**计算结构生物学课程教学大纲**

Course Outline

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| 课程基本信息（Course Information） |
| 课程代码（Course Code） | BI471 | 学时（Credit Hours） | 32 | 学分（Credits） | 2 |
| 课程名称（Course Name） | （中文）计算结构生物学 |
| （英文）computational structural biology |
| 课程性质(Course Type) | 专业必修课 |
| 授课对象（Target Audience） |  |
| 授课语言(Language of Instruction) | 中外双语 |
| 开课院系（School） | （中文）生命科学技术学院（英文）School of Life Sciences and Biotechnology |
| 先修课程（Prerequisite） | （中文）生物化学、分子生物学（英文）Biochemistry or molecular biology |
| 授课教师（Teacher） | （中文）魏冬青、徐沁（英文）Dongqing Wei, Qin Xu | 课程网址(Course Webpage) | http://cbb.sjtu.edu.cn/~qinxu/CADD.htm |
| \*课程简介（Description） | 计算结构生物学及其在药物设计中的应用是一门随着计算机水平的迅速提高而在最近十几年蓬勃发展起来的一门交叉学科。此学科以统计模型、物理化学原理为基础，以多种计算方法为手段，结合结构生物学、系统生物学、生物信息学、转化医学等多种领域的实验方法，实现对蛋白质、核酸等生物大分子的结构和运动进行预测，对药物小分子及类药化合物的筛选、设计、开发，并深入研究其与作为目标靶体的生物大分子之间的相互作用，阐释其生理、药理机制。由于本学科具有多学科交叉融合，新方法、新思路层出不穷等特点，本课程在教学中以系统理论和研究实例相结合，以概念的讲授和具体软件操作的演示相结合，以现有技术领域的介绍和新兴技术的探索研究相结合。基本知识方面涵盖目前计算机辅助药物设计的几大领域，包括小分子库的构建与搜索、蛋白质大分子的结构预测、定量构效关系模型、药效团模型和其它统计模型、全新药物设计、分子对接、分子模拟等。这些领域当中的很多方法不仅仅可以应用在药物设计当中，也在生物信息学、结构生物学的研究中有着诸多应用。为了避免空对空的讲授知识概念，课堂中将介绍众多最新的研究成果作为教学案例，使得学生可以对于相关知识与方法的应用有更为具体的概念，从而在即将到来的毕业设计中可以把课程所学技术和方法与自己的研究课题结合起来，解决科研中遇到的相关问题。同时课堂中会展示一些相关软件的具体使用，使得学生可以利用课余时间对有兴趣的方法自行进行练习，为在毕业设计中使用一些相关技术打下基础。除了课堂教授的内容，本课特意安排学生自主的对于计算机辅助药物设计领域的一些最新进展进行探索和研究，要求其挑选一篇相关领域的文献进行精读，并以读书报告和课堂讨论的方式加以互相交流，从而加强学生的独立科研能力，培养学生的思维方式及研究方法。在课程最后，则以一次模拟课题的方式，加强学生对于本课内容的融合和理解，并锻炼学生们相互合作的能力。最后通过课堂报告和课题报告的方式，考察学生对本课的学习效果，以及展开科学研究的一些基本技能。此课程是针对生命科学高年级本科生的专业课程,也可以作为从事本方向研究的研究生旁听课程。 |
| \*课程简介（Description） | Computational structural biology (CSB) and its application in computer aided drug design (CADD) is a rapid increase interdisciplinary science together with the explosion of computational capacity. Based on physical and chemical rules, together with a variety of statistical models and calculation methods, and with the techniques of structural biology, systems biology, bioinformatics, and translational medicine, it is applied to prediction of structures and dynamics conformational changes of biological macromolecules like protein and nucleic acids, the screening, design and development of drug molecules and drug like compounds, as well as further research on their interaction with their target biological macromolecules, in order to explain the physiological and pharmacological mechanisms.Because the subject is interdisciplinary with various new methods emerging, this course is organized in combination of theory and case study, of lectures and software demonstration, and of introduction of existing technology and exploration of the emerging techniques. The lectures covers several areas of computer aided drug design, including the construction and searching of small molecule libraries, protein structure prediction, quantitative structure-activity relationship model （QSAR）, pharmacophore model and other statistical models, de novo drug design, molecular docking, molecular simulation, etc. Many of these areas not only can be used in drug design, but also in the study of bioinformatics, structural biology and other area. In addition to theoretical knowledge, a good many of research cases will be illustrated to the students. At the same time, some workshops of some useful softwares will be included, allowing students to practice later. In addition, an extensive paper reading with in class discussion, as well as a final research project is required, so as to strengthen the abilities of students to do scientific researches independently or in team work. This course is mainly a professional course for senior undergraduate students of life sciences, but also good for graduate students in this field. |
| 课程教学大纲（course syllabus） |
| \*学习目标(Learning Outcomes) | 学习目标包括：1. 理解掌握多种新型的使用计算机分析结构生物学及相关问题的方法基本概念，包括蛋白质结构预测、分子对接、分子动力学模拟、药效团、构效关系、从头药物设计及其他基于结构的药物设计方法等等。
2. 熟练科技文献的搜索阅读技能，熟悉计算结构生物学新领域的发展。
3. 学以致用，利用课堂上学习到的知识和技术课后独立设计完成一个小的课题。

