# Course Syllabus
# MBMG 512 DNA Engineering
# Academic year 2023 (September 2nd to 20th, 2024)

**Course ID and Name:** MBMG 512 DNA Engineering

**Course coordinator:** Prof. Chalermporn Ongvarrasopone, Ph.D.
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**Instructors:**

1. Prof. Apinunt Udomkit, Ph.D.
2. Prof. Chalermporn Ongvarrasopone, Ph.D.
3. Assoc. Prof. Surapon Piboonpocanun, Ph.D.
4. Asst. Prof. Kusol Pootanakit, Ph.D.
5. Assoc. Prof. Chalongrat Noree, Ph.D.
6. Asst. Prof. Poochit Nonejuie, Ph.D.
7. Lecturer Ittipat Meewan, Ph.D.

**Lab supporting Staff:**

1. Ms. Chanikarn Boonchuay
2. Ms. Sasithorn Mongaim
3. Ms. Somsri Sakdee
4. Mr. Pannaphan Makarathut
5. Dr.Thaneeya Nantapojd

**Credits:** 2(1-2-3)

**Curriculum:** Master of Science Program in Molecular Genetics and Genetic Engineering (required course)

Doctor of Philosophy Program in Molecular Genetics and Genetic Engineering (required course for students from B.Sc.)

**Semester offering:** First semester

**Pre-requisites:** None

**Course learning outcomes:**

At the end of the course, students are able to:

1. Integrate comprehensive knowledge in DNA cloning technology to solve scientific research questions.
2. Conduct experiments related to DNA cloning technology.
3. Analyze and present laboratory data in a scientific manner.
4. Demonstrate scientific integrity, responsibility, and safety practice.
5. Demonstrate critical thinking, teamwork, interpersonal skills and responsibilities for the work assignments.

**Alignment of teaching and assessment methods to course learning outcomes:**

| Program learning outcomes | Course learning outcomes | Teaching and learning approaches | Assessment methods |
|---|---|---|---|
| 1. Integrate comprehensive knowledge in Molecular Biology and related disciplines to solve scientific research problems (M.Sc., Ph.D.) | 1. Integrate comprehensive knowledge in DNA cloning technology to solve scientific research questions. | (1) On-site lecture<br>(2) On-site discussion | (1) Written examination<br>(2) On-site discussion<br>(3) Quizzes<br>(4) Assignment in google classroom |
| 2. Conduct systematic research in Molecular Biology with specialized technical skills. (M.Sc., Ph.D.) | 2. Conduct experiments related to DNA cloning technology | (1) Hands-on practice<br>(2) Class / on-site discussion<br>(3) VDO demonstration | (1) Direct observation<br>(2) Lab performance test |
| 3. Present research findings in Molecular Biology to scientific community. (M.Sc., Ph.D.) | 3. Analyze and present laboratory data in a scientific manner. | (1) Experimental data presentation and discussion in-class | (1) Reports<br>(2) Lab notebooks<br>(3) Short presentation<br>(4) Participation in discussion |
| 4. Demonstrate scientific integrity including ethical responsibilities and safety practices as appropriate. (M.Sc., Ph.D.) | 4. Demonstrate scientific integrity, responsibility, and safety practice. | (1) Assignment in google classroom<br>(2) Lab safety guidelines | (1) Assessment of assigned work<br>(2) Direct observation<br>(3) On-site attendance |
| 5. Acquire professional and interpersonal skills for lifelong learning. (M.Sc., Ph.D.) | 5. Demonstrate critical thinking, teamwork, interpersonal skills and responsibilities for the work assignments. | (1) Group/individual assignment in google classroom | (1) Direct observation<br>(2) Assessment of assigned work<br>(3) Assessment of responsibility for assigned work |

**Course description:**

Basic techniques in genetic engineering; DNA cloning, vectors, restriction enzymes, extraction of DNA from agarose gel, quantitation of DNA, ligation, competent cell preparation, transformation, plasmid DNA purification and screening of the recombinant clones. Principle of instrumentations such as Pipetting techniques, agarose gel electrophoresis, centrifuges, absorption and fluorescence spectroscopy, pH meter, and biological buffer systems. Computational analysis in various aspects such as *In-silico* plasmid construction; restriction enzyme mapping, sequence manipulation, plasmid map construction and *In-silico* DNA concentration estimation by Image analysis. Laboratory safety handling.

