LIFS 3110  Biotechnological Applications of Recombinant DNA Techniques

Course Outline for Fall 2021 – 2022

Teaching Team
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Course Description
Credit Points: 3
Pre-requisite: LIFS 2040 AND LIFS 2210

The course LIFS 3110 Biotechnological Applications of Recombinant DNA Techniques comprises altogether seven laboratory exercises. The goals of these exercises are three-fold: (1) to enhance students' comprehension of what they have learnt in lectures; (2) to demonstrate practical skills in the fields of Biotechnology and Molecular Biology; and (3) to prepare students for advanced laboratory studies.

Students will be given exposure to the following areas of molecular biology and recombinant DNA technology:

- Microbial culture and aseptic techniques
- Analysis of plasmid DNA by agarose gel electrophoresis
- Restriction endonuclease digestion
- Amplification of DNA by polymerase chain reaction
- DNA recovery from agarose gel
- Plasmid construction by Gibson Assembly
- Transformation of E. coli
- Plasmid DNA isolation
- Site-directed mutagenesis
- Quantitative analysis of recombinant proteins
Intended Learning Outcomes (ILOs)

Upon successful completion of this course, students should be able to:

1. Acquire a sound knowledge of recombinant DNA methodology, gene structure and expression.
2. Perform practical skills relating to molecular biology and bacterial culturing to yield recombinant DNA / protein.
3. Demonstrate analytical awareness via interpretation of experimental results.
4. Plan and execute recombinant DNA techniques in order to determine and interpret genetic modifications.
5. Work and coordinate effectively in a group to accomplish laboratory based tasks.
6. Exhibit accuracy and independence in recording and reporting results.

Learning Activities

1. Tutorial: Theoretical concepts related to the experiments will be reviewed in detail. Analysis and interpretation of experimental results will also be explained.
2. Pre-lab talk: Contents will focus on basic theoretical and practical issues pertaining to the experiment.
3. Practical demonstration: Specific techniques in each laboratory exercise will be demonstrated by the instructor or teaching assistant (TA) in real-time or pre-recorded close-up videos. Students are expected to learn a core set of techniques that will be used repeatedly throughout the semester.
4. Laboratory exercise: A group of two to three students will collaborate to perform the experiments. Workbench, routinely used labware and instruments will be assigned to and managed by each group of students.
5. Bench supervision: Each TA will be in charge of one bench of students and provide assistance or instructions to ensure smooth progress. The instructor and technicians will also provide support for the class.
6. In-class discussion: In some exercises, each group of students would be expected to present their results to the instructor or TA. Additional discussion on data analysis may be conducted on a large group basis.
### Course Schedule

<table>
<thead>
<tr>
<th>Tutorial – T1</th>
<th>Laboratory – LA1</th>
<th>Laboratory – LA2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Venue</strong></td>
<td>LT-B</td>
<td>Room 4160 (near Lift 33)</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>15:00-15:50</td>
<td>14:00-17:50, unless otherwise specified</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>6 Sep (Mon)</td>
<td></td>
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<tr>
<td><strong>Exercise 1</strong></td>
<td>Analysis of plasmid DNA by restriction digestion and agarose gel electrophoresis</td>
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<td></td>
<td>13 Sep (Mon)</td>
<td>14 Sep (Tue) 14:00-15:50</td>
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<tr>
<td><strong>Exercise 2</strong></td>
<td>Amplification of DNA by polymerase chain reaction</td>
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<td></td>
<td>20 Sep (Mon)</td>
<td>21 Sep (Tue)</td>
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<tr>
<td><strong>Exercise 3</strong></td>
<td>Plasmid construction by Gibson Assembly</td>
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<td></td>
<td>4 Oct (Mon)</td>
<td>5 Oct (Tue)</td>
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<tr>
<td><strong>Exercise 4</strong></td>
<td>Transformation of <em>Escherichia coli</em> by plasmid DNA</td>
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<td></td>
<td>18 Oct (Mon)</td>
<td>19 Oct (Tue)</td>
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<tr>
<td></td>
<td>20 Oct (Wed) 10:30-11:20*</td>
<td>27 Oct (Wed) 10:30-11:20*</td>
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<tr>
<td><strong>Exercise 5</strong></td>
<td>Plasmid miniprep and restriction analysis</td>
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<td></td>
<td>1 Nov (Mon)</td>
<td>1 Nov (Mon) 10:30-11:20*</td>
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<tr>
<td></td>
<td>2 Nov (Tue)</td>
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<tr>
<td><strong>Exercise 6</strong></td>
<td>QuikChange site-directed mutagenesis</td>
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<td></td>
<td>15 Nov (Mon)</td>
<td>16 Nov (Tue)</td>
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<tr>
<td></td>
<td>17 Nov (Wed) 10:30-11:20*</td>
<td>24 Nov (Wed) 10:30-11:20*</td>
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<tr>
<td><strong>Exercise 7</strong></td>
<td>Quantitative analysis of fluorescence emission by green fluorescent proteins</td>
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<td></td>
<td>29 Nov (Mon)</td>
<td>30 Nov (Tue) 14:00-15:50</td>
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<tr>
<td><strong>Final Examination</strong></td>
<td>To be determined</td>
<td></td>
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</tbody>
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* At least 1 student per group will need to attend the pre-/post-laboratory sessions.
Assessment Scheme

1. Every student will need to submit the worksheets after laboratory sessions. Questions in the worksheets cover underlying principles of experiments, data reporting, data interpretation and statistical analysis.

