| | Universitas Negeri Surabaya<br>Faculty of Mathematics and Natural Sciences<br>Undergraduate Chemistry Education Study Program | Document Code |
|---|---|---|

# SEMESTER LEARNING PLAN

| Courses | CODE | Course Family | Credit Weight | | | SEMESTER | Compilation Date |
|---|---|---|---|---|---|---|---|
| Physical Chemistry III: Chemical Kinetics | 8420403135 | | T=3 | P=0 | ECTS=4.77 | 5 | July 18, 2024 |

| AUTHORIZATION | SP Developer | Course Cluster Coordinator | Study Program Coordinator |
|---|---|---|---|
| | ..... | ..... | Prof. Dr. Utiya Azizah, M.Pd. |

| | |
|---|---|
| **Learning model** | **Project Based Learning** |
| **Program Learning Outcomes (PLO)** | **PLO study program which is charged to the course** |
| | **Program Objectives (PO)** |
| | **PLO-PO Matrix** |

| | P.O |
|---|---|

**PO Matrix at the end of each learning stage (Sub-PO)**

| P.O | Week | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

| | |
|---|---|
| **Short Course Description** | Empirical and theoretical studies of reaction rates as a function of concentration, temperature and catalyst as well as interpretation of reaction rate laws for the discussion and design of reaction mechanisms (including photochemistry). |
| **References** | **Main :** |


1. Wilkinson,Frank. 1975. Chemical Kinetics and Reaction Mechanisms . Victoria: Van Nostrand Reinhold Company.
2. Atkins, P. W. 1995. Psysical Chemistry . Third Edition. NewYork: W. H. Freeman and Company.Castelan
3. Gilbert W. 1983. Psysical Chemistry . Third Edition.Tokyo: Addison-Wesley Publishing Company.


| | |
|---|---|
| **Supporters:** | |
| **Supporting lecturer** | Prof. Dr. Suyono, M.Pd.<br>Nur Hayati, S.Si., M.Si.<br>Bertha Yonata, S.Pd., M.Pd. |

