南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

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	**生物动力系统模拟 (Dynamical Systems Simulation in Biology)**
2.	授课院系 Originating Department	生物系 Department of Biology
3.	课程编号 Course Code	BIO411-16
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业选修课 （生物科学、生物技术、生物信息学专业） Major Elective Courses(Biological Sciences, Biotechnology，Bioinformatics Majors)
6.	授课学期 Semester	秋季 Fall
7.	授课语言 Teaching Language	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）	王冠宇，副教授，生物系第一科研楼 207 室 wanggy@sustech.edu.cn 0755-88018215 WANG Guanyu, Associate Professor, Rm.207, No.1 Research Bldg.
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
10.	选课人数限额(可不填) Maximum Enrolment （Optional）	

11. 授课方式 Delivery Method	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
学时数 Credit Hours	48				48

12.	**先修课程、其它学习要求 Pre-requisites or Other Academic Requirements**	MA101B 高等数学（上）A (Calculus I A) MA107B 线性代数 B (Linear Algebra B) BIO103 生物学原理 (Principles of Biology)
13.	**后续课程、其它学习规划 Courses for which this course is a pre-requisite**	本课程为与生物相关的专业选修课；非生物系学生如果对生物有兴趣，也可选修本课程。This course should be taken by everyone contemplating doing biology related majors. It should however also be suitable for non-specialists, for example, students of non-biology major may take the course if they are interested in biology.
14.	**其它要求修读本课程的学系 Cross-listing Dept.**	无 None

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

鉴于现代生物定量化及整体性的增强，需要对系统层次上的动力学进行建模与仿真以加深对生命的认识。所以本课程对培养生命领域复合型人才起着重要作用。

Modern biology becomes more and more quantitative and holistic, which necessitates modelling and simulation at the systems level to gain deeper insights. This course is pivotal to cultivating interdisciplinary talents in life sciences.

16. 预达学习成果 Learning Outcomes

通过本课程的学习，学生将掌握生命科学中跨层次的模拟方法和计算技术。学生将熟悉能够解决生物科研中带有数值仿真问题的基本方法和技术，对一系列常用生物系统获得理论联系实践的理解。学生还应对一些生物模拟软件建立初步的了解。

After completing this course, students should understand basic modelling methods and computational techniques across multiple biological levels. They will be familiar with a range of techniques for solving research problems of biological nature and will have a conceptual and practical understanding of a range of commonly applied biological systems. They will also developed some familiarity with the bio-modelling package.

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.)

第 1 章 动力系统基本概念 学时：4 小时

Chapter 1 Fundamental concepts of dynamical systems Hours: (4h)

1 状态空间

1 State space

2 连续及离散系统

2 Continuous and discrete systems

3 稳定性

3 Stability

4 系统终态的分类

4 Classification of steady states

第 2 章　线性系统理论　　学时：10 小时

Chapter 2　Linear systems theory　　Hours:（10h)

1 线性系统的解析解

1 Analytical solutions of linear systems

2 脉冲响应函数

2 Impulse response function

3 拉普拉斯变换

3 Laplace transform

4 控制理论初步

4 Control theory preliminaries

第 3 章　生物分子结构介绍　　学时 3 小时

Chapter 3　Introduction to structure of biomolecules　　Hours:（3h)

1 DNA 的结构特点

1 Structural characteristics of DNA

2 RNA 的结构特点

2 Structural characteristics of RNA

3 蛋白质的结构特点

3 Structural characteristics of proteins

第 4 章　生物分子结构的理论计算方法概貌　　学时：5 小时　Hours:（5h)

Chapter 4 Introduction to theoretical and computational methods in biomolecular structures

第 5 章　　力场分类及特点　　学时：2 小时

Chapter 5　　Classification and characteristics of force field　　Hours:（2h)

第 6 章　　全原子分子动力学模拟（操作）　　学时：3 小时

Chapter 6 All-atom molecular dynamics simulation (Operation) Hours: (3h)

1 对 NAMD 模拟方法的实际操作

1 Actual operation using the simulation method NAMD

2 对 Gromacs 模拟方法的实际操作

2 Actual operation using the simulation methods Gromacs

第 7 章 全原子分子动力学模拟（应用） 学时：4 小时 Hours: (4h)

Chapter 7 All-atom molecular dynamics simulation (Application)

1 在生化酶反应等的应用

1 Application to biochemical enzyme reactions

第 8 章 从分子动力学到网络 学时：8 小时

Chapter 8 From molecular dynamics to network Hours: (8h)

1 对基因调控网络建模

1 Network modeling on genetic regulation

2 对信号传导网络建模

2 Network modeling on signal transduction

3 对蛋白相互作用的网络建模

3 Network modeling on protein interactions

第 9 章 生物网络的实例分析 学时：4 小时

Chapter 9 Case analysis on bio-networks Hours: (4h)

第 10 章 从分子网络到生理系统 学时：5 小时

Chapter 10 From network dynamics to physical systems Hours: (5h)

1 血糖-胰岛素系统

1 Plasma glucose-insulin system

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

该课程内容广泛，单一教材难以概括。故不指定教材。

The course is diverse in content and is this difficult to be summarized by a single textbook. Therefore no required text is named.

推荐教材如下 (References)：

Tamar Schlick, Molecular modeling and simulation: an interdisciplinary guide,Springer

Guanyu Wang, Analysis of complex diseases: a mathematical perspective, CRC press.

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		15	正常处罚	
课堂表现 Class Performance				
小测验 Quiz		15	正常处罚	
课程项目 Projects				
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam		70	正常处罚	
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)				

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.