

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	生物化学与分子生物学实验/Biochemistry and Molecular Biology Laboratory
2.	授课院系 Originating Department	生物系/Department of Biology
3.	课程编号 Course Code	BIO222
4.	课程学分 Credit Value	2
5.	课程类别 Course Type	专业基础课（生物科学、生物技术专业） - Major Foundational Courses (Biological Sciences, Biotechnology) 专业选修课（生物信息专业） - Major Elective Courses (Bioinformatics)
6.	授课学期 Semester	春季 Spring
7.	授课语言 Teaching Language	英文 English / 中英双语 English & Chinese
8.	授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	赵颖岚 工程师 南方科技大学生物系 广东省深圳市西丽区南方科技大学第一教学楼 229 室 Tel (电话): (0755)8801-8749 Email: zhaoyl@sustc.edu.cn Dr. ZHAO Yinglan, Engineer, Department of Biology Teaching building 1, room 229 马小英 工程师 南方科技大学生物系 广东省深圳市西丽区南方科技大学第一教学楼 231 室 Tel (电话): (0755) 8801-8746 Email: maxy@sustc.edu.cn Dr. MA xiaoying, Engineer, Department of Biology Teaching building 1, room 231
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	贾方兴 实验员 南方科技大学生物系 广东省深圳市西丽区南方科技大学第一教学楼 232 室 Tel (电话): (0755) 8801-0325 Email: Jiafx@sustc.edu.cn Mr. JIA Fangxing, Laboratory Technician, Department of Biology

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10. **Maximum Enrolment (Optional)**
选课人数限额(可不填)

11. **Delivery Method**
授课方式

讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
		课堂实验 61 学时 61 class hours	实验后期处理、观察 3 学时) 3 class hours observation	64

学时数
Credit Hours

12. **Pre-requisites or Other Academic Requirements**
先修课程、其它学习要求

要求先修《普通生物学实验》、《生物化学 I》课程；学习本实验课的同时学习《分子生物学》课程。
Pre-study General Biology Laboratory and Biochemistry I, and study the Molecular Biology with the experiment course at the same time.

13. **Courses for which this course is a pre-requisite**
后续课程、其它学习规划

14. **Cross-listing Dept.**
其它要求修读本课程的学系

教学大纲及教学日历 SYLLABUS

15. **Course Objectives**
教学目标

蛋白质、糖类、脂类、核酸等生物化学分子是生命体组成成分及各种生理活动的执行者。解析它们的结构、特性和功能是解读生命的一个重要方面。随着现代科学技术的发展，各种先进的手段愈来愈被广泛地应用于生物化学研究中。生物化学实验已是生物系各专业的必修实验课。本课程设置具有层次性，每部分内容能相互衔接，使整个生物化学实验课程形成一个有机的整体。课程内容分为五个模块：生化实验基本技能、核酸模块、蛋白模块，酶动力学模块，碳水化合物模块；内容涉及蛋白质、酶、糖类、核酸等常见生物大分子的提取、分离、检测、功能和应用等。

Experiments in this lab are continues integrity focused on biomolecules, help the students to grasp modern biochemistry and molecular biology techniques. Study the target gene from gene level (molecular cloning), protein level (recombinant protein expression and purification in E. Coli system) and its function (enzyme kinetics analysis). The experiments also include basic concept of acids, bases and buffers, DNA melting curve, to get the student a comprehensive understanding of biology in chemical angle.

16. **Learning Outcomes**
预达学习成果

给学生提供了一个通过实验了解和探索常见生化大分子结构、特性和功能的平台，锻炼学生定性观察和定量检测等技能；希望学生通过对本课程的学习，培养动手能力、设计实验的创新思维及分析解释实验现象，初步培养学生的科学的批判精神和素养。

The laboratory is chosen to give students an opportunity to explore the structure, characteristic and function of biomolecules. With the experiments, practise the ability of qualitative observation and quantitative detection. We hope it can improve students' practical ability, innovative thinking in experiment design and ability to analyse and solve problems. At the same time, it can train the students' critical thinking in scientific work.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

一、生物化学与分子生物学实验简介及溶液配制（4 学时）

Lab 1. Introduction to Biochemistry and Molecular Biology Laboratory and preparation of solutions (4 credit hours)

介绍实验室规则、安全、课程设置及实验安排；实验记录本及实验报告要求；实验课考核及评分标准；初步介绍整个本课程核酸模块及蛋白模块实验基础知识。了解生物化学与分子生物学实验中常用仪器的使用；学习溶液配制，了解溶液配制的计算方法，学生自己计算、称量以及配制实验二所需溶液。

Introduce Biochemistry and Molecular Biology Laboratory safety, course requirement (notebook and report), course schedule (basic content of nucleic acid and protein) and evaluation. To know the usage of basic equipments will meet in this class; Learn how to prepare solutions, and know the methods of calculation. The students should calculate, weight and prepare the solutions needed in experiment 2.

