课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**MSE5025 材料科学与人工智能** **Materials science and artificial intelligence**
2.	**课程性质** **Compulsory/Elective**	专业选修课
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)**	项晓东 讲席教授
6.	**是否面向本科生开放** **Open to undergraduates or not**	是
7.	**先修要求** **Pre-requisites**	大学物理、材料物理 University Physics, Physics of Materials

8. 教学目标
Course Objectives

本课程针对已有良好材料、物理基础，并有意向攻读博士研究生的学生，此课程是本研共上课程。课程将系统介绍组合材料学的理念、历史、要素，形成对组合材料学的整体认识。重点介绍组合材料芯片相关的制备及表征技术，掌握基于组合材料芯片技术获取完整材料数据图谱的系列方法与思维。之后结合人工智能，学习高性能材料的快速筛选方法。重点介绍几种前沿的、创新的高通量表征技术，体验技术创新的过程。

This course is designed for students with good materials and physics skills and the willing to take doctoral degree. This course could be provided for undergraduate and postgraduate students and will systematically introduce the idea, history and elemental factors of Combinatorial Materials and possess an overview. This course focuses on the synthesis and characterization technologies of Combinatorial Materials Chips, aiming to lead the students to understand and master the way to obtain the whole Combinatorial Materials data spectrum. And combined with artificial intelligence, the students could learn the method of screening the high-performance materials efficiently. Several state-of-art innovative high-throughput characterization techniques will be emphatically introduced to help the students to experience the process of technological innovation.

9. 教学方法
Teaching Methods

经过本课程的学习，学生将对组合材料学有基本认识，了解组合材料学的基本概念和核心思想。了解基于连续和分立掩膜技术的高通量离子束溅射、热蒸发、磁控溅射、等离子体增强化学气相沉积技术，以及基于组合材料学思想的电、光、磁、热等性质的高通量表征技术，掌握利用组合材料学和人工智能实现材料高通量筛选的基本实验手段。

After learning this course, students will have a basic understanding of the basic concepts and core ideas of Combinatorial Materials. Students will understand several high-throughput synthesis technologies based on continuous and discrete mask technology, including ion beam sputtering, thermal evaporation, magnetron sputtering and plasma-enhanced chemical vapor deposition, and several techniques of electrical, optical, magnetic and thermal properties characterization. Elemental experiment methods for high-throughput materials discovery based on the concept of Combinatorial Materials and the application of artificial intelligence will be understood.

10. 教学内容
Course Contents

Section 1	Week 1~2:组合材料学概述--Overview of Combinatorial Materials The development of artificial intelligence and big data technology brings new opportunities for material science research. This section mainly introduces the concept of Combinatorial Materials and its important role in the study of

	materials science, and also the development of Combinatorial Materials chip technology and Combinatorial Materials project.
Section 2	Week 3:材料基因组大科学装置--Materials Genome Scientific Infrastructure This section mainly introduces the Materials Genome Scientific Infrastructure in Shenzhen. The high-throughput synthesis technology and characterization technology possessed by the Infrastructure, and their advantages are briefly described.
Section 3	Week 4 ~ 6:一维、二维、三维组合材料芯片制备技术--The Synthesis Of Combinatorial Materials Chips As one of the major components in Combinatorial Materials, the synthesis of Combinatorial Materials chips is the fundamental to collect materials information experimentally. This section introduces different synthesis techniques to obtain combinatorial materials chips with controllable chemical distribution in 1D, 2D and 3D, including high throughput PVD, CVD, variable component fiber synthesis, aerogel synthesis, etc.
Section 4	Week 7:X 射线在高通量表征技术中的应用--Application Of X-Ray In High-Throughput Characterization Technology This lecture will cover the basic principles of X-ray interaction with matter and applications of X-rays in various materials characterization techniques, including X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), X-ray fluorescence (XRF) and Synchrotron Radiation.
Section 5	Week 8 ~ 9:光与物质的相互作用--Interaction Of Light With Matter Optics is concerned with the interaction of electromagnetic radiation with matter. The theoretical description of the phenomena and the analysis of the experimental results are based on Maxwell’ s equation and on their solution for time-varying electric and magnetic fields. The Drude and Lorentz model are presented here to describe the optical properties of solids.
Section 6	Week 10:椭圆偏振测量技术-- Ellipsometry Here mainly describes what is ellipsometry and the specific working principle of the ellipsometer, as well as the application of ellipsometry in high-throughput characterization.
Section 7	Week 11:磁光克尔技术-- Magneto-Optical Technology This section mainly describes what is Magneto-optical Kerr effect, the principle of Magneto-optical Kerr effect, and the application of Magneto-optical Kerr effect。
Section 8	Week 12: 中期论文及报告-- Mid-Term Reports
Section 9	Week 13~14:高通量热学、力学表征技术-- High-Throughput Thermal And Mechanical Characterization Techniques This section focuses on the application of high-throughput far-field optical characterization techniques in thermal and mechanical characterization， and how to measure the parameters such as heat capacity, thermal conductivity and elastic modulus of materials
Section 10	Week 15:中子技术与组合材料学-- Neutron Technology And Combinatorial Materials This lecture will cover the fundamentals of neutron scattering, key components of a high-resolution, high-intensity neutron spectrometer and analysis of neutron diffraction spectrum to determine the atomic or magnetic

		structures of materials.
	Section 11	Week 16: 人工智能-- Artificial Intelligence The rapid development of artificial intelligence has changed the way of research in materials science. What is artificial intelligence? How to combine AI and big data, shorten the research cycle of materials, and promote the rapid development of materials science? The above contents will be presented in this section.
	Section 12	Week 17~18:期末论文及报告- Final exam

11. 课程考核
Course Assessment

出勤 10%
课程项目 Projects 40%
期末报告 Final Presentation 50%

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

项晓东论文集
材料基因组论文
固体光谱学，方容川
Handbook of Applied Solid State Spectroscopy，D.R. Vij，Springer
固体物理导论，基泰尔，化学工业出版社
Elements of Modern X-ray Physics，Jens Als-Nielsen, Wiley
An Introduction to Synchrotron Radiation: Techniques and Applications， Philip Willmott， John Wiley & Sons, Ltd