课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	合成生物学前沿 Frontiers in synthetic biology
2.	**课程性质** **Compulsory/Elective**	选修
3.	**开课单位** **Offering Dept.**	医学院
4.	**课程学分/学时** **Course Credit/Hours**	3 学分/48 学时
5.	**授课语言** **Teaching Language**	中英文
6.	**授课教师** **Instructor(s)**	何涟（hel3@sustech.edu.cn）
7.	**开课学期** **Semester**	2023 年春季
8.	**是否面向本科生开放** **Open to undergraduates or not**	否
9.	**先修要求** **Pre-requisites**	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 无

10. 教学目标
Course Objectives

（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

合成生物学是一门汇集生物学、基因组学、工程学和信息学等多种学科的交叉学科，旨在设计、改造、重建生物分子和生物元件，构建人工的生物系统和生物工厂以满足人们在生物能源，医药诊断及治疗等不同领域的需求。合成生物学建立在分子，细胞和系统生物学等学科优点的基础上，并在近年来取得了快速的发展。在本课程中，我们将从常用合成生物学元件、基因表达调控回路、细胞改造、以及诊断医疗应用等方面进行介绍；包括讲述合成生物学的两个重要分支-光遗传学和化学遗传学的相关技术方法和应用；同时结合文献阅读和讨论的方式学习本学科最新的基础理论和研究进展。通过课程的学习，达到以下目标：1.让学生学习和了解合成生物学的基础知识及前沿领域进展；2.培养学生逻辑思维能力；3.训练提高学生文献阅读和演讲能力。希望学生能够将所学的技术和思维方法应用在自己的课题研究中，为后续的深造学习和科学研究奠定重要基础。

11. 教学方法
Teaching Methods

（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

1. 导师课程讲授为主：用多媒体教学方式授课，促进学生了解课程前沿进展；
2. 采用引入式教学，同时理论联系实际，增强课程的互动性及趣味性；
3. 学生文献阅读及演讲为辅：培养学生的自主阅读及演讲交流能力。

12. 教学内容
Course Contents
（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

Section 1	**1. Introduction to Synthetic biology**
Section 2	**2. DNA Synthesis and Genome Engineering** 2.1 Reading and writing DNA 2.2 Next-generation of genome design technologies 2.3 Site-directed genome modification 2.4 Rational efforts to streamline the Escherichia coli genome
Section 3	**3. Parts and Devices Supporting Control of Protein Expression and Activity** 3.1 Constitutive and regulated promoters 3.2 Splicing and alternative splicing impact on gene design 3.3 Design of ligand-controlled genetic switches based on RNA interference
Section 4	**3. Parts and Devices Supporting Control of Protein Expression and Activity** 3.4 Small molecule-responsive RNA switches 3.5 Programming gene expression
Section 5	**4. Gene circuits and biochemical pathways** 4.1 The synthetic approach for regulatory and metabolic circuits 4.2 Synthetic gene networks
Section 6	**5. Cell-free system** 5.1 Cell-free protein synthesis 5.2 Cell-free biosensing
Section 7	**6. Early Applications of Synthetic Biology** 6.1 Therapeutic designer cells
Section 8	**6. Early Applications of Synthetic Biology** 6.2 Immunotherapy 6.3 Other applications
Section 9	7. Presentation
Section 10	**8. Optogenetics: Light-Sensing Proteins** 8.1 History and perspectives of light-sensing proteins 8.2 Biology of light-sensing proteins in plants and microorganisms 8.3 Modular strategies to exert optogenetic control
Section 11	**9. Optogenetics in Neuroscience** 9.1 Neuroscientific frontline of optogenetics 9.2 Optogenetics for neuronal circuitry and behavior manipulation 9.3 Imaging and manipulating activated neurons 9.4 Optogenetics in Drosophila neuroscience
Section 12	**10. Optogenetics in Biological Systems** 10.1 Ion channels and receptor-mediated signaling 10.2 Organelles and subcellular compartments 10.3 Photoactivatable recombinases 10.4 Immunomodulation 10.5 Programmed cell death 10.6 Genome engineering and transcriptional regulation
Section 13	**11. Medical Optogenetics** 11.1 Towards understanding the neural mechanism of behavioral phenotypes seen in psychiatric disorders 11.2 Gene therapy by using channelrhodopsin-2 to treat blindness 11.3 Optogenetic approaches to restoring intrinsic visual processing features in retinal ganglion cells 11.4 Optogenetic tissue engineering on visual cells
Section 14	**12. Chemogenetics in neurons** 12.1 Designer receptors exclusively activated by designer drugs (DREADD) 12.2 Pharmacologically selective effector molecules (PSEMs)

	Section 15	**13. Chemogenetics in non-neurons** 13.1 Chemogenetic modulators 13.2 Strategies for chemogenetic control 13.3 Application in physiological processes
	Section 16	**14. Discussion, Presentation and Review**

13. 课程考核
Course Assessment

（①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。If the course is open to undergraduates, please indicate the difference.）

①考核形式
开放试卷考试：通过课堂学习及自主文献查阅的方式，进行实验设计等问题回答

②分数构成
期末开放试卷考试：60%
Presentation：30%
平时课堂考勤及表现：10%

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

1. Lee, Sang Yup, Jens Nielsen, and Gregory Stephanopoulos. Synthetic biology: parts, devices and applications. John Wiley & Sons, 2018.
2. Yawo, H., Kandori, H., & Koizumi, A. (Eds.). Optogenetics: light-sensing proteins and their applications. Springer, 2015