NANYANG TECHNOLOGICAL UNIVERSITY

Reg. No. 200604393R

Academic Year	2019/2020	**Semester**	1
Course Coordinator	Asst/P Tan Meng How		
Course Code	CH 4306		
Course Title	Bioanalytical Techniques		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	39 hours lecture, 0 hours tutorial		
Proposal Date	5 Nov 2019		

Course Aims

The aims of the course are to introduce you to modern bioanalytical and analytical methods and techniques are used in the study of a host of analytes including drugs, biopharmaceuticals, and cells etc.; to exploit bioanalytical and analytical approaches that are an integral part of quantitative and qualitative analysis in chemical, biochemical and biomedical engineering; to equip you with the theoretical foundations in the interpretation of experimental data from different emerging analytical techniques in different fields of biotechnology; to link with applications of bioanalytical techniques and instrumentation for studying products resulting from biochemical and biological processes, products of metabolic activities etc.

Intended Learning Outcomes (ILO)

Upon completion of the course, you (as a student) should be able to:

1) Identify and explain how each of the bioanalytical techniques covered functions (i.e. what are the components of an instrument and how does each component operate).
2) Determine where each technique might be applied to yield useful information (e.g. what is measured using the instrument, how sensitive is the technique etc.).
3) Perform the calculations necessary for data interpretation in each of the techniques covered (e.g. what does the signal generated by the instrument mean, how is the signal quantified etc).
4) Identify and explain the theory underlying the operation of each of the instruments discussed (which is useful in diagnosing problems with instrumentation and in optimizing performance).
5) Describe the advantages and disadvantages of each bioanalytical technique.
6) Select an appropriate analytical method for solving a given problem in biology-related fields (e.g. biological chemistry, biomedical sciences, biomedical engineering etc).

Course Content

Biomolecules
The Human Genome
Electrophoresis
Optical Spectroscopy
Molecular Recognition
Nucleic Acid Analysis
Functional Genomics
Protein Analysis
Chromatography
Mass Spectrometry
Enzymology

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
Quiz 1 (20%)	1,2,3,4,5,6	a, b, c, d	20%	Individual	See Appendix 1
Quiz 2 (20%)	1,2,3,4,5,6	a, b, c, d	20%	Individual	See Appendix 1
Final Examination (60%) (2.5hrs, closed book, exam paper not allowed to be removed from exam hall)	1,2,3,4,5,6	a, b, c, d, l	60%	Individual	See Appendix 1
Total			100%		

Mapping of Course ILOs to EAB Graduate Attributes

Course Intended Learning Outcomes	Cat	EAB's 12 Graduate Attributes*											
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	Core	◐	◐	◐	●								○
Identify and explain how each of the bioanalytical techniques covered functions (i.e. what are the components of an instrument and how does each component operate).													a, b, c, d
Determine where each technique might be applied to yield useful information (e.g. what is measured using the instrument, how sensitive is the technique etc.).													a, b, c, d
Perform the calculations necessary for data interpretation in each of the techniques covered (e.g. what does the signal generated by the instrument mean, how is the signal quantified etc).													a, b, c, d
Identify and explain the theory underlying the operation of each of the instruments discussed (which is useful in diagnosing problems with instrumentation and in optimizing performance).													a, b, c, d
Describe the advantages and disadvantages of each bioanalytical technique.													a, b, c, d, l
Select an appropriate analytical method for solving a given problem in biology-related fields (e.g. biological chemistry, biomedical sciences, biomedical engineering etc).													a, b, c, d, l

Legend:
- ● Fully consistent (contributes to more than 75% of Intended Learning Outcomes)
- ◐ Partially consistent (contributes to about 50% of Intended Learning Outcomes)
- ○ Weakly consistent (contributes to about 25% of Intended Learning Outcomes)
- Blank Not related to Student Learning Outcomes

Formative feedback

Quiz and examination results;
Marker's report on overall examination performance will be uploaded to NTULearn;
Quiz answers will be discussed in class

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Demonstrate how to carry out a procedure such as working through a problem, use incomplete handouts which enable you to participate in class.
Tutorial	Not applicable

Reading and References

Andreas Manz, Nicole Pamme, Dimitri Iossifidis, Bioanalytical Chemistry, Imperial College Press, 2015.

