PhD in IE Preliminary Exam

Contents/Policy

The PhD in IE Preliminary exam is a four-hour exam administered two times a year immediately before Fall and Spring semesters and covers the following nine topic areas: Probability/Statistics, Operations Research, Ergonomics, Production Systems, Manufacturing Tools, Manufacturing Methods & Materials, Biomechanics, work/exercise Physiology, and Epidemiology. Students have to select four of the nine areas. Students are not allowed to use books or notes (unless permitted by the faculty preparing the test). Each test usually has three questions and students are asked to answer two (out of three) questions in each area. To pass the exam, a student must receive a passing grade (“B” or better) in each of the selected four areas. A student is allowed no more than two attempts to pass the prelim exam.

The exam is administered according to the following time schedule:
Day 1 (last business day before the semester starts): 8:30 a.m. - 10:30 a.m. (2 classes)
  Probability/Statistics and Ergonomics
Day 2 (first business day of the semester): 8:30 a.m. - 10:30 a.m. (2 classes)
  Operations Research, Production Systems, Epidemiology, Work/Exercise Physiology, Biomechanics, Manufacturing Tools, Biomechanics, Manufacturing Methods and Materials

Descriptions of Preliminary Exam Contents

1. **Probability and Statistics (All Majors):** Random sampling, sampling distributions, one- and two-sample estimation problems and hypothesis tests, confidence interval, simple and multiple linear regression, correlation analysis, ANOVA, nonparametric statistics (sign tests, signed rank tests, rank-sum test, runs test K-W test, rank correlation).

2. **Operations Research (Systems):** Decision modeling and OR analysis, LP formulation and solution (graphical, simplex), duality/sensitivity/parametric analysis, transportation/assignment models, dynamic programming, queuing models (M/M/1/GD/∞/∞, M/M/1/GD/c/∞, M/M/s/GD/∞/∞, M/M/R/GD/K/K), network models (minimum spanning tree, maximum flow, shortest path), integer programming (modeling, branch and bound method for IP, MIP, and 0-1 IP).

3. **Ergonomics (All Majors):** Anthropometry, seat design, workplace design principles, work physiology, hand tool design, manual materials handling, cumulative trauma disorder, development of an ergonomics program, human machine interface, and environment.

4. **Production Systems (Systems):** Classification of manufacturing systems, Push/Pull Systems, capacity planning, production control, master production schedule, scheduling, aggregate production planning, forecasting, and inventory control, factory dynamics including variability.

5. **Manufacturing Tools (Manufacturing):** Tool materials, machine tool kinematics and controls, cutting tool design, work holding principles and components, jig and fixture design, modular tooling, inspection and gauging, press working tools.

6. **Manufacturing Methods & Materials (Manufacturing):** Yield criteria and work hardening behavior of metals; properties of common engineering materials; heat transfer, fluid flow and
microstructure development in casting; heat treatment of steel and aluminum; loads (stresses) and formability (strains) in bulk forming operations such as forging, extrusion and rolling; loads and formability in sheet metal forming processes such as bending, cup drawing and shearing; strain, strain rate, force, temperature and tool wear in orthogonal metal cutting; design of above processes

7. Biomechanics (Ergonomics)

8. Work/Exercise Physiology (Ergonomics)

9. Epidemiology (Ergonomics)

Prelim Exam Calendar:  (Please check related published documents for exact dates in each semester)

Two classes are scheduled on the last Friday before the fall/spring semester, and two classes are scheduled on the first Monday afterwards. In case of a conflict with university holiday, dates will be moved a day back or forward.