



MINISTRY OF HIGHER EDUCATION, SCIENCE, AND  
TECHNOLOGY

UNIVERSITAS NEGERI SURABAYA  
FACULTY OF MATHEMATICS AND NATURAL SCIENCES  
UNDERGRADUATE PROGRAM OF MATHEMATICS EDUCATION

Ketintang Campus, Jalan Ketintang, C8 C9 Building, Surabaya 60231

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Undergraduate Program of Mathematics

Module Handbook

|   |  |
|---|--|
| <b>Module Name:</b>   | Operational Research<br>Riset Operasi  |
| <b>Module Level:</b>  | Sarjana (S-1) / Undergraduate  |
| <b>Abbreviation, if applicable:</b>                             | 8420202004   |
| <b>Sub-heading, if applicable:</b>                              | -  |
| <b>Course included in the module, if applicable:</b>            | -  |
| <b>Semester/term:</b>   | 4 / Second year  |
| <b>Module Coordinator(s):</b>                                   | Prof. Dr. Raden Sulaiman, M.Si   |
| <b>Lecturer(s):</b>   | Dr. Endah Budi Rahaju, M.Pd.<br>Affiati Oktaviarina, S.Si., M.Sc.<br>Dr. Nia Wahyu Damayanti, S.Pd., M.Pd.<br>Novita Vindri Harini, M.Pd.<br>Dr. Mukhtamilatus Sa'diyah, M.Pd  |
| <b>Language:</b>  | Indonesia  |
| <b>Classification within the curriculum:</b>                    | Compulsory course/ <del>elective studies</del>   |
| <b>Teaching format/class hours per week during the semester</b> | Teaching format: lectures, tutorial assignment, and individual Study/3 x 170 minutes = 510 minutes = 8.5 hours lectures  |
| <b>Workload:</b>  | 16 weeks per semester consisting of: <ul style="list-style-type: none"><li>• 1 hour lectures (1 x 50 minutes) per week,</li><li>• 1 hours assignments (1 x 60 minutes) per week,</li><li>➤ 1 hours individual study (1 x 60 minutes) per week,</li></ul> Total workload: $16 \times 3 \times 170 \text{ minutes} = 8,160 \text{ minutes} = 136 \text{ hours} = 4.8 \text{ ECTS}^*$ |
| <b>Credit Point:</b>  | 3  |
| <b>Requirements:</b>  | Elementary Number Theory<br>Teori Bilangan Elementer   |



