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| | **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 |
|---|---|---|---|---|---|---|---|
| **Polyfunctional Organic Compounds** | 8420402326 | Compulsory Curriculum Subjects - National | **T=2** | **P=0** | **ECTS=3.18** | 4 | July 17, 2024 |

| AUTHORIZATION | SP Developer | Course Cluster Coordinator | Study Program Coordinator |
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| | Dr. Mitarlis, S.Pd., M.Si. | Prof. Dr. Suyatno, M.Si. | Prof. Dr. Utiya Azizah, M.Pd. |

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| **Learning model** | **Project Based Learning** | |
| **Program Learning Outcomes (PLO)** | **PLO study program which is charged to the course** | |
| | **PLO-5** | Able to make decisions based on data/information in order to complete tasks that are their responsibility and evaluate performance that has been carried out both individually and in groups, has an entrepreneurial spirit with an environmental perspective (CPL 7) |
| | **PLO-7** | Applying logical, critical, systematic and innovative thinking in the context of the development or implementation of science, technology and art that pays attention to and applies humanities values appropriate to the field of chemistry education in solving problems (CPL 5) |
| | **PLO-10** | Able to design, implement, evaluate, learn and develop chemistry learning media by utilizing Information and Communication Technology (CPL 4) |
| | **PLO-11** | Able to demonstrate knowledge related to theoretical concepts about structure, dynamics and energy, as well as basic principles of separation, analysis, synthesis and characterization of chemicals (CPL 1) |
| | **Program Objectives (PO)** | |
| | **PO - 1** | Utilize learning resources and ICT to support understanding of concepts in polyfunctional organic chemistry material through discussion and collaboration |
| | **PO - 2** | Explain the various types of structures, properties and basic reactions that are characteristic of organic compounds with more than one functional group (polyfunction). |
| | **PLO-PO Matrix** | |

| P.O | PLO-5 | PLO-7 | PLO-10 | PLO-11 |
|---|---|---|---|---|
| PO-1 | | | | |
| PO-2 | | | | |

**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 |
| PO-1 | | | | | | | | | | | | | | | | |
| PO-2 | | | | | | | | | | | | | | | | |

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| **Short Course Description** | Study of polyfunctional organic compounds, polycyclic and heterocyclic aromatic hydrocarbons, carbohydrates, proteins, lipids and biological organic compounds. | |
| **References** | **Main :** | |


1. Fessenden, R.J. dan Fessenden, J.S. (1998). Kimia Organik. Jilid 2. Penerjemah AH Pudjaatmaka. Jakarta: Erlangga.
2. Hart, H., Craine, L.E. & Hart, D.J. (2003). Kimia Organik. Suatu Kuliah Singkat. Edisi ke XI. Penerjemah: Achmadi, S.S., Jakarta: Erlangga.
3. Solomon, T.W.G. & Fryhle, C.B. (2011). Organic Chemistry. New York: John Wiley & Sons, Inc.
4. Carey, F.A. (2000). Organic Chemistry. 4rd Ed. New York: McGraw-Hill Companies, Inc.
5. Brewster, R.Q. (1976). Organic Chemistry. 3rd Edition. New Delhi: Prentice Hall.
6. Matsjeh, S. (1996). Kimia Organik II. Jakarta: Depdikbud Dirjendikti.
7. Antony D. Buss and Mark S. Butler (2010). Natural Product Chemistry for Drug Discovery. RSC Publishing


