculum.
Please complete all requested information.

1. Name __________________________ (Last) ______________________ (First) __________________ (MI)
2. Address _______________________________________________________
3. City ___________________________________________________________
6. Sex:  Male __________ Female __________
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