# Precision Manufacturing and Machining TECHNOLOGY MISSISSIPPI CURRICULUM FRAMEWORK

Program CIP: 48.0501-Machine Shop Technology/Assistant

2017





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### NATIONAL CERTIFICATION & STANDARDS

#### NIMS: National Institute for Metalworking Skills

The National Institute for Metalworking Skills (NIMS) was formed in 1994 by the metalworking trade associations to develop and maintain a globally competitive workforce. NIMS sets skills standards for the industry, certifies individual skills against the standards and accredits training programs that meet NIMS quality requirements.

NIMS operates under rigorous and highly disciplined processes as the only developer of American National Standards for the nation's metalworking industry accredited by the American National Standards Institute (ANSI).

NIMS has developed skills standards in 24 operational areas covering the breadth of metalworking operations including metalforming (Stamping, Press Brake, Roll Forming, Laser Cutting) and machining (Machining, Tool and Die Making, Mold Making, Screw Machining, Machine Building and Machine Maintenance, Service and Repair). The Standards range from entry (Level I) to a master level (Level III). All NIMS standards are industry-written and industry-validated, and are subject to regular, periodic reviews under the procedures accredited and audited by ANSI.

#### **NIMS Credentials**

NIMS certifies individual skills against the national standards. The NIMS credentialing program requires that the candidate meet both performance and theory requirements. Both the performance and knowledge examinations are industry-designed and industry-piloted. There are 52 distinct NIMS skill certifications.

Industry uses the credentials to recruit, hire, place and promote individual workers. Training programs use the credentials as performance measures of attainment, often incorporating the credentials as completion requirements. The credentials are often the basis for articulation among training programs.

# INDUSTRY JOB PROJECTION DATA

The Machinists requires long-term on the job training. There is expected to be an 7.50% increase in occupational demand at the regional level and the state level and 7.42% increase at the national level. Median annual income for this occupation is \$40,539.20 at the state level. A summary of occupational data from <a href="http://www.swib.ms.gov/DataCenter/">www.swib.ms.gov/DataCenter/</a> is displayed below:

#### Table 1: Education Level

Program Occupations	Education Level		
MACHINISTS	LONG-TERM ON THE JOB TRAINING		

#### **Table 2: Occupational Overview**

	Region	State	United States
2014 Occupational Jobs	2080	2080	389,434
2024 Occupational Jobs	2236	2236	418,346
Total Change	156	156	28,912
Total % Change	7.50%	7.50%	7.42%
2014 Median Hourly Earnings	\$19.49	\$19.49	\$19.22
2014 Median Annual Earnings	\$40,539.20	\$40,539.20	\$39,977.60
Annual Openings	15	15	2891

#### Table 3: Occupational Breakdown

Description	2014 Jobs	2024 Jobs	Annual Openings	2014 Hourly Earnings	2014 Annual Earnings 2,080 Work Hours
MACHINISTS	2080	2236	15	\$19.49	\$40,539.20

#### **Table 4: Occupational Change**

Description	Regional	Regional %	State %	National %	
	Change	Change	Change	Change	
MACHINISTS	156	7.50%	7.50%	7.42%	

# ARTICULATION

Articulation credit from Secondary Metal Fabrication to Postsecondary Precision Manufacturing and Machining will be awarded upon implementation of this curriculum by the college. The course to be articulated is Power Machinery I (MST 111[4-6]) with the stipulation of passing the MS-CPAS2.

Articulated Secondary Program	Postsecondary Program	Articulated Postsecondary Course
S 2015 Metal Fabrication	PS Precision Manufacturing and	MST 111(4-6) –Power Machinery I
(CIP: 48.0501)	Machining Technology	or
S2015 Precision Machining	(CIP: 48.0501)	MST 121(1-3)- Drill Press and Band
(CIP: 48.0503)		Saw Operations*

### $T {\tt ECHNICAL} \ S {\tt Kills} \ A {\tt Ssessment}$

Colleges should report the following for students who complete the program with a career certificate, technical certificate, or an Associate of Applied Science Degrees for technical skills attainment. To use the approved Alternate Assessment for the following programs of study, colleges should provide a Letter of Notification to the Director of Career Technical Education at the MS Community College Board. Please see the following link for further instructions: <a href="http://www.mccb.edu/wkfEdu/CTDefault.aspx">http://www.mccb.edu/wkfEdu/CTDefault.aspx</a>.

CIP Code	Program of Study	
48.0501	Precision Manufacturing and Machining	
Level	Standard Assessment	Alternate Assessment
Career	MS-CPAS-2 Postsecondary	National Institute for Metalworking Skills (NIMS) Series
		<ul> <li>Measurement, Material &amp; Safety</li> </ul>
		<ul> <li>Job Planning, Benchwork &amp; Layout</li> </ul>
Level	Standard Assessment	Alternate Assessment
Technical	MS-CPAS-2 Postsecondary	National Institute for Metalworking Skills
		(NIMS) Series
		Vertical Milling
		Turning Operations: Between Center

### **ONLINE AND BLENDED LEARNING OPPORTUNITIES**

Course content includes lecture and laboratory semester credit hours. Faculty members are encouraged to present lecture related content to students in an online or blended learning environment. Training related to online and blended learning will be available to faculty members through the MS Community College Board.

### **INSTRUCTIONAL STRATEGIES**

Instructional strategies for faculty members implementing the curriculum can be found through the Office of Curriculum and Instruction's professional development.

### **ASSESSMENT STRATEGIES**

The Office of Curriculum and Instruction's professional development offer assessment strategies to faculty members implementing the curriculum. Additionally, standards were included in course content when appropriate.

# **R**ESEARCH ABSTRACT

In the spring of 2017, the Office of Curriculum and Instruction (OCI) met with the different industry members who made up the advisory committees for the Precision Manufacturing and Machining Technology program. An industry questionnaire was used to gather feedback concerning the trends and needs, both current and future, of their field. Program faculty, administrators, and industry members were consulted regarding industry workforce needs and trends.

Industry advisory team members from the college involved with this program were asked to give input related to changes to be made to the curriculum framework. Specific comments related to soft skills needed in this program include having a positive attitude, being at work every day and on time, and having reading and writing skills to complete work orders and other forms. Occupation-specific skills stated include knowing how to communicate with the customers, basic math skills, troubleshooting with customer concerns, and understanding the importance of confidentiality.

Included in this revision is the reduction of hours in certain courses. Those courses are Fundamentals of Geometric Design and Tolerance (GD&T), Precision Grinding Operations, and Fundamentals of CAD/CAM.

The Modular Option for Precision Manufacturing and Machining Technology is designed to provide flexibility in scheduling and timely certification testing through NIMS. This curriculum revision was developed by utilizing the national standards for machining skills as developed and approved by the National Institute for Metalworking Skills (NIMS). Industry standards are based on the *National Institute for Metalworking Skills*.

# **REVISION HISTORY:**

2010, Revised, Research and Curriculum Unit, Mississippi State University 2017, Revised, Office of Curriculum and Instruction, Mississippi Community College Board

# **PROGRAM DESCRIPTION**

Precision Manufacturing and Machining Technology is an instructional program that prepares individuals to manufacture precision parts on machines such as lathes, grinders, drill presses, milling machines, and Computer Numerical Control (CNC) equipment. Included is instruction in making computations related to work dimensions, testing, feeds and speeds of machines. In addition, individuals use precision measuring instruments such as layout tools, micrometers and gauges; machining and heat-treating various metals; and laying out machine parts. Also included is instruction in the operation and maintenance of computerized equipment.

The uniform program structure for Precision Manufacturing and Machining Technology is designed to serve as the core of instruction for approximately 75% of each major machine tool operation course. The remaining 25% of each course is to be added at the local level based upon needs of students and local employers.

# SUGGESTED COURSE SEQUENCE

Precision Manufacturing and Machining Technology Courses

#### Accelerated Integrated Career Pathway

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
MST 1413	Blueprint Reading	3	2	2	60	
MST 1613	Precision Layout	3	2	2	60	
	Technical Electives	9				
	Total	15				

#### **Career Certificate Required Courses**

						Program
						Certifications
			SCH Bre	eakdown		
		Semester			lotal	
Course		Credit			Contact	
Number	Course Name	Hours	Lecture	Lab	Hours	
MST 1313	Machine Tool Mathematics	3	2	2	60	
MST 1413	Blueprint Reading	3	2	2	60	
						Drill Press Skills I
						&
						Measurement,
MST 1115	Power Machinery I	4	2	4	90	Material & Safety*
MST 1124	Power Machinery II	4	2	4	90	
						Job Planning,
MST 1613	Precision Layout	3	2	2	60	Benchwork & Layout
						CNC Milling:
	Computer Numerical Control					Programming, Setup
MST 2714	Operations I	4	2	4	90	& Operations
MST 1423	Advanced Blueprint Reading	3	2	2	60	
	Technical Electives	6				
	TOTAL	30				

\*Measurement, Material & Safety does not have a project. It is only a theory assessment.

#### **Technical Certificate Required Courses**

						Program
			SCH Bre	eakdown		Certifications
					Total	
Course		Semester			Contact	
Number	Course Name	Credit Hours	Lecture	Lab	Hours	
						Turning Operations:
						Chucking &
						Vertical Milling &
						Turning Operations:
MST 2134	Power Machinery III	4	2	4	90	Between Center
MST 2144	Power Machinery IV	4	2	4	90	Grinding Skills I
						CNC Turning:
	Computer Numerical Control					Programming, Setup
MST 2724	Operations II	4	2	4	90	& Operations
	Technical Electives	3				
	TOTAL	15				

#### Precision Manufacturing and Machining Technology Modular Option Courses

#### **Career Certificate Required Courses**

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
MST 1313	Machine Tool Mathematics	3	2	2	60	
MST 1413	Blueprint Reading	3	2	2	60	
MST 1213	Drill Press and Band Saw Operations	3	2	2	60	
MST 1223	Lathe Turning Knowledge	3	2	2	60	Measurement, Material & Safety*
MST 1213	Milling Machines Knowledge	3	2	2	60	Drill Press Skills I
MST 1243	Precision Lathe Operations	3	2	2	60	Turning Operations: Between Center
MST 1251	Surface Grinding Operations	1	1	0	15	
MST 1263	Milling Machine Operations	3	2	2	60	
MST 1613	Precision Layout	3	2	2	60	Job Planning, Benchwork & Layout
MST 1423	Advanced Blueprint Reading	3	2	2	60	
MST 2512	Advanced Lathe Operations	2	1	2	45	Turning Operations: Chucking
	TOTAL	30				

#### **Technical Certificate Required Courses**

						Program Certifications
			Serrible			
Course		Semester			Total Contact	
Number	Course Name	Credit Hours	Lecture	Lab	Hours	
MST 2521	Advanced Milling Operations	1	1	0	15	Manual Milling Skills I
						CNC Milling:
	Computer Numerical Control					Programming, Setup &
MST 2714	Operations I	4	2	4	90	Operations
						CNC Turning:
NACT 2724	Computer Numerical Control		2			Programming, Setup &
MST 2724	Operations II	4	2	4	90	Operations
MST 2532	Precision Grinding Operations	2	1	2	45	Grinding Skills I
MST 2542	Gear Types and Manufacturing	2	1	2	45	
MST 2552	Advanced Machining Technologies	2	1	2	45	
	TOTAL	15				

\*Measurement, Material & Safety does not have a project. It is only a theory assessment.

# GENERAL EDUCATION CORE COURSES

To receive the Associate of Applied Science Degree, a student must complete all of the required coursework found in the Career Certificate option, Technical Certificate option and a minimum of 15 semester hours of General Education Core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college. The Southern Association of Colleges and Schools (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement1 describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

			SCH Bre	akdown		Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
	Humanities/Fine Arts	3				
	Social/Behavioral Sciences	3				
	Math/Science	3				
	Other academic courses per local community college requirements for AAS degree	6				
	TOTAL	15				

<sup>1</sup> 

Southern Association of Colleges and Schools Commission on Colleges. (2012). *The principles of accreditation: Foundations for quality enhancement*. Retrieved from <a href="http://www.sacscoc.org/pdf/2012PrinciplesOfAcreditation.pdf">http://www.sacscoc.org/pdf/2012PrinciplesOfAcreditation.pdf</a>

### PRECISION MANUFACTURING AND MACHINING TECHNOLOGY COURSES

\*Any course not listed as a required course may be used as an elective.

,							Program
			SC	H Breakd	lown		Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Externship	Total Contact Hours	
MST 111(4-6)	Power Machinery I	4-6	2-3	4-6		90-135	Drill Press Skills I
MST 112(4-6)	Power Machinery II	4-6	2-3	4-6		90-135	
MST 121(1-3)	Drill Press and Band Saw Operations	1-3	1-2	0 or2		15-60	Drill Press Skills I
MST 122(1-2)	Lathe Turning Knowledge	1_2	1_2	0 or 2		15-60	Measurement, Material &
10131 122(1-3)		1-5	1-2	0.012		15-00	Salety
MST 123(1-3)	Milling Machines Knowledge	1-3	1-2	0 or2		15-60	Turning
MST 124(2-3)	Precision Lathe Operations	2-3	1-2	2		45-60	Operations: Between Center
MST 125(1-2)	Surface Grinding Operations	1-2	1	0 or2		15-45	
MST 126(2-3)	Milling Machine Operations	2-3	1-2	2		45-60	
MST 1313	Machine Tool Mathematics	3	2	2		60	
MST 141(2-3)	Blueprint Reading	2-3	1-2	2		45-60	
MST 1423	Advanced Blueprint Reading	3	2	2		60	
MST 1613	Precision Layout	3	2	2		60	Job Planning, Benchwork & Layout
MST 162(3-5)	Fundamentals of Geometric Design and Tolerance (GD&T)	3-5	3	0-4		45-105	
	Deven Marking III					00.125	Turning Operations: Chucking & Vertical Milling & Turning Operations:
MST 213(4-6)	Power Machinery III	4-6	2-3	4-6		90-135	Between Center
10151 214(4-6)	Power Machinery IV	4-6	2-3	4-6		90-135	Grinaing Skills I Turning
MST 251(2-3)	Advanced Lathe Operations	2-3	1-2	2		45-60	Operations: Chucking
MST 252(1-3)	Advanced Milling Operations	1-3	1-2	0 or 2		15-60	Manual Milling Skills I
MST 253(2-3)	Precision Grinding Operations	2-3	2	0 or 2		30-45	Grinding Skills I

MST 254(1-2)	Gear Types and Manufacturing	1-2	1	0 or 2		15-45	
	Advanced Machining						
MST 255(1-2)	Technologies	1-2	1	0 or 2		15-45	
							CNC Milling:
							Programming,
NACT 271/A C)	Computer Numerical Control	1.6	<b>1</b> 2	1.6		00 125	Setup &
10151 271(4-0)		4-0	2-3	4-0		90-135	CNC Turning:
							Programming
	Computer Numerical Control						Setup &
MST 272(4-6)	Operations II	4-6	2-3	4-6		90-135	Operations
MST 273(3-5)	Fundamentals of CAD/CAM	3-5	3	0-4		45-105	
MST 281(1-3)	Metallurgy	1-3	1	0-4		15-75	
	Special Problem in Precision						
NACT 201(1 A)	Manufacturing and Machining			2.0		20 4 20	
MST 291(1-4)	Lechnology	1-4		2-8		30-120	
	Precision Manufacturing and						
MST 292(1-6)	Machining	1-6			3-18	45-270	
WBL 191(1-3)	Work-based Learning I	1-3			3-9	45-135	
WBL 192(1-3)	Work-based Learning II	1-3			3-9	45-135	
WBL 193(1-3)	Work-based Learning III	1-3			3-9	45-135	
WBL 291(1-3)	Work-based Learning IV	1-3			3-9	45-135	
WBL 292(1-3)	Work-based Learning V	1-3			3-9	45-135	
WBL 293(1-3)	Work-based Learning VI	1-3			3-9	45-135	
	Safety and Fundamentals of						
TDT 1113	Die Fabrication	3	1	4		75	
TDT 1123	Die Repair	3	1	4		75	
TDT 1133	Die Design I	3	2	2		60	
TDT 2183	Jigs, Fixtures, and Tools	3	1	4		75	
	All other electives approved by						
	instructor per local community						
	college policy						

# **C**OURSE **D**ESCRIPTIONS

#### Course Number and Name: MST 111(4-6) Power Machinery I

**Description:** 

This course provides instruction of general shop safety as well as the operation of power machinery, which includes instruction and practice in the safe operation of lathes, band saws, drill presses, and vertical mills.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90
5	2	6	120
6	3	6	135

Prerequisite:

#### Student Learning Outcomes:

1. Discuss and apply general machine shop safety and job planning.

None

- a. Identify, discuss, and test on safety procedures.
- b. Demonstrate safety procedures.
- c. Explain the sequence in job planning.
- d. List the steps to follow in developing a plan.
- e. Lay out the steps in an assigned job.
- 2. Discuss, set up, and perform operations using a band saw and drill press safely.
  - a. Discuss and utilize safety procedures.
  - b. Identify types of band saws and accessories.
  - c. Calculate speeds and feeds.
  - d. Determine the type and length of a blade.
  - e. Fabricate and install the blade.
  - f. Cut a part to specifications using proper feeds and speeds.
  - g. Identify and describe the types and parts of a drill press.
  - h. Identify and re-sharpen different types of drill bits.
  - i. Describe the use of layout instruments.
  - j. Perform project layout using various instruments.
  - k. Set up and perform various drilling operations to include counter boring and counter sinking.
  - I. Perform a tapping operation to specifications.
- 3. Perform cutting operations to project specifications safely.
  - a. Use shop formulas and charts to determine lathe speed and feed rates, and make application to production.
  - b. Perform measurements with precision instruments.
  - c. Explain the procedures for preparing an engine lathe.
  - d. Sharpen a cutoff tool blade, and perform recessing and cutoff operations.
  - e. Grind cutting tools to satisfy special job requirements.
  - f. Identify, select, and use carbide cutting tools.
  - g. Use an engine lathe to turn a taper using the compound.
  - h. Discuss and perform boring operations safely.
  - i. Cut various external threads to specified class of fit.
  - j. Measure thread pitch diameter using thread micrometers and three wire method.
- 4. Set up a milling machine, and perform milling operations safely.
  - a. Identify and study parts of a vertical milling machine.
    - b. Tram the head of a vertical mill.

- c. Perform measurements with precision instruments.
- d. Mount and align a swivel-base vise on a milling machine using a dial indicator.
- e. Identify various cutters and accessories used in milling.
- f. Perform selected milling operations according to project specifications.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### **NIMS Certification**

Drill Press Skills I

MST 112(4-6) Power Machinery II

Description:A continuation of Power Machinery I with emphasis on advanced applications<br/>of lathes, mills, and precision grinders.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	4	2	4	90
	5	2	6	120
	6	3	6	135

Prerequisite:

Instructor Approved

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Prepare the engine lathe, and perform various operations according to specifications safely.
  - a. Use taper formulas to calculate dimensions, and perform taper turning operation using the taper attachment.
  - b. Set up and turn work between centers.
  - c. Chase an unfinished or damaged thread.
  - d. Calculate bore size for various types and sizes of internal threads.
  - e. Turn internal threads to specified class of fit.
- 3. Explain and use a precision surface grinder safely.
  - a. Describe surface grinding types and operations.
  - b. Identify, select, install, and use the different types of grinding wheels for various precision grinding operations.
  - c. Grind different shaped parts using various holding devices.
- 4. Set up and perform vertical milling operations safely according to project specifications.
  - a. Perform boring operations using the precision boring head.
  - b. Perform a compound angling operation.
  - c. Set up work piece in mill using sine bar and gauge blocks.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

MST 121(1-3)

#### .-3) Drill Press and Band Saw Operations

Description:

This course provides instruction of general shop safety as well as the operation of power machinery that includes instruction and practice in the safe operation of band saws and drill presses.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	1	1	0	15
	2	1	2	45
	3	2	2	60

Prerequisite:

None

#### Student Learning Outcomes:

- 1. Discuss and apply general machine shop safety and job planning.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
  - c. Explain the sequence in job planning.
  - d. List the steps to follow in developing a plan.
  - e. Lay out the steps in an assigned job.
- 2. Discuss, set up, and perform operations using a band saw and drill press safely.
  - a. Discuss and utilize safety procedures.
  - b. Identify types of band saws and accessories.
  - c. Calculate speeds and feeds.
  - d. Determine the type and length of a blade.
  - e. Fabricate and install the blade.
  - f. Cut a part to specifications using proper feeds and speeds.
  - g. Identify and describe the types and parts of a drill press.
  - h. Identify and re-sharpen different types of drill bits.
  - i. Describe the use of layout instruments.
  - j. Perform project layout using various instruments.
  - k. Set up and perform various drilling operations to include counter boring and counter sinking.
  - I. Perform a tapping operation to specifications.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection

Process Adjustment and Improvement

#### NIMS Certification

Drill Press Skills Certification

MST 122(1-3)

-3) Lathe Turning Knowledge

Description:

This course provides instruction of general shop safety as well as the operation of the lathe. The course will implement the performance of lathe operations resulting in the manufacture of various parts.

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Semester Credit Hours	Lecture	Lab	Contact Hours
1	1	0	15
2	1	2	45
3	2	2	60

#### Prerequisite:

None

#### Student Learning Outcomes:

- 1. Discuss and apply general machine shop safety and job planning.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
  - c. Explain the sequence in job planning.
  - d. List the steps to follow in developing a plan.
  - e. Lay out the steps in an assigned job.
- 2. Perform cutting operations to project specifications safely.
  - a. Use shop formulas and charts to determine lathe speed and feed rates, and make application to production.
  - b. Perform measurements with precision instruments.
  - c. Explain the procedures for preparing an engine lathe.
  - d. Sharpen a cutoff tool blade, and perform recessing and cutoff operations.
  - e. Grind cutting tools to satisfy special job requirements.
  - f. Identify, select, and use carbide cutting tools.
  - g. Use an engine lathe to turn a taper using the compound.
  - h. Discuss and perform boring operations safely.
  - i. Cut various external threads to specified class of fit.
  - j. Measure thread pitch diameter using thread micrometers and three wire method.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### **NIMS Certification**

Measurement, Material & Safety

#### MST 123(1-3) Milling Machines Knowledge

Description:This course provides instruction of general shop safety as well as the operation<br/>of vertical milling machines. The course will implement the performance of<br/>milling operations resulting in the manufacture of various parts.

Hour Breakdown: S	Semester Credit Hours	Lecture	Lab	Contact Hours
1	L	1	0	15
2	2	1	2	45
3	3	2	2	60

Prerequisite:

None

#### Student Learning Outcomes:

- 1. Discuss and apply general machine shop safety and job planning.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
  - c. Explain the sequence in job planning.
  - d. List the steps to follow in developing a plan.
  - e. Lay out the steps in an assigned job.
- 2. Set up a milling machine, and perform milling operations safely.
  - a. Identify and study parts of the vertical milling machine.
  - b. Tram the head of a vertical mill.
  - c. Perform measurements with precision instruments.
  - d. Mount and align a swivel-base vise on a milling machine using a dial indicator.
  - e. Identify various cutters and accessories used in milling.
  - f. Perform selected milling operations according to project specifications.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### MST 124(2-3) Precision Lathe Operations

**Description:** This course is a continuation of lathe tuning knowledge and provides instruction of general shop safety as well as additional instruction in lathe operations.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	2	1	2	45
	3	2	2	60

Prerequisite:

Instructor Approved

#### Student Learning Outcomes:

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Prepare the engine lathe, and perform various operations according to specifications safely.
  - a. Use taper formulas to calculate dimensions, and perform taper turning operation using the taper attachment.
  - b. Set up and turn work between centers.
  - c. Chase an unfinished or damaged thread.
  - d. Calculate bore size for various types and sizes of internal threads.
  - e. Turn internal threads to specified class of fit.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### **NIMS Certification**

**Turning Operations: Between Centers** 

#### MST 125(1-2) Surface Grinding Operations

Description:This course provides instruction in general shop safety as well as emphasis on<br/>advanced applications of precision grinders.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	1	1	0	15
	2	1	2	45

Prerequisite:

Instructor Approved

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Explain and use a precision surface grinder safely.
  - a. Describe surface grinding types and operations.
  - b. Identify, select, install, and use the different types of grinding wheels for various precision grinding operations.
  - c. Grind different shaped parts using various holding devices.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### MST 126(2-3) Milling Machine Operations

Description:This course provides instruction in general shop safety as well as emphasis on<br/>advanced applications of milling machine operations.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	2	1	2	45
	3	2	2	60

Prerequisite:

Instructor Approved

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Set up and perform vertical milling operations safely according to project specifications.
  - a. Perform boring operations using the precision boring head.
  - b. Perform a compound angling operation.
  - c. Set up and machine work piece in mill using sine bar and gauge blocks.

#### **NIMS Duties**

Job Planning and Management

Job Execution

Quality Control and Inspection

Process Adjustment and Improvement

**General Maintenance** 

Industrial Safety and Environmental Protection

Course Number and Name: MST 1313 Machine Tool Mathematics

Description:An applied mathematics course designed for machinists that includes<br/>instruction and practice in algebraic and trigonometric operations.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

Prerequisite:

None

#### **Student Learning Outcomes:**

- 1. Solve mathematical problems relating to machine tool activities.
  - a. Set up formulas, and solve reading problems.
  - b. Transpose components of algebraic formulas.
- 2. Describe and apply trigonometric functions.
  - a. Describe the trigonometric functions, and state their relationship to the sides and angles of a triangle.
  - b. Use the trigonometric functions to solve for unknown sides and angles of a triangle.
- 3. Identify properties of a circle, and solve mathematical problems relating to the properties, and calculate area and volume for geometric objects.
  - a. Identify the properties of a circle, and solve problems relating to these properties.
  - b. Calculate area and volume for various geometrically shaped objects.

#### **NIMS Duties**

Job Planning and Management

#### MST 141(2-3) Blueprint Reading

**Description:** 

Interpreting and applying prints and specifications designed for machinists.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	2	1	2	45
	3	2	2	60

Prerequisite:

None

#### **Student Learning Outcomes:**

- 1. Identify, describe, and apply dimensions and tolerances.
  - a. Identify, describe, and apply industrial methods for showing dimensions and tolerances.
  - b. Describe and apply the International System of Units (SI) as used in plans.
  - c. Describe and apply the need for metric dimensioning.
  - d. Describe and apply specifications found on plans.
- 2. Identify, describe, and apply auxiliary views, finishes, materials, section lines, and cutting plane lines.
  - a. Identify, distinguish, and apply primary and secondary auxiliary views on a drawing.
  - b. Identify, describe, and apply surface finishes shown on a plan.
  - c. Identify materials used as indicated by section lines, and demonstrate correct selection.
  - d. Describe and apply the use of the cutting plane line.

#### **NIMS Duties**

Job Planning and Management Quality Control and Inspection

Course Number and Name:	MST 1423	Advanced Blueprint Reading
		Advanced blueprint Reading

Description:A continuation of Blueprint Reading with emphasis on advanced features of<br/>prints and specifications includes instruction on the identification of various<br/>projections, views, and assembly components.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

Prerequisite:

Instructor Approved

#### **Student Learning Outcomes:**

- 1. Describe features related to alterations, chamfers, and knurls.
  - a. Recognize alterations and changes in size and specifications made on a drawing, and describe how these alterations and changes are recorded.
  - b. Explain how a chamfer is represented and dimensioned.
  - c. Identify and describe how knurls are dimensioned.
- 2. Describe the purpose and use of assembly drawings.
- 3. Identify and apply the use of geometric tolerance symbols.

#### **NIMS Duties**

Job Planning and Management Quality Control and Inspection

#### Course Number and Name: MST 1613 Precision Layout

**Description:** 

Precision layout for machining operations that includes instruction and practice in the use of layout instruments.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

#### Prerequisite:

None

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Identify precision layout instruments.
  - a. Describe the use of instruments used for precision layout.
  - b. Explain upkeep and preventive maintenance.
- 3. Perform precision layout safely.
  - a. Explain the steps in layout.
  - b. Perform a precision layout to specifications and tolerances.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### **NIMS Certification**

Job Planning, Benchwork, & Layout

### Course Number and Name: MST 162(3-5) Fundamentals of GD&T (Geometric Dimensioning & Tolerancing)

Description:This course is designed to provide students with a solid foundation in the<br/>fundamentals of geometric dimensioning and tolerancing. Includes emphasis<br/>on measurement theory; common terms and definitions; profile, orientation,<br/>locational, runout, and form tolerances as they relate to Machine Tool<br/>Technology.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	3	0	45
	4	3	2	75
	5	3	4	105

Prerequisite: None

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Identify, describe, and apply dimensions and tolerances relating to GD&T.
  - a. Identify, describe, and apply GD&T symbols.
  - b. Describe rules relating to GD&T.
  - c. Identify datums.
  - d. Identify and describe material conditions.
  - e. Perform measurements according to GD&T callouts.

#### **NIMS Duties**

Job Planning Management Quality Control and Inspection Process Adjustment and Control General Maintenance Industrial Safety and Environmental Protection

MST 213(4-6) Power Machinery III

Description:A continuation of Power Machinery II with emphasis on safety and advanced<br/>applications of the engine lathe, milling, and grinding machines.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	4	2	4	90
	5	2	6	120
	6	3	6	135

#### Prerequisite:

Instructor Approved

#### Student Learning Outcomes:

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Calculate and fabricate commonly used threads safely.
  - a. Calculate dimensions and machine additional internal and external thread form types.
- 3. Describe and fabricate various tapers safely.
  - a. Discuss the different types of tapers and the methods used to produce and measure them.
  - b. Machine different types of internal and external tapers to specifications using the taper attachment and/or tailstock offset method.
- 4. Perform eccentric turning operations safely.
  - a. Describe the procedure for eccentric turning.
  - b. Manufacture eccentric parts to specifications.
- 5. Prepare and use a lathe to perform various operations safely.
  - a. Install, set up, and use lathe accessories to include the following: steady rest, follower rest, and tool post grinder (when applicable).
- 6. Perform key cutting operation using a vertical mill.
  - a. Cut a keyway to specifications.
  - b. Cut a keyseat to specifications.
  - c. Set up and manufacture parts correctly using an indexable dividing head.
  - d. Discuss and demonstrate the uses of a rotary table and vertical slotting head.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### **NIMS Certification**

Turning Operations: Chucking Vertical Milling Turing Operations: Between Center

#### Course Number and Name: MST 214(4-6) Power Machinery IV

**Description:** 

A continuation of Power Machinery III with emphasis on advanced operations on the milling machine and engine lathe and discuss advanced machining technologies.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	4	2	4	90
	5	2	6	120
	6	3	6	135

Prerequisite: Instructor Approved

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Discuss and operate indexing safely.
  - a. Identify the various types of gears including spur, helical, bevel, and herringbone.
  - b. Calculate needed gear tooth elements and sizes using the *Machinist Ready Reference* or *Machinery Handbook*.
  - c. Manufacture parts to specifications using direct, simple, and angular indexing.
- 3. Discuss electrical discharge machine (EDM) technology.
  - a. Identify the uses of the EDM.
  - b. Discuss the various types and applications of EDM.
  - c. Discuss the advantages and disadvantages of EDM.
  - d. Manufacture a part to specifications.
- 4. Discuss emerging technologies in Machine Tool Technology.
  - a. Discuss various types and applications of laser cutting equipment.
  - b. Discuss types and applications of CNC plasma cutting equipment.
  - c. Identify and discuss types and applications of water jet cutting.
  - d. Manufacture a part to specifications.
- 5. Operate grinding machinery safely.
  - a. Describe precision grinding operations.
  - b. Discuss and calculate math constants and formulas related to grinding required clearance angles and lands using the *Machinist Ready Reference* or *Machinery Handbook*.
  - c. Perform setup and grind surfaces according to specifications.
  - d. Set up and grind milling machine cutters.

#### **NIMS Duties**

- Job Planning and Management
- Job Execution
- Quality Control and Inspection
- Process Adjustment and Improvement
- **General Maintenance**
- Industrial Safety and Environmental Protection
- Career Management and Employment Relations

#### **NIMS Certification**

Grinding Skills I

#### MST 251(2-3) Advanced Lathe Operations

**Description:** This course provides instruction on safety and advanced applications of the engine lathe.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	2	1	2	45
	3	2	2	60

#### Prerequisite: Instructor Approved

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Calculate and fabricate commonly used threads safely.
  - a. Calculate dimensions and machine additional internal and external thread form types.
- 3. Describe and fabricate various tapers safely.
  - a. Discuss the different types of tapers and how to measure them.
  - b. Machine different types of internal and external tapers to specifications using the taper attachment and/or tailstock offset method.
- 4. Perform eccentric turning operations safely.
  - a. Describe the procedure for eccentric turning.
  - b. Manufacture eccentric parts to specifications.
- 5. Prepare and use a lathe to perform various operations safely.
  - a. Install, set up, and use lathe accessories to include the following: steady rest, follower rest, and tool post grinder (when applicable).

#### **NIMS Duties**

Job Planning and Management

Job Execution

Quality Control and Inspection

Process Adjustment and Improvement

**General Maintenance** 

Industrial Safety and Environmental Protection

#### **NIMS Certification**

Turning Operations: Chucking

MST 252(1-3) Advanced Milling Operations

Description:

This course provides instruction on safety and advanced applications of the vertical milling machine.

Hour Breakdown:

Semester Credit	Lecture	Lab	Contact Hours
Hours			
1	1	0	15
2	1	2	45
3	2	2	60

Prerequisite: Instructor Approved

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Perform key cutting operation using a vertical mill.
  - a. Cut a keyway to specifications.
  - b. Cut a keyseat to specifications.
  - c. Set up and manufacture parts correctly using an indexable dividing head.
  - d. Discuss and demonstrate the uses of a rotary table, sine plate, and vertical slotting head.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### NIMS Certification

Manual Milling Skills I

#### MST 253(2-3) Precision Grinding Operations

Description: This course provides instruction on safety and grinding operations and applications to include tool post grinding, cylindrical grinding, and center-less grinding.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	2	2	0	30
	3	2	2	45

Prerequisite:	Instructor Approved
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#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Operate grinding machinery safely.
  - a. Describe precision grinding operations using various types of machines.
  - b. Discuss and calculate math constants and formulas related to grinding required clearance angles and lands using the *Machinist Ready Reference* or *Machinery Handbook*.
  - c. Perform setup and grind surfaces according to specifications.
  - d. Set up and grind milling machine cutters.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### **NIMS Certification**

**Grinding Skills I** 

MST 254(1-2)

**Gear Types and Manufacturing** 

**Description:** 

This course provides instruction on safety and vertical or horizontal milling operations, formulas, and procedures required to manufacture various types of gears and their applications.

Hour Breakdown:	Semester Credit	Lecture	Lab	Contact Hours
	Hours			
	1	1	0	15
	2	1	2	45

Prerequisite: Instructor Approved

#### **Student Learning Outcomes:**

1. Discuss and apply general machine shop safety.

- a. Identify, discuss, and test on safety procedures.
- b. Demonstrate safety procedures.
- 2. Discuss and operate indexing safely.
  - a. Identify the various types of gears including spur, helical, bevel, and herringbone.
  - b. Calculate needed gear tooth elements and sizes using the Machinist Ready Reference or Machinery Handbook.
  - c. Manufacture parts to specifications using direct, simple, and angular indexing.

#### **NIMS Duties**

Job Planning and Management Job Execution **Quality Control and Inspection Process Adjustment and Improvement General Maintenance** Industrial Safety and Environmental Protection Description:This course provides instruction on safety, operations, and applications of new<br/>machining technologies that apply to precision manufacturing in global<br/>markets. Laser technology, EDM wire, Die sink, plasma and water jets<br/>commonly used in machining and forming shapes in utilizing exotic space age<br/>materials.Hour Breakdown:Semester CreditLectureLabContact Hours

**Advanced Machining Technologies** 

MST 255(1-2)

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	1	1	0	15
	2	1	2	45

Prerequisite: Instructor Approved

#### **Student Learning Outcomes:**

**Course Number and Name:** 

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Discuss electrical discharge machine (EDM) technology.
  - a. Identify the uses of the EDM.
  - b. Discuss the various types and applications of EDM.
  - c. Discuss the advantages and disadvantages of EDM.
  - d. Manufacture a part to specifications.
- 3. Discuss emerging technologies in Machine Tool Technology.
  - a. Discuss various types and applications of laser cutting equipment.
  - b. Discuss types and applications of CNC plasma cutting equipment.
  - c. Identify and discuss types and applications of water jet cutting.
  - d. Manufacture a part to specifications.

#### **NIMS Duties**

Job Planning and Management

General Maintenance

Industrial Safety and Environmental Protection

Career Management and Employment Relations

MST 271(4-6) Computer Numerical Control Operations I

Description:An introduction of computer numerical control (CNC) and computer assisted<br/>manufacturing (CAM) techniques and practices. Includes the use of the<br/>Cartesian coordinate system, programming codes and commands, and tooling<br/>requirements for CNC machines.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	4	2	4	90
	5	2	6	120
	6	3	6	135

Prerequisite: None

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Describe CNC machining, uses, and applications of CNC program.
  - a. Describe the capabilities and limitations of computer numerical control (CNC) equipment.
  - b. Describe the Cartesian coordinate system as used in a CNC machine program.
  - c. Describe the differences in absolute and incremental dimensioning as related to an ISO programming of a CNC machine.
  - d. Describe procedures for CNC machine start-up.
  - e. Describe CAM software.
- 3. Discuss commands for CNC machine codes.
  - a. List and describe the purpose or function of the preparatory commands for a CNC machine (G-codes).
  - b. Explain the purpose or function of the miscellaneous commands used with a CNC machine (M-codes).
  - c. State the purpose of other alphabetical commands used in programming operations of a CNC machine.
- 4. Discuss tooling for CNC operations, and safely use CNC mill, CNC lathe, and CNC machine centers to project specifications.
  - a. Describe the different types of tooling required for CNC mills, CNC lathes, and CNC machine centers.
  - b. Select tooling required for a specific job on a CNC mill, CNC machine centers, and CNC lathe.
  - c. Write and manually input program data.
  - d. Execute programs for CNC mill, CNC lathe, and CNC machine center according to project specifications.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### NIMS Certification

CNC Milling: Programming, Setup & Operations

MST 272(4-6) Computer Numerical Control Operations II

Description:A continuation of Computer Numerical Control Operations I. Includes<br/>instruction in writing and editing CNC programs, machine setup and operation,<br/>and use of CAM software to program and operate CNC machines (CNC lathes,<br/>CNC mills, and CNC machine centers).

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	4	2	4	90
	5	2	6	120
	6	3	6	135

Prerequisite: Instructor Approved

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Manipulate CNC machine programs to specifications safely.
  - a. Describe and perform procedures for editing, altering, inserting, and deleting steps in a CNC program using computer aided design, CAM, and internal machine control unit.
  - b. Write and execute CNC programs to manufacture parts to meet specifications.
  - c. Inspect parts, and adjust program.
  - d. Use a computer assisted manufacturing (CAM) system to generate a program for a CNC machine.
  - e. Interface a CAM system to a CNC machine, and download the program.
- 3. Perform CNC procedures safely to specifications.
  - a. Set up (mount workpiece and tooling) a CNC machine, enter program into memory, and manufacture parts.
  - b. Set up (mount workpiece and tooling) the CNC machine, and execute the CAM program.
- 4. Apply preventive maintenance procedures for CNC machines.
  - a. Discuss safety procedures involving preventive maintenance.
  - b. Lubricate, clean the machine, check coolant, and remove chip debris.
- 5. Discuss operation of CMM (co-ordinate measuring machine).

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection Career Management and Employment Relations

#### **NIMS Certification**

CNC Turning: Programming, Setup & Operations

MST 273(3-5) Fundamentals of CAD/CAM

Description:

This course is designed to provide the students with the fundamental knowledge and skills of Computer Aided Design Manufacturing using various CAD/CAM software packages as they relate to Machine Tool Technology.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	3	0	45
	4	3	2	75
	5	3	4	105

Prerequisite: None

#### **Student Learning Outcomes:**

1. Discuss and apply general machine shop safety.

- a. Identify, discuss, and test on safety procedures.
- b. Demonstrate safety procedures.
- 2. Develop a general understanding of fundamental CAD/CAM concepts.
  - a. Describe the current industrial uses of CAD/CAM.
  - b. Describe the major differences between Computer Aided Design and Computer Aided Manufacturing.
  - c. List the major steps in Computer Aided Design.
  - d. List the major steps in Computer Aided Manufacturing.
- 3. Perform basic operations using CAD/CAM software.
  - a. Create basic graphic objects: lines, circles, arcs, curves solids, and surfaces.
  - b. Modify objects with edit commands.
  - c. Create and manipulate features (tool paths).
  - d. Create and implement CNC programs.

#### **NIMS Duties**

Job Planning Management Quality Control and Inspection Process Adjustment and Control General Maintenance Industrial Safety and Environmental Protection

#### MST 281(1-3) Metallurgy

**Description:** 

Concepts of metallurgy including instruction and practice in safety, metal identification, heat treatment, and hardness testing.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	1	1	0	15
	2	1	2	45
	3	1	4	75

Prerequisite:

None

#### **Student Learning Outcomes:**

- 1. Discuss and apply general machine shop safety.
  - a. Identify, discuss, and test on safety procedures.
  - b. Demonstrate safety procedures.
- 2. Explain heat treatment of metals.
  - a. List different types of metals, their characteristics, and uses.
  - b. Describe the different methods for heat treatment of metals.
  - c. Identify heat treating equipment.
  - d. Harden and temper metal to meet specifications.
- 3. Perform hardness testing safely.
  - a. List the types of hardness testing equipment.
  - b. Describe the use of hardness testing equipment.
  - c. Perform hardness testing procedures.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection

#### MST 291(1-4) Special Problem in Precision Manufacturing & Machining Technology

Description:A course to provide students with an opportunity to utilize skills and knowledge<br/>gained in other Precision Manufacturing and Machining Technology courses.<br/>The instructor and student work closely together to select a topic and establish<br/>criteria for completion of the project.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	1	0	2	30
	2	0	4	60
	3	0	6	90
	4	0	8	120

Prerequisite:

Instructor Approved

#### **Student Learning Outcomes:**

- 1. Develop a written plan that details the activities and projects to be completed.
  - a. Use a written plan that details the activities and projects to be completed.
  - b. Perform written occupational objectives in the special problem.
- 2. Assess accomplishment of objectives.
  - a. Prepare daily written assessments of accomplishment of objectives.
  - b. Present weekly written reports to the instructor of activities performed and objectives accomplished.
- 3. Use and follow a set of written guidelines for the special problem.
  - a. Develop and follow a set of written guidelines for the special problem.

#### **NIMS Duties**

Specific standards for this course will depend upon the nature of the problem under investigation.

# MST 292(1-6) Supervised Work Experience in Precision Manufacturing & Machining Technology

Description:A course that is a cooperative program between industry and education<br/>designed to integrate the student's technical studies with industrial experience.<br/>Variable credit is awarded on the basis of 1 semester hour per 45 industrial<br/>contact hours.

Hour Breakdown:	Semester Credit	Lecture	Externship	Contact Hours	
	Hours				
	1	0	3	45	
	2	0	6	90	
	3	0	9	135	
	4	0	12	180	
	5	0	15	225	
	6	0	18	270	

#### Prerequisite:

Instructor Approved

#### **Student Learning Outcomes:**

- 1. Follow a set of instructor-written guidelines for the supervised work experience program.
- 2. Apply skills needed to be a viable member of the workforce.
  - a. Prepare a description of skills to be developed in the supervised work experience program.
  - b. Practice skills needed to be a viable member of the workforce.
- 3. Practice human relationship skills in the supervised work experience program.
- 4. Practice positive work habits, responsibilities, and ethics.
- 5. Develop written occupational objectives in the supervised work experience program.
- 6. Assess performance of occupational skills.
  - a. Prepare daily written assessments of work performance as specified in the occupational objectives.
  - b. Present weekly written reports to the instructor of activities performed and objectives accomplished.

#### **NIMS Duties**

Specific standards for this course will depend upon the nature of the problem under investigation.

WBL 191(1-3)	Work-Based Learning I
WBL 192(1-3)	Work-Based Learning II
WBL 193(1-3)	Work-Based Learning III
WBL 291(1-3)	Work-Based Learning IV
WBL 292(1-3)	Work-Based Learning V
WBL 293(1-3)	Work-Based Learning VI
	WBL 191(1-3) WBL 192(1-3) WBL 193(1-3) WBL 291(1-3) WBL 292(1-3) WBL 293(1-3)

Description:

A structured work-site learning experience in which the student, program area teacher, work-based learning coordinator, and worksite supervisor/mentor develop and implement an educational training agreement. This course is designed to integrate the student's academic and technical skills into a work environment. Includes regular meetings and seminars with school personnel for supplemental instruction and progress reviews

Hour Breakdown:	Semester Credit Hours	Lecture	Externship	Contact Hours
	1	0	3	45
	2	0	6	90
	3	0	9	135

**Prerequisite:** 

Concurrent enrollment in vocational-technical program area courses

#### **Student Learning Outcomes:**

- 1. Apply technical skills and related academic knowledge needed to be a viable member of the workforce.
  - a. Apply technical skills needed to be a viable member of the workforce.
  - b. Apply skills developed in other related courses in a work-based setting.
  - c. Perform tasks detailed in an educational training agreement at the work setting.
- 2. Apply general workplace skills to include positive work habits and responsibilities necessary for successful employment.
  - a. Demonstrate proactive human relationship skills in the work setting to include conflict resolution, team participation, leadership, negotiation, and customer/client service.
  - b. Demonstrate time, materials, and resource management skills.
  - c. Demonstrate critical-thinking skills such as problem solving, decision making, and reasoning.
  - d. Demonstrate acquiring, evaluating, organizing, maintaining, interpreting, and communicating information.
  - e. Demonstrate positive work habits and acceptance of responsibilities necessary for successful employment.

#### **NIMS Duties**

Specific standards for this course will depend upon the nature of the problem under investigation.

TDT 1113

#### Safety and Fundamentals of Die Fabrication

Description:

Fundamentals of tool and die fabrication procedures including an orientation to metallurgy and instruction of die fabrication.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	1	4	75

#### Prerequisite:

None

#### Student Learning Outcomes:

- 1. Describe general safety rules for working in a shop/lab and industry.
  - a. Describe how to avoid on-site accidents.
  - b. Explain the relationship between housekeeping and safety.
  - c. Explain the importance of following all safety rules and company safety policies.
  - d. Explain the importance of reporting all on-the-job injuries and accidents.
  - e. Explain the need for evacuation policies and the importance of following them.
  - f. Explain the employer's substances abuse policy and how it relates to safety.
  - g. Explain the safety procedures when working near pressurized or high temperature.
- 2. Identify and apply safety around machine tool operations.
  - a. Use proper safety practices when performing machine tool operations.
  - b. Recognize and explain personal protective equipment.
  - c. Inspect and care for personal protective equipment.
- 3. Explain lifting.
  - a. Identify and explain the procedures for lifting heavy objects.
- 4. Explain the Material Safety Data Sheet (MSDS).
  - a. Explain the function of the MSDS.
    - b. Interpret the requirements of the MSDS.
- 5. Explain fires.
  - a. Explain the process by which fires start.
  - b. Explain fire prevention of various flammable liquids.
  - c. Explain the classes of fire and the types of extinguishers.
- 6. Explain safety in and around tool and die situations.
  - a. Explain injuries when electrical contact occurs.
  - b. Explain safety around tool and die hazards.
  - c. Explain action to take when an electrical shock occurs.
- 7. Identify the basic parts of an elementary die and metals used in fabrication of dies.
  - a. Define the role of die sets in industry.
  - b. Identify and describe the use of different metals used in die fabrication.
  - c. Describe the basic parts of an elementary die.
- 8. Describe the use and maintenance of carbide and diamond tipped tools in die making equipment.
  - a. Distinguish between fixed and replaceable cutting tips.
  - b. Describe design requirements for carbide and diamond tipped tools.
- 9. Describe the three cortical stages of shearing action on metals.
  - a. Determine cutting clearances between die and punch for different types of materials (brass, aluminum, steel, etc.).
  - b. Describe factors that affect the life of a die.
  - c. Explain and demonstrate processes of slug and scrap elimination.
- 10. Safely fabricate, harden, temper, and test steel die components to a specified Rockwell hardness.

- a. Describe procedures for heat treatment of die components.
- b. Safely finish hardened die components.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection Career Management and Employment Relations

TDT 1123

Die Repair

**Description:** 

Repair and maintenance of industrial dies, including practice using industrial dies.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	1	4	75

#### Prerequisite:

None

#### Student Learning Outcomes:

- 1. Discuss and apply general tool and die shop safety.
  - a. Identify, discuss, and test safety procedures.
  - b. Demonstrate safety procedures.
- 2. Determine safe and proper handling of a die.
  - a. Determine safe and proper handling and support procedures based on weight and size.
  - b. Identify and describe the different types of failures that can occur in dies.
  - c. Analyze and determine causes of failure of an open die.
- 3. Disassemble, repair, and reassemble die for tryout.
  - a. Disassemble and correct failure.
  - b. Check clearances, realign, and re-dowel.
  - c. Recondition a die set to hold the repaired die.
  - d. Set up die in punch press for tryout.

#### **NIMS Duties**

- Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance
- Industrial Safety and Environmental Protection
- Career Management and Employment Relations

Course Number and Name: TDT 1133 Die Design I

**Description:** 

Basic design of industrial dies that includes instruction and practice in calculations and processes of die design.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

#### Prerequisite:

### None

#### Student Learning Outcomes:

- 1. Discuss and apply general tool and die shop safety.
  - a. Identify, discuss, and test safety procedures.
  - b. Demonstrate safety procedures.
- 2. Describe the basic types of die designs and characteristics.
  - a. Describe the basic types of die designs and the advantages and disadvantages of each.
  - b. Identify and describe the use of the different types of die sets used for mounting dies.
  - c. Describe the characteristics of the different types of industrial dies.
- 3. Sketch a die showing its components and strip layout.
  - a. Sketch a die showing its components.
  - b. Do a strip layout, and calculate the advance for a progressive die.
- 4. Make required calculations for die fabrications.
  - a. Describe the procedures for calculations.
  - b. Calculate cutting clearances, shut height, bend allowance, developed length, offset displacement, blanking tonnage, stripping pressures, spring pressure, and number of springs.
- 5. Select, describe, and determine procedures obtaining die-to-press relationship.
  - a. Describe and demonstrate procedures for obtaining correct die-to-press relationship.
  - b. Select a die set to fit a given punch press.

#### **NIMS Duties**

Job Planning and Management

- Job Execution
- Quality Control and Inspection
- Process Adjustment and Improvement
- **General Maintenance**

Industrial Safety and Environmental Protection

Career Management and Employment Relations

TDT 2183

Jigs, Fixtures, & Tools

**Description:** 

Specialized skills associated with the design and fabrication of work holding devices including jigs, fixtures, and other tools.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	1	4	75

#### Prerequisite:

None

#### **Student Learning Outcomes:**

- 1. Discuss and apply general tool and die shop safety.
  - a. Identify, discuss, and test safety procedures.
  - b. Demonstrate safety procedures.
- 2. Describe and design basic jig and fixture components.
  - a. Identify and describe clamps, drill bushings, gauges, and feet.
  - b. Design drill jigs to meet part specifications.
  - c. Design a work holding fixture to meet job specifications.
- 3. Fabricate, heat treat, and test drill jig and work holding fixture.
  - a. Safely fabricate and try out a drill jig.
  - b. Safely fabricate and try out a work holding fixture.
  - c. Safely heat treat components and test to specified hardness.

#### **NIMS Duties**

Job Planning and Management Job Execution Quality Control and Inspection Process Adjustment and Improvement General Maintenance Industrial Safety and Environmental Protection Career Management and Employment Relations

# RECOMMENDED TOOLS AND EQUIPMENT

### **CAPITALIZED ITEMS**

- 1. Lathes with accessories including digital readout (15)
  - 13 in. or 14 in. (9)
  - 15 in. x 60 in. (2)
  - 15 in. x 48 in. (2)
  - 17 in. x 72 in. (2)
- 2. Vertical mills: 9 in. x 42 in. bed with accessories including digital readout (8)
- 3. Horizontal mill (1)
- 4. Surface grinder, automatic with magnetic chuck and accessories (3)
- 5. Vertical band saw with butt welder 20 in. (1)
- 6. Horizontal band saw 10 in. (1)
- 7. Drill press 20 in. minimum (with accessories) (3)
- 8. Radial drill press 36 in. (1)
- 9. Hydraulic press 50 T (1)
- 10. CNC lathe (2)
- 11. CNC vertical mill (2)
- 12. CNC Machining Center (1)
- 13. Pedestal grinders (10 in. and 12 in.) (4)
- 14. Air compressor (1)
- 15. Dividing head, wide range (2)
- 16. Rotary table (2)
- 17. Sets of drills (taper shank) (2)
- 18. Set of taper shank reamer (1)
- 19. Computers with software (CAM) (15)
- 20. Printers (5)
- 21. Tool post grinder (2)
- 22. Height gauge (electronic and conventional) (1)
- 23. Surface plate 24 in. x 36 in. (1)
- 24. Boring head and boring bar set for vertical mill (5)
- 25. Cutting torch set with cart (1)
- 26. Welding machine with accessories (1)
- 27. Arbor press (5 T) (1)
- 28. Safety glass cabinet with safety glasses (1)
- 29. High speed steel drill and counter drill x 60 degrees 5-piece set #1 #6 (1)
- 30. High speed steel: 6 flute countersink 82 degrees 8 piece set 1/2 in. -1 in. (1)
- 31. Hand reamers set: 1/2 in. 1/2 in. by 1/64th (1)
- 32. Tap and die set: high speed steel -1/4 20 through 9/16 18(1)
- 33. Metric screw pitch gauge, Acme screw pitch gauge, 60 degrees V-sharp screw pitch gage (1 each)
- 34. Keyway broach set 1/8 in. through 3/8 in. (1)
- 35. Horizontal milling cutter set per machine specifications (1)
- 36. Boring head with C. T. boring bar set per machine specifications for horizontal mill (1)
- 37. Radius angle dresser for surface grinder and diamonds (1)
- 38. Heat treating furnace (1)
- 39. Tempering furnace (1)
- 40. Compartor

#### **Non-Capitalized Items**

- 1. Work benches (6)
- 2. Vises (6 in.) (6)
- 3. Drill set (3 in 1 set) 1/16 in. 1/2 in. by 64th, A-Z, and #1 #60 (4)
- 4. Set end mill high speed steel 1/8 in. 3/4 in. by 1/16 2 flute center cut (double end) (4)
- 5. Single end ball end mill (1/8 in. through 3/4 in. by 1/8 in.) (1)
- 6. Abrasive shop roll 1 ft wide x 100 grit, 180 grit, 220 grit (1 each) (1)
- 7. Buffing wheel and buffing compound (1)
- 8. Bench grinders (6 in.) (2)
- 9. Surface grinder wheels to machine specifications (10)
- 10. Bench grinder wheels (6)
- 11. Wheel dressing stick (1)
- 12. Grinder wheel dresser (1)
- 13. Cluster diamond and holder for surface grinder and diamonds (1)
- 14. Set of gage telescopic 5/16 in. 6 in. 6 piece (3)
- 15. Set small hole: 1/2 in. 1/2 in. 4 piece set (3)
- 16. Dial indicators with magnetic based and 1 in. travel (10)
- 17. Angle plates (6 in. x 6 in. and 3 in. x 3 in.) (2)
- 18. "V" block set (2)
- 19. Sine bar 5 in. sine chuck (1)
- 20. Set steel parallel (10 pieces) 1/8 in. (2)
- 21. Combination square set (4 pieces) 4R graduation with 12 in. blades (10)
- 22. Scales 6 in. 4R graduation (20)
- 23. Drill point gauge (15)
- 24. Radius gauge set (4)
- 25. Acme thread gauge set (10)
- 26. Center gauges (10)
- 27. Spring calipers: inside, outside, and hermaphrodite 3 in. x 6 in. (2)
- 28. Dividers 3 in. and 6 in. (2)
- 29. Edge finders (electronic and conventional) (3)
- 30. Metal scribes (10)
- 31. Set, punch center, 8 piece (3)
- 32. Punch drive pin, 8 piece set (4 in. long) (3)
- 33. Combination wrench set (1)
- 34. Set (21 pieces) ½ in. drive socket set (1)
- 35. Set of pliers (1 set slip point, 1 set needlenose, 1 set vise grip) (1)
- 36. Set, pipe wrench (8 in., 10 in., 12 in.) (1)
- 37. Set, adjustable wrench (6 in., 10 in., 12 in.) (1)
- 38. 25 ft power lock tape (1)
- 39. Screwdriver set (6 pieces) (2)
- 40. 12 ft power lock tape (6)
- 41. Demagnetizer for surface grinder files (12 ft power lock tape 12 files with handles and file cards) (1)
- 42. Dead blow hammers (6)
- 43. Ball peen hammers (6)
- 44. Pistol pump oilers (6)
- 45. Grease gun (1)
- 46. Sets, Allen wrenches (2 metric and 2 English) (2)
- 47. C-clamps 6 in. (6)
- 48. Set, steel stamp (numbers and letters) (1)
- 49. Electrical engraver (1)
- 50. Retractable air hoses and reels (3)

- 51. 4 in. disk grinder (1)
- 52. Air pressure regulator (1)
- 53. Drill motors (% in.) (1)
- 54. Drill motor (½ in.) (1)
- 55. Shop vacuum (wet and dry) (1)
- 56. Wheel dolly (4 wheels) heavy duty (1)
- 57. Hack saws with blades (6)
- 58. Trammel points (1)
- 59. Quenching tank (1)
- 60. Set Woodruff key seat cutter (1)
- 61. Refractometer (1)
- 62. Micrometers: 10 @ 0 in. 1 in.; 5 @ 1 in. 2 in.; 2 @ 2 in. 3 in.; and 2 @ 3 in. 4 in. (19)
- 63. Depth micrometers: 2 @ 0 in. 6 in. (2)
- 64. Vernier calipers: 6 in. (2)
- 65. Dial calipers: 6 in. (6)
- 66. Digital caliper: 6 in. (1)
- 67. Sets test indicators and surface gauges (2)
- 68. Gage block set (rectangular) (1)
- 69. Precision grinding vise 4 in. (2)
- 70. Precision square set (4 pieces) (1)
- 71. Level precision 12 in. (1)
- 72. Compound angle vise (2)
- 73. Counter bore (2 sets)
- 74. Precision Pin gages (1/16" to ¾") (4 sets)
- 75. Ring gages (1 set)
- 76. Plug gages (1 set)
- \* Additional equipment may be needed as certification requirements change.

#### **RECOMMENDED INSTRUCTIONAL AIDS**

It is recommended that instructors have access to the following items:

- 1. Scientific calculator (1)
- 2. Teacher computer with operating software with multimedia kit (1)
- 3. Teacher printer
- 4. DVD player (1)
- 5. Projector/screen (1)
- 6. Digital visual presenter (1)
- 7. Digital camera
- 8. Scanner
- 9. Computer
- 10. Computer Lab
- 11. Television

# CURRICULUM DEFINITIONS AND TERMS

- Course Name A common name that will be used by all community colleges in reporting students
- Course Abbreviation A common abbreviation that will be used by all community and junior colleges in reporting students
- Classification Courses may be classified as the following:
  - Career Certificate Required Course A required course for all students completing a career certificate.
  - Technical Certificate Required Course A required course for all students completing a technical certificate.
  - Technical Elective Elective courses that are available for colleges to offer to students.
- Description A short narrative that includes the major purpose(s) of the course
- Prerequisites A listing of any courses that must be taken prior to or on enrollment in the course
- Corequisites A listing of courses that may be taken while enrolled in the course
- Student Learning Outcomes A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
  - Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
  - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
  - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
  - Activities that include integration of academic and career-technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary careertechnical programs
  - Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas
- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses AND a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.

- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:
  - Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework
  - Revising or extending the student learning outcomes
  - Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)

Course Crosswalk						
Precision Manufacturing & Machining (CIP: 48.0501)						
Note: Courses that have been added or changed in the 2017 curriculum are highlighted.						
Existing		Revised				
2010 MS Curriculum Framework			2017 MS Curriculum Framework			
Course	Course Title	Hours	Course	Course Title	Hours	
Number			Number			
MST 111(4-6)	Power Machinery I	4-6	MST 111(4-6)	Power Machinery I	4-6	
MST 112(4-6)	Power Machinery II	4-6	MST 112(4-6)	Power Machinery II	4-6	
	Drill Press and Band Saw			Drill Press and Band Saw		
MST 121(1-3)	Operations	1-3	MST 121(1-3)	Operations	1-3	
MST 122(1-3)	Lathe Turning Knowledge	1-3	MST 122(1-3)	Lathe Turning Knowledge	1-3	
	Milling Machines					
MST 123(1-3)	Knowledge	1-3	MST 123(1-3)	Milling Machines Knowledge	1-3	
MST 124(2-3)	Precision Lathe Operations	2-3	MST 124(2-3)	Precision Lathe Operations	2-3	
MST 125(1-2)	Surface Grinding Operations	1-2	MST 125(1-2)	Surface Grinding Operations	1-2	
MST 126(2-3)	Milling Machine Operations	2-3	MST 126(2-3)	Milling Machine Operations	2-3	
MST 1313	Machine Tool Mathematics	3	MST 1313	Machine Tool Mathematics	3	
MST 141(2-3)	Blueprint Reading	2-3	MST 141(2-3)	Blueprint Reading	2-3	
MST 1423	Advanced Blueprint Reading	3	MST 1423	Advanced Blueprint Reading	3	
MST 1613	Precision Layout	3	MST 1613	Precision Layout	3	
	Fundamentals of Geometric					
	Design and Tolerance			Fundamentals of Geometric	2 5	
MST 162(4-6)	(GD&T)	4-6	MST 162(3-5)	Design and Tolerance (GD&T)	3-5	
MST 213(4-6)	Power Machinery III	4-6	MST 213(4-6)	Power Machinery III	4-6	
MST 214(4-6)	Power Machinery IV	4-6	MST 214(4-6)	Power Machinery IV	4-6	
10151 251(2-3)	Advanced Lathe Operations	2-3	IVIST 251(2-3)	Advanced Lathe Operations	2-3	
MCT 252/1 2)	Advanced Mining	1 2	MCT 252/1 2)	Advanced Milling Operations	1 2	
10131 232(1-3)	Precision Grinding	1-5	10131 232(1-3)	Advanced Winning Operations	1-5	
MST 253(1-2)	Operations	1-2	MST 253(2-3)	Precision Grinding Operations	2-3	
10151 255(1 2)	Gear Types and		10131 233(2 3)	Gear Types and	23	
MST 254(1-2)	Manufacturing	1-2	MST 254(1-2)	Manufacturing	1-2	
	Advanced Machining			Advanced Machining		
MST 255(1-2)	Technologies	1-2	MST 255(1-2)	Technologies	1-2	
	Computer Numerical			Computer Numerical Control		
MST 271(4-6)	Control Operations I	4-6	MST 271(4-6)	Operations I	4-6	
	Computer Numerical			Computer Numerical Control		
MST 272(4-6)	Control Operations II	4-6	MST 272(4-6)	Operations II	4-6	
MST 273(4-6)	Fundamentals of CAD/CAM	4-6	MST 273(3-5)	Fundamentals of CAD/CAM	3-5	
	Gear Types and			Gear Types and		
MST 254(1-2)	Manufacturing	1-2	MST 254(1-2)	Manufacturing	1-2	
	Advanced Machining			Advanced Machining		
MST 255(1-2)	Technologies	1-2	MST 255(1-2)	Technologies	1-2	
	Supervised Work			Supervised Morth Furthering		
	Experience in Precision			supervised work Experience		
MST 202/1 6	Machining	16	MST 202/1 6	and Machining	1 6	
10121 292(1-0)	Safaty and Eurodamontals of	т-о	10121 292(1-0)	Safaty and Eurodamontals of	0-T	
TDT 1112	Die Fabrication	2	TDT 1112	Die Fabrication	2	
101 1112		5	כדדד וסו		5	

TDT 1123	Die Repair	3	TDT 1123	Die Repair	3
TDT 1133	Die Design I	3	TDT 1133	Die Design I	3
TDT 2183	Jigs, Fixtures, and Tools	3	TDT 2183	Jigs, Fixtures, and Tools	3