ENGR480 Course Topics

1) Analyzing the product and the process
   a) production scale
   b) adding value
   c) how would you make this by hand?
   d) what is your required production rate?
   e) part tolerances
   f) orientation and symmetries
2) Documentation
   a) Memos
   b) Reports
   c) Drawings & part lists
3) Generating motion
   a) linear motion
      i) pneumatic cylinders
      ii) electric solenoids
      iii) vibratory systems
   b) rotary motion
      i) DC motors
      ii) AC motors
         (1) stepper
         (2) brushless
         (3) induction
   c) conversion between rotary and linear
      i) lead screws
      ii) rack & pinion
4) Control of motion
   a) On/off control
      i) pneumatic logic
      ii) electric controls
         (1) relays
         (2) programmable logic controllers (PLC)
            (a) digital logic
            (b) ladder diagrams
            (c) timing diagrams
            (d) state machines
               (i) state diagrams
               (ii) state transition tables
               (iii) state logic equations
               (iv) RLL-Plus stage programming
            (e) input and output
               (i) DC
                  1. sinking
                  2. sourcing
               (ii) AC
            (f) higher level functions
               (i) timers
               (ii) counters
               (iii) math
         (3) position sensing
            (a) mechanical

(b) optical
(i) modulated/non-modulated
(ii) reflective/transmissive
(iii) light on/dark on
(iv) fiber optic
(c) magnetic
(i) reed switch
(ii) hall effect
(iii) inductive proximity

b) Proportional control
i) sensors
(1) resistive and bridges
(2) optical
(a) incremental
(b) absolute
(3) PLC highspeed I/O
(a) highspeed counter
(b) quadrature counter
(c) stepper drive
(4) magnetostrictive
(5) 4-20mA interface
(6) PLC analog I/O
ii) PID controllers
(1) PLC PID control functions
(2) Basic control theory
(a) P,I,D control
(b) PI, PD, and PID composite control
(c) analog and pneumatic controllers

c) Factory communications
i) wiring
(1) noise sources
(a) common impedance coupling
(b) magnetic field coupling
(c) electric field coupling
(2) twisted-pair
(3) coax (and twin-ax)
(4) shielding and grounding
(5) transmission line theory
(a) reflections
(b) termination
ii) signalling
(1) RS-232
(2) RS-485
(3) Ethernet
iii) protocols
(1) master/slave vs. peer-to-peer
(2) deterministic vs. asynchronous
(3) examples
(a) TCP/IP
(b) DeviceNet
iv) PLC communications

v) Future of factory communications
d) Human/machine interface (HMI or MMI)
i) system control
ii) data acquisition
iii) analysis and display
iv) factory database
v) resource and work-in-process tracking
vi) statistical process control
vii) alarms and logging

5) Putting it all together
a) Feeding parts
i) conveyors
ii) vibratory feed bowls
iii) pick & place
b) Material removal
i) CNC
ii) Rotating work
(1) lathe
(2) turning center
iii) Rotating tool
(1) vertical mill
(2) horizontal mill
(3) machining center
(4) clamping and fixturing
iv) Automatic screw machines
v) Centerless grinding
c) Forming
i) sheet metal
(1) folding
(2) punching
(3) shearing
ii) sintering
iii) molding and casting
iv) extruding
d) Joining
i) Rivets
ii) press-fit fasteners
iii) Threaded fasteners
iv) Snap fastening
v) Adhesives
vi) Welding

6) Additional topics not really covered
a) Non-discrete manufacturing
i) web materials
ii) continuous flow processes
b) Efficiency and effectiveness
i) Just-In-Time
ii) Flexible manufacturing
c) Throughput and production rate
i) Jams & malfunctions
ii) buffers