| Week- | Final abilities of each learning stage (Sub-PO) | Evaluation | | Help Learning, Learning methods, Student Assignments, [ Estimated time] | | Learning materials [ References ] | Assessment Weight (%) |
|---|---|---|---|---|---|---|---|
| | | Indicator | Criteria & Form | Offline ( *offline* ) | Online ( *online* ) | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1** | Explain the physical meaning of the reaction rate law. | Formulate the reaction rate law, if given data on the function of concentration versus time correctly. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. 1. Participation during lectures, carried out through observation (weight 2)<br>3. 2. UTS and UAS, carried out once, assessing all relevant indicators through a written exam, averaged and weighted (2))<br>4. 3. Tasks are weighted (3)<br>5. 4. The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10 | Practice transforming and interpreting differential form equations into integral form for the zeroth power to the nth power<br>Discussion<br>3 X 50 | | **Material:** Physical meaning of the reaction rate law<br>**Reader:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 0% |
| **2** | Understand the physical meaning of the reaction rate law. | Formulate the reaction rate law, if given data on the function of concentration versus time. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. 1. Participation during lectures, carried out through observation (weight 2)<br>3. 2. UTS and UAS, carried out once, assessing all relevant indicators through a written exam, averaged and weighted (2))<br>4. 3. Tasks are weighted (3)<br>5. 4. The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10 | Practice transforming and interpreting differential form equations into integral form for the zeroth power to the nth power<br>Discussion<br>3 X 50 | | **Material:** Transforming and interpreting differential form equations into integral form for the zero to the nth power.<br>**Reference:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 0% |
| **3** | Understand the physical meaning of the reaction rate law. | Formulate the reaction rate law, if given data on the function of concentration versus time. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. 1. Participation during lectures, carried out through observation (weight 2)<br>3. 2. UTS and UAS, carried out once, assessing all relevant indicators through a written exam, averaged and weighted (2))<br>4. 3. Tasks are weighted (3)<br>5. The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10 | Formulate the reaction rate law, if given data on the function of concentration versus time. [studying; practicum]<br>Structured assignments (BKT KF3 KPM)<br>3 X 50 | | **Material:** reaction rate law, if given data on the function of concentration versus time.<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 0% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **4** | Understand the physical meaning of the reaction rate law. | Use the rate law to predict the rate of a reaction at another known concentration. | **Criteria:**<br>1.The assessment is carried out on the following aspects:<br>2.Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10 | Practice predicting reaction rates at other known concentrations.<br>3 X 50 | | **Material:** Rate law for predicting reaction rates at other known concentrations.<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 0% |
| **5** | Understand the physical meaning of the reaction rate law. | Use the rate law to predict the reaction rate at other known concentrations. | **Criteria:**<br>1.The assessment is carried out on the following aspects:<br>2.Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** : Participatory Activities | Practice predicting the reaction rate at other known concentrations and calculating the value of k<br>3 X 50 | | **Material:** rate law for predicting reaction rates at other known concentrations.<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 10% |
| **6** | Explain the physical meaning of the function of reaction rate against reaction temperature. | 1.Using Arrhenius‘ law to analyze data (more than two) k functions on temperature.<br>2.Using Arrhenius‘ law to analyze data (two data) on the function of k on temperature. | **Criteria:**<br>1.The assessment is carried out on the following aspects:<br>2.Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10 | discussion and practice questions<br>3 X 50 | | **Material:** Arrhenius law to analyze data (more than two) k functions on temperature, Arrhenius law to analyze data (two data) k functions on temperature<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 0% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **7** | Explain the physical meaning of the reaction rate function on a catalyst. | Using Arrhenius‘ law to predict changes in reaction rates due to the addition of a catalyst at a certain temperature. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10 | Presentation and discussion 3 X 50 | | **Material:** Arrhenius‘ law to predict changes in reaction rates due to the addition of a catalyst at a certain temperature.<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 0% |
| **8** | UTS | 1. Formulate the reaction rate law, if given data on the function of concentration versus time.<br>2. Formulate the reaction rate law, if given data on the function of concentration versus time.<br>3. Formulate the reaction rate law, if given data on the function of concentration versus time.<br>4. Use the rate law to predict the rate of a reaction at another known concentration.<br>5. Use the rate law to predict the reaction rate at other known concentrations<br>6. Using Arrhenius‘ law to analyze data (more than two) k functions on temperature.<br>7. Using Arrhenius‘ law to analyze data (two data) on the function of k on temperature.<br>8. Using Arrhenius‘ law to predict changes in reaction rates due to the addition of a catalyst at a certain temperature. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** : Test | 3 X 50 | | | 20% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **9** | Understand how to determine mechanisms using the reaction kinetics approach. | Testing the correctness of the reaction mechanism design, both simple reactions and complex (chain) reactions. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10 | Discussion and practice questions<br>3 X 50 | | **Material:** Test the correctness of the reaction mechanism design, both simple reactions and complex (chain) reactions.<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 5% |
| **10** | Explain how to determine the mechanism using the reaction kinetics approach. | Testing the correctness of the reaction mechanism design, both simple reactions and complex (chain) reactions. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10 | Discussion and practice questions<br>3 X 50 | | **Material:** Test the correctness of the reaction mechanism design, both simple reactions and complex (chain) reactions.<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 0% |
| **11** | Explain how to determine the mechanism using the reaction kinetics approach. | 1. Testing the correctness of the reaction mechanism design, both simple reactions and complex (chain) reactions.<br>2. Testing quantitative measures to gain advantages in implementing the chain length concept. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** : Participatory Activities | discussion and practice questions<br>3 X 50 | | **Material:** Test the correctness of the reaction mechanism design, both simple reactions and complex reactions (chain), test quantitative actions to gain advantages in implementing the concept of chain length.<br>**References:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 10% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **12** | Explain how to determine the mechanism using the reaction kinetics approach. | 1. Testing quantitative measures to gain advantages in implementing the chain length concept.<br>2. Determining alignment with ideas about reaction mechanisms. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** : Participatory Activities | Discussion and practice questions<br>3 X 50 | | **Material:** How to determine mechanisms using a reaction kinetics approach.<br>**Reference:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 10% |
| **13** | Explain the mechanisms for homogeneous catalytic reactions in solution. | 1. Evaluate the types of activated complexes in the Herzfeld mechanism (general homogeneous catalytic reactions in solution).<br>2. Evaluating the Arrhenius complex type Herzfeld mechanism for the case of extremely different substrate and catalyst concentrations. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** : Participatory Activities | Presentation and discussion<br>3 X 50 | | **Material:** Mechanisms for homogeneous catalysis reactions in solutions.<br>**Reference:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 10% |
| **14** | Explain the mechanism of acid or base catalyzed reactions. | 1. Determine the intermediate and solvent species for different types of catalyst (strong acid, weak acid, strong base, or weak base).<br>2. Distinguish between protolytic type and prototropic type acid catalysis mechanisms. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** : Participatory Activities | Discussion and practice questions<br>1 X 1 | | **Material:** Mechanisms of acid or base catalyzed reactions.<br>**Reference:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 10% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **15** | Explain the mechanism of acid or base catalyzed reactions. | Distinguish between specific protolytic type and general protolytic type base catalysis mechanisms. | **Criteria:**<br>1. The assessment is carried out on the following aspects:<br>2. Participation during lectures is carried out through observation (weight 2)UTS and UAS, carried out once, assessing all relevant indicators through written exams, averaged and given a weight (2))Assignments are given a weight (3)The final NA is (participation value x2 ) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** : Participatory Activities | Discussion and practice questions<br>3 X 50 | | **Material:** Distinguish between specific protolytic type and general protolytic type base catalysis mechanisms.<br>**Reference:** *Wilkinson, Frank. 1975. Chemical Kinetics and Reaction Mechanisms. Victoria: Van Nostrand Reinhold Company.* | 10% |
| **16** | UAS | UAS | **Criteria:**<br>UAS<br><br>**Form of Assessment** : Test | UAS<br>3 X 50 | | | 20% |

**Evaluation Percentage Recap: Project Based Learning**

| No | Evaluation | Percentage |
|---|---|---|
| 1. | Participatory Activities | 60% |
| 2. | Test | 40% |
| | | 100% |

**Notes**

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.