**Course schedule:**

Date: Monday-Friday
Time: 09.00-16.30
Rooms C405 / on-site (Lecture) and D408 (Lab), Institute of Molecular Biosciences, Mahidol University.

| Date/time | Topics/Details | Number of Hours | Class Activity/Teaching Media | Lecturers |
|---|---|---|---|---|
| **Wk1/Sept. 2** 9.00-10.00 | Orientation /Laboratory safety handling | 1 | Lecture | Chalermporn |
| 10.00-12.00 | Recombinant DNA technology overview | 2 | Lecture | Chalermporn |
| 12.00-12.30 | Checking equipment | 1 | Lab | Chalermporn |
| 13.30-14.30 | Pipetting techniques | 1 | Lab | Chalongrat, Ittipat |
| **Sept. 3** 9.00-11.00 | Reagent preparation | 2 | Lab | Chalermporn, Surapon Ittipat |
| 13.00-14.30 | pH meter | 1 | Lecture | Surapon |
| 15.00-16.00 | Prepare agar plate | 1 | Lab | Chalermporn, Chalongrat Thaneeya |
| **Sept. 4** 9.00-11.00 | Vectors and restriction enzymes | 2 | Lecture | Surapon |
| 13.00-15.00 | Spectrophotometry | 1-1(2) | Lecture-Lab | Ittipat |
| **Sept. 5** 9.00-12.00 | DNA concentration quantitation | 3 | Lab | Chalermporn Poochit Ittipat |
| 13.00-15.00 | Agarose gel electrophoresis | 2 | Lecture | Poochit |
| 15.00-16.00 | Self study | 1 | | |
| **Sept. 6** 9.00-10.00 | Set Agarose gel | 1 | Lab | Chalermporn, Poochit |
| 10.00-11.00 | Restriction enzyme | 1 | Lab | Chalermporn, |

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| | analysis | | | Surapon, Poochit, |
| 11.00-12.00 | Running agarose gel electrophoresis (1) | 1 | Lab | Chalermporn, Surapon, Poochit, |
| 13.00-15.00 | Bioinformatic tools in DNA engineering (1): *In-silico* plasmid construction | 1-2 (2) | Lecture-Lab | Poochit |
| 15.00-17.00 | Running agarose gel electrophoresis, Cut gel (2) | 2 | Lab | Chalermporn, Poochit, Surapon |
| **Wk2/Sept. 9** 9.00-12.00 | DNA purification by gel extraction method | 3 | Lab | Chalermporn, Poochit, Surapon, |
| 13.00-14.00 | Estimation of DNA concentration by agarose gel electrophoresis | 1 | Lab | Chalermporn, Poochit, Surapon, |
| 14.00-16.00 | Bioinformatic tools in DNA engineering (2): *In-silico* DNA concentration estimation: Image analysis | 1-2 | Lecture-Lab | Poochit |
| **Sept. 10** 9.00-12.00 | Bacterial transformation lecture | 3 | Lecture | Poochit |
| 13.00-15.00 | Centrifuges | 1-2 | Lecture-Lab | Apinunt |
| 15.00-16.00 | Bacteria competent cell preparation (1): Streaking | 1 | Lab | Poochit, Ittipat |
| **Sept. 11** 9.00-10.00 | DNA ligation | 1 | Lecture | Surapon |
| 10.00-11.00 | Self-study | 1 | | |
| 13.00-15.00 | Set up DNA ligation | 2 | Lab | Surapon, Chalermporn, Poochit, Ittipat |
| 15.00-16.00 | Bacteria competent cell preparation (2): Inoculation | 1 | Lab | Poochit, Ittipat |
| **Sept. 12** 10.00-14.00 | Bacteria competent cell preparation (2) | 4 | Lab | Poochit, Chalermporn, Surapon |
| 14.00-17.00 | Bacterial transformation (1) | 3 | Lab | Poochit, Chalermporn, Surapon, Ittipat |
| **Sept. 13** 8:45-9:00 | Collect plates | 0.5 | | Students' representative |
| | Bacterial transformation | 2 | Lab | Poochit, |