**Supporters:**

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| | 1. K. Peter C. Vollhardt, Neil E. Schore(2011). Organic Chemistry. 6th Ed. W. H. Freeman.<br>2. Janice G. Smith (2011). Organic Chemistry. 3rd Ed. McGraw-Hill.<br>3. Jurnal – jurnal Internasional: Phytochemistry, Journal of Natural Products, Planta Medica, Natural Product Research, Natural Product Sciences, Fitoterapia<br>4. Mauricio A. Rostagno and Juliana M. Prado (2013). Natural Product Extraction Principles and Applications. RSC Green Chemistry |
| **Supporting lecturer** | Dr. Mitarlis, S.Pd., M.Si.<br>Dr.Hj. Rinaningsih, S.Pd., M.Pd.<br>Dr. Ratih Dewi Saputri, S.Si., M.Si.<br>Dr. First Ambar Wati, S.Si. |

| 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 | 1. Understand the Polyfunctional Organic Chemistry lecture system 2. Explain the various types of structures, properties and basic reactions that are characteristic of organic compounds with more than one functional group (polyfunction) | 1. Explain the RPS, lecture system, assessment system, determination of graduation and course rules for Polyfunctional Organic Chemistry 2. Explain the chemical reactions of dicarboxylic acids 3. Explain the formation of lactones and lactides from hydroxy carboxylic acids 4. Explain the decarboxylation reactions in oxocarboxylic acids 5. Explain Diels Alder reaction | **Criteria:**<br>1. Participation during lectures, carried out through observation (weight 2)<br><br>**Form of Assessment** :<br>Participatory Activities | 1. Explain the RPS, lecture system, assessment system, determination of graduation and course rules for Polyfunctional Organic Chemistry<br>2. Explain the chemical reactions of dicarboxylic acids<br>3. Explain the formation of lactones and lactides from hydroxy carboxylic acids<br>4. Explain the decarboxylation reaction in oxocarboxylic acids<br>5. Explain Diels Alder reaction<br>100 minutes | | **Material:** 1. Dicarboxylic acids, 2. Hydroxy carboxylic acids, 3. Oxocarboxylic acids 4. Dihydroxy compounds, 5. Hydroxy carbonyl compounds 6. Dicarbonyl compounds, 7. Diels-Alder reaction<br>**Reference:**<br>*Carey, FA (2000). Organic Chemistry. 4th Ed. New York: McGraw-Hill Companies, Inc.*<br><br>**Material:** 1. Polycyclic aromatic hydrocarbons, 2. Heterocyclic aromatic hydrocarbons.<br>**References:**<br>*Solomon, TWG & Fryhle, C.B. (2011). Organic Chemistry. New York: John Wiley & Sons, Inc.* | 5% |
| 2 | Explain the various types of structures, properties and basic reactions that are characteristic of organic compounds with more than one functional group (polyfunctionality). | 1. Explain the chemical reactions of dicarboxylic acids 2. Explain the formation of lactones and lactides from hydroxy carboxylic acids 3. Explain the decarboxylation reactions in oxocarboxylic acids 4. Explain the Diels Alder reaction | **Criteria:**<br>1.1. Participation during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3) | assignments, discussions, questions and answers, and practice questions<br>3 X 50 | assignments, discussions, questions and answers, and practice questions | **Materials:** 1. Dicarboxylic acids, 2. Hydroxy carboxylic acids, 3. Oxocarboxylic acids 4. Dihydroxy compounds, 5. Hydroxy carbonyl compounds 6. Dicarbonyl compounds, 7. Diels-Alder reaction<br>**Reference:**<br>*Janice G. Smith (2011). Organic Chemistry. 3rd Ed. McGraw-Hill.* | 5% |

