Course Schedule of MST Program
Semester: Spring, 2009

Course: Modern Experimental Techniques 現代實驗技術
Time: F6F7F8 Friday (14:20~17:00) or Thursday(週四 9:10~12:00)
Room:311 IAMS
Required, credit: 3
Course No.: TIGP722100

Date	lecturer	Date	lecturer
2/27 Friday 14:20~17:00	Prof. Jyhpyng Wang	4/24 Friday 14:20~17:00	Prof. Jyhpyng Wang
3/6 Friday 14:20~17:00	Prof. Jyhpyng Wang	4/30 Thursday 9:10~12:00	Prof. Jim Lin
3/13 Friday 14:20~17:00	Prof. Jyhpyng Wang	5/7 Thursday 9:10~12:00	Prof. Jim Lin
3/20 Friday 14:20~17:00	Prof. Juen-Kai Wang	5/14 Thursday 9:10~12:00	Prof. Jim Lin
3/27 Friday 14:20~17:00	Prof. Juen-Kai Wang	5/21 Thursday 9:10~12:00	Prof. Jim Lin
4/3 Friday 14:20~17:00	Prof. Juen-Kai Wang	5/29 Friday 14:20~17:00	Prof. Ker-Jar Song
4/10 Friday 14:20~17:00	Prof. Juen-Kai Wang	6/5 Friday 14:20~17:00	Prof. Yuh-Lin Wang
4/17 Friday 14:20~17:00	Prof. Jyhpyng Wang	6/12 Friday 14:20~17:00	Prof. Ker-Jar Song

The course of Modern Experimental Techniques is composed of four component mini-courses: (1) Vacuum Technology taught by Profs. Ker-Jar Song and Jim Jr-Min Lin, (2) Optics, Lasers, and Optical Signal Detection taught by Prof. Juen-Kai Wang, (3) Laboratory Electronics taught by Prof. Jyhpyng Wang, and (4) Charged-Particle Optics taught by Prof. Yuh-Lin Wang. An introduction of each component mini-course is listed below:

Speaker	Part 1 (4 Weeks) Prof. Jim Lin 林志民教授 Part 2 (2 Week) Prof. Ker-Jar Song 宋克嘉教授
Class Outline	(1) Vacuum Technology List of subjects: Part I: mean free path, gas flow, adsorption and desorption Part II: pressure measurements, pumps, chambers and parts, outgas

Introduction	1. Do and don't, stories and lessons learned from years of ultra-high vacuum practice. 2. Experimenting with a real ultrahigh vacuum system for one week. A residual gas analyzer is available so that students get to know what happens in the chamber for each step of his operation. Students will practice venting the system, replacing components, pumping it down, leak/dirt testing, baking, e-beam bombardment, and all kind of tricks that can help bring good vacuum the fastest way.
Grading	40% from written examination on general principles of vacuum technology, 60% from how good a vacuum one can obtain.
Textbook	1. Building Scientific Apparatus, 2nd edition or 3rd edition by Moore, Davis and Coplan 2. Operating manuals of components of the UHV system.

Speaker	Part 3 (4 Weeks) Prof. Juen-Kai Wang 王俊凱教授
Class Outline	(2) Optics, Lasers, and Optical Signal Detection List of subjects: 1. ABC of optical components: optics, opto-mechanics, vibration isolation and motion control 2. Know your laser system: basic principles, laser engineering, frequency conversion and laser safety 3. Detect optical radiation: intensity, wavelength, polarization and phase 4. Build an optical instrument: initial concept, computer drawing/simulation, revision and construction
Introduction	This course is to provide basic knowledge to use optical and laser instruments in laser laboratories and eventually to have a basic training about how to construct an optical setup for a specific experiment. Furthermore, the course provides a hand-on experimental experience to learn how to manipulate optical components.
Grading	1. A construction plan for an optical setup: proposal (10%), computer drawing (20%), item list (10%), report (20%) 2. A hand-on experiment: on-site experimental test (20%), Experimental report (20%).

Textbook	1. Fundamentals of Photonics, B. E. A. Saleh and M. C. Teich (John Wiley & Sons, New York 1991). 2. Laser Spectroscopy: Basic concepts and instrumentation, W. Demtröder (Springer-Verlag, Berlin, 1996)

Speaker	Part 4 (4 Weeks) (汪老師另加一週共 5 週) Prof. Jyhpyng Wang 汪治平教授
Class Outline	(3) Laboratory Electronics List of subjects: Part 1: circuit construction: circuit elements and diagrams, construction and diagnosis tools, soldering and assembling, shielding and grounding, circuit protection Part 2: basic electronics: diodes and transistors, impedance and passive filters, amplifiers, active filters and oscillators, negative-feedback control, digital circuits, digital/analog interface
Introduction	In a modern laboratory, data are transmitted by electronic signals. Machines are also controlled by electronic signals. Therefore it is extremely important for students to know what is going on behind the switches, knobs, cables, detectors, etc. In this course we will teach students the basics of real-world electronics. In part 1, we begin with an extensive introduction to common electronic components and tools, and then we teach some important techniques of circuit construction. In part 2, we shall discuss common building blocks of electronic circuits. Starting from the most basic diodes and transistors, we show the construction of filters, amplifiers, and oscillators. Then we move to feedback control, and finally to digital circuits and digital/analog interface. These building blocks are so often used in laboratory electronics that by knowing them well, students can build up the confidence in handling laboratory electronics.
Grading	1. Constructing a working electronic device, such as an electronic clock, a stepping motor system, a function generator, a regulated power supply, etc. (50%) 2. Written examination. (50%)
Textbook	The art of electronics, 2nd ed. Horowitz and Hill, Cambridge Univ. Press.

Speaker	Part 4 (1Weeks) Prof. Yuh-Lin Wang 王玉麟教授
Class Outline	(4) Charged-Particle Optics List of subjects: 1. Solving the Laplace equation for a rotationally symmetric electrostatic and magnetic fields 2. Trajectory of charged particles in static electric and magnetic fields 3. Gaussian imaging by charged particle 4. Electrostatic lenses, scanning electron microscope and focused ion beam
Introduction	Basic principles of image formation using electron or ion beam and a brief introduction to electron and ion microscopy
Grading	Homework assignment
Textbook	Aberration Theory in Electron and Ion Optics (Ximen Jiye, Academic Press, 1986).