Course Policies and Student Responsibilities

General: You are expected to complete all online activities and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements. You are expected to participate in all tutorial discussions and activities.

Continuous assessments: You are required to attend all continuous assessments.
Absenteeism: Continuous assessments make up a significant portion of your course grade. Absence from continuous assessments without officially approved leave will result in no marks and affect your overall course grade.

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. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Tan Meng How	N1.2-B2-33	6513-8063	mh.tan@ntu.edu.sg
Chen Ming-Hsu	N1.2-B2-24	6316-8867	minghsu.chen@ntu.edu.sg
Guan Xue Li	Experimental Medicine Building (Level 4)	6592-3957	xueli.guan@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Biomolecules The Human Genome	1	Chapter 1
2	Electrophoresis	1, 2, 4, 5, 6	Chapter 3
3	Optical Spectroscopy Molecular Recognition	1, 2, 3, 4, 5, 6 1, 2, 3, 4, 5, 6	Chapter 5 Chapter 6
4	Nucleic Acids Analysis	1, 2, 3, 4, 5, 6	Chapter 7
5	Protein Analysis	1, 2, 3, 4, 5, 6	Chapter 8
6	Functional Genomics	1, 2, 4, 5, 6	Lecture Notes
7	Chromatography	1, 2, 3, 4, 5, 6	Chapter 2
8	Chromatography	1, 2, 3, 4, 5, 6	Chapter 2
9	Mass Spectrometry	1, 2, 3, 4, 5, 6	Chapter 4
10	Mass Spectrometry	1, 2, 3, 4, 5, 6	Chapter 4
11	Enzymology	1, 2, 3, 4, 5, 6	Lecture Notes
12	Revision	1, 2, 3, 4, 5, 6	Lecture Notes

Appendix 1: Assessment Criteria

Criteria	Unsatisfactory: <40%	Borderline: 40% to 49%	Satisfactory: 50% to 69%	Very good: 70% to 89%	Exemplary: >90%
Knowledge & Comprehension Understanding the underlying principles, strengths, and weaknesses of various bioanalytical techniques	• Lacks understanding • Does not know the advantages or disadvantages of any methods.	• Fair understanding • Has a little knowledge of the strengths and weaknesses of a few methods.	• Satisfactory understanding • Aware of the strengths and weaknesses of some methods.	• Good understanding • Good knowledge of the strengths and weaknesses of most methods taught in the course.	• Very good and comprehensive understanding • Full knowledge of the strengths and weaknesses of all bioanalytical techniques.
Data Analysis Able to process experimental data and draw appropriate conclusions	Some attempts are made but are unsuccessful and off the mark.	Some attempts are made, but are mostly unsuccessful with only a few correct conclusions.	Attempts made and conclusions drawn are mostly correct, but there are some logic flaws and/or incorrect calculations.	Attempts made and conclusions drawn are almost all correct, with only minor errors.	All attempts made are successful and the conclusions are all logical and correct.
Problem Solving Able to analyze problems using appropriate bioanalytical methods.	Unable to choose appropriate methods to solve any problems.	Can choose appropriate methods to solve only a few problems. Logic may be shaky.	Can choose appropriate methods to solve some problems, but no ability to think outside the box.	Can choose appropriate methods to solve all problems, but is restricted only to textbook knowledge. Limited ability to think outside the box.	Can choose appropriate methods to solve all problems. Can identify potential caveats and suggest reasonable alternatives accordingly.

Appendix 2: The EAB (Engineering Accreditation Board) Accreditation SLOs (Student Learning Outcomes)

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems
b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change