Metrology Syllabus

1. **The international standard of length**
   a. The SI standard
   b. Practical standards including
      - Gage blocks
      - Stabilized lasers
      - Line scales
      - Step gages

2. **Traceability and the Guide to the Uncertainty in Measurement**
   a. National Measurement Institutes (NMIs)
   b. Uncertainties
      - Type A
      - Type B
   c. Combination of uncertainties and correlation of errors

3. **Fixed gaging including hard gaging**
   a. Go and no-go plug gages, pin gages
   b. Thread gages
   c. Ring gages
   d. Air gages

4. **Angle metrology**
   a. Angle blocks
   b. Indexing tables
      - Calibration by subdivision
   c. Autocollimators
   d. Angular interferometers

5. **Definition, measurement and specification of all Y 14.5 characteristics**
   a. Straightness, flatness, circularity (roundness), cylindricity, profile of a surface, profile of a line, angularity, perpendicularity, parallelism, position, concentricity, symmetry, circular runout, total runout

6. **Coordinate metrology**
   a. CMM types
      - Rigid body analysis of machine errors (see machine tools)
   b. CMM probes
   c. CMM usage
   d. Software and measurement procedures
   e. Task specific uncertainty
   f. B89.4.10360

7. **Temperature effects in dimensional metrology and precision manufacturing**
a. Environmental temperature variation error
b. Uncertainty in nominal differential expansion
c. Thermal effects diagram
e. Computation of errors due to non standard temperatures

8. **Machine tool metrology**
   a. Specification of machine errors
   b. Standard tests for machining centers and lathes
      - ASME B5.54
      - ASME B5.57
   c. Rigid body analysis of machine errors (see CMMs)

9. **Basics of gear and thread metrology**
   a. Pitch and pitch diameter
   b. Thread angle
   c. Involute curves
   d. Pitch diameter measurement over wires
   e. Measurement of gear and thread wires

10. **Surface metrology**
    a. Stylus methods
        - Instruments
        - Filters
        - Parameters
    b. Optical methods
        - White light interferometers
        - Other area instruments

11. **References**
    d. ASME Y14.5, B5.54, B5.57 and B89 standards