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| **3** | Explain the structure, nomenclature, and chemical properties of polycyclic and heterocyclic aromatic hydrocarbons | 1. Explain electrophilic substitution reactions in polycyclic hydrocarbon compounds. 2. Write examples of oxidation and reduction reactions in polycyclic aromatic hydrocarbon compounds. 3. Explain the basicity of heterocyclic aromatics and their solubility in water in relation to hydrogen bonds. 4. Explain electrophilic substitution reactions in heterocyclic aromatic hydrocarbon compounds | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities | Questions and Answers, Class discussions, Completion of assignments (reading assignments, making summaries) Practice questions<br>3 X 50 | | **Material:** 1. Polycyclic aromatic hydrocarbons, 2. Heterocyclic aromatic hydrocarbons.<br>**References:** *Solomon, TWG & Fryhle, C.B. (2011). Organic Chemistry. New York: John Wiley & Sons, Inc.* | 5% |
| **4** | Explain the structure, nomenclature, and chemical properties of polycyclic and heterocyclic aromatic hydrocarbons | 1. Explain electrophilic substitution reactions in polycyclic hydrocarbon compounds. 2. Write examples of oxidation and reduction reactions in polycyclic aromatic hydrocarbon compounds. 3. Explain the basicity of heterocyclic aromatics and their solubility in water in relation to hydrogen bonds. 4. Explain electrophilic substitution reactions in heterocyclic aromatic hydrocarbon compounds | **Criteria:**<br>1.1. Participation during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities | Questions and Answers, Class discussions, Completion of assignments (reading assignments, making summaries) Practice questions<br>3 X 50 | | **Material:** 1. Polycyclic aromatic hydrocarbons 2. Heterocyclic aromatic hydrocarbons.<br>**Bibliography:** *K. Peter C. Vollhardt, Neil E. Schore (2011). Organic Chemistry. 6th Ed. WH Freeman.* | 5% |
| **5** | Understand the structure, nomenclature and chemical properties of carbohydrates | .1. Explain the structure of carbohydrates 2. Explain the cyclization process in monosaccharides 3. Explain the reactions that occur in carbohydrates 4. Explain the role of carbohydrates for living things | **Criteria:**<br>1.1. Participation during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities | Questions and Answers, Class<br>3 X 50<br>discussion | | **Material:** 1. Definition, structure and nomenclature of carbohydrates 2. Monosaccharides 3. Disaccharides 4. Polysaccharides 5. Carbohydrate reactions<br>**References:** *K. Peter C. Vollhardt, Neil E. Schore (2011). Organic Chemistry. 6th Ed. WH Freeman.* | 5% |
| **6** | Understand the structure, nomenclature and chemical properties of carbohydrates | .1. Explain the structure of carbohydrates 2. Explain the cyclization process in monosaccharides 3. Explain the reactions that occur in carbohydrates 4. Explain the role of carbohydrates for living things | **Criteria:**<br>1.1. Participation during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities | Questions and Answers, Class<br>3 X 50<br>discussion | | **Material:** 1. Definition, structure and nomenclature of carbohydrates 2. Monosaccharides 3. Disaccharides 4. Polysaccharides 5. Carbohydrate reactions<br>**References:** *K. Peter C. Vollhardt, Neil E. Schore (2011). Organic Chemistry. 6th Ed. WH Freeman.* | 5% |

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| **7** | Understand the structure, nomenclature and chemical properties of carbohydrates | 1. Explain the structure of carbohydrates 2. Explain the cyclization process in monosaccharides 3. Explain the reactions that occur in carbohydrates 4. Explain the role of carbohydrates for living things | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities, Practical Assessment | Case study (Case Study)<br>3 X 50 | | **Material:** application of carbohydrate material in its application to living things.<br>**Reference:** *K. Peter C. Vollhardt, Neil E. Schore (2011). Organic Chemistry. 6th Ed. WH Freeman.*<br><br>**Material:** reviewing journals related to carbohydrates for living creatures.<br>**Library:** *International journals: Phytochemistry, Journal of Natural Products, Planta Medica, Natural Product Research, Natural Product Sciences, Fitotherapy* | 10% |
| **8** | Mid-Semester Exam to assess the achievement of Final Skills from TM 1 to 7 | Mid-semester exam to assess achievement of indicators from TM 1 to 7 | **Criteria:**<br>1.Attached to the UTS question assessment rubric<br>2.Sub-summative test, carried out twice, assesses all relevant indicators through written examinations (UTS), averaged and weighted (2)<br><br>**Form of Assessment** :<br>Test | Midterm Exam<br>2 X 50 | | | 10% |
| **9** | Understand the structure, types and chemical properties of amino acids and proteins | 1. Explain the structure of amino acids 2. Explain chemical reactions in amino acids 3. Explain the reaction to form peptides 4. Explain the structure and function of proteins 5. Explain the process of protein denaturation | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities, Practical Assessment | Questions and Answers and Discussion for class<br>3 X 50 | | **Material:** 1. Amino acids 2. Peptides 3. Proteins and enzymes<br>**References:** *Hart, H., Craine, LE & Hart, DJ (2003). Organic Chemistry. A Short Lecture. XIth Edition. Translator: Achmadi, SS, Jakarta: Erlangga.* | 5% |