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| <b>Learning Goals:</b>         | <p><b>PLO-5:</b> Possesses basic mathematical knowledge to solve mathematical problems and their applications in education.</p> <p><b>PLO-6:</b> Masters the principles of mathematical knowledge to support mathematical thinking skills in solving mathematical problems.</p>  |                                   |                                |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
|--------------------------------|--|-----------------------------------|--------------------------------|-----------------------------------|----------------|---|-------|-------|---|---|-------|-------|---|---|-------|-------|---|---|-------|-------|---|---|-------|-------|---|---|-------|-------|---|---|-------|-------|---|---|-------|-------|----|---|-------|-------|---|----|-------|-------|---|----|-------|-------|---|----|-------|-------|---|----|-------|-------|---|----|-------|-------|---|----|-------|-------|---|----|-------|-------|----|-------|-----------------|-------------|---|------|----------------------|----|------|------------------|
| <b>Content:</b>                | Studying linear program modeling and its solution methods (simplex, Big M, Two Phase, duality), use of computer applications, and application to transportation and assignment methods.  |                                   |                                |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| <b>Study/exam achievements</b> | <ul style="list-style-type: none"><li>Students are considered competent and pass if the final score is at least 55 or C.</li><li>Final score is calculated as follows:<table><tr><th>Week</th><th>Course Learning Outcomes (CLO)</th><th>Programme Learning Outcomes (PLO)</th><th>Evaluation (%)</th></tr><tr><td>1</td><td>CLO-1</td><td>PLO-6</td><td>5</td></tr><tr><td>2</td><td>CLO-1</td><td>PLO-5</td><td>2</td></tr><tr><td>3</td><td>CLO-1</td><td>PLO-5</td><td>2</td></tr><tr><td>4</td><td>CLO-1</td><td>PLO-6</td><td>5</td></tr><tr><td>5</td><td>CLO-1</td><td>PLO-5</td><td>2</td></tr><tr><td>6</td><td>CLO-1</td><td>PLO-5</td><td>5</td></tr><tr><td>7</td><td>CLO-1</td><td>PLO-5</td><td>5</td></tr><tr><td>8</td><td>CLO-1</td><td>PLO-5</td><td>20</td></tr><tr><td>9</td><td>CLO-3</td><td>PLO-5</td><td>5</td></tr><tr><td>10</td><td>CLO-2</td><td>PLO-5</td><td>5</td></tr><tr><td>11</td><td>CLO-2</td><td>PLO-5</td><td>2</td></tr><tr><td>12</td><td>CLO-2</td><td>PLO-5</td><td>5</td></tr><tr><td>13</td><td>CLO-2</td><td>PLO-6</td><td>5</td></tr><tr><td>14</td><td>CLO-2</td><td>PLO-5</td><td>2</td></tr><tr><td>15</td><td>CLO-3</td><td>PLO-6</td><td>5</td></tr><tr><td>16</td><td>CLO-3</td><td>PLO-6</td><td>30</td></tr></table></li><li>Final index is defined as follow:<table><tr><th>Index</th><th>Converted Score</th><th>Score Range</th></tr><tr><td>A</td><td>4.00</td><td><math>85 \leq A \leq 100</math></td></tr><tr><td>A-</td><td>3.75</td><td><math>80 \leq A &lt; 85</math></td></tr></table></li></ul> | Week                              | Course Learning Outcomes (CLO) | Programme Learning Outcomes (PLO) | Evaluation (%) | 1 | CLO-1 | PLO-6 | 5 | 2 | CLO-1 | PLO-5 | 2 | 3 | CLO-1 | PLO-5 | 2 | 4 | CLO-1 | PLO-6 | 5 | 5 | CLO-1 | PLO-5 | 2 | 6 | CLO-1 | PLO-5 | 5 | 7 | CLO-1 | PLO-5 | 5 | 8 | CLO-1 | PLO-5 | 20 | 9 | CLO-3 | PLO-5 | 5 | 10 | CLO-2 | PLO-5 | 5 | 11 | CLO-2 | PLO-5 | 2 | 12 | CLO-2 | PLO-5 | 5 | 13 | CLO-2 | PLO-6 | 5 | 14 | CLO-2 | PLO-5 | 2 | 15 | CLO-3 | PLO-6 | 5 | 16 | CLO-3 | PLO-6 | 30 | Index | Converted Score | Score Range | A | 4.00 | $85 \leq A \leq 100$ | A- | 3.75 | $80 \leq A < 85$ |
| Week                           | Course Learning Outcomes (CLO)   | Programme Learning Outcomes (PLO) | Evaluation (%)                 |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 1                              | CLO-1  | PLO-6                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 2                              | CLO-1  | PLO-5                             | 2                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 3                              | CLO-1  | PLO-5                             | 2                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 4                              | CLO-1  | PLO-6                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 5                              | CLO-1  | PLO-5                             | 2                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 6                              | CLO-1  | PLO-5                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 7                              | CLO-1  | PLO-5                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 8                              | CLO-1  | PLO-5                             | 20                             |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 9                              | CLO-3  | PLO-5                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 10                             | CLO-2  | PLO-5                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 11                             | CLO-2  | PLO-5                             | 2                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 12                             | CLO-2  | PLO-5                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 13                             | CLO-2  | PLO-6                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 14                             | CLO-2  | PLO-5                             | 2                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 15                             | CLO-3  | PLO-6                             | 5                              |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| 16                             | CLO-3  | PLO-6                             | 30                             |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| Index                          | Converted Score  | Score Range                       |                                |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| A                              | 4.00   | $85 \leq A \leq 100$              |                                |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |
| A-                             | 3.75   | $80 \leq A < 85$                  |                                |                                   |                |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |   |   |       |       |    |   |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |   |    |       |       |    |       |                 |             |   |      |                      |    |      |                  |



