Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year (New format)	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Assoc Prof Kim Hie Lim
Course Author Email	hlkim@ntu.edu.sg
Course Title	Principles of Heredity & Ecological Genetics
Course Code	ES2301
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	ES2003 AND BS1001
Co-requisites	NIL
Pre-requisite to	ES3301, ES3303, ES4301
Mutually exclusive to	NIL
Replacement course to	NIL
Remarks (if any)	

Course Aims

In this course, you will understand the genetic inheritance which is the transmission of genetic information across molecules, cells, and individuals. You will develop the concepts through studying basic molecular biology and genetics to understand the principles of each level of transmission: first, how to transmit genetic information across molecules in cells, from DNA to RNA, and from RNA to protein, second, how to transmit them between cells, third, how to transmit them between individuals, which is the transmission between generations and eventually populations. You will learn not only classical genetics but also the most advanced techniques to generate and analyze the genomic data since the current genomics became to be significantly important to study ecological genetics. Finally, you will have opportunities to develop your idea on how to apply genetics to ecology through the last part of lectures.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Describe the characteristics of genetic materials and mechanisms of the inheritance of the genetic information over molecules, cells, and individuals over generations.
ILO 2	Explain the biological mechanisms of generating and maintaining the genetic diversity in a population during the evolutionary process.
ILO 3	Associate the genetic information with phenotypic traits in various living organisms.
ILO 4	Analyze DNA sequence data, identify genetic variants, and estimate the extent of the genetic diversity.
ILO 5	Evaluate the status of a population in terms of their genetic diversity and estimate the future of the population.
ILO 6	Develop the ability to apply genetic knowledge and techniques to study the ecosystem.

Course Content

1. The law of inheritance and DNA
2. Cell cycle and DNA synthesis
3. Consequences and mechanisms of occurrence of mutations
4. The central dogma: DNA replication, transcription, and translation
5. Gene regulation and epigenetics
6. Recombination and structural changes
7. Genomes and current genomics
8. Genetic variations in genome
9. Population genetics: genetic drift and demography
10. Molecular evolution: The Neutral theory and natural selection
11. Conservation genetics

Reading and References (if applicable)

Anthony J.F. Griffiths et al. Introduction to Genetic Analysis, 11th Edition ISBN-13: 978-1464109485
Daniel L. Hartl, Essential Genetics A genomics perspective, 6th Edition ISBN-13: 978-1449686888

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	The law of inheritance and DNA	1, 2, 3	In-person	Griffiths et al, chapter 2	Griffiths et al, chapter 2
2	Cell cycle and DNA synthesis	1, 2, 3	In-person	Lecture and Field trip for Sample collection	Cell cycle and DNA synthesis
3	The central dogma: DNA replication, transcription, and translation	1, 2, 3	In-person	Lecture and Sample preparation	Griffiths et al, chapter 9
4	Consequences and mechanisms of occurrence of mutations	1, 2, 3, 4	In-person	Lecture and DNA extraction	Griffiths et al, chapter 16
5	Gene regulation and epigenetics	1, 2, 3, 4	In-person	Lecture and DNA amplification	Griffiths et al, chapter 11
6	Recombination and structural changes	1, 2, 3, 4	In-person	Lecture and DNA quantification	Griffiths et al, chapter 17
7	Genomes and current genomics	1, 3, 4, 6	In-person	Lecture and Midterm quiz	No reading
8	Genetic variants in genome	1, 2, 3, 6	In-person	Lecture and SCELSE tour	No reading
9	Conservation genetics	1, 2, 3, 4, 5, 6	In-person	Lecture and Sequencing data quality and control	Quammen, D. (1996). The song of the dodo: Island biogeography in an age of extinctions. Scribner
10	Population genetics	1, 2, 3, 4, 5, 6	In-person	Lecture and Alignment and variant calling	No reading
11	Natural selection	5, 6	In-person	Lecture and Genetic distance and phylogenetic analysis	No reading
12	Student team presentation	5, 6	In-person	Student presentation and Natural selection test	No reading
13	Review	1, 2, 3	In-person	Final quiz	No reading

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	In the first half of the course, you will learn basic knowledge of genetics and molecular biology (learning outcomes, LO- 1, 2, and 3) to understand further science fields, such as current genomics, population genetics, -omics, and ecology (LO- 4, 5, and 6). During the course, you will have opportunities to meet with guest lecturers who are conducting the most advanced science in their field and can hear their ongoing research (LO- 5 and 6). Various type of media will help you to understand the complicated biological process and concepts (LO- 1, 2, 4, and 6). Some hands-on exercise will be carried on during the class to understand the genetic theory (LO- 4 and 5).
Lab	You will carry on a research project for in the laboratory course. The project includes sample collection in the field, DNA extraction, sequencing, and analyses of the DNA sequence (LO-1,2,3,4,5,6). You will write a report for every session of the project. Writing the report will help you to understand the process of research and enhance to think scientifically and critically (LO-1,2,3,4,5,6). You will work laboratory and analyse the data with your classmates collaboratively (LO-4,5, and 6). One week, we will visit the SCELSE laboratory of genomic sequencing to understand better the most advanced technologies in the field (LO -4, 5, and 6).
Student team project	In preparing and delivering a team presentation, you will research a topic in ecological genetics, synthesise scientific information, and communicate your findings to others. This approach helps you achieve outcomes related to integrating genetic concepts, evaluating evidence, and presenting scientific ideas clearly, supporting ILO 4–6 while also developing collaborative and communication skills.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Presentation(Group Presentation)	1, 2, 3, 5, 6	1,2,3,4,5,6	15		Team	Analytic	Relational
2	Continuous Assessment (CA): Others(Lab Assignment)	1,2,3,4,5,6	1,2,3,4,5,6	30		Individual	Analytic	Relational
3	Continuous Assessment (CA): Others(Participation)	1,2,3,4,5,6	3, 6	5		Individual	Holistic	Multistructural
4	Continuous Assessment (CA): Test/Quiz(Mid Semester Quiz)	1,2,3,4,5,6	1,2,3,4,5	20		Individual	Holistic	Multistructural
5	Continuous Assessment (CA): Test/Quiz(Final Quiz)	1,2,3,4,5,6	1,2,3,4,5	30		Individual	Analytic	Relational

Description of Assessment Components (if applicable)

Formative Feedback

You will receive feedback as comments/corrections on your reports or essay submitted. The tutorial exercise will help you to achieve the learning outcomes 1~6.
After the mid-term quiz and final exam, you can review your answer sheet with the instructor. The quiz and exam will evaluate your learning outcomes 1~6.
After you give a team presentation, you can feel your accomplishment by audiences' response and instructor's comments. The process of preparation of your presentation as a team project will help you to achieve the learning outcomes 1, 2, 5, and 6.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Care for Environment	Advanced
Collaboration	Advanced
Self-Management	Advanced
Project Management	Advanced
Critical Thinking	Advanced

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

Diversity and inclusion policy
Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

It is our goal at ASE to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences, and that honours your identities; including ethnicity, gender, socioeconomic status, sexual orientation, religion or ability.

To help accomplish this:

- If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety disorder or social phobia;
- If you feel like your performance in the class is being impacted by your experiences outside of class;
- If something was said in class (by anyone, including the instructor) that made you feel uncomfortable;

Please speak to your teaching team, a peer or senior, Janelle or Michel (either in-person or via email) about how we can help facilitate your learning experience.

As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.

All members of the class are expected to adhere to the NTU anti-harassment policy. if you witness something that goes against this or have any other concerns, please speak to your instructors or an ASE faculty member.

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