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**

a. Whitehouse, D.J. ,"Handbook of Surface Metrology," Institute of Physics Publishing, IOP Publishing Ltd 1994

b. Hocken, R.J. and Pereira, P.H., "Coordinate Measuring Machines and Systems", 2nd edition, CRC Press, 2011

c. Kennedy, C. W., Hoffman E. G., and Bond S.D., "Inspection and Gaging," Industrial Press, N.Y. 6th ed. 1987.

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