二、酸、碱及缓冲液（5 学时）

Lab 2. Acids, Bases and Buffers (5 credit hours)

学习 pH 计的校准及使用；配制醋酸缓冲液和 Tris-Cl 缓冲液；了解缓冲液对酸、碱的缓冲能力及稀释对缓冲液缓冲能力的影响；计算缓冲液的缓冲能力；滴定法计算氨基酸的滴定曲线。

To learn how to standardize and perform pH meter; prepare acetate buffer and tris-HCl buffer with the solutions made in last class. To study the influence of acid, base and dilution to buffer, and calculate the buffer capacity of buffer. To understand the buffer region by calculating titration curve of unknown amino acids.

三、测定 DNA 溶解曲线（4 学时）

Lab 3. DNA melting curve (Calf thymus DNA solution) (4 credit hours)

了解 DNA 的增色效应及消色效应；检测高 pH 溶液中小牛胸腺 DNA 溶解曲线；检测不同离子强度溶液中小牛胸腺 DNA 溶解曲线；比较不同条件对 DNA 溶解曲线的影响及其在生物学中的作用。

To learn hyperchromicity and hypochromicity of DNA, compare the melting curve of calf thymus DNA solution in high pH and different ionic strength with control to understand the effects of different conditions to DNA melting curve and its function.

四、质粒提取及限制性内切酶酶切（5 学时）

Lab 4. Plasmid purification and Restriction Enzyme Digestion (5 credit hours)

介绍分子克隆基础知识及质粒提取原理（着重介绍溶液 1、2、3 每种成分的作用，理解乙醇沉淀原理等）；Nanodrop 测定提取质粒 DNA 浓度；对提取质粒进行限制性内切酶酶切，特别强调微量操作方法。

Introduction the basic knowledge of molecular cloning and principle of preparation of plasmid DNA by alkaline lysis with SDS. To let the student understand the function of each element in solution 1, 2, 3 and the principle of ethanol precipitation. To detect the DNA concentration with Nanodrop and then digest with plasmid with EcoRI and XhoI. In this

experiment, we especially focus on submicroliter fluid handling.

五、琼脂糖凝胶电泳及胶回收（5 学时）

Lab 5. Restriction endonuclease digestion, Electrophoresis, Gel extraction (5 credit hours)

了解琼脂糖凝胶电泳的原理；琼脂糖凝胶电泳制备；通过琼脂糖凝胶电泳观察提取的质粒及酶切产物；胶回收试剂盒回收酶切后目的 DNA 片段。

To understand the principle for agarose gel electrophoresis. To know how to prepare agarose gel and observe the result of electrophoresis - plasmid and restriction enzyme digest products. Cut the desired fragment from agarose gel and do gel extraction to get pure DNA fragments.

六、连接及转化（5 学时）

Lab 6. Ligation and Transformation (5 credit hours)

掌握连接及转化的基本原理；将胶回收产物（目的片段及载体）进行连接；连接产物转化大肠杆菌。课堂实验 4 学时，第二天观察 1 学时。

To master the basic principle for ligation and transformation. Ligate target fragment and vector (extract from agarose gel) and transformed to E.coli. 4 class hours for the classroom teaching and 1 class hour for the results observed in the next day.

七、菌落 PCR 筛选阳性克隆及引物设计（5 学时）

Lab 7. Screening PCR and Primer design (5 credit hours)

掌握菌落 PCR 筛选阳性克隆的原理；菌落 PCR 扩增平板上克隆；琼脂糖凝胶电泳检测 PCR 产物，筛选阳性克隆；了解引物设计基本原理及应用。

To master the principle for screening positive colonies by the method of colony PCR. Detect the PCR results with agarose gel electrophoresis to select the positive colonies. To study the principle and application of primer design.

