



# Frank Phillips College

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## 1. General Course Information

- 1.1. Course Number: **MCHN 1320**
- 1.2. Course Title: **Precision Tools and Measurement**
- 1.3. THECB CIP Number 48.0501

1.4. **SCH [Semester Credit Hours]: 3** **CEU [Continuing Education Units] 4.8**

**NB: THIS CLASS CAN BE TAKEN FOR ACADEMIC CREDIT OR CEU BUT NOT BOTH**

**➔ BE SURE YOU ARE ENROLLED IN THE CORRECT SECTION**

- 1.5. Pre-requisites: none
- 1.6. Co-requisites: none
- 1.7. Course Description: An introduction to the modern science of dimensional metrology. Emphasis on the identification, selection, and application of various types of precision instruments associated with the machining trade. Practice of basic layout and piece part measurement while using standard measuring tools is also included.
- 1.8. **Term and Year** **Spring Semester 2001/2002**
- 1.9. **Day and Time:** **Wednesday 6:00 PM through 9:39 PM at the Service Drilling Southwest Center for Access and Innovation**

## 2. Instructor:

- 2.1. **Name:** Dr. F. George McDuffee<sup>1</sup>
- 2.2. **Office:** Library Building Room 10 on the Borger Campus
- 2.3. **Extension:** 791
- 2.4. **Hours:** 9AM-4PM M-F Note: I am frequently out of the office
- 2.5. **Email:** gmcduffee@fpc.cc.tx.us

## 3. Audience:

Anyone wanting to learn the correct application and use of basic precision measurement tools and procedures including but not limited to:

- 3.1. Scales,
- 3.2. Calipers, [dial and vernier]
- 3.3. Micrometers, [OD/ID and Depth in both digital and conventional versions]
- 3.4. Dial indicators, and other mechanically, electronically and pneumatically amplified indirect measuring devices.

<sup>1</sup> AS Coffeyville Junior College 1960, BS [Applied Mathematics and Statistics] Southern Illinois University at Edwardsville, 1969, MS [Manufacturing Technology] Pittsburg State University 1993, EdS [Industrial Education] Pittsburg State University 1995, EdD [Occupational and Adult Education] Oklahoma State University 1999. With some overlap, 30 years manufacturing, 15 years consulting [technology transfer] and 10 years teaching.

- 3.5. Standards such as gauge blocks,
- 3.6. An introduction to the basic processes and assumptions of statistical process control including control charts,
- 3.7. An introduction to the basic concepts in geometric dimensioning and tolerancing.

4. **Objective of this class:**

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

- 4.1. Identify and properly apply basic measurement tools and techniques commonly used the machine trades.
- 4.2. Describe and justify the importance of dimensional measurement.
- 4.3. Identify and convert SI and US system units of measurement commonly used in the machine trades.
- 4.4. Identify and interpret dimensioned drawings made using both 1st and 3<sup>rd</sup> angle projection.
- 4.5. Identify and use both metric and inch rules to measure specimens.
- 4.6. Identify and correctly operate common precision measurement tools.
- 4.7. Describe the features and calibration of micrometers and calipers.
- 4.8. Perform routine maintenance, adjustment, and verification of calibration for common measuring instruments
- 4.9. Perform 3 and 4 place decimal US measurements of lab specimens.
- 4.10. Perform metric measurements of lab specimens.
- 4.11. Describe the features, function, and applications for two types of gages.
- 4.12. Describe the procedure and conduct a set-up of a digital and a dial indicator.
- 4.13. Calculate and prepare a stack of gage blocks for a sine bar for a specified angle.
- 4.14. Calculate the angle of lab specimens using a sine bar and dial indicators.
- 4.15. Describe and apply the basic concepts for (SPC) Statistical Process Control.
- 4.16. Identify, describe and give examples of the two most common types of variation and control charts.
- 4.17. Describe the concept of 'normal distribution'- shape, X-bar, standard deviation.
- 4.18. Generate an X-bar, R control chart manually using data from lab specimens.
- 4.19. Describe the basic concepts and assumptions of Geometric Dimensioning and Tolerancing. [GDT]
- 4.20. Define tolerance and calculate dimensional limits from a conventionally dimensioned product part drawing.
- 4.21. Identify and state the basic assumptions of dual dimensioned prints using SAE conventions.
- 4.22. Correctly express the following GDT terms FITS, FEATURE, FORM, LMC, MMC, RFS, DATUM, and BASELINE in their own words.
- 4.23. Identify and match features to the thirteen standard GD&T symbols
- 4.24. Demonstrate adequate record keeping and written communication skills by:
- 4.25. Showing the sequence of mathematical calculations and problem solutions in their log book
- 4.26. Neatly and clearly recording their findings in their log book
- 4.27. Maintaining their logbook for future reference and job-hunting portfolio.

5. **Units/Blocks of Instruction:** NOTE: blocks do not correspond to class periods and classes may cover topics from one or more blocks.
  - 5.1. What do we mean by measurement?
    - 5.1.1. Measurement vs. comparison
    - 5.1.2. Attribute “measurement”
    - 5.1.3. Ordinal “measurement”
    - 5.1.4. Interval Measurement
    - 5.1.5. Continuous Measurement
  - 5.2. Common measurement units (Its not the inch any more)
    - 5.2.1. Inch (Imperial) vs. Metric systems
  - 5.3. Three different but overlapping concepts
    - 5.3.1. Accuracy
    - 5.3.2. Repeatability / Reliability
    - 5.3.3. Precisions / Discrimination
  - 5.4. The steel rule [scale]
  - 5.5. Verniers, linear and circular
    - 5.5.1. 25 division inch
    - 5.5.2. 50 division inch
    - 5.5.3. Metric
    - 5.5.4. Arc vernier
      - 5.5.4.1. Degrees, Minutes, and seconds
      - 5.5.4.2. Decimal degrees
      - 5.5.4.3. Grads
      - 5.5.4.4. Mils
      - 5.5.4.5. Grade
      - 5.5.4.6. Radians
  - 5.6. Micrometers – Measuring by counting turns
    - 5.6.1. Using the .001 inch micrometer
    - 5.6.2. Using the vernier in counting turns
    - 5.6.3. Using the .0001 inch micrometer
    - 5.6.4. Using the Metric micrometer
    - 5.6.5. Measuring to .01 MM using the vernier on the metric micrometer
    - 5.6.6. The reverse reading micrometer
  - 5.7. Affects of temperature extremes on precision measurement.
  - 5.8. Using amplified comparative measuring instruments.
  - 5.9. Measuring angles
    - 5.9.1. Vernier

- 5.9.2. Sine bars, 5 inch, 10 inch and metric
- 5.10. How big is too big? Determining limits from conventional prints
- 5.11. How big is too big, part II? Determining limits from GDT prints
- 5.12. Basic assumptions and philosophy of SPC as expressed by Deming and Cosby.
- 5.13. Why Stability is required before Improvement can begin.
- 5.14. Using SPC to reduce the need to measure.
- 5.15. Using the SPC chart to identify likely areas for improvement.

## 6. Textbook and Other Required Materials

- 6.1. **(Required) NOTE: While expensive, this text is used in several other Manufacturing Technology classes and is a basic reference.**

*Machine tool practice Seventh Edition*

Kibbe, R. R., et al

Prentice Hall

ISBN 0-13-033447-2

- 6.2. Other Required Materials

**NOTE:** *These items are used in several other Manufacturing Technology classes, are basic tools for precision measurement. Any person involved in manufacturing technology should own essential these essential tools as a minimum.*

- 6.2.1. Personal logbook. This can be most any ledger or theme book *with permanently bound pages*. Quadrille [square] ruled pages are suggested to assist in sketching, however this is not required. Suitable books are available at the FPC bookstore, Wal-Mart, etc. for about 2.50\$
- 6.2.2. MINIMUM 5-function calculator. An engineering or scientific calculator with trig and inverse trig functions will be helpful in several sections but is not required.

## 7. Classroom Policy and Instructor Expectations

- 7.1. The students and instructor will show mutual respect at all times. *Please see the S.C.A.N.S. section below for additional discussion on this point.*
- 7.2. Behavior inconsistent with a safe and student-friendly learning environment for **all** students is not acceptable. *Please see the S.C.A.N.S. section below for additional discussion on this point.*
- 7.3. Habits of neatness and safety are common workplace requirements. They are therefore required in this class. *Please see the S.C.A.N.S. section below for additional discussion on this point.*
- 7.4. Honesty is expected of all students. Cheating and plagiarism are violations of honesty. Cheating occurs whenever one uses deceitful means, for example crib notes or copying assignments. Plagiarism is presenting the language and ideas of another as ones own work such as coping papers, themes, abstracts, sections of books, magazine articles, etc.