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| 9.00-11.00 | (2)<br>Calculate transformation efficiency | | | Chalermporn, Ittipat |
| 11.00-12.00 | Class discussion | 1 | Discussion | Poochit Chalermporn |
| 13.00-16.00 | Self-study | 4 | Self-study | |
| **Wk3/Sept. 16**<br>14.00-15.00 | Pick up colony | 1 | Lab | Poochit, Ittipat |
| **Sept. 17**<br>9.00-12.00 | Plasmid DNA extraction | 3 | Lab | Kusol, Apinunt, Ittipat |
| 13.00-16.00 | Plasmid DNA digestion and agarose gel electrophoresis | 3 | Lab | Kusol, Apinunt, Ittipat |
| **Sept. 18** | Self-study | | Self-study | |
| **Sept. 19**<br>10.00-11.30 | Examination I (Lecture) | 1h 30 min | Assignment | Chalermporn, Poochit |
| **Sept. 20**<br>10.00-12.00 | Examination II (Lab) | 2 | Written/Practical examination | Chalermporn, Poochit, Surapon, Kusol, Chalongrat Ittipat |

**Assessment Criteria:**

| Course learning outcomes | Assessment Criteria | Assessment Method | Scoring Rubric |
|---|---|---|---|
| CLO2, CLO4 | Laboratory performance 40% | (1) Direct observation<br>(2) Practical examination<br>(3) On-site discussion and short presentation | (1) Ability to follow procedure or to design a procedure for experiment<br>(2) Use of equipment<br>(3) Working area and safety |
| CLO1, CLO3 | Laboratory report/ Lab notebook 25% | (1) Electronic reports and lab notebooks | (1) Writing style<br>(2) Report sending<br>(3) Presentation of data<br>(4) Data analysis and conclusion<br>(5) Lab notebook |
| CLO1, CLO2 | Practical examination 30% | (1) Written examination<br>(2) Practical test | (1) Comprehension |
| CLO5 | Class participation, Group presentation, Group assignment | (1) Direct observation<br>(2) Short presentation<br>(3) On-site discussion | (1) Class participation<br>(2) Group work<br>(3) Assigned work |

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| | 5% | and short presentation | sending<br>(4) Group presentation |

Student's achievement will be graded using symbols: A, B+, B, C+, C, D+, D and F based on the criteria as follows:

| Percentage | Grade | Description |
|---|---|---|
| 80–100 | A | Excellent |
| 75–79 | $B^+$ | Very Good |
| 70–74 | B | Good |
| 65–69 | $C^+$ | Fairly Good |
| 60–64 | C | Fair |
| 55–59 | $D^+$ | Poor |
| 50–54 | D | Very Poor |
| 0–49 | F | Fail |

| Lab Performance Evaluation Rubric | | | | |
|---|---|---|---|---|
| **Criteria** | **Excellent (4)** | **Good (3)** | **Satisfactory (2)** | **Needs to Improve (1)** |
| **1. Ability to Follow Procedure or to Design a Procedure for Experiment (25 %)** | Actively followed the instructions in the procedure with no assistance. Showed ability to perform additional experiments or tests beyond what was required in the procedure. | Followed the instructions in the procedure with little or no assistance. If the procedure was not provided, the student was able to determine an appropriate experiment to satisfy the lab objectives. | Had difficulty with some of the instructions in the procedure and needed clarification from the instructor or lab partner. If the procedure was not provided, the student needed some guidance about experiments to perform to satisfy the lab objectives. | Had difficulty reading the procedure and following the directions. Several mistakes were made during the experiment. If the procedure was not provided, student was incapable of designing a set of experiments to satisfy the given lab objectives. |
| **2. Use of Equipment (10 %)** | Showed proper techniques for handling tools and lab equipment without error. | Showed proper techniques for handling tools and lab equipment with a few minor errors. | Showed adequate care for handling tools and lab equipment with some minor errors. | Showed improper techniques for handling with some major errors. |
| **3. Working Area and Safety (5 %)** | Lab was carried out with full attention to relevant safety procedures & directions. No incident occurred. Outstanding job cleaning up working area, tools and equipment. Lab tools were organized and stored with care. | Lab was generally carried out with attention to relevant safety procedures & directions. No incident occurred. Good job on cleaning up working area, tools and equipment. Lab tools were properly stored. | Lab was carried out with some attention to relevant safety procedures & directions. A few incidents occurred. Had to be reminded to clean up area and equipment. Sometimes showed disorganized storage of lab tools. | Safety procedures were ignored. Did not follow directions. Several incidents occurred. Did not clean up area and equipment after working. Showed disorganized storage of lab tools. |
| **Total (40 %)** | **Total points earned =** | | | |

| Lab Report/ Lab notebook Evaluation Rubric | | | | |
|---|---|---|---|---|
| **Criteria** | **Excellent (4)** | **Good (3)** | **Satisfactory (2)** | **Needs to Improve** |

