课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**MSE5002 高等材料化学 Advanced Materials Chemistry**
2.	**课程性质** **Compulsory/Elective**	专业核心课
3.	**课程学分/学时** **Course Credit/Hours**	3/48
4.	**授课语言** **Teaching Language**	英文/English
5.	**授课教师** **Instructor(s)**	田颜清 教授
6.	**是否面向本科生开放** **Open to undergraduates or not**	否
7.	**先修要求** **Pre-requisites**	Materials Chemistry (undergraduate course), Principle of chemistry, and Fundamental of materials science

8. 教学目标
Course Objectives

随着技术创新进步的迅猛发展，尖端材料领域正成为其中的一个特别关键因素。材料必须满足一系列不同的需求，同时市场也迫切需要种子理念，来开发多种高科技物质以支持尖端技术。先进材料化学课程通过涵盖先进合成和化学反应、固体中的小分子、聚合物、玻璃和陶瓷、金属、半导体、超导体和纳米材料来应对当前的社会发展趋势。课程重点将放在和电子、光子、生物医药、以及可再生能源等方面应用相关的化学。将兼顾广度和深度，运用化学方法从原子和分子微观尺度设计和研究先进材料，力求反映当代材料化学的科技成就和前沿成果。学生将获得并增强材料化学相关的先进专业知识，解决问题的能力，表达能力以及沟通能力，为最终将能够在自己的研究领域中具有独立领导前沿研究和开发的能力服务。

With technological innovation progressing at a rapid pace, the field of cutting-edge materials is becoming a particularly critical one. Materials must satisfy a host of different demands, and the market desperately needs seed ideas that will allow it to develop numerous high-tech substances to support cutting-edge technologies. The Advanced Materials Chemistry Course is responding to current social trends by structuring its coursework covering advanced synthesis and reaction chemistry, small molecules in solids, polymers, glasses and ceramics, metals, semiconductors, superconductors, and nanomaterials. Through the class, emphasis will be given to chemistry related to materials' applications in electronics, photonics, biomedicine and renewable energy. Will take into account the breadth and depth of research using chemical methods to design and investigate advanced materials from atomic and molecular microscopic scale, sought to reflect the outcome of scientific and technological achievements of the cutting-edge contemporary materials chemistry. Students will gain and strengthen sophisticated expert knowledge, problem-solving ability, presentation skills, and communication skills in materials chemistry capable of independently leading cutting-edge research and development in their chosen field.

9. 教学方法
Teaching Methods

1.课程绝大多数章节采用英语授课，个别难以理解的术语加入中文解释，使学生能充分理解并完全理解课程内容。The vast majority of chapters will be taught in English, for a few individual incomprehensible terms, Chinese will be added to enable the students to fully understand the course content.

2.课程中要求学生对文献进行介绍，使学生能跟踪世界前沿的化学知识和技术在先进材料中的重要作用。The course requires the students to introduce literature, so that students can keep track of the important role of the world's cutting-edge knowledge and technology in chemistry on advanced materials.

3.对部分章节引入录像教学，将采用世界名家的讲课录像使学生能对某些重要反应，设计，过程，机理，以及材料的优异性质等有达到世界前沿教学水平的了解。Videos will be introduced to some chapters. These videos will be those of the world famous lecturers so that students can understand some important reactions, design, process, mechanism, and excellent material properties by reaching the world cutting edge level of teaching.

4.作业将采用灵活的方式， 约两周一次作业， 作业内容将促进学生对基础知识的掌握理解。Homework will adopt a flexible approach, which will be about once per two weeks. The contents of the homework will facilitate students to master the fundamentals in materials chemistry.
5.期末考试将采用在课堂上开卷的形式， 3 小时， 将评价学生的理解能力而不是回想和记忆能力，考查学生利用已经掌握的基础知识和课堂记录灵活地利用材料化学知识应用到新领域，新状况，分析设计和合成，以及评价材料性质等综合能力。Final exam will be using “open-note” style in classroom for 3 hours. Students are evaluated on understanding rather than recall and memorization. Students will be expected to apply materials to new situations; analyze elements and relationships, synthesis, and/or structure; as well as evaluate using their materials as evidence.

10. 教学内容
Course Contents

Section 1	Basic Materials Chemistry – atomic, molecular, and hybrid orbitals; chemical bonds
Section 2	Crystalline and Amorphous Materials – crystal structures, size, shape, and packing of molecular units, orders and disorder in solids
Section 3	Synthesis and reaction chemistry – isolation of elements, advanced organic and inorganic synthesis, reaction kinetics and thermodynamics
Section 4	Synthesis and reaction chemistry – isolation of elements, advanced organic and inorganic synthesis, reaction kinetics and thermodynamics
Section 5	Small molecules in solids - packing of small molecules, liquid crystals, charge transfer complexes, clathrates
Section 6	Polymers – advanced synthesis of polymers, linear and branched geometries, thermal responsive polymers, photo-responsible polymers, pH responsible polymers, structure-property relationships, conjugated polymers, applications
Section 7	Polymers – advanced synthesis of polymers, linear and branched geometries, thermal responsive polymers, photo-responsible polymers, pH responsible polymers, structure-property relationships, conjugated polymers, applications
Section 8	Polymers – advanced synthesis of polymers, linear and branched geometries, thermal responsive polymers, photo-responsible polymers, pH responsible polymers, structure-property relationships, conjugated polymers, applications
Section 9	Polymers – advanced synthesis of polymers, linear and branched geometries, thermal responsive polymers, photo-responsible polymers, pH responsible polymers, structure-property relationships, conjugated polymers, applications
Section 10	Glasses and ceramics - Pauling bonding rules, zeolites, nitride and oxide-based ceramics; applications
Section 11	Metals- metallic structures; electrical, thermal, and magnetic properties; bulk metallic glasses
Section 12	Semiconductors – organic polymer semiconductors; devices and applications
Section 13	Nanomaterials – synthesis, structures and properties, theories, 0D, 1D, & 2D materials; applications
Section 14	Nanomaterials – synthesis, structures and properties, theories, 0D, 1D, &

		2D materials; applications
	Section 15	Nanomaterials – synthesis, structures and properties, theories, 0D, 1D, & 2D materials; applications
	Section 16	Nanomaterials – synthesis, structures and properties, theories, 0D, 1D, & 2D materials; applications
	Section 17	Final exam

11. 课程考核
Course Assessment

Policy and date:
1. Journal club: Each week a team of students will be assigned a journal article from the recent literature, reflecting the class content. At the start of the class, this team will give a 5-10 minute overview of the article, presenting no more than 2 slides total.
* Note: On your presentation day, please e-mail me your slides by 8 am of your presenting day
* If you are not able to present in-class, you will be asked to prepare a one-page summary of a journal article on the last homework set.
2. Homework: Homework problems will be distributed approximately once every two weeks. Homework will generally be issued on the middle of the week and will be due the following weekday of next weel. Unless prior approval is obtained, late homework will be scored according to the relation:
Homework Score(tdays) = HomeworkScore(Duedate)* 2Exp(-t)
3. Exams will be "open note" (1 page, single sided sheet) but limited time format. Final exam will be 3 hours.
4. Course grades will be weighted as follows:
Quiz: 10%
Journal club: 20%
Homework: 40%
Final Exam: 30%

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

参考教材:

There is no one text that can cover the entire field of materials chemistry. Some of the lectures will be draw from "Materials Chemistry, 2 nd Ed", by Bradley D. Fahlman, Springer, Netherland.

For additional information, we would recommend
1: The Physics and Chemistry of Materials by Joel Gersten
2: 彭正合主编.《材料化学》.(科学出版社)