2. The performance of students in laboratory sessions, including efficiency, discipline and safety awareness, will be evaluated individually and on a group basis.

3. Every student will be assessed individually in the final examination. Knowledge on concepts and principles of recombinant DNA technology, as well as the ability to analyze laboratory data will be evaluated.

<table>
<thead>
<tr>
<th>Method of assessment</th>
<th>Percentage</th>
<th>ILOs* to be assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worksheets</td>
<td>18% (6% per worksheet)</td>
<td>(1), (3) and (6)</td>
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<tr>
<td>Laboratory performance</td>
<td>14% (2% per exercise)</td>
<td>(1), (2), (4) and (5)</td>
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<tr>
<td>Final examination</td>
<td>68%</td>
<td>(1), (3), (4) and (6)</td>
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* Listed on Page ii

Evaluation on Worksheets:
Each student is required to submit THREE worksheets selected from Exercise 2 to 7. Each exercise can only be selected by one student (for groups of two), or one to two students (for groups of three). Group members should discuss in advance to arrange their submission accordingly to cover all six exercises.

Each worksheet should include your Name, Student Number, Group Number, Date, Course Code, Exercise Number, as well as the Answer to all questions. Clearly indicate the question number (e.g. 1a, 2c) that you are answering WITHOUT COPYING the questions (to avoid abnormally high percentage of similarity in Turnitin check). Completed worksheets should be submitted to the corresponding Canvas Assignment within 1 week after the exercise. Therefore, the submission will be due on NEXT TUESDAY at 6 pm, unless otherwise specified.

Students should note that all submissions MUST BE YOUR OWN WORK writing in your own words. Academic integrity and honesty are key values at HKUST, therefore, any CHEATING (e.g. making up data) or PLAGIARISM (e.g. copying from others/ course notes/ books/ internet)
may be subjected to ZERO MARKS, “FAIL” in the course and/or other disciplinary actions. (Check these links for details: http://ugadmin.ust.hk/ug-guide/integrity/dishonesty.html; https://libguides.ust.hk/referencing/plagiarism)

**Evaluation on Laboratory Performance:**

In each exercise, laboratory performance of students, including practical performance, discipline and laboratory safety, will be assessed by the TA. This accounts for 14% of the total score of the course. The assessment will focus on the following.

- Motivation to accomplish the experimental tasks
- Proper execution of the experimental procedures
- Communication with group members and TA
- Completion of experiments in a timely manner
- Tidiness of the bench after experiments

Full marks will be awarded if all criteria are satisfied.

In addition, marks will be DEDUCTED FROM THE TOTAL SCORE every time when the following rules are broken:

**Attendance**

- Attend the laboratory sessions for the entire duration, except when permission is granted. 3%
- Attend pre-/post-laboratory sessions as required. 2%
- Come ON TIME (not more than 5 minutes late) for any sessions. 1%

**Dress Code**

- Wear proper clothing to ensure your lower body is fully covered (i.e. no shorts, short skirts, open-toe shoes/sandals) and minimize injuries against spills. 1%
- Wear lab coats at all times and wear gloves when needed as protection against potential hazards. 1%
- Tie up long loose hair securely to avoid contacting with open flame, chemicals and etc. 1%

**Performance**

- Follow lab instructions and safety precautions carefully and accurately. 1%
Safety Precautions

Working in a laboratory may expose one to potentially dangerous tools and hazardous reagents. Therefore, students need to exercise discipline and caution to ensure the experiments are conducted under the best and safest conditions. Violation to any of these rules will result in mark deduction in the laboratory performance evaluation.

1. Wear lab coats AT ALL TIMES in the laboratory and wear gloves when handling bacterial cultures, hazardous chemicals/reagents, nucleic acids or proteins.

2. Read and understand the laboratory manual BEFORE coming to the laboratory. Do not perform any unauthorized experiments or improvise any procedures.

3. Do not operate any equipment until properly instructed. Seek advice if you are unsure about any procedures or the operation/handling of equipment/tools.

4. Report to the instructor IMMEDIATELY for any accidents, such as cuts, burns, and spillage of culture or toxic reagents.

5. Clean the laboratory bench with 70% ethanol BEFORE and AFTER the experiment. Do not put any unnecessary personal items on the bench.

6. Do not eat, drink or put anything in your mouth while in the laboratory.

7. Clearly label all laboratory samples with your group number and sample name BEFORE submission.

8. Handle Bunsen burners carefully and make sure the gas is turned off when not in use.

9. Wash your own apparatus and dispose any wastes of in designated locations (e.g. throw tubes of bacterial culture in Biohazardous Waste bag). Do not take any equipment, consumables and reagents away from the laboratory.

10. Wash your hands thoroughly before leaving the laboratory.

# Note that learning activities, course schedule and assessment scheme are subject to changes due to special arrangement during COVID-19 pandemic. Any changes will be announced on Canvas or via direct email as early as possible.