课程大纲

COURSE SYLLABUS

1.	课程名称(中英文) **Course Title(Chinese and English)**	**光谱学与光谱技术 SPECTROSCOPY AND SPECTRAL TECHNOLOGY**
2.	**课程类别 Course Type**	专业选修课 Subject Elected
3.	授课院系 **Originating Department**	电子与电气工程系 Department of Electrical and Electronic Engineering
4.	可选课学生所属院系 **Open to Which Majors**	所有专业 All Majors
5.	**课程学时 Credit Hours**	48
6.	**课程学分 Credit Value**	3
7.	授课语言 **Teaching Language**	英文 English
8.	**授课教师 Instructor(s)** （如果是一个课题组共同讲授的，请标明 MI 以及其他构成成员。）	陈锐 Chen Rui
9.	**先修课程、其它学习要求** **Pre-requisites or Other Academic Requirements**	无 None
10.	**教学目标 Course Objectives**	
	学生在完成本课程学习后，应能掌握：（1）各种光谱技术的原理，对各类检测方法有较全面的了解，在今后的科研工作中能够将光谱学知识应用于自己的研究；（2）掌握光谱学基础、光谱仪器系统、常规光谱技术和激光光谱技术等。 After the completion of this course, students should know the following items. (1) Familiar with the principle of all kinds of spectrum technology; have a comprehensive understading of all kinds of detection methods which will be useful for their future research work; (2) Understand the specific content including spectroscopy, conventional spectra-system and laser spectroscopy technology.	
11.	**教学方法及授课创新点 Teaching Methods and Innovations**	
	教学方法：课堂教授，习题，学生选择相关主题进行演讲比讨论。 **创新：**本课程将为学生提供第一手的机会，掌握光谱学与光谱技术。除了理论教学，本课程将包括各种应用于科学研究的现代光谱技术，不仅可以使学生掌握相关的知识，也有利于他们基于这些先进的测试手段服务于研究生阶段的科学研究。	

Teaching Methods: lecture, tutorial, students will choose the related topics to present and discuss during the lecture.

Innovations: This course will provide students first-hand opportunities to master problem-solving skills with modern laser spectroscopy. In addition to theoretical teaching, this course will include a variety of modern laser technology applied to scientific research. This course will not only enable students to master the relevant knowledge, but also can serve for their graduate research based on these advanced measurement techniques.

12. 教学内容及学时分配 **Course Contents and Course Schedule**

Chapter 1. Introduction: Introduce the outline of the course

Chapter 2. Absorption and Emission of Light: Cavity Modes;Thermal Radiation and Plancks Law; Absorption， Induced， and Spontaneous Emission; Basic Photometric Quantities; Polarization of Light; Absorption and Emission Spectra; Transition Probabilities; Coherence Properties of Radiation Fields

Chapter 3. Spectroscopic Instrumentation: Spectrographs and Monochromators; Interferometers; Comparison Between Spectrometers and Interferometers; Accurate Wavelength Measurements; Detection of Light;

Chapter 4. Lasers as Spectroscopic Light Sources: Fundamentals of Lasers; Laser Resonators; Spectral Characteristics of Laser Emission; Experimental Realization of Single-Mode Lasers; Controlled Wavelength Tuning of Single-Mode Lasers; Linewidths of Single-Mode Lasers; Tunable Lasers; Nonlinear Optical Mixing Techniques; Gaussian Beams

Chapter 5. Nonlinear Spectroscopy: Linear and Nonlinear Absorption; Saturation of Inhomogeneous Line Profiles; Saturation Spectroscopy; Polarization Spectroscopy; Multiphoton Spectroscopy; Special Techniques of Nonlinear Spectroscopy

Chapter 6. Laser Raman Spectroscopy: Basic Considerations; Experimental Techniques of Linear Laser Raman Spectroscopy; Nonlinear Raman Spectroscopy; Special Techniques; Applications of Laser Raman Spectroscopy

Chapter 7. Time-Resolved Laser Spectroscopy: Generation of Short Laser Pulses; Measurement of Ultrashort Pulses; Lifetime Measurement with Lasers; Pump-and-Probe Technique

Chapter 8. Coherent Spectroscopy: Level-Crossing Spectroscopy; Quantum-Beat Spectroscopy; Excitation and Detection of Wave Packets in Atoms and Molecules; Optical Pulse-Train Interference Spectroscopy; Photon Echoes; Optical Nutation and Free-Induction Decay; Heterodyne Spectroscopy; Correlation Spectroscopy

Chapter 9. Laser Spectroscopy of Collision Processes: High-Resolution Laser Spectroscopy of Collisional Line Broadening and Line Shifts; Measurements of Inelastic Collision Cross Sections of Excited Atoms and Molecules; Spectroscopic Techniques for Measuring Collision-Induced Transitions in the Electronic Ground State of Molecules; Spectroscopy of Reactive Collisions; Spectroscopic Determination of Differential Collision Cross Sections in Crossed Molecular Beams; Photon-Assisted Collisional Energy Transfer; Photoassociation Spectroscopy of Colliding Atoms

Chapter 10. New Developments in Laser Spectroscopy: Optical Cooling and Trapping of Atoms; Spectroscopy of Single Ions; Optical Ramsey-Fringes; Atom Interferometry; The One-Atom Maser; Spectral Resolution Within the Natural Linewidth; Absolute optical Frequency Measurement and Optical Frequency Standards; Squeezing

	Chapter 11. Applications of Laser Spectroscopy: Applications in Chemistry; Environmental Research with Lasers; Applications to Technical Problems; Applications in Biology; Medical Applications of Laser Spectroscopy
13.	课程考核 **Course Assessment**
	作业（30%），报告（30%）和项目（40%） Assignments (30%), Presentation (30%), and Project (40%)
14.	教材及其它参考资料 **Textbook and Supplementary Readings**
	指定教材：德姆特勒德，激光光谱学，第三版，世界图书出版公司，2008 **推荐参考资料：**Sune Svanberg, Atomic and Molecular Spectroscopy: Basic Aspects and Practical Applications, Springer-Verlag, 2003 **Textbook:** Demtroder W., Laser Spectroscopy: Basic concepts and Instrumentation, 3rd Ed. Springer-Verlag, 1982 **Supplementary Readings:** Sune Svanberg, Atomic and Molecular Spectroscopy: Basic Aspects and Practical Applications, Springer-Verlag, 2003