## 8. Additional/Supplemental References

- 8.1. Photocopies will be provided by the instructor as required

## 9. Methods of Evaluation

Verification of acquisition by the student of the knowledge, skills and competencies indicated will be done by several methods, which may include but not limited to:

- 9.1. Performance tests in which the student demonstrates the correct technique and obtains the correct results.
- 9.2. Observation of student behavior and actions, including attendance and participation
- 9.3. Examination and evaluation of the student's log book
- 9.4. Peer review, evaluation or rating
- 9.5. Promptness as demonstrated by the on-time submission of projects or assignments

## 10. Attendance Policy

- 10.1. While attendance in many college classes is optional, attendance in life and at work is not, therefore **all participants are expected to attend all sessions**. *Please see the S.C.A.N.S. section below for additional discussion on this point.*
- 10.2. I do not waste my or the class's time by presenting unimportant or non-essential information, therefore **every class is important**.
- 10.3. **Much of the material is cumulative**, that is to understand material presented in class two it is essential that you attended class one.
- 10.4. **Participation is an important part of life**, and class participation is a significant element in student evaluation. **If you do not attend, you can't participate**. *Please see the S.C.A.N.S. section below for additional discussion on this point.*
- 10.5. It is assumed that you are participating in this class to obtain skills and knowledge. It is obvious that if you do not attend, you cannot obtain these skills and knowledge.

- 10.6. FPC has excellent relations and high credibility with the area employers. A major factor in this is that our graduates have traditionally exhibited high “on-the-job” performance consistent with the skills and knowledge described in the course syllabi. The only way to maintain these relationships and credibility is to insure that every student is presented with the opportunity to obtain these skills and knowledge, and verification of the acquisition of these skills and knowledge, which obviously requires class attendance.
- 10.7. One of the most valuable and enjoyable aspects of adult education is the sharing of knowledge and experiences among the participants. If you do not attend, you cannot contribute your unique experiences and observations. Thus, your absences affect not only your learning opportunities but also the learning opportunities of all the other participants, which includes the instructor.

## 11. SCANS<sup>2</sup> Workplace Competencies Addressed in this Class:

- 11.1. Resources: Identifies, organizes, plans, and allocates resources:
- 11.1.1. Time--Selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules
  - 11.1.2. Money--Uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives [*included for completeness but not used in this class*]
  - 11.1.3. Material and Facilities--Acquires, stores, allocates, and uses materials or space efficiently
  - 11.1.4. Human Resources--Assesses skills and distributes work accordingly, evaluates performance and provides feedback
- 11.2. Interpersonal: Works with others
- 11.2.1. Participates as Member of a Team--contributes to group effort
  - 11.2.2. Teaches Others New Skills
  - 11.2.3. Serves Clients/Customers--works to satisfy customers' expectations
  - 11.2.4. Exercises Leadership--communicates ideas to justify position, persuades and convinces others
  - 11.2.5. Responsibly challenges existing procedures and policies
  - 11.2.6. Negotiates--works toward agreements involving exchange of resources, resolves divergent interests
  - 11.2.7. Works with Diversity--works well with men and women from diverse backgrounds
- 11.3. Information: Acquires and uses information
- 11.3.1. Acquires and Evaluates Information
  - 11.3.2. Organizes and Maintains Information
  - 11.3.3. Interprets and Communicates Information

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<sup>2</sup> Secretary's Commission on Achieving Necessary Skills  
see <http://ueblo.pc.maricopa.edu/MariMUSE/SCANS/SCANS.html> for details.

#### 11.3.4. Uses Computers to Process Information

#### 11.4. Systems: Understands complex inter-relationships

11.4.1. Understands Systems--knows how social, organizational, and technological systems work and operates effectively with them

11.4.2. Monitors and Corrects Performance--distinguishes trends, predicts impacts on systems operations, diagnoses deviations in systems' performance and corrects malfunctions

11.4.3. Improves or Designs Systems--suggests modifications to existing systems and develops new or alternative systems to improve performance

#### 11.5. Technology: Works with a variety of technologies

11.5.1. Selects Technology--chooses procedures, tools or equipment including computers and related technologies

11.5.2. Applies Technology to Task--Understands overall intent and proper procedures for setup and operation of equipment

11.5.3. Maintains and Troubleshoots Equipment--Prevents, identifies, or solves problems with equipment, including computers and other technologies

### **12. Next Recommended Course in Sequence**

This is a “stand-alone” course. The skills and knowledge obtained in this course can be immediately applied in the workplace at an introductory or basic level without any additional coursework. This course is an excellent foundation for most of the Manufacturing Technology courses such as Materials and Processes, conventional machining and CNC machining.