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| Module designation | Mathematical Modeling |
| Semester(s) in which the module is taught | 6 |
| Person responsible for the module | Dr. Eti Dwi Wiraningsih |
| Language | Indonesia |
| Relation to curriculum | *Compulsory*  |
| Teaching methods | Teaching methods used in this course are:* Lecture (i.e., small group discussions and project-based learning)
* Structured assignments (i.e., project development and presentations)
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| Workload (incl. contact hours, self-study hours) | Total workload is 510 minutes  per week which consists of 150 minutes learning activity, 180 minutes structured task and 180 minutes individual learning per week for 16 weeks.  **TOTAL WORKLOAD PER SEMESTER**  **510 X 16 = 8160 minutes = 136 hours** |
| Credit points | 136 hours / 30 hours ≈ 4,5 ECTS  |
| Required and recommended prerequisites for joining the module | Elementary Differential Equations |
| Program intended learning outcomes | **PLO 8**. Master the principles of mathematical modeling, linear programming, differential equations, dan numerical methods.**PLO 9**. Capable to conduct research independently or in groups that can be used to guide stakeholders in choosing diverse alternative solutions to problems in mathematics. Course Learning Outcomes (CLO) to be achieved in this course are:

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| CLO 1 | : | Students are able to understand the meaning of modeling and examples of modeling |
| CLO 2 | : | Students are able to understand the definitions and terms of modeling methodology |
| CLO 3 | : | Students are able to understand methodology as well as flow chart modeling and methodology in practice formulating background problems |
| CLO 4 | : | Students are able to understand differential equations, random numbers, Data, mechanical vibration problems, population dynamics problems, and traffic flow problems in the application of mathematical concepts |
| CLO 5 | : | Students are able to understand mechanical vibrations, population dynamics, traffic flows in the selection of topics or cases |
| CLO 6 | : | Students are able to understand literature, consult in designing models |
| CLO 7 | : | Students are able to literature, conceptualize, and apply mathematical concepts in analysis and model solutions |
| CLO 8 | : | Students master the concept of understand literature studies, design modeling solutions, and consult in model Analysis for development |
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The relationship between PLO and CLO in this course is described as follows:

|  |  |
| --- | --- |
| CLO | PLO |
| 8 | 9 |
| 1 | √ |  |
| 2 | √ |  |
| 3 | √ |  |
| 4 | √ |  |
| 5 | √ |  |
| 6 |  | √ |
| 7 |  | √ |
| 8 |  | √ |
| 9 |  | √ |

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| Content | **Students will learn about:**Mathematical modeling which includes introduction to modeling concepts and theories, modeling methodology, application of mathematical concepts in mathematical modeling, selection of topics or cases of mathematical modeling, model design, model Analysis and model solutions, and model Analysis for model development. |
| Examination forms | Assessment for this course includes:50% structured assignments, 20% midterms and 30% final exams (project) |
| Study and examination requirements  | **Study and examination requirements:*** Students must attend 15 minutes before the class starts.
* Students must inform the lecturer if they cannot attend the class due to sickness, etc.
* Students must submit all class assignments before the deadline.

**Form of examination:**Individual and group projects |
| Reading list | **Main References:** 1. V. Capasso, "Lecture Notes in Biomathematics: Mathematical Structures of Epidemic Systems," New York : Springer-Verlag , 2008
2. E. A. Bender, "An Introduction to Mathematical Modelling," New York : John Wiley & Sons, Inc., 1978.
3. C. L. Dym, "Principles of Mathematical Modelling" Second Edition, Elsevier Academic Press, 2004.
4. Haberman, Richard. 1998. Mathematical Models. SIAM, Pentice Hall, Inc, New Jersey.
5. Edward, Diwlyn. 2001. Guide to Mathematical Modelling. 2nd Ed. Palgrave

 **Additional References:*** MZ Ndii, Z Amarti, ED Wiraningsih, AK Supriatna. Rabies Epidemic Model with Uncertainty in Parameters: Crisp and Fuzzy Approaches. 2018. IOP Conference Series: Materials Science and Engineering 332 (1), 012031.
* Wiraningsih E.D., Amarti Z., Supriatna A.K. Herd Vaccination Threshold for Rabies Disease with Fuzzy Initial Condition and Fuzzy Transmission Coefficient. 2018. Proceeding International Conference on Engineering, Technologies, and Applied Sciences (ICETsAS 2018).
* Wiraningsih E.D., Agusto F., Lenhart S., Widodo, Aryati L., Toaha S., and Govaerts W. Stability analysis of rabies model with vaccination effect and culling in dogs. 2015. International journal of applied mathematics and statistics. CESER publication.
* Wiraningsih E.D., Widodo, Aryati L., and Toaha S. Optimal control for SEIR rabises model between Dogs and Human with Vaccination Effect both in dogs and Human. 2010. Proceeding the Third International Conference on Mathematics and Natural Sciences (ICMNS), Bandung Institute of Technology, Indonesia.
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