八-九、蛋白表达及 SDS-聚丙烯酰胺凝胶电泳（9 学时）

Lab 8&9. Protein expression and SDS-PAGE (9 credit hours)

掌握大肠杆菌表达外源蛋白的原理并掌握 SDS-聚丙烯酰胺凝胶电泳分离蛋白质的原理及制样方法；在不同条件下诱导大肠杆菌表达目的蛋白；样品制备。SDS-聚丙烯酰胺凝胶电泳及染色观察，检测蛋白表达。课堂实验 8 学时，第二天观察 1 学时。

To learn the principle of foreign protein expression in E.coli and SDS-PAGE. Induce the protein expression under different conditions and harvest the cells. Cast SDS-PAGE gel and prepare sample for electrophoresis. To run the SDS-PAGE and stain the gel, detect the protein expression level. 8 class hours for the classroom teaching and 1 class hour for the results observed in the next day.

十、His-Tag 融合蛋白纯化（5 学时）

Lab 10. Purify a His-Tag protein and SDS-PAGE (5 credit hours)

学习亲和层析的原理，重点学习 Ni-柱纯化 His-Tag 融合蛋白的原理；Ni 柱纯化融合蛋白；SDS-聚丙烯酰胺凝胶电泳检测纯化产物。课堂实验 4 学时，第二天观察 1 学时。

To learn the principle of affinity chromatograph, especially Ni-column purify His-tagged fusion protein. Using Ni-column

purify the target protein and detect the purity by SDS-PAGE. 4 class hours for the classroom teaching and 1 class hour for the results observed in the next day.

十一、凝胶过滤层析与 Bradford 法定量蛋白质（4 学时）

Lab 11. Gel-filtration chromatography & Protein Quantification by Bradford Assay (4 credit hours)

介绍凝胶过滤层析的原理及其在本实验中的实验目的-脱盐纯化；根据聚丙烯酰胺凝胶电泳结果选取纯度及浓度最佳的样本进行蛋白定量。学习不同蛋白定量原理，着重学习 Bradford 法及紫外分光光度计法。利用标准曲线，在 excel 中作图，对目的蛋白定量。

To introduce the principle of gel-filtration chromatography and understand the usage in this experiment -desalting (for purification); Choose the best sample with highest concentration and purity for protein quantification. To learn the principle of protein quantification with different methods, especially focus on Bradford and UV-vis spectroscopy assay. Draw the standard curve in excel and calculate the protein quantification.

十二、乳酸脱氢酶动力学（5 学时）

Lab 12. Kinetics of LDH (5 credit hours)

理解酶动力学特性；运用分光光度计法检测乳酸脱氢酶 K_M 及 V_{max} ；计算乳酸脱氢酶的比活力。

To understand the characteristic of enzyme kinetics. To detect the K_M and V_{max} of LDH and calculate enzyme activity.

十三、DNS 法检测还原性糖（4 学时）

Lab 13. Determination of Reducing Sugar with DNS (4 credit hours)

掌握对碳水化合物定量测定的原理；了解分光光度计法定量检测物质浓度（标准曲线法）；测定不同双糖、多糖在酶作用、酸水解后还原性单糖的含量。

To master the principle of carbohydrate quantification, and take advantage of standard curve to determine the concentration of different sugar solution. Compare the reducing sugar content by Hydrolysis with acid and enzyme digest.

十四、实验回顾与总结（4 学时）

Lab 14. Review (4 credit hours)

学生根据课程内容对实验原理、步骤、实验结果进行回顾，并对本实验相关内容进展扩展，以演讲形式讲解。

The students will summary the lab course by themselves and expand the mind. They will do the presentation with PPT.

18. 教材及其它参考资料 Textbook and Supplementary Readings

Biochemistry Laboratory: Modern Theory and Techniques, 2nd. (R.F. Boyer, 2011)

Lehninger Principles of Biochemistry, 7th. (D.L. Nelson, M.M. Cox, 2017)

Laboratory Manual of Biochemistry: Methods and Techniques. (R.S. Sengar, 2014)

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		
课堂表现 Class Performance		20		实验习惯 habits, 实验结果 results, 课堂表现 performance
小测验 Quiz		15		
课程项目 Projects				
平时作业 Assignments		20		Notebook
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation				
其它 (可根据需要 改写以上评估方式) Others (The above may be modified as necessary)		35		实验报告 report, 20 实验操作考试 experimental operation, 10 Presentation 5

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading
 B. 二级记分制 (通过/不通过) Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

本课程经生物系本科教学指导委员会审议通过。
This Course has been approved by Undergraduate Teaching Steering Committee of Department of Biology.