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|                |  |                   |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
|----------------|--|-------------------|------|-------------------|---|------|------------------|----|------|-------------------|----|------|-------------------|---|------|------------------|---|------|------------------|---|------|-----------------|
|                | <table><tr><td>B+</td><td>3.50</td><td><math>75 \leq B+ &lt; 80</math></td></tr><tr><td>B</td><td>3.00</td><td><math>70 \leq B &lt; 75</math></td></tr><tr><td>B-</td><td>2.75</td><td><math>65 \leq B- &lt; 70</math></td></tr><tr><td>C+</td><td>2.50</td><td><math>60 \leq C+ &lt; 65</math></td></tr><tr><td>C</td><td>2.00</td><td><math>55 \leq C &lt; 60</math></td></tr><tr><td>D</td><td>1.00</td><td><math>40 \leq D &lt; 55</math></td></tr><tr><td>E</td><td>0.00</td><td><math>0 \leq E &lt; 40</math></td></tr></table>  | B+                | 3.50 | $75 \leq B+ < 80$ | B | 3.00 | $70 \leq B < 75$ | B- | 2.75 | $65 \leq B- < 70$ | C+ | 2.50 | $60 \leq C+ < 65$ | C | 2.00 | $55 \leq C < 60$ | D | 1.00 | $40 \leq D < 55$ | E | 0.00 | $0 \leq E < 40$ |
| B+             | 3.50   | $75 \leq B+ < 80$ |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| B              | 3.00   | $70 \leq B < 75$  |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| B-             | 2.75   | $65 \leq B- < 70$ |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| C+             | 2.50   | $60 \leq C+ < 65$ |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| C              | 2.00   | $55 \leq C < 60$  |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| D              | 1.00   | $40 \leq D < 55$  |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| E              | 0.00   | $0 \leq E < 40$   |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| Forms of Media | Slides and LCD projectors, whiteboard  |                   |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| Literature     | <ol style="list-style-type: none"><li>1. Ravindran, A R., Operations Research and Management Science, 2008, Taylor &amp; Francis Group.</li><li>2. M. S. Bazaraa, J. J. Jarvis and H. D. Sherali, 2010, Linear Programming and Network Flows, Fourth Edition, John Wiley &amp; Sons, New York.</li><li>3. Thaha, H.A, 2007, Operations Research: An Introduction, Eighth edition, Pearson Education Inc</li><li>4. Poler, 2014, Operation Research Problems, Statements and Solutions, Springer.</li><li>5. Harini, N. V, 2024, Design Contextual Problems and Solutions Related to Linear Programming Topics with The Help of Geogebra. Noumerico: Journal of Technology in Mathematics Education, 2(2), 156-164.</li></ol> |                   |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |
| Note           | Based on the regulation of the minister of education and culture of Indonesia number 3 of 2020 concerning national higher education standards, it is state 1 CU equals to 170 minutes per week. Therefore, in one semester (16 weeks, including midterm a final exam) 1 CU = 170 X 16 = 2.720 minutes or 45.3 hours. Therefore, workhours in 144 CU x 45.3 hours = 6.523,2 hours. Unesa decided that 1 ECTS with 144 CU, 6.523,2/229 ECTS = 28.48 hours, so that 1 CU = 1.59 ECTS  |                   |      |                   |   |      |                  |    |      |                   |    |      |                   |   |      |                  |   |      |                  |   |      |                 |