After completing the course, students should:1．understand and master the basic concepts and techniques of computational structural biology, such as protein structure prediction, molecular docking, molecular dynamics simulations, pharmocophore, QSAR, de novo drug design and other techniques of structure based rational drug design;2．get familiar with paper reading and searching and learn about the new developments in computational structural biology;3．apply the knowledge in practical research, finish a project independently or in teams after class  |
| \*教学内容、进度安排及要求(Class Schedule& Requirements) |

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| 教学内容topics | 学时Credit hours | 教学方式Teaching methodology | 作业及要求tasks | 基本要求Intended learning outcomes | 考查方式Assessment methods |
| 计算结构生物学与计算机辅助药物设计简介 | 4 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 序列分析 | 2 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 蛋白质数据库 | 2 | 课堂授课与上机 | 课后作业 | 熟悉相关数据库 | 1页小报告 |
| 蛋白质结构预测 | 2 | 课堂授课 | 无 | 熟悉相关概念 | 无 |
| 蛋白质结构预测 | 2 | 上机实验 | 无 | 熟悉相关网站和软件 | 无 |
| 蛋白质调控的动力学模拟 | 2 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 药物-靶标蛋白的相互作用 | 2 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 计算结构生物学与计算机辅助药物设计进展 | 2 | 课堂讨论 | 课后阅读 | 了解相关领域进展 | 课堂汇报与1页纸面报告 |
| 分子对接 | 2 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 小分子的结构特征 | 2 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 药效团 | 2 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 从头药物设计 | 2 | 课堂授课与上机 | 无 | 了解相关概念与技术 | 无 |
| 结构相似性药物设计 | 2 | 课堂授课与上机 | 无 | 了解相关概念与技术 | 无 |
| 构效关系 | 2 | 课堂授课 | 无 | 了解相关概念 | 无 |
| 计算结构生物学与计算机辅助药物设计在生化研究中的应用 | 2 | 课堂讨论 | 课后研究 | 实际独立解决一个小研究课题 | 课堂演示与10页报告 |

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| 教学内容topics | 学时Credit hours | 教学方式Teaching methodology | 作业及要求tasks | 基本要求Intended learning outcomes | 考查方式Assessment methods |
| Introduction of CSB & CADD | 4 | Lectures | NA | Understand related concepts | NA |
| Sequence analysis | 2 | Lectures | NA | Understand related concepts | NA |
| Structural databases of proteins | 2 | Lectures | homework | Familiar with popular databases | One page report |
| Protein structure prediction | 2 | Lectures  | NA | Familiar with related concepts | NA |
| Protein structure prediction | 2 | Labs | NA | Familiar with popular websites & softwares | NA |
| MD Simulations on protein regulation | 2 | Lectures | NA | Understand related concepts | NA |
| Drug-target interactions | 2 | Lectures | NA | Understand related concepts | NA |
| New developments in CSB & CADD | 2 | In class discussion | After class paper reading | Learn new developments in CSB & CADD | Presentations and one page report |
| Molecular docking | 2 | Lectures | NA | Understand related concepts | NA |
| Structural features of small molecules | 2 | Lectures | NA | Understand related concepts | NA |
| Pharmacophore | 2 | Lectures | NA | Understand related concepts | NA |
| De novo drug design | 2 | Lectures and labs | NA | Understand related concepts | NA |
| Structure based drug design | 2 | Lectures and labs | NA | Understand related concepts | NA |
| QSAR | 2 | Lectures | NA | Understand related concepts | NA |
| Applications of CSB & CADD in Bioresearch | 2 | In class discussion | After class project | Practically use CADD to solve a specific question  | Presentations and more than 10 pages report |

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| \*考核方式(Grading) | 1. 出勤Attendance （20%）of 16 classes
2. 平时小作业，数据库拓展学习Study on databases (10%) and give a short summary in one page with snapshots of key web-pages attached
3. 期中，文献阅读Paper reading by mid-term（20%）： Search for a paper related to CSB or CADD, finish a short summary in one page（10%）and give a 5min oral presentation (10%)
4. 期末，课题报告Project proposal（50%）：Finished by one person or one teams, give a 10 min presentation （20%）and a proposal (>10 pages) (30%) by each team
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| \*教材或参考资料(Textbooks & Other Materials) | 1. 分子模拟与计算机辅助药物设计，魏冬青等编著，上海交通大学出版社，2012，ISBN 9787313079800
2. Advance in Structural Bioinformatics, Advances in Experimental Medicine and Biology Vol. 827, by Dongqing Wei et. al., published by Springer and Shanghai Jiao Tong University Press, 2015, ISBN 9789401792455
3. 计算机辅助药物分子设计，徐筱杰等编著，化学工业出版社，2004， ISBN 9787502555207
4. 计算机辅助药物设计导论，叶德泳著,化学工业出版社，2004，ISBN 7502549811
5. Textbook of Drug Design and Discovery，fourth edition, by Povl Krogsgaard-Larsen, published by CRC Press，2009，ISBN 9781420063226
6. Computational Medicinal Chemistry for Drug Discovery， by Patrick Bultinck, et. al，published by CRC press， 2003，ISBN 9780824747749
7. Molecular Modeling for Beginners，second edition，by Alan Hinchliffe，published by John Wiley and Sons，2008，ISBN 9780470513132
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| 其它（More） |  |
| 备注（Notes） |  |

备注说明：

1．带\*内容为必填项。

2．课程简介字数为300-500字；课程大纲以表述清楚教学安排为宜，字数不限。