COURSE CATALOG

2021-2022 Autumn Semester

International College of UCAS

Online students

Index

General Introduction

1. General Degree Requirements for Doctors

The requirement of UCAS for Doctor Degree is to get at least 9 credits before graduation. 4 credits should be from two Professional Degree Courses. And students need to take two professional degree courses. But students from institutes need to check out the requirements of your own institutes. Each institute has different requirement of credits. Please contact the Educational Administration of your own institutes first.

2. General Degree Requirements for Masters

The requirement of UCAS for Masters is to get at least 30 credits before graduation. At least 13 credits should be from Professional Degree Courses. Every master student needs to take at least 2 credits from optional courses.

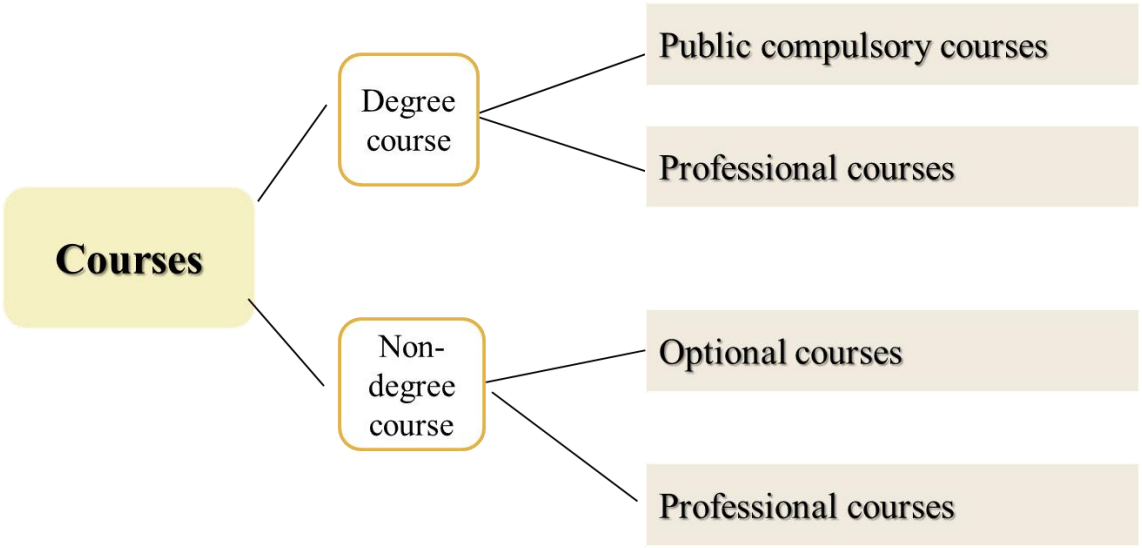
3. General Degree Requirements for MD-PhD Students

The requirement of UCAS for MD-PhD students is to get at least 38 credits before graduation. 13 credits are from the Public Compulsory courses. At least 16 credits should be from Professional Degree Courses. Every student needs to take at least 2 credits from optional courses.

Types	Public compulsory courses	Optional courses	Professional degree courses	In total
Masters	**7credits**	**≥2 credits**	**≥13 credits**	**≥30 credits**
PhD	**7 credits**	**None**	**≥4 credits and ≥2 courses**	**≥9 credits**
MD-PhD	**13 credits**	**≥2 credits**	**≥16 credits**	**≥38 credits**

4. Courses Type

Courses are classified as degree courses and non-degree courses.



4.1 Public compulsory courses (7 credits in total)—Degree Courses

(1) Elementary Chinese 1 (2 credits);
(2) Elementary Chinese 2 (2 credits);
(3) China Panorama (2 credits).
(4) Academic Morality and Writing Norms (1 credits).

These four Public compulsory courses are Degree Courses for all international students. However, we have a rule about **Course Waiver**. Students who can meet one of the conditions can apply for course waiver and will get 6 credits directly (**except Academic Morality and Writing Norms**). **All students should take Academic Morality and Writing Norms as it is required for graduation.**

A. Providing a certificate of HSK Level 3;
B. Got a bachelor's degree or master's degree which are taught in Chinese.

Students who apply for the course waiver need to contact Ms. Li (**lishuang@ucas.ac.cn)** before September 20th.

4.2 Professional courses—Degree Courses and Non-degree Courses

Professional courses this year in Yanqihu campus cover several academic areas. If one professional course has several parts, students who select this course need to complete all parts of this course, otherwise s/he may fail the course.

The professional courses can be classified as one of two types: Degree Courses and Non-degree Courses. This final decision of course classification for each student is left to the supervisor, as s/he is in the best position to assess the courses for the graduate programs. If students find the professional courses are totally not related to his/her major and will not help the research for PhD, then these courses can be seen as Non-degree Courses (Optional Courses). If the professional courses will help the research for PhD, then they should be Degree Courses (Compulsory Courses). This classification of one course will be shown on the course selection form and the final score sheet. All the students have two weeks to attend the professional classes and choose them.

4.3 Optional courses—Non-degree Courses

This semester we have 3 optional courses, which should be Non-degree courses.

1. Research Ethics (1 credit);
2. Scientific Writing (1 credit);
3. Public Speaking (1 credit);

5. Rules about courses results

Students should drop out of the university under one of the following circumstances:
1、Master candidates who fail two degree courses within one semester and still fail one after relearning the courses, or fail three degree courses during the school years.
2、PhD candidates who fail one degree course and still fail after relearning the course, or fail two courses during their school years.
The Public Compulsory Courses are all Degree Courses.

6. Course Selection System

This course selection system is for students registering professional courses online. Students will receive an email from the Course Selection System one week before courses start. Then students will have two weeks to choose the professional courses online and change the courses. Please use the Google Chrome or 360 browsers. Do not choose two courses schedule overlap. After courses starting two weeks, the system will be closed. Then everyone will receive the message from the assistant teachers to confirm your courses.

Website: http://ic-course.ucas.ac.cn/
Username: Your Passport ID
Original password: 123456

The capacity of every course is limited and first come first select.

Date	**Process**
Aug.30-Sep.12	Register courses online
Sep.13	Courses start.
Sep.13-Sep.26	Determine which professional courses you need to tell the teacher assistant to confirm it.
Jan. 14	Courses end.

7. Contact Information

Education Coordinator for Professional Courses:

- Phone: 010-82680563, Ms. Sophie
- E-mail: hutian@ucas.ac.cn

Education Coordinator for Public compulsory courses and Optional courses:

- Phone: 010-69671192, Ms. Li
- E-mail: lishuang@ucas.ac.cn

About the VooV Meeting app, please check the attachment——
VooV Meeting(腾讯会议) Installation and Operation Guide

About the ZOOM Meeting app, please check the attachment——
Solutions to several common problems about Zoom

Check the latest announcement please click here——
http://ic-en.ucas.ac.cn/category/announcement/page/1

8. Professional Courses and Optional Courses List

Code	Name	Hours/Credits	Type	Professors	Time	First Class Date	VooV Meeting(Online)	Assistant teacher
0702I0D01002H	Overview of Recent Development of Physics	51/3	Professional course	ZHOU Yufeng&SHI Xinghua	Thu. 13:30-16:20	Sep.16	ID: 59287166858; PW:202116	tianfl@nanoctr.cn
0703I0M01001H	Organometallic Chemistry	50/3	Professional course	SUN Wenhua	Mon. 13:30-16:20	Sep.13	ID:31768717120; PW:802802	myanping@iccas.ac.cn
0703I0D01001H	Organometallic Chemistry and Catalysis	50/3	Professional course	SUN Wenhua	Mon.19:00-21:50	Sep.13	ID:66176552637; PW:802802	myanping@iccas.ac.cn
0704I0D01001H	Fundamentals of Modern Astronomy	50/3	Professional course	GOU Lijun&WANG Lan	Tue. 13:30-16:20	Sep.14	ID:58721862527; PW:618618	jacobfeng@bao.ac.cn
0705I0D01002H	Remote Sensing Image Processing	52/3.5	Professional course	JIANG Xiaoguang et al.	Tue.13:30-16:20	Sep.14	ID:42148973019; PW:654321	weiletian19@mails.ucas.ac.cn

0705I0D01003H	Geographic Information Systems-A	51/3.5	Professional course	SONG Xianfeng et al.	Wed. 13:30-16:20	Sep.15	ID: 96885353182; PW:0915	hujinghao20@mails.ucas.ac.cn
0705I0D01008H	Geographic Information Systems-B	51/3.5	Professional course	ZHOU Xiang et al.	Fri. 13:30-16:20	Sep.17	**ZOOM** Meeting ID: 771 603 9997 Passcode: 106367	wangjin01@radi.ac.cn
0705I0D01004H	Land Change Science	60/4	Professional course	DONG Jinwei et al.	Wed.13:30-16:20&Fri.13:30-16:20	Sep.15	Wed-ID:84038935378; Fri-ID: 56026628333	mengzq.20b@igsnrr.ac.cn
0705I0D01005H	Eco-Environmental Informatics	69/5	Professional course	YUE Tianxiang	Mon.13:30-16:20&Fri.13:30-16:20	Oct.8	Mon-ID:57347116157; Fri:40129793979	zhaoyp@lreis.ac.cn
0706I0D01002H	Overview of Climate Change Sciences	60/4	Professional course	KANG Shichang et al.	Tue.13:30-16:20	Sep.14	ID: 76870591945; PW:210914	xin.wan@itpcas.ac.cn
0708I0D01001H	Introduction to Geodynamics	72/4.5	Professional course	WANG Shimin	Tue.13:30-16:20&Thu.13:30-16:20	Sep.14	Tue-ID:83317295321;Thu-ID:54156214917;PW:070810	791233395@qq.com

0708I0D01002H	Earth System Science	51/3	Professional course	CHEN Fang&JIA Gensuo	Mon.13:30-16:20	Sep.13	ID:92561762043;PW:969969; ID:65616946345(From Nov.15)	liutch5@qq.com; xiyan.xu@tea.ac.cn(From Nov.15)
0710I0D01001H	Plant Physiology and Developmental Biology	60/4	Professional course	CHENG Youfa&LE Jie	Mon.13:30-16:20	Sep.13	ID:90095825598; PW:210906	1412662705@qq.com
0710I0D01002H	Plant Molecular Biology and Genomics	60/4	Professional course	JING Haichun et.al.	Fri.13:30-16:20	Sep.17	ID:65334006911	lucheng@ibcas.ac.cn
0710I0D01003H	The Frontier of Genomics and Precision Medicine	60/4	Professional course	ZHANG Zhihua et al.	Fri.13:30-16:20	Sep.17	ID:85170258714; PW:202109	zhengsq@big.ac.cn
0710I0D01004H	Fundamental Immunology	52/3	Professional course	FANG Min&DUAN Xuefeng	Tue13:30-16:20&Fri 13:30-16:20	Sep.14	ID-Tue:68757330298; Fri:76483252057	guguangl@163.com
0710I0D01005H	Model Animals in Developmental Biology	60/4	Professional course	YUAN Li	Tue.13:30-16:20	Sep.14	ID:72917309499; PW:914567	cailu18@mails.ucas.edu.cn

0710I0D01012H	Organelle Biology	50/3	Professional course	LIU Pingsheng	Wed.13:30-16:20	Sep.15	ID:48612435905; PW:202103	caozhenld@163.com
0805I0D01001H	Functional Nanostructures: Syntheses, Characterization and Device Application	51/3	Professional course	WEI Zhixiang et al.	Wed.13:30-16:20	Sep.15	ID:51416683751; PW:825455	tiancy2020@nanoctr.cn
0805I0D01002H	Materials Production and Environmental Science	60/4	Professional course	DU Hao	Mon.13:30-16:20	Sep.13	ID:80698600666	yqlv1314@163.com
0805I0D01003H	Fundamentals and frontier of Materials Science	60/4	Professional course	ZHANG Guangjin et al.	Thu. 13:30-16:20	Sep.16	ID:65523722152	wanghaifan20@mails.ucas.ac.cn
0812I0D01001H	Intelligent Software Engineering	60/4	Professional course	LUO Tiejian	Thu.8:30-11:20	Sep.16	ID-78699378357; PW:210916	wanghao184@mails.ucas.ac.cn
0812I0D01002H	Data Science	60/4	Professional course	LUO Tiejian	Tue.8:30-11:20	Sep.14	ID:35417079277; PW:210914	luffy.lcc@gmail.com
0817I0D01004H	Multiphase Reactor Theory and Analysis	51/3	Professional course	LIU Xiaoxing	Fri.13:30-16:20	Sep.17	ID:77075943706; PW:202109	guohui@ipe.ac.cn

0817I0D01006H	Chemical Process Safety	60/4	Professional course	YANG Ning&GUAN Xiaoping	Tue.19:00-21:40&Fri.13:30-16:20	Oct.12	ID-Tue:31436000352; Fri:74334820545	zhangjingchang@ipe.ac.cn
0830I0D01001H	Environmental Chemistry	60/4	Professional course	TIAN Zhenyu	Tue.8:30-11:20	Sep.14	ID:82548535733	zhengzhihao@iet.cn
0830I0D01002H	Advanced Diagnostic Technologies of Chemical Reactions and Its Application	60/4	Professional course	TIAN Zhenyu	Tue.13:30-16:20	Sep.14	ID:61028994352	zhengzhihao@iet.cn
0830I0D01003H	Environmental and Natural Resource Economics	60/4	Professional course	DENG Xiangzheng et al.	Tue.19:00-21:40& Satur.19:00-21:40	Sep.14	ID-Tue:37741480435 Satur:85364737737	pengl.18b@igsnrr.ac.cn
0830I0D01004H	Advanced Physical/Chemical Water Treatment	60/4	Professional course	LIU Chao et al.	Tue.13:30-16:20&Thur.13:30-16:20	Sep.14	ID-Tue: 86712980273 (PW: 0508) Thu: 50274503574 (PW: 0508)	18661638226@163.com
0830I0D01005H	Water Chemistry	60/4	Professional course	LIU Chao et al.	Tue.19:00-21:50&Thur.19:00-21:50	Sep.14	ID-Tue: 60838351175 (PW: 0508) Thu: 73677857033 (PW: 0508)	18661638226@163.com

0812I0DGX001H	MATLAB with Applications to Mathematics, Science, Engineering, and Finance	45/2	Professional course	LUO Cuicui	Tue.19:00-21:50	Sep.14	ID:76838615459; PW: 209205	zongkai19@mails.ucas.ac.cn
0714I0D01001H	Data Mining	60/4	Professional course	LIU Ying	Mon.13:30-15:10& Wed.13:30-15:10	Sep.13	ID-Mon:50957851796; Wed:43287562669	renyihui18@mails.ucas.ac.cn
010105DGX001H-01-online	Ethics in Scientific Research, Bioethics, & Survival Skills for A Research Career	30/1	Optional course	ZENG Changqing	Fri.13:30-16:20	Oct.29	ID:51797378566	juanli@big.ac.cn
050200DGX002H-01-online	Scientific Writing	40/1	Optional course	YU Hua	Wed. 13:30-16:20	Sep.15	ID: 53515035225 Code:0901	yuhuatj@ucas.ac.cn
050200DGX002H-02-online	Scientific Writing	40/1	Optional course	PENG Gong	Tue.19:00-21:40	Sep.14	ID:757 8999 5060 Code: 210914	penggong@ucas.ac.cn
050200DGX002H-03-onl	Scientific Writing	40/1	Optional course	HONG Lei	Thur. 13:30-16:20	Sep.16	ID:975 2858 5653 Code:2021	leihong@ucas.ac.cn

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050200DGX002H-04-online	Scientific Writing	40/1	Optional course	CHEN Nianning	Tue. 13:30-16:20	Sep.14	ID:870 7737 8178 Code: 202109	cnn2008@ucas.ac.cn
050200DGX002H-05-online	Scientific Writing	40/1	Optional course	PENG Gong	Mon. 13:30-16:20	Sep.13	ID:889 6644 4040 Code:210913	zhouxinye19@mails.ucas.ac.cn
050200DGX003H-online	Public Speaking	40/1	Optional course	MENG Yanli	Wed.13:30-16:20	Sep.29	ID: 644 4466 9009 Code: 210929	yanlimeng@ucas.ac.cn

9. Public Compulsory Courses List

Class No.	Code	Name	Hours/ Credits	Date&Time	VooV Meeting ID	Professors	First Class	Assistant teacher
Y-1	050102DGB002H-1	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	637 3392 4440	LIU Xiaomeng	Sep.13rd	joe06082000@163.com
				Wed. (8:30-12:10)	381 6014 6681			
				Thur.(8:30-12:10)	550 9388 2705			
				Fri. (8:30-12:10)	988 2823 1450			
Y-2	050102DGB002H-2	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	601 5048 6748	HE Fei	Sep.13rd	mengzhilv221@126.com
				Wed. (8:30-12:10)	924 1183 9194			
				Thur.(8:30-12:10)	457 7494 2516			
				Fri. (8:30-12:10)	992 7766 0037			
Y-3	050102DGB002H-3	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	574 1793 3340	LI Ya	Sep.13rd	xiaoying796@163.com
				Wed. (8:30-12:10)	642 4296 3136			
				Thur.(8:30-12:10)	753 4505 5681			
				Fri. (8:30-12:10)	365 5462 9131			
Y-4	050102DGB002H-4	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	384 2343 9477	LI Ran	Sep.13rd	liran1008@126.com
				Wed. (8:30-12:10)	786 3303 9648			
				Thur.(8:30-12:10)	951 4330 0699			
				Fri. (8:30-12:10)	975 4938 8918			
Y-5	050102DGB002H-5	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	501 3513 5382	LUO Lei	Sep.13rd	1585368900@qq.com
				Wed. (8:30-12:10)	786 8333 4617			
				Thur.(8:30-12:10)	814 6297 8345			
				Fri. (8:30-12:10)	385 1868 2713			
Y-6	050102DGB002H-6	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	676 5289 6991	LUO Wei	Sep.13rd	luowei_official@163.com
				Wed. (8:30-12:10)	770 3660 5826			
				Thur.(8:30-12:10)	796 7578 2881			
				Fri. (8:30-12:10)	845 7130 6884			
Y-7	050102DGB002H-7	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	906 2707 6938	WANG Lei	Sep.13rd	1625355608@qq.com
				Wed. (8:30-12:10)	772 4305 9221			

