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MODULE HANDBOOK

Module name	**Science Simulation**
Module level	Undergraduate
Code	MII-3203
Courses (if applicable)	Science Simulation
Semester	Even
Contact person	Dr. Suprapto, M.I.Kom
Lecturer	-
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program, compulsory, 4th and 6th semester. 2. International undergraduate program, compulsory, 4th and 6th semester.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 20 students, 2. International undergraduate program: lectures, < 15 students.
Workload	1. Lectures: 3 x 50 = 150 minutes (1 hours 50 menit) per week. 2. Exercises and Assignments: 2 x 60 = 120 minutes (2 hours) per week. 3. Private study: 2 x 60 = 120 minutes (2 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 Process
Learning outcomes (course outcomes) and their corresponding PLOs	After completing this module, a student is expected to:

CO1	Students master mathematical basic concepts, such as theory of probability, and several required standard distributions.
CO2	Students capable of explaning the basic concepts of queueing system, queueing model, Kendall's notations and performance measurements, also analysing single server systems, their types, and using them.
CO3	Students capable of explaning and analysing queueing network systems, their types, and capable of implementing techniques they have learned to solve the real problems found in queuing network and simulation.
CO4	Students capable of explaning the components of discrete-event simulation model, identifying event types, system states, controlled and uncontrolled variables, and measurement's functions.

	CO5 — Students capable of implementing several statistical distribution functions to generate random numbers or data for simulation process, and queueing theory in developing model for queueing systems both single server and multi servers. CO6 — Students capable of presenting model in standard form of system design, and implementing in either simulation language or general purpose programming language they master. Also capable of doing simple verification toward simulation model they developed.

PLO		CO1	CO2	CO3	CO4	CO5	CO6
Program Learning Outcome (PLO)	PLO1	√	√	√	√	√	√
	PLO2	√		√			
	PLO3		√		√		
	PLO4					√	√
	PLO5						

Contents	(a) Basic concept of probability theory: discrete random variable, generating functions, probability distributions, Poisson process. (b) Queueing model: Kendall's notations, occupation rate, performance measurements, Little law. (c) Analysis of single queeu: G/M/1 (arrival distribution, sojourn distribution, mean of sojourn time). (d) Analysis of queueing network: Markovian property (memoryless), properties of Poisson process, applications of Little law, Jackson's queueing network, conservation of the flow, Jackson's theorem. (e) Basic Simulation: discrete-event simulation model, time-advance simulation, components and organisation of discrete-event simulation models, modeling real cases. (f) Complex systems modeling: list processing in Simulation, simple simulation language Simlib, random numbers generator, single server queueing simulation with Simlib, solving real cases. (g) Simulation software: comparison between simulation packages and programming languages, and classifying them. (h) Building a valid simulation model: introduction and definition, guidelines to determine model detail level, verification of simulation computer programs, techniques to increase model validity.
Study and examination's requirements and forms of examination	The evaluation is performed in 3 forms, i.e.: 1. Midterm and finalterm, 2. two tasks, both individual (ind task) and team (tm task). It must be completed within a certain time interval before midterm, and 3. another two tasks, both individual and team. It must be completed within a certain time interval before finalterm. Assessment is performed using benchmark, the purpose is to measure the level of student understanding respect to the target and class rank.

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<tr><td>Media employed</td><td>LCD, blackboard, and websites.</td></tr>
<tr><td>Assessments and Evaluation</td><td>
<table>
<tr><th>Type</th><th>Percentage</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th><th>CO5</th><th>CO6</th></tr>
<tr><td>Ind task 1</td><td>10%</td><td>√</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ind task 2</td><td>10%</td><td></td><td></td><td></td><td>√</td><td></td><td></td></tr>
<tr><td>Tm task 1</td><td>15%</td><td></td><td>√</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td>Tm task 2</td><td>15%</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td></tr>
<tr><td>Midterm</td><td>25%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>Final</td><td>25%</td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100%</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Reading List</td><td>W1: Adan, I. and Resing, J., 2015, Queueing Systems, Department of Mathematics and Computing Science, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands.
W2: Law, A.M., and Kelton, W.D., Simulation Modeling and Analysis, 5th Edition, McGraw-Hill, 2014.</td></tr>
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