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| **10** | Understand the structure, types and chemical properties of amino acids and proteins | 1. Explain the structure of amino acids 2. Explain chemical reactions in amino acids 3. Explain the reaction to form peptides 4. Explain the structure and function of proteins 5. Explain the process of protein denaturation | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities, Practical Assessment | Questions and Answers and Discussion for class<br>3 X 50 | | **Material:** 1. Amino acids 2. Peptides 3. Proteins and enzymes<br>**References:**<br>*Hart, H., Craine, LE & Hart, DJ (2003). Organic Chemistry. A Short Lecture. XIth Edition. Translator: Achmadi, SS, Jakarta: Erlangga.*<br><br>**Material:** application of amino acids, proteins and enzymes in macromolecular compounds.<br>**Reference:**<br>*Solomon, TWG & Fryhle, CB (2011). Organic Chemistry. New York: John Wiley & Sons, Inc.* | 5% |
| **11** | Understand the structure, nomenclature, chemical properties of lipids | .1. Explain the structure and function of lipids 2. Explain the chemical reactions of lipids 3. Explain the structure of steroids and their role as hormones | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities, Practical Assessment | questions and answers and discussion<br>3 X 50 | | **Material:** can apply the material on hydrogenation of vegetable oils and the saponification process of oils and fats and can solve problems in making detergents.<br>**Reference:**<br>*Janice G. Smith (2011). Organic Chemistry. 3rd Ed. McGraw-Hill.*<br><br>**Material:** The process of soaping oils and fats and can solve problems in making detergents.<br>**Library:**<br>*International journals: Phytochemistry, Journal of Natural Products, Planta Medica, Natural Product Research, Natural Product Sciences, Fitotherapy* | 10% |

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| **12** | Understand the structure, nomenclature, chemical properties of lipids | .1. Explain the structure and function of lipids 2. Explain the chemical reactions of lipids 3. Explain the structure of steroids and their role as hormones | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities, Practical Assessment | Case study (Case Study) and presented 3 X 50 | | **Material:** can apply the material on hydrogenation of vegetable oils and the saponification process of oils and fats and can solve problems in making detergents.<br>**Reference:**<br>*Janice G. Smith (2011). Organic Chemistry. 3rd Ed. McGraw-Hill.*<br><br>**Material:** The process of soaping oils and fats and can solve problems in making detergents.<br>**Library:**<br>*International journals: Phytochemistry, Journal of Natural Products, Planta Medica, Natural Product Research, Natural Product Sciences, Fitotherapy* | 5% |
| **13** | Explain the bioactive compounds (secondary metabolites including terpenoids, steroids, flavonoids and alkaloids) of plants and state their benefits in the pharmaceutical industry | 1. Explain the types of bioactive compounds (secondary metabolites) from plants 2. Name the types of plants native to Indonesia that have medicinal properties | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.2. The mid-term exam (UTS) is carried out to assess the TM 1-7 indicators, through a written exam, and is given a weighting of (2)<br>3.3. Structured task assessments are averaged, then given a weight (3)<br>4.4. The final semester exam (UAS) is used to measure the achievement of the TM 9-15 indicators, through a written exam, and the results are given a weight of 3.<br>5.5. The final NA is (participation grade") (Assignment grade%2 3) (UTS grade%2 2) UAS grade (3) divided by 10<br><br>**Form of Assessment** :<br>Participatory Activities, Practical Assessment | Discussion, presentation and assignment 3 X 50 | | **Material:** secondary metabolites of terpenoid compounds, steroids, flavonoids and alkaloids<br>**Reference:**<br>*Mauricio A. Rostagno and Juliana M. Prado (2013). Natural Product Extraction Principles and Applications. RSC Green Chemistry*<br><br>**Material:** secondary metabolite compound material and bioactivity of secondary metabolite compound content<br>**Library:**<br>*International journals: Phytochemistry, Journal of Natural Products, Planta Medica, Natural Product Research, Natural Product Sciences, Fitotherapy* | 5% |

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| **14** | Explain the bioactive compounds (secondary metabolites including terpenoids, steroids, flavonoids and alkaloids) of plants and state their benefits in the pharmaceutical industry | 1. Explain the types of bioactive compounds (secondary metabolites) from plants 2. Name the types of plants native to Indonesia that have medicinal properties | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities, Practical Assessment | Discussion, presentation and assignment<br>3 X 50 | | **Material:** secondary metabolites of terpenoid compounds, steroids, flavonoids and alkaloids<br>**Reference:** *Mauricio A. Rostagno and Juliana M. Prado (2013). Natural Product Extraction Principles and Applications. RSC Green Chemistry*<br><br>**Material:** secondary metabolite compound material and bioactivity of secondary metabolite compound content<br>**Library:** *International journals: Phytochemistry, Journal of Natural Products, Planta Medica, Natural Product Research, Natural Product Sciences, Fitotherapy* | 5% |
| **15** | Explain the bioactive compounds (secondary metabolites including terpenoids, steroids, flavonoids and alkaloids) of plants and state their benefits in the pharmaceutical industry | 1. Explain the types of bioactive compounds (secondary metabolites) from plants 2. Name the types of plants native to Indonesia that have medicinal properties | **Criteria:**<br>1.1. Participation is assessed during lectures, carried out through observation (weight 2)<br>2.3. Structured task assessments are averaged, then given a weight (3)<br><br>**Form of Assessment** :<br>Participatory Activities, Portfolio Assessment | Case study: Can name types of native Indonesian plants that have medicinal properties and can solve problems with native Indonesian plants that can be continued as herbal products<br>3 X 50 | | **Material:** secondary metabolites of terpenoid compounds, steroids, flavonoids and alkaloids<br>**Reference:** *Mauricio A. Rostagno and Juliana M. Prado (2013). Natural Product Extraction Principles and Applications. RSC Green Chemistry*<br><br>**Material:** secondary metabolite compound material and bioactivity of secondary metabolite compound content<br>**Library:** *International journals: Phytochemistry, Journal of Natural Products, Planta Medica, Natural Product Research, Natural Product Sciences, Fitotherapy* | 5% |

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| **16** | Students understand the concepts, attitudes and skills in the Polyfunctional Organic Chemistry course | Understand the concepts, attitudes and skills in the Polyfunctional Organic Chemistry course | **Criteria:**<br>1. Attached to the UAS assessment rubric<br>2. UAS scores are given a weight of 3. The final NA is (participation score x2) (Assignment score x 3) (UTS score x 2) UAS score (3) divided by 10<br><br>**Form of Assessment** :<br>Test | Final Semester Examination (UAS)<br>2 X 50 | | | 15% |

**Evaluation Percentage Recap: Project Based Learning**

| No | Evaluation | Percentage |
|---|---|---|
| 1. | Participatory Activities | 50% |
| 2. | Portfolio Assessment | 2.5% |
| 3. | Practical Assessment | 22.5% |
| 4. | Test | 25% |
| | | 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.