**UNDERGRADUATE PROGRAM IN COMPUTER SCIENCE**
**DEPARTMENT OF COMPUTER SCIENCE AND ELECTRONICS**
**FACULTY OF MATHEMATICS AND NATURAL SCIENCES**
**UNIVERSITAS GADJAH MADA**

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| Module name | **Queueing and Simulation** | |
| Module level | Undergraduate | |
| Code | MII - 4012 | |
| Courses (if applicable) | Queueing and Simulation | |
| Semester | Spring (Genap) | |
| Contact person | 1. Reza Pulungan, Dr.-Ing., M.Sc.<br>2. Suprapto, Dr. | |
| Lecturer | 1. Reza Pulungan, Dr.-Ing., M.Sc.<br>2. Suprapto, Dr. | |
| Language | Bahasa Indonesia | |
| Relation to curriculum | 1. Undergraduate degree program, elective, 4th or 6th semester.<br>2. International undergraduate program, elective, 4th or 6th semester. | |
| Type of teaching, contact hours | 1. Undergraduate degree program: lectures, < 60 students,<br>2. International undergraduate program: lectures, < 30 students. | |
| Workload | 1. Lectures: 3 x 50 = 150 minutes (2.5 hours) per week.<br>2. Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week.<br>3. Private study: 3 x 60 = 180 minutes (3 hours) per week. | |
| Credit points | 3 credit points (sks). | |
| Requirements according to the examination regulations | A student must have attended at least 75% of the lectures to sit in the exams. | |
| Recommended prerequisites | Probability and Stochastic | |
| Learning outcomes and their corresponding PLOs | After completing this module, a student is expected to: | |
| | **LO1** Students are able to master basic concepts required in this course, especially basic mathematical concepts, probability theory, and standard distributions needed. | **PLO3** |
| | **LO2** Students are able to explain basic concepts of queueing systems, modelling queues, Kendall's notation, and performance measures of a queueing system. | **PLO4** |
| | **LO3** Students are able to explain and analyze single queueing systems, their types, and how to use them. | **PLO4** |

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| | **LO4** Students are able to explain and analyze queueing network systems, their types, and able to apply techniques to solve real problem in queueing systems and simulation. | **PLO5** |
| | **LO5** Students are able to explain the components of discrete-event simulation model, and identify the event types, state(s) of system, controllable and uncontrollable variables, and measurement's function. | **PLO4** |
| | **LO6** Students are able to implement several statistical distribution functions to generate random numbers or random data for simulation process, and implement queueing theory to develop model for queueing systems both with single server as well as multi servers. | **PLO5** |
| | **LO7** Students are able to represent models in standard forms of system design, then implement them using a certain (at least one) either simulation or programming language. | **PLO5** |
| | **LO8** Students are able to perform simple verifications for the simulation models have been developed. | **PLO5** |
| Content | This course deals with the modeling and analysis of queueing systems, with applications in communications, manufacturing, computers, call centers, service industries and transportation. Topics include birth-death processes and simple Markovian queues, networks of queues and product form networks, single and multi- server queues, and multi-class queueing networks. To obtain data required for simulation models, students are introduced to distribution functions, especially for generating random variables and also probability theory.<br><br>Students are also introduced to the concept of model verification. For implementations, students are introduced to simulation and the required programming languages. | |
| Study and examination requirements and forms of examination | 1. Exercises.<br>2. Assignment.<br>3. Mid-term examination.<br>4. Final examination. | |
| Media employed | LCD, whiteboard, and websites. | |

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| Assessments and Evaluation | **LO1**: Problem 1 in midterm (7.5%), and exercise 1 (5%).<br>**LO2**: Problem 2 in midterm (7.5%), and exercise 2 (5%).<br>**LO3**: Problem 3 in midterm (7.5%), and exercise 3 (5%).<br>**LO4**: Problem 4 in midterm (7.5%), and exercise 4 (5%).<br>**LO5**: Problem 1 in final exam (7.5%), and exercise 5 (5%).<br>**LO6**: Problem 2 in final exam (7.5%), and exercise 6 (5%).<br>**LO7**: Problem 3 in final exam (7.5%), and exercise 7 (5%).<br>**LO8**: Problem 4 in final exam (7.5%), and exercise 8 (5%). |
| Reading List | **W1**: Ivo Adan and Jacques Resing, Queueing Systems, Eindhoven University of Technology, 2015.<br><br>**W2**: Albrecth, M.C., and Az, P.E., Introduction to Discrete Event Simulation, 2010.<br><br>**A1**: Law, A.M., and Kelton, W.D., Simulation Modeling and Analysis, 2nd Edition, McGraw-Hill, 1991. |