Course: IENG 455 - Simulation by Digital Methods

Semester: Fall 2018
Course format & credit hours: 3 hr lecture, 3 credits
Instructor: Xiaofei Shi
Instructor's Office Hours: 2:00 pm – 3:00 pm T, TH (or by appointment via email)
Location: ESB 305A
Email: **xashi@mix.wvu.edu**

Assignment submission email:
ieng455@gmail.com

- The gmail account is for the purpose of collecting assignments only.
- **Please use the instructor's email address for any other matters.**

Description: Introduction to Monte Carlo simulation methods and their application to decision problems. Student identifies constraints on problems, collects data for modeling and develops computer programs to simulate and analyze practical situations. Interpretation of results emphasized.

Prerequisites: IENG 213 (Engineering Statistics), IENG 331 (Computer Applications in Industrial Engineering).

- Excel and word processing.
- Statistics, particularly the relationship between probability distribution functions and cumulative distribution functions; confidence-interval procedures based on the normal and *t* distributions; sample mean and variance.

Textbook: Simulation with Arena, by Kelton, Sadowski, and Sturrock, 6th Ed-McGraw Hill

Course Supplement: the PowerPoint lecture notes will be posted on the course website.

Additional References:
Discrete-Event System Simulation, by Banks, Carson, Nelson and Nicol
Simulation Modeling and Analysis, by Law and Kelton - McGraw Hill

Course Website: eCampus (https://ecampus.wvu.edu)
Course materials, homework assignments/solutions, projects, and labs will be posted on this website.

Softwares:

1. Arena: **It has to be Arena 14.5!**
Available in the textbook CD or at the following link:
http://highered.mheducation.com/sites/0073401315/student_view0/arena_software_download.html

2. SIMTOOLS and FORMLIST: available at http://home.uchicago.edu/~rmyerson/addins.htm

- *SIMTOOLS User Manual* is available at the course website under the folder **<Software>**, which includes the installation guidance and introduction of SIMTOOLS and FORMLIST.
- Both softwares are installed on the PCs in the IMSE computer labs (ESB 305 & 355), ESB 225, 231, 239, and MRB 249.

Important Policies:

1. Grading Elements, Weighting and Scale:

Grade Element	Weighting	Grade Scale
5 Tests	80% (16% per test)	A: 90-100
		B: 80-89
2 Projects	8%	C: 70-79
Homework	9%	D: 60-69
Labs	3%	F: 0-59

Optional Final Exam:

- The final exam will be comprehensive.
- If you choose to take the final exam, then your final exam grade will replace the lowest test score you've obtained earlier.

2. On-time Attendance: Attending and participating in class adds to your knowledge as IEs beyond what can be evaluated on projects and exams.

- The attendances in the first week do not count.
- Class attendance is NOT required. But roll will be taken each class before the lecture begins at **12:30 pm**.
- **No late arrivals will be accepted**.
- If a student misses less than or equal to 3 classes in the semester, then 3 extra credits will be added to the student's final numeric grade. **These 3 classes are supposed to cover absences for justifiable medical or personal reasons.**

3. **Electronic Submission:** All the electronic assignments are required to be sent to the **Gmail** account.

- Please title your email "LastName_AssignmentName".
  Eg., "Shi_Project 1", "Shi_Homework 1"
- If technical difficulties are encountered with the gmail account, please use the instructor's email address.
- Please remember to CC yourself on all the emails submitting electronic assignments, and make sure that at least the email has been successfully delivered to your own mail box. Please keep your own copy of the submission until you have received the grade for that assignment.

Other Policies:

1. Homework grading policy:
   — Homework turned in when due: grading starts at 100%
   — Homework turned in 1 day late: grading starts at 90%
   — Homework turned in 2 days late: grading starts at 80%...
   — Homework turned in 3 days late: grading starts at 70%...
   — Homework turned in later - 0 on the homework

2. **Projects:** the grading policy for projects are as follows
   — Project turned in when due - grading starts at 100%
   — Project turned in 1 day late - grading starts at 90%
   — Project turned in 2 days late - grading starts at 80%

— Project turned in 3 days late - grading starts at 70%

— Project turned in later - 0 on the project

3. **Labs:** Some lecture time will be used as lab sessions.

4. **Working together:** You are encouraged to discuss the design problems, but all programming and analysis is to be done in **a team of one, two or three**. Numerical results will differ depending on how you code your simulation, so comparing them is no guarantee, anyway. *Notice that 85% of the course grade is determined by the tests, and it is not possible to be successful on the examination without understanding what was done on the design projects.*

5. **Regrades:** Regrades of projects are obtained by submitting a written explanation via the instructor's mailbox within 48 hours of when the work was returned in class. Regrades will only be discussed *after* submitting the work in this manner.

6. **Make-up tests:** According to the department policy, no make-up tests are allowed. A student who misses a test without prior permission of the instructor must be assigned a 0 (zero). The secretary of the IMSE Department will have a telephone number where the instructor can be reached.

Course Goals:

1. To provide students with the basic concepts of simulation.
2. To provide students with hands-on experience in the application of a widely used, general-purpose simulation software.
3. To provide students with basic knowledge on the analysis of simulation output.

Student Learning Objectives:

Upon completing the course, the student will be able to:

a) Recognize problems that can be modeled and solved using simulation techniques.

b) Become familiar with the main elements and principles needed to build and implement valid and credible simulation models.

c) Identify the input data needed for the model, perform proper statistical analysis, and select the input probability distributions.

d) Generate random numbers and random variates.

e) Perform basic statistical analysis on the output of the simulation models.

f) Develop good simulation models using SIMTOOLS and ARENA.

g) Perform a complete simulation study (problem definition and formulation, model building, data acquisition, model translation, model verification, model validation, model implementation, and analysis of the results.)

Course Contribution to Professional Component:

Engineering Science - 50%, Engineering Design - 50%

Course Relationship to Program Educational Outcomes:

The course relates strongly to the following program educational outcomes.

1. The course enables the students to acquire the ability to use modern and classical industrial engineering methodologies pertaining to simulation modeling (Outcome 1).
2. The course enables the students to acquire the ability to apply knowledge of math, statistics, and industrial

engineering (Outcome 2).

3. The course enables the students to acquire the ability to design and conduct experiments, analyze and interpret data, develop implementation strategies, shape recommendations so that results will be achieved, and communicate findings effectively (Outcome 3).

4. The course enables the students to acquire the ability to work individually and on teams to identify, formulate, and solve problems using simulation and statistical analysis tools (Outcome 4).

5. The course enables the students to acquire the ability to design integrated systems (Outcome 5)

Course Topics (Note: This schedule is tentative and flexible)

- Review of probability theory and statistics relevant to simulation (1 week)
- Introduction to spreadsheet simulation and SIMTOOLS basics (1 week)
- Input modeling (1 week)
- Output analysis (1.5 week)
- System simulation and queueing basics (1 week)
- Arena topics: Chapter 2 & 3 (2 weeks)
- Arena topics: Chapter 4 & 5 (2 weeks)
- Output analysis for terminating systems: Chapter 6 (1 week)
- Output analysis for steady state system: Chapter 7 (1.5 week)
- Arena topics: Chapter 8 & 9 (2 weeks)
- Verification and validation & Managing simulation projects (1 week)

Statement on Social Justice:

West Virginia University is committed to social justice. I concur with that commitment. I expect to foster a nurturing learning environment that is based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, you must make appropriate arrangements through Disability Services (293-6700). They will identify the nature of the accommodation your disability requires.