				Thur.(8:30-12:10)	464 5312 6644			
				Fri. (8:30-12:10)	959 9224 1602			
Y-8	050102DGB002H-8	Elementary Chinese1、2	128/2.0	Mon.(8:30-12:10)	909 8876 9736	QI Bopeng	Sep.13rd	790158532@qq.com
				Wed. (8:30-12:10)	795 8813 0794			
				Thur.(8:30-12:10)	349 8899 8274			
				Fri. (8:30-12:10)	335 5583 5252			
X-1	050102DGB001H-1	China Panorama	48/2.0	Fri.13:30-16:20	418 6753 2319	JIANG Hong'en	Sep.17th	wanglijing17@163.com
X-2	050102DGB001H-2	China Panorama	48/2.0	Mon.19:00-21:40	692 9569 0469	Chen Tianjia	Sep.13rd	1437909744@qq.com
X-3	050102DGB001H-3	China Panorama	48/2.0	Fri.19:00-21:40	634 8583 2258	LUO Wugan	Sep.17th	wangxiaoting18@mails.ucas.ac.cn
X-4	050102DGB001H-4	China Panorama	48/2.0	Thur. 13:30-16:20	327 1504 88	ZHU Jian	Sep.16th	jzhu@ucas.ac.cn
X-5	050102DGB001H-5	China Panorama	48/2.0	Mon.19:00-21:40	988 2683 4498	YANG Yimin	Sep.13rd	lvnanning20@mails.ucas.ac.cn
X-6	050102DGB001H-6	China Panorama	48/2.0	Wed.13:30-16:20	925 4561 4372	CHU Guofei	Sep.15th	cgfzzs@163.com
X-7	050102DGB001H-7	China Panorama	48/2.0	Mon.19:00-21:40	ID:45668043378 Code:9999	CAO Zhihong	Sep.13th	zyy381024@163.com
X-8	050102DGB001H-8	China Panorama	48/2.0	Tue. 13:30-16:20	347 9683 4048	LAN Li	Sep.14th	panyitong@aliyun.com
A-1	120500MGB011H-1	Academic Morality and Writing Norms	20/1.0	Mon.19:00-21:40	ID:67375532404 Code:210913	YE Qing	Sep.13rd	caosihe20@mails.ucas.ac.cn
A-2	120500MGB011H-2	Academic Morality and Writing Norms	20/1.0	Tue.19:00-21:40	ID:63616282685 Code:210914	YE Qing	Sep.14th	caosihe20@mails.ucas.ac.cn
A-3	120500MG	Academic Morality and	20/1.0	Mon.14:20-17:10	406 7057 3574	YU Jun	Sep.13rd	shannon052

	B011H-3	Writing Norms						5y@gmail.com
A-4	120500MGB011H-4	Academic Morality and Writing Norms	20/1.0	Mon.14:20-17:10	534 3286 5380	LAN Li	Sep.13rd	panyitong@aliyun.com
A-5	120500MGB011H-5	Academic Morality and Writing Norms	20/1.0	Wed.13:30-16:20	957 5581 7005	LI Zhihong	Sep.15th	lizhih@ucas.ac.cn
A-6	120500MGB011H-6	Academic Morality and Writing Norms	20/1.0	Thur.19:00-21:40	399 9532 7464	LI Zhihong	Sep.16th	lizhih@ucas.ac.cn

2021－2022 学年秋季学期(Autumn Semester)校历

年度 year	2021																	2022	
月份 month	九月(Sep)				十月(Oct)					十一月(Nov)				十二月(Dec)				一月(Jan)	
周次 week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
星期一（Mon）	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10
星期二（Tue）	31	7	14	21 中秋	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11
星期三（Wed）	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12
星期四（Thu）	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13
星期五（Fri）	3	10	17	24	1 国 庆节	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14
星期六（Sat）	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1 元旦	8	15
星期日（Sun）	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16
说 明	1、Courses in International College start from Sep. 13th.																			

Course Syllabus

Course title

Functional Nanostructure: Synthesis, Characterizations and Device Applications

Instructor(s)-in-charge:

Prof. WEI Zhixiang, Prof. SUN Xiangnan, Assist. Prof. WANG Feng

Course type:

Lecture

Course Schedule:

3hrs/week by instructor

Course Assessment:

Homework: 16 assignments

Grading Policy:

Typically 40% homework, 40% each midterm, 20% final.

Course Prerequisites:

Solid state physics, semiconductor physics, general chemistry，physical chemistry

Catalog Description:

This course includes three sections: inorganic semiconductor nanostructures, organics functional nanostructure and application of functional nanomaterials. The first section provides atoms-to-device introduction to the latest semiconductor quantum heterostructures. It covers nanostructures growth, characterization, their electronic, optical, and transport properties, their role in exploring new physical phenomena, and their utilization in devices. For the second part, student will know principles of organic electronics, understand how to use various strategies to produce organic functional nanomaterials, get the ideas how to construct organic electronic and optoelectronic devices. The third provides the various application areas of functional nanostructures, including water splitting, photodetection, light-emitting diode, field-effect transistors, spintronic devices, thermoelectric devices and photovoltaic devices

Schedule of the course

section	content	hours
1	Introduction of Nanoscience and Technology	3
2	Physics Basics	3
3	Typical Nanostructures	3
4	Growth Methods	3
5	Characterizations of Nanostructures	6
6	Organic electronics	3
7	Applications of Nanostructures: Water splitting and photodetection	6
8	Applications of Nanostructures:	6

	Light-emitting diode and field-effect transistors	
9	Applications of Nanostructures: Spintronics and thermoelectrics	6
10	Applications of Nanostructures: Photovoltaics	6
11	Student Presentation and Discussion	6
total		51

Contents of the course

1. Introduction of Nanoscience and Technology
   - Definitions of Nanoscience and Nanotechnology
   - Special properties of nanomateirals: size effect, specific surface effect, and quantum effect
2. Physics Basics
   - Basics of Semiconductors: band theory, impurities and charge carriers, p-n junctions, photoelectric effect
3. Typical Nanostructures
   - Quantum dots
   - Nanowires and carbon nanotubes
   - Two-dimensional materials
4. Growth Methods
   - Vacuum science and technology (2 presentations)
   - Chemical Vapor Deposition (CVD) and Metal Organics Chemical Vapor Deposition (MOCVD)
   - Molecule Beam Epitaxy (MBE)
5. Characterizations of Nanostructures
   - Spectroscopic Characterization: X-ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), Raman Spectroscopy, Energy Dispersion X-ray Spectroscopy (EDS)
   - Electron Microscopic Characterization: Scan Electron Microscope (SEM), Transmission Electron Microscope (TEM)
6. Organic electronics
   - The discovery of organic conductor and semiconductor
   - General properties of organic semiconductor and general applications of organic electronics
7. Applications of Nanostructures
   - Water splitting
   - Photodetection
8. Applications of Nanostructures: Light-emitting diode and field-effect transistors
   - Preparation Methods
   - Properties and Applications: Organic Field-Effect-Transistor (OFET), Organic Light Emitting Diode (OLED
9. Applications of Nanostructures: Spintronic devices and thermoelectric devices

- Preparation Methods
- Properties and Applications: Organic spin valve and related devices, organic thermoelectric devices

10. Applications of Nanostructures: Photovoltaic devices
    - Preparation Methods
    - Properties and Applications: photovoltaic device based on various nano-materials
11. Student Presentation and Discussion

Textbook and any related course material:

Low dimensional semiconductor structures: fundamental and device applications
Edited by Keith Barnham and Dimitri Vvedensky
Organic Electronics, Materials, Processing, Electronics, and Apllications
Edited by Franky So
Characterization of Materials, edited by Elton N. Kaufmann (editor-in-chief), Wiley-Interscience.

Expected level of proficiency from students entering the course:

Mathematics: strong
Physics: strong
Chemistry: strong

Course title

Overview of Recent Development of Physics Part I

Instructor(s)-in-charge:

Prof. ZHOU Yufeng .

Course type:

Lecture

Catalog Description:

This course will introduce some basic concepts and recent progresses in theoretical physics. It will mainly focus on high-energy physics and its connections with modern cosmology. The topics include:

Overview of elementary particles physics and cosmology

The Standard Model of particle physics

-- history of elementary particles

-- the symmetry principle

-- gauge interactions between elementary particles

-- unification of electromagnetic and weak interactions

-- The Higgs boson

The standard model of cosmology

-- General relativity

-- the homogeneous and isotropic Universe

-- thermal history of the Universe

-- the original of matter in the Universe

Connecting the particle physics and Cosmology

-- dark matter problem

-- dark energy problem

Course title

Overview of Recent Development of Physics Part II-Overview of Modern Mechanics

Instructor(s)-in-charge:

Prof. SHI Xinghua

Course type:

Lecture

Office: R209@South Building, National Center for Nanoscience and Technology, CAS

Email: shixh@nanoctr.cn

Textbook: F. Bower, Applied Mechanics of Solids, CRC Press, 2009 (http://solidmechanics.org); Ya-Pu Zhao (赵亚溥), Lecture on Mechanics (力学讲义), 科学出版社, 2018

Pre-requisites and Co-requisites: None

Exam: Attendance 30%, Performance 20%, Homework 30%, Final project 20%

Course Content:

This course is designed primarily for the non-mechanics students who are interested in the mechanics-related problems in their future research work. This course is an introduction to the modern mechanics among which we would discuss the basic concepts and theories of deform and motion of an object, as well as the analytical methods. In the process, we will show how these concepts, theories and analytical methods work in the structural design, material selection and safety assessment in mechanical engineering, aerospace engineering, civil engineering, and other related fields like biology.

The topics we will cover include:

- Basic concepts of mechanics, such as displacement, strain, stress, constitutive relation, material strength, fracture, fatigue, etc
- Classical mechanics, Newtonian mechanics, Lagrangian mechanics
- Elastic mechanics, plastic mechanics, entropic elasticity, soil mechanics, biomechanics, etc
- Basic concepts of contact mechanics, fracture mechanics
- Basic concepts of finite element method (FEM)
- Basic concepts of fluid mechanics
- Some implications of mechanics you will find in life and research, like AFM, flexible electronics, gecko, cell, high speed train, etc

Schedule of the course:

section	content	hours
1	Introduction of the basic concepts of mechanics, the implications, Classical mechanics, Newtonian Mechanics	4
2	Lagrangian mechanics, elastic mechanics, entropic elasticity	4
3	Strength of materials, plastic mechanics, soil mechanics	4

4	Contact mechanics, fracture mechanics	4
5	Finite element method	4
6	Basic concepts of fluid mechanics, microfludics	4
7	Presentation, Lab tour	4
total		28

Course title

Organometallic Chemistry

Instructor(s)-in-charge:

Prof. SUN Wenhua & Associate Prof. MA Yanping

Course type:

Lecture

Course Schedule:

3hrs/week by instructor. 1 hr/week by teaching assistant.

Course Assessment:

Homework: 14 assignments

Grading Policy:

Typically 40% homework, 10% evaluation，30% for assessment (2 times, 15% each), 20% final. 5% plus to student presentation

Course Prerequisites:

General chemistry

Catalog Description:

Chemistry is the center of sciences, and organometallic chemistry is the useful tool for chemists to understand how organic molecules or groups interact with compounds of the inorganic elements. On the base of Organometallic Chemistry, the industries of chemical, petrochemical, pharmacy and organic materials have been continuously developing. With regard to Periodic Table of Elements, main group elements consisting of the s and p blocks and the transition elements of the d and f blocks would be discussed, respectively. Those organometallic compounds have been useful building blocks for nanoparticles and assembling materials. Importantly, organometallic compounds have been stoichiometric reagents and (pre)catalysts in tremendously industrial processes. In addition, organometallic compounds are also considerable for molecule biology. Therefore organometallic chemistry is a Capital Stone for scientists in chemistry, material science and nano-science.

Schedule of the course

section	content
1	Organometallic Chemistry: Definition & Scope Periodic Table of Elements *Evaluation regarding student background*
2	Various ligands and their electrons contributions
3	Alkali Metal Organometallics Alkaline Earth Metal Organometallics
4	Zinc, Cadmium, and Mercury organometallics Stoichiometric reactions *Tutorial assessment*
5	Synthetic methodology oriented organometallic chemistry: A Practice
6	Organometallics of the Boron Group Organometallics of the Carbon group

7	Transition metal Organometallics: Common types of organometallic complexes; 16/18 ev; ligand types and behaviors and oxidation states
8	Metal Carbonyl Complexes: Definition and types; from mononuclear to nanoparticles Industrial hydroformylation
9	Organometallic compounds ligated by alkenes, dienes, and alkynes Student presentations (Topic discussions)
10	Metallocene and Arene complexes
11	Sigma Complexes *Tutorial assessment*
12	Organometallic application: C-C and C-N cross couplings
13	Industrial processes: ethylene oligomerization and olefin polymerization
14	Student presentations (interpretation conceptual novelty to literature) Q and A sessions
15	**Open note test** **(notebook and files within personal computer allowed, but not any text books)**
total	

Textbook and any related course material:

Organometallics and Catalysis: An Introduction Edited by Manfred Bochmann. Oxford University Press 2015.

THE ORGANO METALLIC CHEMISTRY OF THE TRANSITION METALS Sixth Edition, Edited by Robert H. Crabtree. John Wiley & Sons, Inc 2014.

Course title

Fundamentals of Modern Astronomy

Instructor(s)-in-charge:

Dr. Lijun Gou, Dr. Lan Wang

Teaching assistant:

Dr. Lu Feng (Jacobfeng@bao.ac.cn)

Course type:

Lecture

Course Schedule:

3 *hrs/week by instructors*

Pre-requisites and Co-requisites:

None

Credits:

2.5

Course Content:

This course is designed primarily for the non-astronomy student who wishes to explore in depth a single topic in astronomy without becoming involved in detailed mathematical developments. In the process, we will see how scientific ideas develop and how scientists think about or approach problems.

This course is an introduction to our modern view of the universe, its contents, and how they got to be the way they are. Among the topics we will discuss are galaxies, quasars, stars, and black holes as well as the modern cosmology. For each of these objects, we will talk about what they are, how they are observed, how they form, and how they fit into the overall scheme of things in the universe. Due to the constraints of time, there are a number of topics, which we will not be able to discuss in detail. These omissions are made not because the subjects are of no interest to astronomers, but rather because we will not have time to discuss all of the interesting and important topics in astronomy.

Classical topics in astronomy, such as constellations and the appearance of the night sky, will not be covered in this course.

The topics we will cover include:

- Planet and its formation
- The nature and lives of stars
- The stellar remnants (neutron stars and black holes, etc)
- The nature of our Milky Way Galaxy
- Properties of other galaxies and the foundation of modern cosmology
- Dark Energy, and the fate of the Universe
- Life in the Universe

Course Objectives:

By the conclusion of this course, students should be able to:

•Explain the scientific process and how scientific theories are developed and tested.

•Recall basic physical concepts such as gravitational and conservation laws, and how light and matter interact.
•Describe the general characteristics of the universe.
•Apply scientific thinking to the natural world to understand, e.g. what powers the sun, why galaxies differ, and how the universe began.
•Formulate a scientific hypothesis, identify a testable prediction, verify by carrying out an experiment, and assess the results.

Textbook:
The Cosmic Perspective, 7 th Edition by Bennett, Donahue, Schneider, & Voit; Pearson Press.

Course title

The Frontier of Genomics and Precision Medicine

Instructor(s)-in-charge:

Prof. Zhihua Zhang (Beijing Institute of Genomics, Chinese Academy of Sciences)
Prof. Tingting Li (Peking University, School of Life Sciences)
Prof. Zhaoqi Liu (Beijing Institute of Genomics, Chinese Academy of Sciences)
Prof. Peilin Jia (Beijing Institute of Genomics, Chinese Academy of Sciences)

Course type:

Lecture

Course Schedule:

3hrs/week by instructor.

Course Assessment:

Homework: 2 assignments

Grading Policy:

Attendance: 10% , Homework: 30% , Final paper review: 60%

Course Prerequisites:

Molecular biology, Statistics, Computer programming

Catalog Description:

Epigenome and Genome structures. This section introduces the concept of "epigenetics" and the structures of chromatins. It covers chromatin remodeling and the modifications of DNA and histones, and their roles in chromatin structure maintenance. Contemporary life sciences and medicine are moving towards the era of large data as represented by high-throughput sequencing. How to model, analyze and interpret genomic data will determine whether we can quickly and accurately discover new biological phenomena and rules, and provide accurate medical care for patients. This course will introduce common data types in genomics, such as DNA-seq, RNA-seq, and statistical analysis and graphing methods commonly used in data analysis.

Proteomics is a fast and powerful discipline aimed at the study of the whole proteome or the sum of all proteins from an organism, tissue, cell or biofluid, or a subfraction thereof, resulting in an information-rich landscape of expressed proteins and their modulations under specific conditions. In the section for proteomics, we will introduce the most common technologies and workflows used in proteomic studies. Details of this section include principles and techniques in proteomics, recent advances in proteomics and application of proteomic technology. In the section for protein phase separation, we will introduce physical basis of phase separation, biological functions of phase separation and computational screening of biological phase-separating proteins.

In the section for genetics and genomics studies, we will introduce technologies used to understand the genetic architectures underlying human complex traits, disorders, and diseases. These include genome-wide association studies, next-generation sequencing technologies, as well as the computational methods used to mine and

interpret the genetics and genomics data. We will introduce approaches for basic association studies to identify disease-associated loci, including common variants, rare variants, and de novo mutations. We will also introduce approaches for advanced analyses widely used in the post-GWAS era to interpret and prioritize causal variants. These include integrative methods that rely on multi-omics data (such as transcriptome data and epigenomics data), deep learning methods to fine map genetic variants, and statistics methods to understand the regulatory roles and functional impacts of genetic variants in disease-relevant contexts.

In the last section, we mainly talks about computational cancer biology, but with a highlight on the implication of computational analysis in solving practical problem in cancer and the development of related treatment. We will first introduce the concept of tumor intra heterogeneity which is the main reason of drug resistance to standard treatment. We will discuss computational approaches for understanding tumor intrinsic subtyping, clonal evolution as well as therapeutic implications. A big part of the course will focus on cancer transcriptomics including canonical gene expression, non-coding elements, regulatory network and mRNA splicing. We will summarize computational methods and current challenges in cancer splicing analysis. Splicing factors are recurrently mutated in human cancers, which provide genetic evidence directly linking RNA splicing dysregulation to tumorigenesis. We will particularly talk about spliceosomal mutations in human cancer and therapeutic targeting of those mutations. Lastly, we will introduce pan-cancer analysis which takes advantage of the increasing amount of genomic data and human cancer projects, and cancer pharmacogenomics studies towards a speed-up of translational medicine.

Schedule of the course

Transcriptome	Zhihua Zhang	Basic principle of transcription;
		Identification of transcription regulatory factor binding sites
		Transcription regulatory factor binding sites and human disease
Epigenome	Zhihua Zhang	Promoter and enhancer identification methods
		DNA methylation, histone Modification and Gene expression Regulation
		Basic experimental techniques for Noncoding RNA
		Noncoding RNA and Human Disease
3D genome	Zhihua Zhang	Basic experimental techniques for 3D Genome
		Methods for recognition of Compartment A/B and TAD
		Reconstruction of the 3D genomic structure
		Chromatin loop identification methods based on multi-omics approach
		3D genomics and human disease

Basic Concepts of population Genetics I	Zhihua Zhang	Introduction to Gene Regulatory Network
		Basic Concepts of population Genetics I
		Basic Concepts of population Genetics II.
Proteomics: technologies and their applications	Tingting Li	Proteomics: principles and techniques
		Recent advances in proteomics
		Application of proteomic technology
Biological function and computational analysis of phase separation	Tingting Li	Physical basis of phase separation
		Biological functions of phase separation
		Computational screening of biological phase-separating proteins
Genomics: introduction of GWAS and complex diseases	Peilin Jia	Principles of GWAS: common variants, rare varaints, and de novo mutations
		Techniques: array based and next-generation sequencing
		Trends in genomics data analysis
Genomics: post-GWAS analysis I	Peilin Jia	Gene-based analysis
		Set-based analysis
		Regulatory roles of genetic variants: QTL
Biobank and resource	Peilin Jia	GWAS Catalog, 1KGP, UK10K
		GTEx: tissue transcriptomes and eQTL
		Roadmap and ENCODE
Genomics: post-GWAS analysis II	Peilin Jia	Colocalization analysis of GWAS data
		Summary-based Mendelian Randomization
		Transcriptome-wide association study (TWAS)
Machine learning and deep learning to mine genetic variants	Peilin Jia	Regulatory elements and epigenomics
		Convolutional Neural Network in analysing sequence data I
		Convolutional Neural Network in analysing sequence data II
Tumor	Zhaoqi	Tumor intrinsic subtyping

heterogeneity	Liu	
		Tumor clonal evolution Therapeutic implications of tumor heterogeneity
Cancer transcriptomics	Zhaoqi Liu	Gene expression study
		Non-coding RNA in cancer Regulatory network analysis
Altered splicing in cancer	Zhaoqi Liu	mRNA splicing and dysregulation in cancer
		Computational deciphering of splicing dysregulation Computational challenges in cancer splicing analysis
Spliceosomal mutations in cancer	Zhaoqi Liu	Spliceosomal mutations in cancer
		Review of cancer splicing studies Therapeutic targeting of RNA splicing
Pan-cancer analysis and pharmacogenomics	Zhaoqi Liu	Human cancer projects and cell line based drug screening systems
		Computational analysis reveal pan-cancer similarities and tumor-specific characteristics Pharmacogenomic studies by patient-tumor-derived short-term cultures

Reference:

1. *《An Introduction to Statistical Learning with Applications in R》*
Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, Springer
Free PDF version: http://www-bcf.usc.edu/~gareth/ISL/
2. *《Epigenetics》*, Cold Spring Harbor Laboratory Press; 2 edition S by C. David Allis, Marie-Laure Caparros, Thomas Jenuwein , Danny Reinberg.
3. *《The Biology of Cancer》*, Second Edition，Robert A. Weinberg，Garland Science

NOTE: All those books are only suggestive, not imperative.

Expected level of proficiency from students entering the course:

Mathematics and statistics: medium
Computer programming: medium
Molecular biology: medium
Genetics: entry level
Cell biology: entry level
Math: Basic calculation

Course title

Plant Molecular Biology

Instructor(s)-in-charge:

Profs. Hai-Chun Jing et al.

Course type:

Lecture

Course Schedule:

4hrs/week by instructors

Course Assessment:

Homework: 15 assignments

Grading Policy:

Typically 40% homework, 20% attendance, 40% final.

Course Prerequisites:

without

Catalog Description:

This course invites lab bench-based researchers from Institute of Botany, Chinese Academy of Sciences, to share their cutting-edge knowledge of Plant Molecular Biology and Genomics. The course will explain the concept of the gene, genome and epigenome, and theories and experimental tools/platforms to explore their variations, functions, interactions and regulatory networks in the context of plant speciation and evolution, growth and development as well as adaptation to the environments. Emphasis will also be given to how to translate know-hows gained from the basic science into plant breeding. The course puts more weight into how to rationalize, design and execute scientific researches, rather than to spoon feed the attendees with jargons to memorize. We encourage actively answer-seeking rather than rote learning, do require the attendees to have ideally at least college-level education in Plant Biology and relevant fields.

Schedule of the course

Section	Content	Hours	Tutor
1	The Gene, Genome and Epigenome in Plants, Plant Sciences and *Science* 125 questions	12	Hai-Chun Jing
2	Molecular Biology and Genomics for Plant Breeding	12	Hai-Chun Jing
3	Molecular Biology of Photo-morphogenesis and Light Signalling	9	Rong-Chen Lin
4	Plant Circadian Molecular System and Epigenetic Controls	12	Lei Wang
5	Plant Genome Biology and Evolution	12	Ya-Long Guo
6	Q&A	3	Hai-Chun Jing
total		60	

Contents of the course

Section 1: The Gene, Genome and Epigenome in Plants (Hai-Chun Jing)

1. The Gene

- **The Missing Science of Heredity**
- **The Dreams of Genetists**
- **Plant Genetics**

2. The Genome

- **The Spacious Genome**
- **RNA out of the Shadows**
- **Code, Non-Code, Garbage, and Junk**

3. The Epigenome

- **The Discovery of Epigenetics**
- **DNA Methylation**
- **Histone Modifications**
- **Chromatin Remodelling**
- **Interactions between Different Epigenetic Modifcations**

Section 2:Plant Genome Biology and Evolution（Ya-Long Guo, three afternoons）

- **Genome sequencing and genomics**
- **Comparative genomics**
- **Population genomics and adaptive evolution**

Section 3: Molecular Biology of Light Signaling and Photomorphogenesis (Rong-Cheng Lin, two afternoons)

- **Light and plant development**
- **Photoreceptors: light perception**
- **Light signaling transduction**
- **Photo morphogenesis**

Section 4: Plant Circadian Molecular System and Epigenetic Controls (Lei Wang, three afternoons)

- **Plant circadian molecular system (Concept, assembly of core oscillator)**
- **Regulation of circadian clock core oscillator**
- **Circadian clock and plant development**

Section 5: Molecular Biology and Genomics for Plant Breeding (Hai-Chun Jing)

- **Crop Domestication and Plant Genetic Resources**
- **Plant Biotechnology and Moelcular Breeding**
- **Future of Plant Breeding**

Textbook and any related course material

1. Epigenetics, edited by Allis CD, Jenuwein T and Reinberg D, Caparros ML (editor-in-chief), Cold Spring Harbor Laboratory Press, New York.

2. Genes Ⅴ/Ⅷ, Benjamin Lewin.

3. Genomics of tropical crop plants: Moore PH, Ming DR. Sringer, 2008.

4. Plant Genomics: Methods and Protocols. Daryl J. Somers DJ, PeterLangridge, J.P. Gust. Humana Press Inc.2011.

5. Plant Genomics: Methods and Protocols. Busch.Humana Press Inc. 2017.

Course title

Organelle Biology

Instructor(s)-in-charge:

Prof. Pingsheng Liu

Course type:

Lecture

Course Schedule:

See Schedule of the course (50 hours)

Course Assessment:

Homework: 7 assignments

Grading Policy:

70% homework, 30% classroom activities.

Course Prerequisites:

Without

Catalog Description:

1. Introduction **3 h**

Definition

Contents

2. Macromolecules **3 h**

Functions

Regulation

Structure

3. Cellular Compartments **3 h**

Cytoskeletons

Organelles

-Membrane-bound organelles

-Non-membrane organelles

4. Cell Organelles and Human Health **3 h**

5. Discussion 1 **3 h**

3 students/group, one topic/group, one presentation/group

Presentation includes a short talk with ppt (10 min) plus discussion (5 min)

There will be three discussion sessions, every student has one opportunity to present.

6. Metabolic Syndrome **3 h**

Cardiovascular disease

None alcoholic fatty liver disease

7. Introduction of Lipid Droplets **3 h**

History

Distributions

Difference with lipoproteins and other cellular organelles

Recent progress

Uncertainty and problems

Future studies

8. Lipid Droplet Proteins **3 h**

Structural Proteins:

PLINs
Oleosins
MPL, MLDP, MLDS, LDP, CLDPs

Protein Composition:

Lipid synthetic and catalytic
Membrane trafficking
Signaling
Protein degradation

9. Life of Lipid Droplets **3 h**

Born/biogenesis/formation
Grow
Die/usage/degradation

10. Discussion 2 **3 h**

3 students/group, one topic/group, one presentation/group
Presentation includes a short talk with PPT (10 min) plus discussion (5 min)
There will be three discussion sessions, every student has one opportunity to present.

11. Functions of Lipid Droplets **3 h**

Storage
Trafficking (movement and interaction with other cellular organelles)
Lipid synthesis
Signaling
Protein degradation
DNA protection

12. Lipid Droplets in Mammals and Other Organisms **3 h**

Mammals:

Adipose tissue
Mammary gland
Liver
Macrophages
Lymphocytes
Muscle
Other mammalian cells

Plants:

Plant seeds
Chloroplasts

Genetic Model Organisms:

Drosophila
C. elegans

Microorganisms:

Yeast
Green algae
Bacteria

13. Evolution of Lipid Droplets **3 h**

Origin

Conserved properties

14. Methods in Lipid Droplet Biology **3 h**

Isolation
Proteomics
Imaging
Fusion
Fission
Movement
Genetic screen
Artificial lipid droplets

15. Discussion 3 **3 h**

3 students/group, one topic/group, one presentation/group
Presentation includes a short talk with PPT (10 min) plus discussion (5 min)
There will be three discussion sessions, every student has one opportunity to present.

16. Laboratory Visiting **5 h**

Visit of IBP CAS
Equipment of Cell Fractionation
Equipment of Proteomics

Course material:

All references are listed in course ppt.
You are welcome to copy the ppt.

Course title

Fundamental Immunology

Instructor(s)-in-charge:

Prof. Min Fang & Assoc Prof. Xuefeng Duan

Course type:

Lecture

Course Schedule:

6hrs/week by instructors. 36 hrs in total by Prof. Min Fang; 16 hrs in total by Assoc Prof. Xuefeng Duan.

Course Assessment:

Homework: 6 assignments

Grading Policy:

Typically 50% homework, 20% attendances; 30% final presentation.

Course Prerequisites:

Immunology, Cell Biology, Microbiology，Virology

Catalog Description:

Fundamental Immunology is designed as a comprehensive course of immunology for research postgraduates in biology field. The class will give students a general view of immunology and some detailed development in certain selected area of immunology. As a course for postgraduates research case studies are incorporated into the course to provide examples for researches carried out in respective fields. This course covers the components of the immune system, Innate immunity, the cell biology of antigen processing and presentation, antibody and B cells, T cell response, the molecular structure and assembly of MHC molecules, and the pathogenesis of immunologically mediated diseases and immune system as defense system against infectious disease and tumor, and immunology as tool for general biology including antibody technology and flow cytometry. The course is structured as a series of lectures and mini-seminars in which individual research cases are discussed with faculty tutors. It will cover the following topics:

Schedule of the course

section	content	hours	Date
1	**Introduction of Immunology** Introduction to Immunology; General Properties of Immune Responses; Cells and Tissues of the Immune Systems; The development stages of Immunology.	4	Prof. Min Fang
2	**Innate Immunity** Features of Innate Immune Recognition; Components of the Innate Immune System; The Intersection of Innate and Adaptive Immunity	4	Prof. Min Fang
3	**NK cell development and function** General properties of NK cells; NK cell development and differentiation; NK cells in	4	Prof. Min Fang

	anti-viral immunity; Memory NK cells		
4	**Immunoglobulins and B lymphocytes** Immunoglobulins: Structure and Function; Antigen-antibody interactions and Monoclonal Antibody; B lymphocytes Development and Biology; B lymphocytes Signaling Mechanisms and Activation.	4	Prof. Min Fang
5	**T lymphocytes** T cell Antigen Receptors; T lymphocyte Signaling Mechanisms and Activation; Development of T cells; Peripheral T lymphocyte responses and Function.	4	Prof. Min Fang
6	**Major Histocompatibility Complex (MHC) Molecules and Antigen Presentation** MHC Structure, Function, and Genetics; Cell Biology of Antigen Processing and Presentation.	4	Prof. Min Fang
7	**Immunity to infectious Agents** The Immune Responses to Parasites and bacteria; Immunity to Viruses; Vaccines; Research case study.	4	Prof. Min Fang
8	**Immunologic Tolerance and Autoimmunity** B lymphocyte tolerance, and tolerance induced by foreign protein antigens; T lymphocyte tolerance; Mechanisms of autoimmunity; Advances in immunologic tolerance and autoimmunity	4	Assoc Prof. Xuefeng Duan
9	**Immunity to Tumors** Overview and tumor antigens; Immune responses to tumors and evasion of immune responses by tumors; Immunotherapy for tumors and the role of innate and adaptive immunity in promoting tumor growth; Advances in immunity to tumors	4	Assoc Prof. Xuefeng Duan
10	**Hypersensitivity Disorders and Allergy** Causes of hypersensitivity diseases; Mechanisms and classification of hypersensitivity; selected immunologic diseases: pathogenesis and therapeutic strategies; IgE-dependent allergic reactions; Allergic diseases in humans: pathogenesis and therapy; Advances in hypersensitivity	4	Assoc Prof. Xuefeng Duan

	and allergy		
11	**The Immune system in Disease** Systemic Autoimmunity; Transplantation Immunology; Overview of immunodeficiency diseases; Congenital immunodeficiencies; Acquired immunodeficiencies	4	Assoc Prof. Xuefeng Duan
12	**Immunity in the mucosal system** Overview of the mucosal system; The mucosal immune system; Immunity in the mucosal system; Mucosal diseases; Vaccine design	4	Prof. Min Fang
13	**Students Final Presentation** 3-5 minutes per student, the student can choose any topic in immunology and discuss their understanding and thoughts.	4	Prof. Min Fang
total		52	

Contents of the course

Section 1: Introduction of Immunology and Innate Immunity

1. Introduction of Immunology;
2. Cells and Tissues of the Immune Systems;
3. The development stages of Immunology
4. Features of Innate Immune Recognition;
5. Components of the Innate Immune System;
6. NK cells: General properties of NK cells; NK cell development and differentiation; NK cells in anti-viral immunity; Memory NK cells

Section 2: Adaptive Immunity

1. Humoral Immunity: Immunoglobulins: Structure and Function; Antigen-antibody interactions and Monoclonal Antibody; B lymphocytes Development and Biology; B lymphocytes Signaling Mechanisms and Activation.

2. Cellular Immunity: T cell Antigen Receptors; T lymphocyte Signaling Mechanisms and Activation; Development of T cells; Peripheral T lymphocyte responses and Function.

3. Antigen Presentation: MHC Structure, Function, and Genetics; Cell Biology of Antigen Processing and Presentation.

Section 3: Specialized Immunity

1. Immunity in the mucosal system: The mucosal immune system; Immunity in the mucosal system; Mucosal diseases; Vaccine design

Section 4: Immune Systems and Diseases

1. Immunity to infectious Agents: The Immune Responses to Parasites and bacteria; Immunity to Viruses; Vaccines; Research case study.

2. Immunologic Tolerance and Autoimmunity: B lymphocyte tolerance,

and tolerance induced by foreign protein antigens; T lymphocyte tolerance; Mechanisms of autoimmunity; Advances in immunologic tolerance and autoimmunity.

3. Immunity to Tumors: Overview and tumor antigens; Immune responses to tumors and evasion of immune responses by tumors; Immunotherapy for tumors and the role of innate and adaptive immunity in promoting tumor growth; Advances in immunity to tumors

4. Hypersensitivity Disorders and Allergy: Mechanisms and classification of hypersensitivity; selected immunologic diseases: pathogenesis and therapeutic strategies; IgE-dependent allergic reactions; Allergic diseases in humans: pathogenesis and therapy; Advances in hypersensitivity and allergy

Textbook and any related course material:

Cellular and Molecular Immunology, 8th Edition, Edited by Abul K .Abbas, Andrew H. Lichtman,
and Shiv Pillai
Fundamental Immunology, 7th Edition, Edited by Paul, William E.
Principles of Virology, 3rd Edition, Edited by S.J. Flint, L.W. Enquist, V.R. Racaniello, A.M. Skala

Expected level of proficiency from students entering the course:

Cell Biology: strong
Immunology: basic
Virology: basic

Course title

Model Animals in Developmental Biology

Instructor:

Prof. YUAN Li

Course description:

The goal of this course is to introduce postgraduate students to the field of animal developmental biology, and to help them understand how the choice of model organisms matters for their research.

Topics related to growth, differentiation, morphogenesis and organogenesis in different model animals would be covered. Using genetic and molecular biological techniques, developmental biologists have moved beyond animal developmental anatomy and now study the causal mechanisms of development using a number of invertebrate and vertebrate model organisms. Thus, animal developmental Biology has a rich and fascinating history as people, events, and disciplines coalesced to form the field. It continues as one of the most rapidly expanding areas of biological research.

Course type:

Lecture, mini-seminar, discussions

Notes:

PowerPoint slides for each lecture will be sent to you in advance. During the lecture period, you will be presented with a series of discussion questions. These questions are designed to challenge you to think critically about the principles of animal developmental biology. The goal of these questions is to introduce you to the process of interpreting scientific data as well as the experimental paradigms that form the foundation of developmental biology. I will benefit from these questions by gaining feedback about your level of understanding of the presented concepts, and you can in turn use these discussion questions to gauge your own grasp of the material.

Studying developmental biology is rigorous and demanding, but the rewards can be great. I look forward to learning with you.

Grading information:

Components of Model Animals in Developmental Biology will be worth the following percentages of your total grade:

Homework assignments: 20%

Discussion questions: 20%

Attendance: 10%

Final open-book examination: 50%

Schedule of the course

Chapter	Content
1	Introduction to model animals in developmental biology
2	Studying developmental biology – tools and techniques
3	Introducing animal embryonic development
4	Cell-cell communication in development
5	Germ cells, fertilization and sex determination

6	Early *Drosophila* development and genes that pattern the *Drosophila* body plan
7	Early amphibian development
8	Early zebrafish development
9	Early development in chickens
10	Early mammalian development
11	Early development in *C. elegans*
12	Development of the nervous system Section 1: The Emergence of the Ectoderm: central nervous system and epidermis Section 2: The neural crest cells and axonal specificity
13	Organogenesis: (1) Paraxial mesoderm: somitogenesis (2) Intermediate mesoderm: the urogenital system
	Repetition; Open-book examination
Total	

Course title

Plant Physiology and Developmental Biology

Instructor(s)-in-charge:

Prof. CHENG Youfa

Course type:

Lecture, mini-seminar, discussions

Catalog Description:

This course is designed as an introduction course of plant physiology and developmental biology for graduate students. In this course, we will discuss plant physiology and developmental events during plant life and the underlying mechanisms controlling plant developmental processes and responses to environmental stimuli. Emphasis will be given on the molecular genetic basis of the developmental events. The entire life span will be examined, from gametocyte development to embryogenesis and post-embryonic development, such as root, leaf, flower and fruit development. Hormones and signal transduction will also be discussed.

It will cover the following topics:

Schedule of the course

section	content
1	Introduction to Plant Physiology and Developmental Biology
2	Methods in Plant Physiology and Developmental Biology I
3	Methods in Plant Physiology and Developmental Biology II
4	Hormone and Signal Transduction in Plants I
5	Hormone and Signal Transduction in Plants II
6	Embryogenesis I
7	Embryogenesis II
8	Stem Cell and Meristem I
9	Stem Cell and Meristem II
10	Organogenesis I
11	Organogenesis II
12	Flowering and Flower Development I
13	Flowering and Flower Development II
14	Stress physiology
15	exam
total	

Course title

Environmental and Natural Resource Economics

Instructor(s)-in-charge:

Prof. DENG Xiangzheng, Prof. LIU Yuexian, Dr. LI Zhihui

Course type:

Lecture

Course Schedule:

3hrs/week by instructors. 1 hr/week by teaching assistant.

Catalog Description:

The Environmental and Natural Resource Economics course is designed for research postgraduates in Environmental Sciences field. The class will give students a general view of environmental and natural resource economics and some detailed development in certain selected areas. As a course for research students, a mini-seminar series are incorporated into the course to provide examples for researches carried out in respective fields. This course covers the components of the environmental economics and natural resource utilization analysis and research, their key definitions and research approaches, economics of natural science based environmental changes and assessment, natural resources categories and their scientific issues, issue-oriented analysis and discussion of environmental justice and sustainable development, etc. The course is structured as a series of lectures and mini-seminars, in which individual research cases are discussed with faculty tutors. It will cover the following topics:

Schedule of the course

Section	Content
1	**The Economic Approach** 1.1 The Human–Environment Relationship: -the role of economics; -studying human behavior in a laboratory; -the environment as an asset. 1.2 Environmental Problems and Economic Efficiency: -property rights and efficient market allocation; -improperly designed property rights systems; -the pursuit of efficiency. 1.3 Externalities as a Source of Market Failure: -public goods; -imperfect market structures; -government failure; -an efficient role for government.
2	**Evaluating Trade-Offs** 2.1 Normative Criteria for Decision Making: -pollution control; -preservation *versus* development; -issues in benefit estimation. 2.2 Approaches to Cost Estimation: -the Treatment of Risk; -distribution of benefits and costs; -choosing the discount rate; -divergence of social and private discount rates; -cost-effectiveness analysis;

	-impact analysis. 2.3 Valuing the Environment: -identification of types of values of environment; -classification of valuation methods; -preference based models (stated preference, revealed preference, travel cost, hedonic property and wage, averting expenditure). 2.4 GIS based modeling works: -examples and practices.
3	**Dynamic Efficiency and Sustainable Development** 3.1 Efficiency vs Equality: -a two-period model; -defining intertemporal fairness; -efficient allocations and sustainability criterion. 3.2 Sustainable Development: -market allocations; -efficiency and sustainability; -trade and environment. 3.3 Environmental Policy for Sustainable Development: -implications for environmental policy; -depletable resource allocation; -efficient intertemporal allocation; -market allocation of depletable resource.
4	Student presentations and discussions
5	**Replenishable but Depletable Resources: Water** 5.1 The Potential for Water Scarcity: -the efficient allocation of scarce water; -water transfers; -water markets; -water prices; -GIS and water resource. 5.2 Watershed based efficiency and cost-effectiveness: -nature of water pollution problem; -water pollution control. 5.3 Mini-seminars: -group discussions
6	**A Locationally Fixed, Multipurpose Resource: Land** 6.1 The Economics of Land Allocation: -land use; -land use conversion; -examples and practices. 6.2 Efficiency of land use: -sources of inefficient use and conversion; -innovative market-based policy remedies; -establishing property rights; -transferable development rights. 6.3 Mini-seminars: -group discussion.
7	**Reproducible Private Property Resource: Agriculture and Food Security** 7.1 Global Scarcity and food security: -outlook for the future; -the role of agricultural policies; -distribution of food resource. 7.2 Climate changes and food security: -feast and famine cycles;

	-examples and summary, 7.3 Mini-seminars: -group discussion.
8	Student presentations and discussions
9	**Land Storable, Renewable Resources: Forests** 9.1 Sources of Inefficiency: -perverse incentives for the landowner and nations; -poverty and debt; -sustainable forestry. 9.2 Public Policy: -carbon sequestration credits; -REDD. 9.3 Mini-seminars: -group discussion.
10	**Economics of Pollution Control** 10.1 The Efficient Allocation of pollution: -a pollutant taxonomy; -market allocation of pollution; -efficient policy responses. 10.2 Policy Analysis: -cost-effective policies for uniformly mixed fund pollutants: -cost-effective policies for nonuniformly mixed surface pollutants: -responses to changes in the regulatory environment; -price volatility; -instrument choice under uncertainty; -product charges as an indirect form of environmental taxation. 10.3 Air Pollutions: -conventional pollutants; -cost-effectiveness of the command-and-control approach; -innovative approaches; -regional pollutants. 10.4 Mini-seminars: -group discussion.
11	Student presentations and discussions
12	**Course conclusion and discussion**
13	**Final Exam**
Total	

Course title

Overview of Climate Change Sciences

Instructor(s)-in-charge:

Prof. KANG Shichang et al.

Course type:

Lecture

Grading Policy:

Part one: Attendance (20%)

Part two: Presentation (30%)

Part three: Final Exam (50%)

Catalog Description:

*Climate Change Science 2021 fall semester is designed as an introductory course in the **climate system change and related Issues** for graduate students majored in Earth Sciences. The class will give students an overview of climate system and its changes and impacts, mitigation and adaptation of climate changes as well as some updated developments in selected fields. As a course for graduate students a mini-seminar series are incorporated into the course to provide examples of research conducted in selected fields. This course covers the components of the climate system including atmosphere, cryosphere, hydrosphere, biosphere, anthroposphere, and their changes as well as mechanisms, forcing, attribution and predictions of the changes, multisphere interactions in Earth surface. Impacts, mitigation and adaptation of climate changes and regional and global sustainable development are also introduced. The course is structured as a series of lectures and mini-seminars in which individual research cases are discussed with faculty tutors.*

Schedule of the course and contents

	Section	Hours	Content
1	Overview of Climate Change	6	Weather, climate and climate System
			What has hanged
			Why has it changed
			How will it change
2	Paleo-climate Change	6	Glacial and interglacial cycle
			Holocene
			Past 2000 yeas
			Anthropocene
3	Changes in Atmospheric Composition	6	Aerosols and precursors
			Short lived gases
			Well mixed greenhouse gases
			Toxic species
4	Changes in Atmospheric Circulation	3	Global atmospheric circulation
			Stratospheric circulation
			Mid to high latitude circulation
			Tropical circulation

			Monsoon system
			Climate pattern
5	Changes in Climate Extremes	3	Temperature extremes
			Precipitation extremes
			Tropical storms
6	Changes in the Cryosphere	6	Glacier
			Ice sheet
			Permafrost
			Seasonal snow
			Sea ice
			Other ice
7	Changes in Hydrological Cycle	6	Global and regional hydrological cycle
			Precipitation
			Streamflow and runoff
			Evapotranspiration including Pan Evaporation
			Surface and tropospheric humidity
			Clouds
8	Modeling Climate Change and Prediction	6	Aerosol and clouds
			Anthropogenic and natural radiative forcing
			Detection and attribution of climate change
			CMIP5
			Regional climate model
			Climate change prediction
9	Impacts, Vulnerability of Climate Change	3	Assessment methods of impacts and vulnerability
			Major fields and regions of impacts and vulnerability
			Resilience in response to climate change
10	Mitigation and Adaptation of Climate Change	3	Mitigation approaches
			International policies for mitigation
			Adaptation under sustainable development
11	Question, discussion and presentation	6	Climate change in East Asia
			Climate change in South Asia
12	Question, discussion and presentation	6	Climate change in Central Asia
			Climate change in other countries

Course title

Earth System Science Part I-Introduction to Remote Sensing

Instructor(s)-in-charge:

Prof. Fang Chen

Course type:

Lecture

Course Schedule:

Monday from 13: 30 - 16:20 p.m.

September 14, 2020 *September 21, 2020* *September 28, 2020*
October 12, 2020 *October 19, 2020* *October 26, 2020*
November 2, 2020 *November 9, 2020*

Course Assessment:

Homework: 2 assignments

Grading Policy:

The grading for this course will be based on:
- Participation (30% of grade)
- Assignments (30% of grade)
-Short presentation (20% of grade)
-Comprehensive final exam (20% of grade)

**Participation in lectures, discussions, and other activities is an essential part of the instructional process. Students are expected to attend class regularly. Those who are compelled to miss class should inform the instructor and TA of the reasons for absences. Unexcused late assignments will have at a minimum 5 points deducted. To avoid this penalty you must contact the instructor and TA prior to the due date. Each student is expected to give a presentation on the topical area of Assignment-2 in front of the class. The presentation will be followed by discussion during which other students are expected to ask questions and engage. The presentations may be limited to 5-10 minutes and Q&A will be limited to 2-5 minutes (depend on the number of students). Students will be graded both as presenters and participation in discussion.*

Course Prerequisites:

This course does not have any pre-requisites.

Catalog Description:

This course is intended to provide an introduction to remote sensing, with particular attention to the role of remote sensing for the monitoring the Earth's land surface. It will introduce the basic principles of image interpretation, remote sensing, and digital data processing in relation to optical, thermal, and microwave remote sensing systems. Examples of remote sensing applications will be resented along with methods for obtaining quantitative information from remotely sensed imagery.

Writing Assignments

1. *Assignment-1-- Write a short (3-4 page) paper on **a topic of your understanding of remote sensing** related to the class subject matter. DUE in class, October 12.*
2. *Assignment-2-- Write a short (3-4 page) paper on the topic of **the use of remote***

***sensing for disaster management**. DUE in class, November 9.*

Keys to Success:

This course is challenging for many students because of the highly quantitative nature of the field of remote sensing. In order to assist all students in the course, I have identified several keys to success in this course:

1. *Attend all lectures which are critical components of this class. Attending lecture will make the difference of an entire grade.*
2. *Read the assigned text chapters/sections before coming to class.*
3. *During lectures, focus on listening to the material being presented and synthesizing this information by taking notes that summarized the key points.*

Schedule of the course

Section	Content	Date	Readings	Assignments Due
1	*Introduction to Remote Sensing*	*September 14*	*-Ch.1,3*	
2	*Image Processing/RS Applications*	*September 21*		
3	*Remote Sensing for Disaster Management*	*September 28*		
4	*Remote Sensing of Vegetation- Spectral/Temporal Characteristics, Indices, and Change Detection*	*October 12*	*-Ch.11,12*	*Assignment-1 due by beginning of class*
5	*Remote Sensing of Water, Soil, and Urban Areas*	*October 19*	*-Ch.13,14*	
6	*Students presentation (**Offline presentation**)*	*October 26*		
7	*Students presentation (**Online presentation**)*	*November 2*		
8	*Students presentation (**Online presentation**)*	*November 9*		*Assignment-2 due by beginning of class*

Textbook and any related course material:

Jensen, J. R., 2007, Remote Sensing of the Environment: An Earth Resource Perspective. Prentice Hall series in Geographic information Science, NJ. (ISBN: 0-13-188950-8)

Essay Template

TITLE: ESSAY TEMPLATE FOR THE INTRODUCTION TO REMOTE SENSING COURSE (TITLE IN CAPS, 12PT BOLD CENTERED)

First Author[1,2] (10pt bold centered)

[1] *Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, China*

[2] *Voeikov Main Geophysical Observatory, Roshydromet, Russian Federation (10pt italicized centered)*

Abstract Summary: This section should briefly summarize the main contents of your essay.

Recommended length is 10 lines using Time New Roman 9pt.

Keywords: *Disaster, Flooding (9pt in italics, maximum five words)*

1. INTRODUCTION (headline in CAPITALS, 10pt Bold)

In order to have a similar format for all essays in the assignments, we are offering some recommendations to the authors for composing their essay.

The essay should be in A4 format with page margins of 25 mm on the left and right sides and 25 mm on the top and bottom. The maximum allowed length is 4 pages. Pages must not be numbered. The first page must begin with the essay title in capital letters, centered. Authors' name and affiliations must appear just below the title. A summary and keywords should directly follow.

The text should be divided in several sections, and main contents includes: 1) natural hazard and disaster mitigation in your country or region; 2) the development of remote sensing technology in your country or region; 3) your opinion on technologies that might significantly improve current disaster mitigation in your country or region, 4) challenges and recommendations of advancing disaster risk management with remote sensing technologies in your country or region.

The title of each section should be in capital letters. The text must be in a single column format. For the body, the text must be single-spaced and justified, using Times New Roman font. Font sizes are specified at various locations. It should be structured in paragraphs; each new paragraph should begin with an indent without an empty line between paragraphs. The paper should be written in English.

Tables and figures could be added in your essay. A caption must be provided for each table and figure you choose to include. Captions should be below the figures/tables and must be numbered (Tab. 1; Fig. 1).

References will appear at the end of the extended abstract. Given size constraints, only limited key references need to be included. List all citations alphabetically in the reference section. Two examples of citations are given in this document (Bougeault et al. 2001, Schwitalla et al. 2007).

Table 1 Most meaningful example of a data table with columns and lines filled with a minimum of quantitative information
(Table entries in 10pt; caption in 9pt).

Test Table	Column 1	Column 2	Column 3	Column 4
Line 01	1	2	3	4
Line 02	5	6	7	8
Line nn				

Figure 1 Two photos of polar bears. Left: Figure explanation; Right: Figure explanation (9pt)

2. NATURE HAZARDS AND DISASTER MITIGATION IN YOU COUNTRY (headline in CAPITALS, 10pt Bold)

3. REMOTE SENSING IN YOUR COUNTRY (headline in CAPITALS, 10pt Bold)

4. TECHNOLOGIES REQUIREMENT FOR… (headline in CAPITALS, 10pt Bold)

To reduce risk and vulnerability, to mitigation the effects of natural disaster, and to improve rescue operations, we must use science and technology to explore the potentially positive aspects...

5. CHALENGES AND RECOMMENDATIONS… (Headline in CAPITALS, 10pt Bold)

Provide a scientific and practical guide to Academies of Sciences, with example of good practices in implementing mitigation risk with remote sensing. ...

6. SUBMISSION OF ESSAY

The extended essay should be produced with MS-Word. **Note that if you do not submit your essay, it will not appear in the Final Scores.** Please use the following naming convention to help ease the compilation of the Volume of Essay:

```
Surname Firstname (You Student ID).doc
```

Acknowledgements: *(9pt italics)*

I thank all …

REFERENCES (in 9pt; second line indented for better distinction)

Bougeault, P., P, Binder, A. Buzzi, R. Dirks, R. Houze, J. Kuettner, R. B. Smith, R. Steinacker, and H. Volkert, 2001: the MAP Special Observing Period. *Bull. Amer. Meteorol. Soc.* **82**, 433-462.

Schwitalla, T., G. Zangl, H. S. Bauer, and V. Wulfineyer, 2007: Convective initiation in the Black Forest region in high-resolution MM5 simulations. *Proc. 29th Intern. Conf. on Alpine Meterology*, Chambery, France, 261-264.

Course title

Earth System Science Part II-Earth System Dynamics

Instructor(s)-in-charge:

Prof. JIA Gensuo

Course type:

Lecture

Course Schedule:

Once a week from November 16, 2020 to January 11, 2021

Course Assessment:

Homework: 4 assignments

Grading Policy:

The grading for this course will be based on:

- *Participation (30% of grade)*
- *Assignments (40% of grade)*
- *Comprehensive final exam (30% of grade)*

Course Prerequisites:

Preferred but not required: Ecology, environmental sciences, climate science

Catalog Description:

This course focuses on patterns and variability of the Earth system. It addresses a number of fundamental science questions. How does the Earth system operate in the absence of significant human influence? How do human-driven processes shape land surface and climate system as addition to those due to natural variability? What are the implications of global change for human well-being? How robust is the Earth System in the face of natural and anthropogenic changes? The course covers various aspects of our scientific knowledge about the nature of the Earth system and global environmental change, and includes the following sections: 1) Spatial patterns and temporal variability of the Earth system; 2) Heterogeneity and connectivity of the Earth system; 3) Human dominated changes in global environment; 4) Land surface and terrestrial ecosystem processes; 5) Interactive changes of land-use, ecosystem, and climate; 6) Disaster risks under changing climate; 7) Earth observation of global environmental change. To encourage involvement and interaction, international students will also be given opportunity to discuss ways towards a sustainable Earth system with their local, national, and regional perspectives at a well-designed science-policy forum.

Schedule of the course | Monday 1:30-4:20 pm

section	content	hours	Date
1	Spatial patterns and temporal variability of the Earth system (1)	3	November 16
2	Spatial patterns and temporal variability of the Earth system (2)	3	November 23
3	Heterogeneity and connectivity of the Earth system	3	November 30
4	Human dominated changes in global environment	3	December 7
5	Land surface and terrestrial ecosystem processes	3	December 14

6	Interactive changes of land-use, ecosystem, and climate	3	December 21
7	Disaster risks under changing climate	3	December 28
8	Earth observation of global environmental change	3	January 4
9	Science-policy forum: towards a sustainable Earth system	3	January 11
total		27	

Textbook and any related course material:

Steffen, W., A. Sanderson. P.D. Tyson, et al. 2004
Global Change and the Earth System
Springer. 336 pp

Shugart, H.H. and F.I. Woodward. 2011.
Global Change and the Terrestrial Biosphere: Achievements and Challenges,
Wiley-Blackwell Press, Oxford. 242 pp

Relevant science journals:
http://jiong.tea.ac.cn/Journals.html

Global and Planetary Change, 0921-8181
Global Change Biology, 1354-1013
Global Ecology and Biogeography, 0960-7447
Global Environmental Change - Human and Policy Dimensions, 0959-3780

Course title

Introduction to Geodynamics

Instructor(s)-in-charge:
Prof. Shimin Wang
Course type:
Lecture
Course Schedule:
6 hrs/week by instructor
Course Assignments:
8 homework assignments and 1 final report
Grading Policy:
20% class attendance, 40% homework, 40% final report.
Course Prerequisites:
Calculus, General Physics
Catalog Description:
This course will introduce the field of geodynamics, the study of dynamical processes of the solid Earth. As such, it is rooted in fundamental physics and highly interdisciplinary. Mathematics is the central tool used to apply physical theories and create predictive models of the Earth. Geodynamics provides the quantitative foundation for the theory of Plate Tectonics, the basic organizing paradigm for our understanding of the solid Earth.
Schedule of the course

Chapter	content	hours	Date
1	Plate Tectonics	15	
2	Stress and Strain	6	
3	Elasticity and Flexure	6	
4	Heat Transfer	9	
5	Gravity	6	
6	Fluid Mechanics	12	
7	Rock Rheology	6	
8	Faulting and Earthquake	6	
9	Flows in Porous Media	6	
total		72	

Contents of the course
Chapter 1: Plate Tectonics

1. Structure of the Earth
2. Basic concepts and origin of plate tectonics theory
3. Processes and characteristics of plate boundaries
4. Plate motion models
5. Plate motion calculations
6. Comparative planetology

Chapter 2: Stress and Strain

1. Stress analysis
2. Strain analysis
3. Measurements of crustal stresses and displacements

Chapter 3: Elasticity and Flexure

1. Linear elasticity
2. Thin plate bending and applications to lithospheric flexure
3. Thickness of elastic lithosphere

Chapter 4: Heat Transfer

1. Heat transfer in solid earth
2. Heat conduction and Fourier's law
3. Thermal structure of lithosphere
4. Thermal structure of mantle

Chapter 5: Gravity

1. Gravity and gravity anomalies
2. Isostatic geoid anomalies and ridge push
3. Gravity measurements

Chapter 6: Fluid Mechanics

1. Governing equations of fluid mechanics
2. 1D viscous fluid flows
3. 2D viscous fluid flows and geodynamic examples
4. Stokes flows and mantle plume modeling
5. Mantle convection

Chapter 7: Rock Rheology

1. Microscopic mechanism for rock rheology
2. Rock viscosity and macroscopic characteristics
3. Viscoelastic models and examples
4. Elastic-plastic models and examples

Chapter 8: Faulting and Earthquake

1. Classification of faulting
2. Elastic rebound and stick-slip of faulting
3. Co-seismic and inter-seismic elastic solutions

Chapter 9: Flows in Porous Media

1. Darcy's law
2. Solutions to porous flows
3. Thermal convection in porous media

Textbook:

Geodynamics, 3rd Edition, Donald L. Turcotte & Gerald Schubert, Cambridge University Press, 2014.

Reference book:

Mantle Convection in the Earth and Planets, Gerald Schubert, Donald L. Turcotte & Peter Olson, Cambridge University Press, 2001.

Course title

Materials Production and Environmental Science

Credits: 4

Instructor(s)-in-charge:

Prof. Hao Du

Course type:

Lecture

Course Schedule:

Listed in the table below.

Course Assessment:

Homework: 10 assignments, will be given after each class, extensive literature reading is expected.

Grading Policy:

Assignments 40%, Final 20%, Presentation 20%, Attendance 20%

Course Prerequisites:

College Chemistry, College Mathematics, English.

Catalog Description:

This course includes two sections. First, the introduction of different processes to recover some of the more important industrial materials; Second, introduction of the environmental issues involved in different metal recovery processes, and the methods for the pollution control. Emphasis will also be given to the clean production related to industry application.

It is expected that after taking this course, students will be familiar with most common metallic materials production processes and environmental issues related.

Schedule of the course

section	content
1	Overview
2	Steel
3	Aluminum
4	Titanium
5	Vanadium
6	Gold
7	Copper
8	Chromium and manganese
9	Zinc and lead
10	Phosphorus and potassium
11	Rare earth metals
12	Lithium
13	Spent battery and E-waste recovery
14	Student presentation
15	Summary and highlights
total	

Contents of the course

Textbook and any related course material:

No textbook, and electronic course reading materials will be provided one week before each class.

Course title

Multiphase Reactor Theory and Analysis

Instructor(s)-in-charge:

Prof. Xiaoxing Liu, Associate Professor Bona Lu

Course type:

Lecture

Course Assessment:

Homework: 8 assignments

Grading Policy:

Typically 40% attendance, 30% homework, 30% final.

Course Prerequisites:

Be familiar with the basic knowledge of multi-phase (gas, liquid, solid) system and transport phenomena.

Catalog Description:

Reactors involving multiphase flow (gas-liquid, gas-solid, liquid-solid, gas-liquid-solid) are commonly encountered in a variety of chemical engineering processes. For the proper design, operation and optimization of chemical reactors handling multiphase flows, it is critical to get a basic understanding of the hydrodynamic, mass- and thermal transfer, and reaction characteristics of multi-phase systems. This course will be started with basic knowledge of chemical reaction theory, followed by a general introduction of the characterization and classifications of multi-phase flow phenomena. The heaviest parts of this course will be contributed to the introduction of the hydrodynamic, mixing and heat transfer phenomena occurred in the gas-solid fluidized bed reactors, the related measurement techniques and instrumentation, and typical applications of fluidized bed reactors. Technologies of numerical modelling of multiphase reactors will also be addressed and discussed.

Schedule of the course

section	content
1	Mole balances and conversion
2	Rate laws
3	Preliminary Reactor design
4	Distribution of residence time
5	Gas-solid Fluidized Bed---A General Review
6	General introduce of powder/granular assembly
7	particle characterization and fluid (particle)-particle interaction
8	Dense Fluidization 1
9	Dense fluidization 2
10	CFB & Design Criteria
11	Mass and heat transfer
12	Application of Fluidization Bed Reactors

13	Numerical simulations of multiphase reactors 1
14	Numerical simulations of multiphase reactors 2
total	

Textbook and any related course material:

Fogler H. Scott, Elements of Chemical Reaction Engineering (Fourth edition), 2006
Fan Liang-Shi, Zhu Chao, Principles of gas-solid flows, 1998
Kunii, D., Levenspiel, O. Fluidization Engineering. Butterworth-Heinemann. 1991.
Davidson, J. F., Harrison, D. Fluidization. Academic Press. 1971.
Kwauk, M. Fast Fluidization. Advances in Chemical Engineering Vol. 20., Academic Press. 1994.
Grace, J. et al. Fluidized Beds. Multiphase Flow Handbook. Taylor & Francis. 2006.
Some materials are selected and cited from latest journal papers.

Course title

Environmental Chemistry

Instructor(s)-in-charge:

Prof. TIAN Zhen-Yu

Course type:

Lecture

Course Schedule:

Listed in the table below.

Course Assessment:

Homework: 10 assignments

Grading Policy:

Assignments 40%, Final 40%, Attendance 20%

Course Prerequisites:

Familiar with the basic knowledge of college chemistry and college mathematics.

Catalog Description:

This course offers an introduction to chemical principles and concepts and applies them to relevant environmental situations and issues. The topics include introduction to environmental science, technology, and chemistry, basic chemical concepts; the chemistry of the atmosphere and its pollution; toxicological chemistry of chemical substances; aquatic chemistry; geosphere and geochemistry; soil environmental chemistry; principles of industrial ecology. It is expected that after taking this course, students will be familiar with basic chemistry principles on environmental science, technology and chemistry.

Schedule of the course

section	content
1	Introduction of environmental science
2	Advanced chemical concepts: energy, entropy and rates of reaction
3	Toxicological chemistry of chemical substances
4	Environmental chemical analysis
5	Atmospheric chemistry I: energy transfer, particles
6	Atmospheric chemistry II: pollutants, smog
7	Air and gas analysis
8	Chemical analysis of water and waste water
9	Oxidation and reduction
10	The geosphere and geochemistry
11	Aquatic chemistry
12	Geosphere and geochemistry
13	Soil Environmental chemistry
14	Principles of industrial ecology
15	Presentation and examination
Total	

Contents of the course

Section 1: Environmental Science, technology and chemistry

1. What is Environmental Science
2. Some basic chemical concepts
3. Atmospheric chemistry

Section 2: Environmental chemical analysis

4. The anthrosphere, industrial ecosystems, and environmental chemistry
5. Fundamentals of aquatic chemistry
6. Oxidation and reduction
7. Phase interactions
8. Aquatic microbial biochemistry
9. Water pollution
10. Water treatment
11. The atmosphere and atmospheric chemistry
12. Particles in the atmosphere
13. Gaseous inorganic air pollutants
14. Organic air pollutants
15. Photochemical smog
16. The geosphere and geochemistry
17. Soil Environmental chemistry

Textbook and any related course material:

1) John Wright, Environmental Chemistry, Routledge, 2003.

2) Stanley E. Manahan, Environmental Chemistry, CRC Press LLC, 2000.

3) H.J.M. Bowen, Environmental Chemistry Volume 2, Royal Society of Chemistry, 2010.

Expected level of proficiency from students entering the course:

Mathematics: college mathematics

Chemistry: college chemistry

Course title

Advanced Diagnostic Technologies of Chemical Reactions and Its Application

Instructor(s)-in-charge:

Prof. TIAN Zhen-Yu

Course type:

Lecture

Course Schedule:

Listed in the table below.

Course Assessment:

Homework: 10 assignments

Grading Policy:

Assignments 40%, Final 40%, Attendance 20%

Course Prerequisites:

Familiar with the basic knowledge of college chemistry and college mathematics.

Catalog Description:

The course is mainly focusing on the principles of advanced diagnostics in the homogeneous and heterogeneous chemical reactions, particularly the applications of these diagnostic methods in the chemical and environmental field will be introduced. In detail, this course will be started with spectrophotometric methods, electrochemical methods of analysis, chromatography and mass spectrometry, following by their application in gas-, liquid- and surface reactions. Moreover, theoretical calculations and kinetic modeling will be also introduced to further improve the understanding the homogeneous and heterogeneous reactions.

Schedule of the course

section	content
1	Introduction of the diagnostic technologies
2	Reactors
3	Classical methods
4	Spectrophotometric methods I
5	Spectrophotometric methods II
6	Electrochemical methods of analysis
7	Chromatography
8	Mass spectrometry I
9	Mass spectrometry II
10	Air and gas analysis
11	Chemical analysis of liquid-phase reactions
12	Diagnostic analysis of surface reactions
13	Coupling with theoretical calculations
14	Comparison with modeling results
15	Presentation and examination
Total	

Contents of the course

Section 1: Diagnostic technologies

1. Introduction of the diagnostic technologies
2. Classical methods
3. Spectrophotometric methods
4. Electrochemical methods of analysis

5. Chromatography
6. Mass spectrometry

Section 2: Applications in homogeneous and heterogeneous systems

7. Gas-phase reactions
8. Liquid-phase reactions
9. Surface reactions
10. Coupling with theoretical calculations
11. Comparison with modeling results

Textbook and any related course material:

1) Robert J. Cotter, Time of flight mass spectrometry, Washington, DC, 1993.
2) Stanley E. Manahan, Environmental Chemistry, CRC Press LLC, 2000.

Expected level of proficiency from students entering the course:

Chemistry: college chemistry

Course title

Geographic Information Systems-class1

Credits/Hours:
3 credits/51 hours
Instructor(s)-in-charge:
Prof. SONG Xianfeng, Dr. SONG Ci and Dr. YI Jiawei
Course type:
Lecture
Course Schedule:
4hrs/week by instructor
Course Assessment:
Homework: 2 assignments
Grading Policy:
Typically 50% homework, 50% final.
Course Prerequisites:
Introductory courses related to geography, environmental sciences, and cartography.
Catalog Description:
This course includes two parts - lectures and laboratory practice. The lectures introduce the methods of managing and processing geospatial data, and cover the topics of coordinate systems, spatial data models and structures, spatial analysis, and GIS models and modeling. The laboratory practice is designed to help students to master a GIS software (i.e. ArcGIS desktop or QGIS) by a number of experiences on data management, data analysis, GIS modeling, and result presentation.
Schedule of the course

chapter	content	hours
1 2	Nature of Geographic data Coordinate Systems	2
3	Vector Data Model	2
4	Raster Data Model	2
5	Spatial Data Acquisition	1
6	Geometric Transformation	2
7	Spatial Date Edition	3
8	Attribute Data Management	2
9	Cartography and GIS Mapping	3
	Homework 1	
10	Data Exploration	4
11	Vector Data Analysis	4
12	Raster Data Analysis	3
13	Spatial Interpolation	6
	Homework 2	
14	Terrain Mapping and Analysis	2
15	Viewshed and Watershed Analysis	3
16	Least Cost Path and Network Analysis	3

17	GIS Models and Modeling	6
	Q&A	
	Exam	3
Total		51

Contents of the course

Section 1: Conceptual Frameworks for GIS

1 Nature of Geographic data
2 Coordinate Systems
3 Vector Data Model
4 Raster Data Model

Section 2: Spatial Data Management

5 GIS Data Acquisition
6 Geometric Transformation
7 Spatial Data Accuracy and Quality
8 Attribute Data Management
9 Data Display and Cartography

Section 3: Spatial Analysis

10 Data Exploration
11 Vector Data Analysis
12 Raster Data Analysis
13 Spatial Interpolation
14 Terrain Mapping and Analysis
15 Viewshed and Watershed Analysis
16 Least Cost Path and Network Analysis

Section 4: GIS Modeling

17 GIS Models and Modeling

Textbook and any related course material:

Introduction to Geographic Information Systems, 8th Edition, 2016
Edited by Kang-tsung Chang.
Geospatial Analysis: a comprehensive guide to principles, techniques and software tools, 6th Edition, 2018
http://www.spatialanalysisonline.com/HTML/index.html
Edited by Michael J de Smith, Michael F Goodchild, Paul A longley
Geospatial Analysis: a comprehensive guide to principles, techniques and software tools), 3rd Edition, 2007
Edited by Michael J de Smith, Michael F Goodchild, Paul A longley

Expected level of proficiency from students entering the course:

Geosciences: strong
Computer Sciences: middle

Course title

Geographic Information Systems-class2

Instructor(s)-in-charge:

Prof. ZHOU Xiang et al.

Course type:

Lecture

Course Schedule:

3hrs/week by instructor

Course Assessment:

Homework: 3 assignments

Grading Policy:

Typically 50% homework, 50% final.

Course Prerequisites:

Introductory courses related to geography, environmental sciences, and cartography.

Catalog Description:

This course includes two parts - lectures and laboratory practice. The lectures introduce the methods of managing and processing geospatial data, and cover the topics of coordinate systems, spatial data models and structures, spatial analysis, and GIS models and modeling. The laboratory practice is designed to help students to master a GIS software (i.e. ArcGIS desktop or QGIS) by a number of experiences on data management, data analysis, GIS modeling, and result presentation.

Schedule of the course

Hours	Section	Content
3	An Introduction to GIS	**Keys：** 1. What is GIS 2. Contents of GIS 3.Applications of GIS referPPT: PPT\1 - An Introduction to GIS.pdf **Hand-onTasks：** 1、Introduction to ArcCatalog 2、Introduction to ArcMap referhand-on\lab1_instructions.pdf
3	Coordinate Systems	**Keys：** 1. Geographic Coordinate System 2. Map Projection and Commonly Used Projections 3.Projected Coordinate Systems 4.Options for Coordinate Systems in GIS referPPT: PPT\3 - Geodesy, Datums, Map Projections and Coordinate Systems.pdf **Hand-onTasks：** 1.Project from a Geographic to a Projected Coordinate System 2 Import a Coordinate System 3.Projet Using a Predefined Coordinate System referhand-on\lab3_instructions.pdf

Hours	Section	Content
3	Geo-data Organization (vector)	**Keys：** **Vector:** 1. Representation of Spatial Features: point\line\polygon 2. Georelational Data Model:Coverage\Shape 3. Object-Based Data Model: Geodatabase referPPT: PPT\2 - Data Models.pdf; PPT\lecture1.pdf; PPT\lecture4.pptx ; PPT\struct.ppt **Hand-onTasks：** 1.Examine and view the Data File Structure of Coverage and Shape 2 Create File Geodatabase, Feature Dateset and Feature Class 3. Convection between shape/coverage and Geodatabase referhand-on\lab2_instructions.pdf
3	Geo-data Organization (raster)	**Keys：** **Raster:** 1.Elements of the Raster Data Model 2.Satellite Images,DEM and Other Types of Raster Data 3.Data Conversion and Integration referPPT: PPT\2 - Data Models.pdf; PPT\lecture1.pdf; PPT\lecture4.pptx ; PPT\struct.ppt **Hand-onTasks：** 1.View a satellite Image and view a Land Cover Image 2.Convert Vector Data to Raster Data referhand-on\lab2_instructions.pdf
3	Spatial Data Acquisition	**Keys：** 1. Existing GIS Data 2. Conversion of Existing Data 3.Creating of New Data referPPT: **Hand-onTasks：** 1.Download RS data 2.Digitize on Screen 3.Add XY Data 4.Kmz Files and Display in Google Earth referhand-on\chapter_6.pdf
3	Geometric Transformation	**Keys：** 1. Geometric Transformation 2. Root Mean Square (RMS) Error 3. Interpretation of RMS Errors on Digitized Maps 4. Resampling of Pixel Values referPPT: **Hand-onTasks：** 1.Georeference and Rectify a Scanned Map 2. Perform Image to Map Transformation
3	Attribute	**Keys：**

Hours	Section	Content
	Data Management	1. Attribute Data in GIS 2. Joint, Relates and Relationship Classes 3. Manipulation of Fields and Attribute Data referPPT: PPT\8 - Attribute Data and Tables.pdf PPT\4 - Maps, Data Entry, Editing, and Output.pdf **Hand-onTasks：** 1. Use Validation Rule for Entering Attribute Data 2. Join Tables\ Relate Tables 3. Create New Attribute by Data Classification 4. Create New Attribute by Data Computation referhand-on\lab8_instructions.pdf
3	Cartography and GIS Mapping	**Keys：** 1.Cartographic Representation 2.Types of Quantitative maps 3.Map Design 4.Map Production referPPT: PPT\8 - Attribute Data and Tables.pdf PPT\4 - Maps, Data Entry, Editing, and Output.pdf **Hand-onTasks：** 1. Make a Choropleth Map 2. Use Graduated Symbols, Line Symbols, Highway Shield Symbols, and Text Symbols referhand-on\lab8_instructions.pdf
3	Data Exploration	**Keys：** 1.Data Exploration 2.Map-Based Data Manipulation 3.Attribute Data Query 4. Spatial Data Query 5.Raster Data Query **Hand-onTasks：** 1. Select Features by Location 2. Make Dynamic Chart 3. Query Attribute Data from a Joint Table 4. Query Attribute Data from a Relational Database 5. Combine Spatial and Attribute Data Queries 6.Perform Spatial Join 7. Query Raster Data
3	Vector Data Analysis	**Keys：** 1.Buffering 2.Overlay 3.Distance Measurement 4.Pattern Analysis 5.Feature Manipulation **Hand-onTasks：** 1.Perform Buffering and Overlay 2.Overlay Multicomponent Polygons 3.Perform Areal Interpolation 4.Compute General and Local G-Statistics

Hours	Section	Content
		5.Perform Select and Clip 6.Perform Dissolve
3	Raster Data Analysis	**Keys：** 1 Data Analysis Environment 2 Local Operations 3 Neighborhood Operations 4 Zonal Operations 5 Physical Distance Measure Operations 6 Other Raster Data Operations 7 Map Algebra 8 Comparison of Vector- and Raster-Based Data Analysis **Hand-onTasks：** 1. Perform a Local Operation 2. Perform a Combine Operation 3. Perform a Neighborhood Operation 4. Perform a Zonal Operation 5. Measure Physical Distances 6. Perform Extract by Attributes and by Mask 7.Run Map Algebra
3	Terrain	**Keys：** 1 Data for Terrain Mapping and Analysis 2 Terrain Mapping 3 Slope and Aspect 4 Surface Curvature 5 Raster Versus TIN refer：PPT\11 - Terrain Analysis.pdf **Hand-onTasks：** 1. Use DEM for Terrain Mapping 2. Derive Slope, Aspect,and Curvature from DEM 3.Build and Display a TIN 4. Convert LiDAR Data to Raster
3	Viewshed and Watershed Analysis	**Keys：** 1. Viewshed Analysis 2.Parameters of Viewshed Analysis 3.Applications of Viewshed Analysis 4.Watershed Analysis 5.Applications of Watershed Analysis refer：PPT\11 - Terrain Analysis.pdf **Hand-onTasks：** 1.Perform Viewshed Analysis 2.Create a New Lookout Shapefile for Viewshed Analysis 3.Delineate Areawide Watersheds
3	Spatial Interpolation	**Keys：** 1.Elements of Spatial Interpolation 2.Global Methods 3.Local Methods 4.Kriging

Hours	Section	Content
		5.Comparison of Spatial Interpolation Methods refer： PPT\12 - Spatial Estimation Interpolation Prediction and Core Area Delineation.pdf **Hand-onTasks：** 1. Use Trend Surface Model for Interpolation 2.Compute Kernel Density Estimation 3.Use IDW for Interpolation 4.Use Ordinary Kriging for Interpolation 5.Use Universal Kriging for Interpolation
3	Least Cost Path and Network Analysis	**Keys：** 1.Least-Cost Path Analysis 2.Applications of Least-Cost Path Analysis 3.Network 4.Assembly of a Network 5.Network Analysis **Hand-onTasks：** 1.Compute the Least Accumulative Cost Distance 2. Compute the Path Distance 3.Run Shortest Path Analysis 4.Build a Geodatabase Network Dataset 5.Find Closest Facility 6.Find Service Area
3	GIS Models and Modeling	**Keys：** 1.Basic Elements of GIS Modeling 2.Binary Models 3.Index Models 4.Regression Models 5.Process Models refer： PPT\13 - Spatial Models and Modeling.pdf **Hand-onTasks：** 1.Build a Vector-Based Binary Model 2.Build a Raster-Based Binary Model 3.Build a Vector-Based Index Model 4.Build a Raster-Based Index Model

Textbook and any related course material:

Introduction to Geographic Information Systems, 8th Edition, 2016
Edited by Kang-tsung Chang.
Geospatial Analysis: a comprehensive guide to principles, techniques and software tools, 6th Edition, 2018
http://www.spatialanalysisonline.com/HTML/index.html
Edited by Michael J de Smith, Michael F Goodchild, Paul A longley
Geospatial Analysis: a comprehensive guide to principles, techniques and software tools), 3rd Edition, 2007
Edited by Michael J de Smith, Michael F Goodchild, Paul A longley

Expected level of proficiency from students entering the course:
Geosciences: strong
Computer Sciences: middle

Invitation ID_UCAS_GIS(Prof. Xiang Zhou)_Week1
Online Class Tool: **Zoom** Client(V5.2.1)

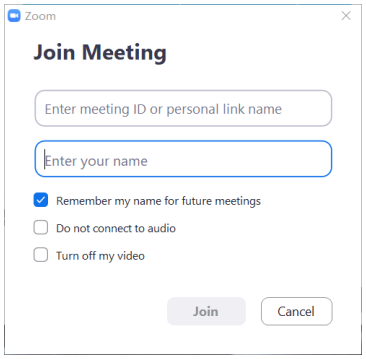
Topic: **UCAS_GIS(Prof. Xiang Zhou)_Week1**
Time: **Sep 18, 2020 13:00 Beijing(UTC+8)**
<Zoom Software test: from 13:00 to 13:30 >

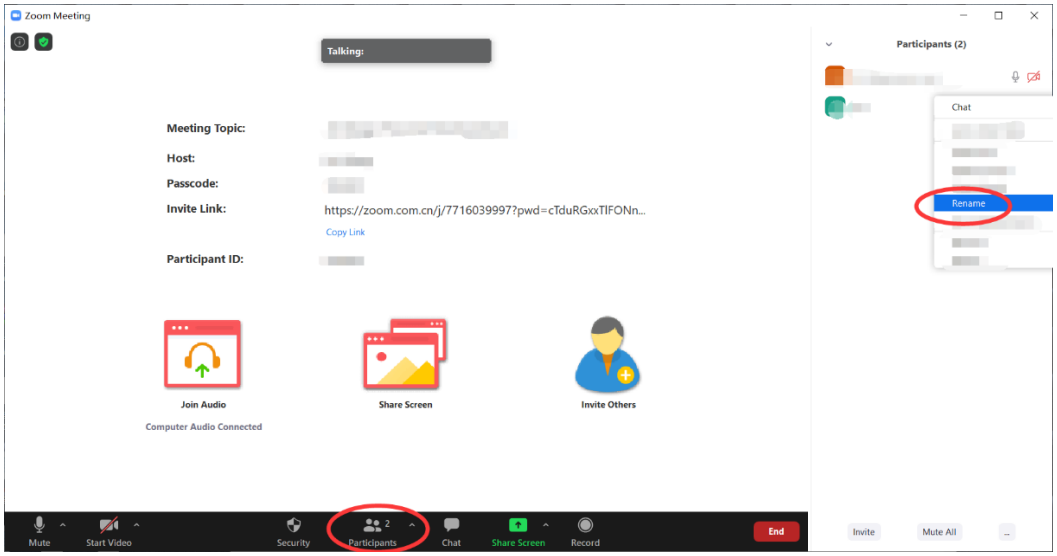
Join Zoom Meeting
https://zoom.com.cn/j/7716039997?pwd=cTduRGxxTlFONndvNHljSWN1c3RYUT09

Meeting ID: **771 603 9997**
Passcode: **106367**
One tap mobile
+13462487799,,7716039997#,,,,,,0#,,106367# US (Houston)
+14086380968,,7716039997#,,,,,,0#,,106367# US (San Jose)

Dial by your location
+1 346 248 7799 US (Houston)
+1 408 638 0968 US (San Jose)
+1 646 876 9923 US (New York)
+1 669 900 6833 US (San Jose)
+1 8186657236(Voxbone) US (Los Angeles)
+1 253 215 8782 US (Tacoma)
+1 301 715 8592 US (Germantown)
+1 312 626 6799 US (Chicago)
Meeting ID: 771 603 9997
Passcode: 106367
Find your local number: https://zoom.com.cn/u/ibdOCLZAH2

Please fill in your real name, when you are **[Joining a meeting]**;
Or use **[Participants]→ [Rename]** to give your real name.
So that the teacher can count your class attendance.





For **every week's online class**, we need a screenshot with all the students' faces on.
Please **[Start Video]** for a few seconds, when the teacher asks you to do that.

Enjoy your online class time and good luck for you!

Course title

Data Science

Instructor(s)-in-charge:

Prof. Tiejian Luo

Course type:

Lecture

Course time：

Tue.8:30-11:20

Course Venue:

WeMeeting ID:35417079277 Password:210914

Course Discuss Room:

Wechat QR Code:

Course Schedule:

4hrs/week by instructor. 60hrs in total.

Course Assessment:

Homework: 4 assignments and 1 teamwork project

Grading Policy:

Typically, 20% assignments, 40% project（with python codes）and 40% presentation (report and paper).

Course Prerequisites:

Discrete Mathematics

Course Syllabus:

Data Science (DS) is designed as a postgraduate course. DS is a new, exponentially growing field, which consists of a set of tools and techniques used to extract useful information from data. DS is an interdisciplinary, problem-solving oriented subject that learns to apply scientific techniques to practical problems. In short, DS is a multidisciplinary field focusing to collect information, detect patterns and generate knowledge from data sets.

The course orients on practical classes and self-study during preparation of datasets and programming of data analysis tasks. Prerequisites good mathematical background

and programming skills sufficient enough to learn new languages and software are required. Basic knowledge of statistics, linear algebra would be additional plus.

Aims

- To develop practical data analysis skills, which can be applied to practical problems.
- To develop fundamental knowledge of concepts underlying data science projects.
- To develop practical skills needed in modern analytics.
- To explain how math and information sciences can contribute to building better algorithms and software.
- To give a hands-on experience with real-world data analysis.
- To develop applied experience with data science software, programming, applications and processes.

After completing the study of the discipline DS the student should:

- Know basic notions and definitions in data analysis, machine learning.
- Know standard methods of data analysis and information retrieval
- Be able to formulate the problem of knowledge extraction as combinations of data filtration, analysis and exploration methods.
- Be able to translate a real-world problem into mathematical terms.
- Possess main definitions of subject field.
- Possess main software and development tools of data scientist.
- Learn to develop complex analytical reasoning.

Teaching Plan:

chapter	content	hours
1	Introduction	4
2	Research Topics	4
3	Domain Problems and Case Study	8
4	IPython-Beyond-Normal-Python	8
5	Introduction to NumPy	8
6	Data Manipulation with Pandas	4
7	Visualization with Matplotlib	4
8	Machine Learning	4
9	Special Topics 1	4
10	Special Topics 2	4
11	Special Topics 3	4
	Final Course Project	4
total		60

Teaching Contents:

Chapter 1: Introduction

1.1 Course contents

1.2 Teaching outcomes

1.3 Competency = [knowledge +Skills + Disposition]in Task

1.4 Assignment and assessment

Chapter 2: Research Topics

Chapter 9: Special Topics 1

9.1 Instructional objectives

9.2 Naive Bayes Classification

9.3 Linear Regression

9.4 Exercises

Chapter 10: Special Topics 2

10.1 Instructional objectives

10.2 Support Vector Machines

10.3 Decision Trees and Random Forests

10.4 Exercises

Chapter 11: Special Topics 3

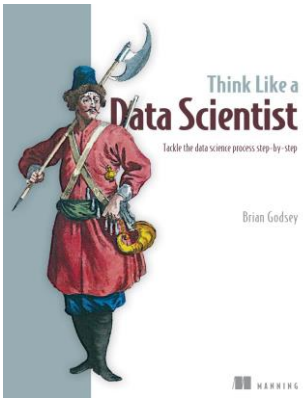
11.1 Instructional objectives

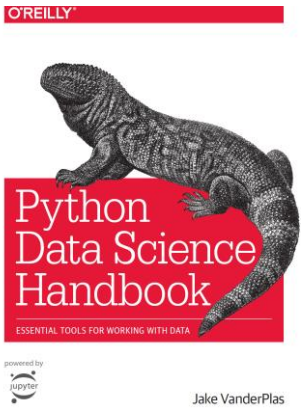
11.2 Principal Component Analysis

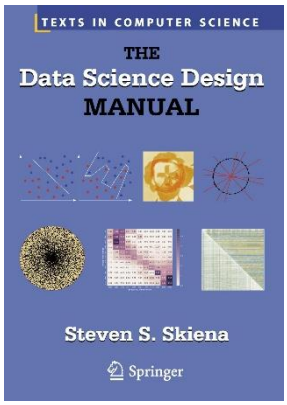
11.3 k-Means Clustering

11.4 Exercises

Reference books:







Course title

Advanced Software Engineering

Instructor(s)-in-charge:

Prof. Tiejian Luo

Course type:

Lecture

Course time：

Thu.8:30-11:20 (to be adjusted, as far as possible does not conflict with participant's schedule)

Course Venue:

WeMeeting, ID:78699378357, Password:210916

Course Discuss Room:

Wechat Room QR Code:

Course Schedule:

4hrs/week by instructor. 60hrs in total.

Course Assessment:

Homework: 6 assignments and 1 teamwork project

Grading Policy:

Typically, 20% assignments,40% project (i.e. working prototype system) and 40% presentation (i.e. report and paper).

Course Prerequisites:

Any Programing Languages

Syllabus:

Intelligent Software Engineering is designed as a postgraduate course. Software is a system containing computer program code, data and its representation. It is an intellectual tool for solving domain problems (such as work, life, research, etc.). Intelligent Software engineering is a discipline to study how to develop systems with some specific capability at high efficiency, high quality and low cost. The course

focuses on the three types of fundamental issues, two typical implementation methods and nine kinds of work tasks in engineering intelligent system. I hope that learners will improve their cognitive abilities in the following five aspects through thinking and practice.

1. Being aware of theoretical methods suitable situation and scope in crafting software.

2. By analyzing a given domain problem, transform them into effective use cases or user stories; According to cost, scope and quality of software, present a project plan.

3. Doing survey for the solutions of similar domain problem. Articulating why your solution is novelty.

4. Designing a software architecture that supports efficient development and health iterative to adapted changes while don't affect the original software working.

5. Reflecting on your way of working and current software, making a good refactoring direction for the new version.

Teaching Plan

chapter	content	hours
1	Introduction	4
2	Research Topics	4
3	Domain Problems and Their Scenarios	8
4	Business Modeling and Data Modeling	8
5	Architecture and Application Framework	8
6	Design Patterns and Code Refactoring	4
7	User Experience and Interface Design	4
8	Verification and Automated Testing	4
9	System Threats and Prevention	4
10	System Scalability and Performance	4
11	Continuous Integrated Deployment and Services	4
	Final Course Project	4
total		60

Teaching Contents

Chapter 1: Introduction

1.5 Course contents

1.6 Teaching outcomes

1.7 Competency = Knowledge+Skills+Disposition]in Task

1.8 Assignment and assessment

Chapter 2: Research Topics

2.1 The computing theory founders

2.2 Three challenges for creating intelligent system

2.3 Two way to implement intelligent system

2.4 Nine kinds of tasks in developing intelligent system

8.3 Software verification methods

8.4 Construct test cases

8.5 Exercises

Chapter 9: System Threats and Prevention

9.1 Instructional objectives

9.2 Reason about the cause of security events

9.3 Countermeasures to stop hacking

9.4 Exercises

Chapter 10: System Scalability and Performance

10.1 Instructional objectives

10.2 Performance metrics

10.3 Improve performance

10.4 Exercises

Chapter 11: Continuous Integrated Deployment and Services

11.1 Instructional objectives

11.2 Continuous integration and deployment

11.3 System service and business models

11.4 Exercises

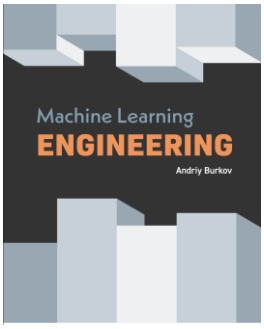
Reference material:

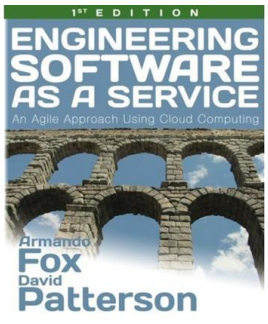
Books:

Armando Fox, and David Patternson, Engineering software as a service, 1st edition， Strawberry Canyon LLC

Andriy Burkov, Machine Learning Engineering, 1st edition, True Positive Inc.

Capers Jones, The Technical and Social History of Software Engineering 1930-2019





Papers:

1. Senapathi M, Buchan J, Osman H. DevOps capabilities, practices, and challenges: Insights from a case study[C]//Proceedings of the 22nd International Conference on Evaluation and Assessment in Software Engineering 2018. 2018: 57-67.
2. Kim M, Zimmermann T, DeLine R, et al. Data scientists in software teams: State of the art and challenges[J]. IEEE Transactions on Software

Engineering, 2017, 44(11): 1024-1038.

3. Murphy B, Bird C, Zimmermann T, et al. Have agile techniques been the silver bullet for software development at Microsoft? [C]//2013 ACM/IEEE international symposium on empirical software engineering and measurement. IEEE, 2013: 75-84.
4. Rahman A, Parnin C, Williams L. The seven sins: Security smells in infrastructure as code scripts[C]//2019 IEEE/ACM 41st International Conference on Software Engineering (ICSE). IEEE, 2019: 164-175.
5. Amershi S, Begel A, Bird C, et al. Software engineering for machine learning: A case study[C]//2019 IEEE/ACM 41st International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP). IEEE, 2019: 291-300.

Course title

Remote Sensing Image Processing

Instructor(s)-in-charge:

Prof. JIANG Xiaoguang, Dr. HU Ronghai and Dr. JIang Yazheng

Course type:

Lecture

Course Schedule:

3hrs/week by instructor

Course Assessment:

Homework: 3 assignments

Grading Policy:

Typically 50% homework, 50% final exam.

Course Prerequisites:

Introductory courses related to geography and remote sensing.

Catalog Description:

Combining theory with practice, this course includes two interrelated parts - lectures and laboratory practice. The lectures introduce the basic principles and methods of remote sensing technology and image processing briefly. The laboratory practice is the key points of the course, it is designed to help students to master the remote sensing image analysis software ENVI by a number of experiences on image processing, image management and image analysis.

Schedule of the course

chapter	content	hours
1-2	Remote Sensing overview Introduction to ENVI	4
3-4	Image Display and Management Coordinate Systems	4
5-6	Image Subset Image Registration	4
7-8	Image Geometric Correction Image Mosaicking	4
	Homework 1	
9-10	Image Registration Workflow Image Orthorectification	4
11-12	Band Math Image Fusion	4
13-14	Image Supervised Classification Image Unsupervised Classification	4
15-16	Image Classification with Decision Tree Classifier Post Classification	4
	Homework 2	
17-18	Radiometric Calibration Atmospheric Correction	4

19-20	Vegetation Analysis Spectral Analysis	4
21-22	Terrain Analysis and Visualization DEM extraction of Stereo Tie Points	4
23-24	Spatial Change Analysis Temporal Change Analysis	4
	Homework 3	
	Exam	4
Total		52

Contents of the course

Section 1: The Basic Operation of Image

1 Remote Sensing overview
2 Introduction to ENVI
3 Image Display and Management
4 Coordinate Systems
5 Image Subset

Section 2: Image Registration and Geometric Correction

6 Image Registration
7 Image Geometric Correction
8 Image Mosaicking
9 Image Registration Workflow
10 Image Orthorectification

Section 3: Band Math and Image Fusion

11 Band Math
12 Image Fusion

Section 4: Image Classification

13 Image Supervised Classification
14 Image Unsupervised Classification
15 Image Classification with Decision Tree Classifier
16 Post Classification

Section 5: Radiometric Correction

17 Radiometric Calibration
18 Atmospheric Correction

Section 6: Vegetation Analysis and Spectral Analysis

19 Vegetation Analysis
20 Spectral Analysis

Section7: Terrain Analysis

21 Terrain Analysis and Visualization
22 DEM extraction of Stereo Tie Points

Section8: Remote Sensing Dynamic Monitoring

23 Spatial Change Analysis
24 Temporal Change Analysis

Textbook and any related course material:
Introduction to ENVI Analytics, Revised for Print January, 2016
ENVI User's Guide

Expected level of proficiency from students entering the course:
Remote Sensing: strong
Geosciences: middle
Computer Sciences: middle

Course title

Fundamentals and Frontier of Materials Science

Instructor(s)-in-charge:

Prof. Zhang, Guangjin,
Prof. Han Yongsheng
Prof. Yang Jun

Course type:

Lecture

Course Assessment:

Homework: 10 assignments, presentations

Grading Policy:

Assignments 40%, Final 40%, Attendance 20%

Course Prerequisites:

The basic knowledge of materials science, chemistry, crystallization.

Catalog Description:

The purpose of this course includes: Introduction to the fundamental knowledge of materials science, increase the interest to materials science, extend scope of knowledge. Knowing the basic knowledge of materials science, the basic theories, frontier and developments; Getting the ideas on how to develop function materials and can apply the learned knowledge in your further research works. The topics include basic principles of material chemistry and physics, metal materials, crystalline materials, semiconductor materials, carbon materials, porous materials, soft materials, organic materials, ceramic materials, catalytic materials…. .

Schedule of the course

section	content	hours
1	Materials Science: a general review	4
2	Materials chemistry and physics	4
3	Metal materials	4
4	Crystalline materials	4
5	Carbon materials	4
6	Semiconductor materials	4
7	Soft materials	4
8	Ceramic materials	4
9	Catalytic materials	4
10	Structured materials?	4
11	Kinetics in materials synthesis	4
12	Thermodynamics in materials synthesis	4
13	Crystallization	4
14	Mesoscience in materials	4
15	Examination	4
Total		**60**

Course title

MATLAB with Applications to Mathematics, Science, Engineering, and Finance

Instructor(s)-in-charge:

Dr. LUO CUI CUI

Course type:

Lecture

Course Schedule:

3hrs/week by instructor, 1 hr/week by teaching assistant（14 hours in total）.

Course Assessment:

Homework: 2 assignments, 1 final project

Grading Policy:

Attendance: 15%, Homework: 40%, Project: 35%, Final presentation: 10%

Course Prerequisites:

Calculus, Linear Algebra, Probability and Statistics

Catalog Description:

This course studies the design, implementation and use of computer programs to solve practical mathematical problems of relevance to health, biology, finance and risk management. This course will help develop your quantitative skills and ability to reason logically and mathematically and apply these skills to problems of relevance to social sciences. It emphasizes the importance of understanding the underlying mathematics, computational techniques and problems solving skills.

Schedule of the course

Section	Content	Hours	Date
1	Introduction to MATLAB	3	September 14
2	Plotting with MATLAB and Data Interpolation	3	September 21
3	Introduction to programming in MATLAB	9	September 28 October 12 October 19
4	Simulations and Optimization	6	October 26 November 2
5	MATLAB Applications to Statistics	6	November 9 November 16
6	MATLAB Applications to Finance	6	November 23 November 30
7	Machine Learning with MATLAB	6	December 7 December 14
8	Student presentation	3	December 21
9	Final Exam	3	December 28
total		45	

Contents of the course

Section 1: Introduction to MATLAB and Basic Data Types

1. Introduction to MATLAB

2. Basic data types and operators

Section 2: Plotting with MATLAB

1. Plotting with MATLAB
2. Data Interpolation

Section 3: Introduction to programming in MATLAB

1. Scripts and functions
2. Control statement
3. Debugging

Section 4: Simulations and Optimization

1. Simulations
2. Linear programming
3. Quadratic programming

Section 5: MATLAB Applications to Statistics

1. Basic probabilities and descriptive data analysis
2. Time series and its main characteristics
3. Univariate time models
4. Multivariate time series

Section 6: MATLAB Applications to Finance

1. Weiner processes, stochastic diff erential equations, stochastic integrals
2. Option pricing: Black–Scholes formula, PDE
3. Stochastic volatility, ARCH and GARCH models, EWMA

Section 7: Machine Learning with MATLAB

Supervised and unsupervised machine learning algorithms, including support vector machines (SVMs), boosted and bagged decision trees, k-nearest neighbor, k-means, Gaussian mixture models, and hidden Markov models

Textbook and any related course material:

MATLAB help, https://www.mathworks.com/help/

Textbooks: MATLAB Handbook with Applications to Mathematics, Science, Engineering, and Finance 1st Edition by Jose Miguel David Baez-Lopez, David Alfredo Baez Villegas

Expected level of proficiency from students entering the course:

Mathematics: moderate

Statisticss: moderate

Course title

Ethics in Scientific Research, Bioethics, & Survival Skills for A Research Career

Part 1. Scientific integrity and misconduct

1. Types of major research misconduct
2. Case analysis of fraud
3. Data selection in presentation
4. Other ethical issues in research activities
5. Be aware of unethical deeds in research
6. System efforts on keeping scientific integrity
7. Research ethic issues in China

Part 2. Bio-ethics

1. Bioethics: Rising moral challenges
2. Institutional Review Board [IRB]
3. Resources of bioethical regulations
4. Topic 1: Cloning and gene editing
5. Topic 2: DNA sample collection
6. Topic 3: Data sharing and privacy protection

Part 3. Survival skills for a research career

1. Being a successful trainee surviving in busy work
2. Attending academic meetings
3. Making your presentation effective
4. Collaboration in research
5. Sharpening your communication and writing skills
6. Paper writing and publication
7. Application for funding

Part 4. Home Work and Class Discussion

A list of topics will be provided. As the homework each student chooses one topic to prepare a short oral presentation (~5 min). In your PPT you may practice the presentation skill mentioned in Part 3. There will be a short discussion following each presentation.

Examination: no scoring test. Pass or not depends on class attendance and if you

complete the homework.

Course title

Scientific Writing

Objectives

For graduate students, writing academic papers in English not only means a fundamental skill in their academic study, but also symbolizes their professional development and achievement. Grounded on the common difficulties and challenges that science students may encounter in their academic writing, the aim of this course is to help them understand academic papers' style, guidelines, and writing methods, improve their language accuracy in academic contexts, and therefore, improve their confidence and capacity in academic English writing.

Main Contents

This course is designed as a series of 4-hour lectures, 12 lectures in total for the present course syllabus. The topics of these lectures range from stylistic features of academic papers to abstract writing, to approaches of integrating outside sources, to visual information, to cohesive devices, and to how to make academic presentation.

Teaching Approaches

Class instruction

Textbooks and Reference Books

1. Grace Canseco. Inside Academic Writing: Understanding Audience and Becoming Part of an Academic Community, Ann Arbor University of Michigan Press, 2010.
2. Robert A. Day and Barbara Gastel. How to Write and Publish a Scientific Paper (Sixth Edition), Peking University Press, 2012.
3. John M. Swales and Christine B. Feak. Academic Writing for Graduate Students: Essential Tasks and Skills (3rd Edition), University of Michigan Press, 2012.

Course title

Public Speaking

Instructor(s)-in-charge:

Associate Prof. Meng Yanli

Course type:

Lecture and seminar combined

Course Schedule:

3hrs/week by instructor

Course Assessment:

Assignment and public speeches made by students

Grading Policy:

10% Attendence, 20% assignment, 10% introductory speech, 30% informative speech, 30% persuasive speech.

Course Prerequisites:

no

Catalog Description:

The purpose of this course is to improve your skills of writing and presenting effective public speeches, with special emphasis on informative and persuasive discourse. The principles you learn in this class will benefit you not only in subsequent courses, but also in your career and in your life as a citizen in a global age. The course will introduce major principles and strategies in speech-making, including choosing a topic, audience analysis, supporting your idea, orgazing the main points, beginning and ending your speech, using visual aids, language rhetorics, and so on. The charm of the class includes the use of a large amount of excellent speeches as samples for analysis and the encouragement for student practice and participation.

Schedule of the course

Session	Content	Hours	Date
1	Introduction to public speaking	3	9.29
2	Delivering the speech Preparing for your first speech	3	10.6
3	Introductory speech presentation Comments and discussion	3	10.13
4	Selecting a topic and a purpose	3	10.20
5	Analyzing the audience	3	10.27
6	Supporting your ideas	3	11.3
7	Outlining the speech Organizing the body of the speech	3	11.10
8	Beginning and ending the speech	3	11.17
9	Using language	3	11.24
10	Using visual aids, Speaking to inform	3	12.1
11	Presentation of informative speeches	3	12.8
12	Speaking to persuade	3	12.15
13	Presentation of persuasive speeches	4	12.22

total		40	13 weeks

Contents of the course

Session 1: Overview of public speaking

1. Course overview
2. Icebreaker activity
3. Basic principles of public speaking
4. Speaking confidently and ethically

Session 2: Delivering the speech

1. Principles of effective speech delivery
2. Sample analysis and practice students' delivery skills

Session 3: Introductory speech presentation

1. Students' presentation of introductory speeches
2. Comments and discussion

Session 4: Selecting a topic and a purpose

1. Selecting a topic
2. Determine general purpose, specific purpose
3. Phrase the central idea

Session 5: Analyzing the audience

1. What is audience-centredness?
2. Factors in audience analysis
3. Exercise and sample analysis

Session 6: Supporting your ideas

1. Types of supporting materials
2. Tips in using supporting materials in a speech
3. Exercise and sample analysis

Session 7: Outlining the speech, Organizing the body of the speech

1. Outlining the speech
   1.1 Drafting a speech outline for your manuscript
   1.2 Drafting a speaking outline for your delivery
   1.3 Exercise and sample analysis
2. Organizing the body of the speech
   2.1 The concept of strategic structure
   2.2 Methods of organization
   2.3 Use of connectives to smooth the progression of ideas
   2.4 Exercise and sample analysis

Session 8: Beginning and ending the speech

1 The four objectives of an effective speech introduction
2 Tips for creating an effective speech introduction
3 The two objectives of an effective speech conclusion
4 Tips for creating an effective speech conclusion
5 Exercise and sample analysis

Session 9: Using language

1 Criteria of using English in public speaking
2 Rhetorical devices and exercises

3 Sample analysis

Session 10 Using visual aids, Speaking to inform

1. Using visual aids
   1.1 Types of visual aids
   1.2 Tips of creating and presenting visual aids
   1.3 Exercise and sample analysis
2. Speaking to inform
   2.1. Types of informative speeches
   2.2 Tips for informatie speaking
   2.3 Exercise and sample analysis

Session 11: Presentation of informative speeches

1. Students' presentation of informative speeches
2. Comments and discussion

Session 12: Speaking to persuade

1. Methods of persuasion
2. Tips for persuasive speaking
3. Exercise and sample analysis

Session 13: Presentation of persuasive speeches

1. Students' presentation of persuasive speeches
2. Comments and discussion

Textbook and any related course material:

Stephen E. Lucas. 2011. *The Art of Public Speaking.* Beijing: Foreign Language Teaching and Research Press

Expected level of proficiency from students entering the course:

English language: strong

Course title

Advanced Physical/Chemical Water Treatment

Instructor(s)-in-charge:

Prof. Chao LIU, Asso. Prof. Huiyu DONG, & Asso. Prof. Mengkai LI

Course type:

Lecture

Course Schedule:

4hrs/week by instructor.

Course Assessment:

Homework: 5 assignments

Grading Policy:

Typically 25% homework, 25% presentation, 50% final.

Course Prerequisites:

General Chemistry,

Catalog Description:

Environmental engineering helps improve people's way of life and the world as a whole. Essentially, it improves processes in the environment that are very fundamental to life. One area of focus is advanced water treatment processes, which help streamline how water is obtained and used. The Advanced Physical/Chemical Water Treatment course aims to equip participants with the necessary competencies and skills in advanced technologies. Participants will have a better understanding of water quality testing and monitoring with respect to emerging chemical and biological contaminants, water and used water treatment technologies. Participants will also acquire knowledge on how to evaluate performance of the current plants and works, identify potential problems and take corrective actions.

Schedule of the course

Section	Content	Hours
1	Introduction	**3**
2	Part 1: Water Quality	**6**
3	Part 2: Water treatment principle	12
4	Presentation	**3**
5	Part 3: Physical Separation	**12**
6	Part 4: Physical/Chemical Treatment	15
7	Part 5: Disinfection products, distribution, and management	9
Total		60

Contents of the course

Part 1: Water Quality

- Physical and chemical quality of water
- Microbiological quality of water
- Water quality management strategy

Part 2: Water Treatment Principles

- Principles of Chemical Reactions

- Principles of Reactor Analysis and Mixing
- Principles of Mass Transfer
- Chemical Oxidation and Reduction

Part 3: Physical Separation

- Coagulation and floccuation
- Gravity Separation
- Granular Filtration/Biofiltration
- Membrane Filtration

Part 4: Physical/Chemical Treatment

- Advanced Oxidation
- Adsorption
- Ion Exchange
- Disinfection
- Air Stripping and Aeration

Part 5: Disinfection products, distribution, and management

- Disinfection/Oxidation By-products
- Removal of Selected Constituents
- Residuals Management

Textbook and any related course material:

MWH's Water Treatment: Principles and Design, Third Edition. *John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe and George Tchobanoglous*

Expected level of proficiency from students entering the course:

Mathematics: strong

Chemistry: strong

Course title

Eco-Environmental Informatics

Instructor(s)-in-charge:

Prof. TianXiang Yue et al.

Course type:

Lecture, including offline and online discussions

Course Schedule:

6hrs/week

Course Assessment:

Homework: 4 assignments

Grading Policy/Scores:

20% in-class, 40% homework, 40% final examination (Open-book examination).

Course Prerequisites:

Mathematics, geography, ecology, environmental science, geographical information system

Catalog Description:

This course includes six sections: general introduction to eco-environmental informatics, data and information sources, methods and theories, surface modelling of climatic change, surface modelling of ecosystems and biodiversity, and surface modelling of soil properties. The first section provides the general introduction to background, conception and general view on eco-environmental informatics. By studying of the second section, student would know various information sources such as ground monitoring network and spatial sampling as well as satellite remotely sensing on different spatial resolutions. The third provides knowledge on the fundamental theorem for eco-environmental surface modelling and its corollaries corresponding to spatial interpolation, spatial upscaling, spatial downscaling, data fusion and model-data assimilation. The fourth provides different methods to simulate climate change trend and scenarios as well as their impacts on ecosystems. In the fifth section, students would know how to construct surface models of ecosystems and biodiversity. After the sixth section, students would learn spatial prediction of soil properties.

Schedule of the course

Section	Content	Hours
1	General introduction to eco-environmental informatics	3
2	Data and information sources	3
3	Methods and theory: fundamental theorem, scale transformation, spatial interpolation, data fusion and model-data assimilation, including lab tours for 3 hours	15
4	Surface modelling of climatic change including lab tours for 3 hours	15
5	Surface modelling of ecosystems and biodiversity, including lab tours for 3 hours	12

6	Surface modelling of soil properties, including lab tours for 3 hours	15
	Summary & final examination	6
Total		69

Contents of the course

Section 1: General introduction to eco-environmental informatics (TianXing YUE)

1. Conception of eco-environmental informatics
2. Related international programmes
3. Related international organizations
4. Related models

Section 2: Data and information sources (ZeMeng FAN)

5. Ground observations data
6. Remote sensing data
7. Statistical data
8. Documentary data
9. Social data
10. Simulated data

Section 3: Methods and theories (TianXiang YUE)

11. Background
12. The fundamental theorem for eco-environmental surface modelling
13. Spatial interpolation
14. Up-scaling
15. Down-scaling
16. Data fusion
17. Model-data assimilation
18. Lab tours

Section 4: Surface modelling of climatic change (Na ZHAO)

19. Methods and models
20. Change trends and scenarios of climate variables
21. Understanding the climate events
22. Impacts of climate change on ecosystems
23. Lab tours

Section 5: Surface modelling of ecosystems and biodiversity (ZeMeng FAN)

24. Change trends and scenarios of terrestrial ecosystems
25. Change trends and scenarios of land cover scenarios
26. Spatial modelling of biodiversity
27. Lab tours

Section 6: Surface modelling of soil properties (WenJiao SHI)

28. Methods and models
29. Mapping soil properties combined with environmental information
30. Mapping soil compositional data

31. Mapping soil compositional data combined with environmental information
32. Lab tours

Summary & Review would be on December 21, 2020

Final examination, an open-book examination, would be on December 28, 2020

Textbook and any related course material:

Surface modelling: High accuracy and high speed methods, written by TianXiang Yue
Ecological informatics, edited by Friedrich Recknagel and William Michener
Environmental Informatics and Modeling, edited by Mikko Kolehmainen and Kostas Karatzas

Course title

Chemical Process Safety

Instructor(s)-in-charge:
Prof. YANG Ning, Associate Prof. Xiaoping Guan
Course type:
Lecture
Course Schedule:
2hrs/week by instructor. 1 hr/week by teaching assistant.
Course Assessment:
Homework: 6 assignments
Grading Policy:
Typically 60% homework, 40% final.
Course Prerequisites:
general chemistry, chemical reaction engineering
Catalog Description:
The primary objective of this course is to present the important technical fundamentals and case studies of chemical process safety, and help students to understand the concepts and apply them accordingly. The application requires a significant quantity of fundamental knowledge and technology, integrating different aspects of knowledge on chemistry, chemical engineering and fluid mechanics. This course then aims to provide the base by integrating and applying these various aspects of knowledge in chemical process safety.
Schedule of the course

section	content	hours
1	Introduction to Chemical Process Safety	4
2	Toxicology	3
3	Industrial Hygiene	3
4	Source models	3
5	Toxic Release and Dispersion Models	6
6	Fires and Explosions	6
7	Concepts to Prevent Fires and Explosions	6
8	Chemical Reactivity	3
9	Introduction to Reliefs	3
10	Relief Sizing	3
11	Hazards Identification	3
12	Risk Assessment	3
13	Safety Procedures and Designs	6
14	Case Histories	6
15	Exam	2
total		60

Contents of the course

Section 1: Introduction to Chemical Process Safety

1-1 Safety Programs 1-2 Engineering Ethics 1-3 Accident and Loss Statistics 1-4 Acceptable Risk 1-5 Public Perceptions 1-6 The Nature of the Accident Process 1-7 Inherent Safety 1-8 Seven Significant Disaster

Section 2: Toxicology

2-1 How Toxicants Enter Biological Organisms Gastrointestinal Tract Skin Respiratory System 2-2 How Toxicants Are Eliminated from Biological Organisms 2-3 Effects of Toxicants on Biological Organisms 2-4 Toxicological Studies 2-5 Dose versus Response 2-6 Models for Dose and Response Curves 2-7 Relative Toxicity 2-8 Threshold Limit Values 2-9 National Fire Protection Association (NFPA) Diamond

Section 3: Industrial Hygiene

3-1 Government Regulations 3-2 Industrial Hygiene: Anticipation and Identification 3-3 Industrial Hygiene: Evaluation 3-4 Industrial Hygiene: Control

Section 4: Source Models

4-1 Introduction to Source Models 4-2 Flow of Liquid through a Hole 4-3 Flow of Liquid through a Hole in a Tank 4-4 Flow of Liquids through Pipes 2-K Method 4-5 Flow of Gases or Vapors through Holes 4-6 Flow of Gases or Vapors through Pipes 4-7 Flashing Liquids 4-8 Liquid Pool Evaporation or Boiling 4-9 Realistic and Worst-Case Releases 4-10 Conservative Analysis

Section 5: Toxic Release and Dispersion Models

5-1 Parameters Affecting Dispersion 5-2 Neutrally Buoyant Dispersion Models 5-3 Dense Gas Dispersion 5-4 Dense Gas Transition to Neutrally Buoyant Gas 5-5 Toxic Effect Criteria 5-6 Effect of Release Momentum and Buoyancy 5-7 Release Mitigation

Section 6: Fires and Explosions

6-1 The Fire Triangle 6-2 Distinction between Fires and Explosions 6-3 Definitions 6-4 Flammability Characteristics of Liquids and Vapors 6-5 Limiting Oxygen Concentration and Inerting 6-6 Flammability Diagram 6-7 Ignition Energy 6-8 Autoignition 6-9 Auto-Oxidation 6-10 Adiabatic Compression 6-11 Ignition Sources 6-12 Sprays and Mists 6-13 Explosions

Section 7: Concepts to Prevent Fires and Explosions

7-1 Inerting 7-2 Static Electricity 7-3 Controlling Static Electricity 7-4 Explosion-Proof Equipment and Instruments 7-5 Ventilation 7-6 Sprinkler Systems 7-7 Miscellaneous Concepts for Preventing Fires and Explosions

Section 8: Chemical Reactivity

8-1 Background Understanding 8-2 Commitment, Awareness, and Identification of Reactive Chemical Hazards 8-3 Characterization of Reactive Chemical Hazards Using Calorimeters 8-4 Controlling Reactive Hazards

Section 9: Introduction to Reliefs

9-1 Relief Concepts 9-2 Definitions 9-3 Location of Reliefs 9-4 Relief Types and Characteristics

Section 10: Relief Sizing

10-1 Conventional Spring-Operated Reliefs in Liquid Service 10-2 Conventional

Spring-Operated Reliefs in Vapor or Gas Service 10-3 Rupture Disc Reliefs in Liquid Service 10-4 Rupture Disc Reliefs in Vapor or Gas Service 10-5 Two-Phase Flow during Runaway Reaction Relief Simplified Nomograph Method 10-6 Pilot-Operated and Bucking-Pin Reliefs 10-7 Deflagration Venting for Dust and Vapor Explosions

Section 11: Hazards Identification

11-1 Process Hazards Checklists 11-2 Hazards Surveys 11-3 Hazards and Operability Studies 11-4 Safety Reviews 11-5 Other Methods

Section 12: Risk Assessment

12-1 Review of Probability Theory 12-2 Event Trees 12-3 Fault Trees 12-4 QRA and LOPA

Section 13: Safety Procedures and Designs

13-1 Process Safety Hierarchy 13-2 Managing Safety 13-3 Best Practices 13-4 Procedures—Operating 13-5 Procedures—Permits 13-6 Procedures—Safety Reviews and Accident Investigations 13-6 Procedures — Safety Reviews and Accident Investigations 13-8 Miscellaneous Designs for Fires and Explosions 13-9 Designs for Runaway Reactions 13-10 Designs for Handling Dusts

Section 14: Case Histories

14-1 Static Electricity 14-2 Chemical Reactivity 14-3 System Designs 14-4 Procedures 14-5 Training

Textbook and any related course material:

Daneil A. Crowl, Chemical Process Safety: Fundamentals and Applications, 2011, Prentice Hall

Expected level of proficiency from students entering the course:

Mathematics: intermediate
Chemistry: intermediate

Course title

Land Change Science

Instructor(s)-in-charge:
Prof. DONG Jinwei, Prof. FENG Min, Prof. CUI Huijuan, and Prof. PENG Shushi
Course type:
Lecture
Course Schedule:
8hrs/week by instructor.
Course Assessment:
Homework: 5 assignments and 1 final project
Grading Policy:
Typically 20% Attendance, 30% homework, 30% Oral Presentation, 20% final.
Course Prerequisites:
Geography, Geoinformatics, Remote Sensing
Catalog Description:
Land cover and land use change is a fundamental component of global environmental change and sustainability research, so called land change science (LCS) which is considering as an increasingly important interdisciplinary science. This course introduces the emerged land change science, including 1) observation and monitoring, 2) process and pattern, 3) causes and driving factors, and 4) consequences of land cover and land use changes from regional to global scales. The course will be organized from the four topics of LCS as following: The observation and monitoring of land use changes will introduce basics of remote sensing like widely-used sensors, and also cover the cutting-edge algorithms of land classification and the application of the planetary-scale geospatial analysis platform (e.g., Google Earth Engine); The causes of land use changes will be analyzed by considering both natural and human drivers using case studies across the world, and also using a comprehensive review of land change modeling which will help an understanding of the land change process; The process and pattern of rapid land use change in China since Reform and Opening-up will be introduced; The ecological, climate, hydrological consequences of land use changes (e.g., deforestation, afforestation, land reclamation, urbanization) from the classic and highly-cited studies will be discussed in the classes.
Schedule of the course

section	content	hours	Instructor
1	**Course Introduction, Introductory Lecture** Concepts of Land Change Science (LCS) Current International Research Programs on LCS State-of-the-art and perspective of LCS Existing global land cover/use maps and their applications	3	Dong
2	**Observation and monitoring of land change** Introduction of cloud computing platform	6	Dong

	(Google Earth Engine) Introduction on main sensors (GF, Landsat, MODIS)		
3	**Observation and monitoring of land change** Field data collection (field photos, apps, & visual interpretation) Accuracy Assessment	3	Feng
5	**Observation and monitoring of land change** Land cover classification (machine learning; phenological approach; deep learning) Land change detection (CCDC, VCT, BFAST, LandTrendr)	6	Feng
6	**Process and pattern of land change** Theme I: Agricultural land use change Theme II: Deforestation and afforestation	3	Dong
7	**Process and pattern of land change** Theme III: Urbanization Theme IV: Surface water dynamics	3	Feng
8	**Student presentation** Literature review and topic selection for final project	3	Dong/Feng/Cui
9	**Causes and driving factors of Land change: China and Global perspective** