A. **TITLE:** Manufacturing Processes I

B. **COURSE NUMBER:** MECH 121

C. **CREDIT HOURS:** (3)

D. **WRITING INTENSIVE COURSE:** No

E. **COURSE LENGTH:** (15)

F. **SEMESTER(S) OFFERED:** Fall and Spring

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**
   2 lecture hours per week
   3 laboratory hours per week

H. **CATALOG DESCRIPTION:**
   This course provides an overview of material removal, change in form, change in condition, and heat treatment processes. The student begins with a fundamental understanding of machine tools theory and practice. Instruction includes precision layout and measurement, lathe operations and tooling, milling operations and tooling, drills, reamers, and drilling machines. Instruction involves the selection and calculation of proper cutting speeds and feeds for processes involving different materials. Instruction also includes an investigation to the variety of casting processes, products produced through each process and common defects found. Students further investigate material properties and how change can occur through processing and heat treatments. The laboratory provides the opportunity to apply the material from lecture through the hands on operation of the tooling and equipment.

I. **PRE-REQUISITES/CO-REQUISITES:** None

J. **GOALS (STUDENT LEARNING OUTCOMES):**
   By the end of this course, the student will be able to:

<table>
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<tr>
<th>Course Objective</th>
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<tr>
<td>1. Properly setup and safely operate Hass TL1-lathes, drill presses, vertical and horizontal milling machines.</td>
<td>3. Professional Competence</td>
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<td>2. Determine the proper spindle speed or cutter speed and feed rates for various materials and operations.</td>
<td>3. Professional Competence</td>
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<td>3. Select the correct measuring device and accurately read the device for inspection of machined parts.</td>
<td>2. Critical Thinking</td>
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<td>4. Identify cutting tools used in the machine</td>
<td>2. Critical Thinking</td>
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| **5.** | Select the correct cutting tool for a machining operation. | 2. Critical Thinking  
3. Professional Competence |
| **6.** | Identify five basic processes used to manufacture products and site an example where this processes is used to manufacture a product in the market. | 2. Critical Thinking |
| **7.** | Use the Machinery’s Handbook to reference information pertaining to industrial practice. | 3. Professional Competence |

**K. TEXTS:** John R. Walker, Modern Metalworking 2004 edition, Goodheart-Wilcox  

**L. REFERENCES:**

**M. EQUIPMENT:** Machine Tools Laboratory (NS 106)

**N. GRADING METHOD:** (A-F)

**O. MEASUREMENT CRITERIA/METHODS:**

Homework & Quizzes, Exams (4), LAB: Safety, project accuracy, work habits

Students MUST pass the laboratory if they wish to pass this course. A grade of ‘F’ in lab will earn a grade of ‘F’ for the course.

**P. DETAILED COURSE OUTLINE:** Attached

**Q. LABORATORY OUTLINE:** Attached
I. Introduction to Manufacturing Processes
   A. Shop Safety
   B. Classification of Processes
   C. Tool and Process Selection

II. Measurement in Manufacturing
   A. Measurement System
      1. Inch
      2. Metric
   B. Direct Reading Instruments
      1. Steel Rules
      2. Combination Set
      3. Micrometer caliper (outside/inside) (inch/metric)
      4. Vernier caliper
      5. Vernier height page
      6. Vernier bevel protractor
      7. Vernier micrometer
      8. Micrometer depth gage
      9. Gear tooth micrometer
      10. Screw thread micrometer
   C. Measurement by Transfer
      1. Outside/Inside calipers
      2. Hermaphrodite calipers
      3. Telescope gages
      4. Small hole gages
      5. Fillet/Radius gages
      6. Feeler/Thickness gages
      7. Screw pitch gage
   D. Surface Plates
   E. Gage Blocks
   F. Sine Bar
   G. Gages
      1. Plug gage
      2. Ring gage
      3. Snap gage
      4. Thread gage
   H. Dial Indicators
      1. Balanced
      2. Continuous

III. Material Removal Processes
   1. Lathe Operations
      A. Lathe Nomenclature
1. Major parts of a lathe
2. Lathe Chucks
   a. 3 jaw universal
   b. 4 jaw universal
   c. 4 jaw independent
   d. Jacobs
   e. Draw in collect
3. Steady vs. Follower rests

B. Cutting Tool holders - H.S.S.
   1. Left hand
   2. Right hand
   3. Straight

C. Cutting Tools Holders - Carbide
   1. Holds tool parallel to tool holder base
   2. Inserted tool holder - uses replaceable insert

D. Other tool holders
   1. Cut-off, for parting
   2. Turret type
   3. Quick Change
   4. Boring Bar tool holder
   5. Heavy duty

E. Cutting Tools
   1. Cutting tool materials
      a. H.S.S.
      b. Carbides
      c. Ceramics
      d. Diamonds
      e. Tool coatings (TiC, TiN, alumina)

F. Cutting Tool Nomenclature
   1. Left cut vs. Right cut
   2. Roughing vs. Finishing tools
   3. Facing tool
   4. Round nose tool
   5. Threading tool
   6. Body
   7. Face
   8. Side Rake
   9. Back Rake
   10. Side clearance
   11. End clearance
   12. Cutting edge

G. Cutting Speeds and Feeds
   1. Calculations
   2. Charts

H. Lathe Operations
   1. Facing
2. Turning Steps
   a. Rough turning
   b. Finish turning
3. Filing
4. Polishing
5. Knurling
6. Grooving
7. Foam Turning
8. Drilling, reaming
9. Boring
10. Turning between centers

I. Cutting Tapers on a Lathe
   1. Compound rest
   2. Taper attachment
   3. Offset tailstock

J. Cutting Screw threads on a lathe
   1. Screw thread forms
   2. Center gage for 60 deg. thread
   3. Thread chasing dial

2. Milling Operations and Tooling
   A. Type of milling machines
      1. Horizontal
      2. Vertical
      3. Fixed bed vs. Column and knee
      4. Plain vs. Universal

   B. Tool holding devices
      1. Arbors
      2. Adapters

   C. Milling operations
      1. Face milling
      2. Side(peripheral) milling
      3. Straddle milling
      4. Gang milling
      5. Sawing and slitting
      6. Indexing using dividing head
         i. Direct indexing
         ii. Simple of Plain indexing
         iii. Differential indexing

   D. Milling cutters
      1. Two general types
         a. Solid cutter
         b. Inserted tooth
      2. Milling cutter classification
         a. Arbor cutters
b. Shank cutters  
c. Facing cutters

3. Milling cutter material  
a. H.S.S.  
b. Cemented tungsten carbide

4. Face milling cutters  
a. Face milling cutter  
b. Fly cutter

5. End mills  
a. Multi-flute  
b. Left vs. right hand helix  
c. Ball end mills  
d. T-slot  
e. Shell end  
f. Key cutters

6. Arbor milling cutters  
a. Slab  
b. Plain  
c. Left vs. Right hand helix  
d. Light duty vs. heavy duty  
e. Side milling cutter  
   i. Single side  
   ii. Double side  
   iii. Half side  
   iv. Staggered tooth  
   v. Interlocking  
f. Angle cutters  
g. Slitting Saw  
   i. Side teeth  
   ii. Dished  
h. Formed milling cutters  
   i. concave  
   ii. convex  
   iii. corner rounding  
   iv. gear

3. Drill Press Operations and Twist Drills  
   A. Type of drill press machines  
      1. Bench  
      2. Radial  
      3. Portable Magnetic  
      4. Gang  
      5. Multiple spindle  
      6. CNC  
   B. Type of drill press operations  
      1. Drilling
2. Reaming
3. Countersinking
4. Boring
5. Spotfacing
6. Tapping
7. Counterboring

C. Type of Drills
1. Twist drill
2. Straight flute gun drill
3. Coolant feed drills
4. Core drills
5. Step drills
6. Micro drills
7. Half-round straight flute drills
8. Indexable-insert drills
9. Spade drills

D. Drill index system
1. Fractional
2. Letter
3. Number
4. Metric

E. Drill measurement
1. Stamped
2. Micrometer across margins
3. Drill gage

F. Drill Shanks
1. Straight
2. Tapered

G. Drill Nomenclature
1. Point
   a. Dead Center
   b. Cutting lips
   c. Lip clearance
2. Body
   a. Flutes
   d. Margin
   e. Body clearance
   f. Longitudinal clearance
3. Drill point angles and clearances

H. Reamers
1. Reamer parts
   a. Shank
   b. Body
   c. Angle of chamfer
2. Type of reamers
   a. Hand
b. **Machine**
   1. Rose
   2. Fluted
   3. Carbide tipped
   4. Shell
   5. Adjustable
   6. Expansion

3. **Reamer allowances**
   1. 1/64” allowance up to ½” hole size
   2. 1/32” allowance over ½” hole size

I. **Speeds and feeds for drills and reamers**
J. **Cutting Threads**
   1. Determining Tap Drill Sizes
   2. Thread designations
   3. Taps and Dies
   4. Class Fits

IV. **Change of Form Processes**
A. **Casting Processes**
   1. Sand
   2. Investment
   3. Permanent
   4. Die (Hot & Cold chamber)
   5. Lost Foam
   6. Centrifugal
   7. Gravity Feed
   8. Low Pressure
B. **Selection of Casting Process**

V. **Heat Treatment**
A. Hardening of Steels
B. Tempering
C. Annealing
D. Relationship between hardness and strength
E. Iron Carbon Diagram
LABORATORY OUTLINE/PROJECTS

Laboratory Sessions (Fourteen - 2 hr. 50 min. labs)

Students acquire hands-on experience in the operation of basic machine tools such as lathes, horizontal and vertical milling machines, drill presses, band saws, and power hacksaws by making and assembling a parallel clamp, hacksaw and ball peen hammer. Much of the laboratory activities are timed or sequenced with lecture material. This provides students the opportunity to combine theory with practical application. A laboratory manual containing all the working drawings and job sheets is available on the Learning Network System (LNS). A major emphasis is placed on the safety precautions necessary in a manufacturing operation as well as the manufacturing processes themselves.