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| | | | | **(1)** |
| **1. Writing Style (3 %)** | Report was neat and well organized with minimum spelling error. | Report was neat and appropriately organized with a few spelling errors. | Report was somewhat neat and organized with some spelling errors. | Report was disorganized with many spelling errors. |
| **2. Report Sending (1%)** | Report was sent on time. | Report was sent one day late. | Report was sent two days late. | Report was sent more than two days late. |
| **3. Presentation of Data (4%)** | Experimental data was clearly presented with tables, diagrams, pictures or graphs that effectively present the experimental data. Showed clear detail of results and graphical data were labeled accurately. | Experimental data was presented in an appropriate format with only a few minor errors or omissions. Showed clear detail of results and graphical data were labeled accurately. | Experimental data was presented in an appropriate format but some significant errors were noticed. Some tables, graphical data could be better organized. Some units, labels, and titles were missing. | Experimental data was poorly presented. Graphs or tables were poorly constructed with several errors. Data was missing or incorrect. Some units, labels, and titles were not included. |
| **4. Data Analysis and Conclusion (2%)** | Reasonable scientific explanations for the results were discussed and logically analyzed. Conclusion was well written with a complete answer to the question or hypothesis. Provided description of what was learned, possible sources of error, good suggestions for improving the experiment and application. | Scientific explanations for the results were given. Conclusion was appropriately written with a possible answer to the question or hypothesis. Provided description of what was learned, possible sources of error, suggestions for improving the experiment and application. | Scientific explanations for the results were given but not complete or accurate. Conclusion was written with inaccurate answer to the question or hypothesis. Description of what was learned, possible sources of error, suggestions for improving the experiment and application were missing. | Scientific explanations for the results were given but not complete or accurate. Conclusion was poorly written with inaccurate answer to the question or hypothesis. Description of what was learned, possible sources of error, suggestions for improving the experiment and application were missing. |
| **5. Lab notebook (15 %)** | Lab notebook was complete including procedure for each experiment, calculation, results and conclusion. | Lab notebook was sufficiently complete with only minor omissions. | Lab notebook had partial information with major omissions. | Lab notebook was incomplete and difficult to understand. |
| **Total (25 %)** | **Total points earned =** | | | |

| Class participation, Group presentation, Group assignment Rubric | | | | |
|---|---|---|---|---|
| **Criteria** | **Excellent (4)** | **Good (3)** | **Satisfactory (2)** | **Needs to Improve (1)** |
| **1. Class participation (1 %)** | Used time well in class and focused attention on the lecture and experiments. Actively participated in the group and in classroom discussion. | Used time pretty well. Stayed focused on the lecture and experiments most of the time. Usually provided useful ideas when participating in the group and in classroom discussion. | Focused on the class but did not appear very interested. Sometimes provided useful ideas when participating in the group and in classroom discussion. | Participation was minimal. Rarely provided useful ideas when participating in the group and in classroom discussion. |
| **2. Group work (2%)** | Shared a lot of work with others. Gave ideas and helped others to complete the assigned work. | Shared equal work as others. Gave ideas and completed the assigned work in the group. | Did almost as much work as others. Sometime gave ideas and asked for help from others. | Did less work than others. Did not give ideas or ask for help from others. |
| **3. Assigned work sending (1%)** | Completed assigned work on time. | Completed assigned work one day late. | Needed some reminding; work was late but no more than two days. | Needed much reminding; work was late more than two days. |
| **4. Group presentation (1%)** | The presentation was well organized, and easy to follow. All of the group members contributed equally to the presentation. | The presentation had good organization. Everyone gave some presentation but someone gave more contributions than others. | The presentation could be better organized. Certain people did not do as much work as others. | The presentation lacked organization. A few people or only one person worked on the presentation. |
| **Total (5 %)** | **Total points earned =** | | | |

**Date revised:** August 21st, 2024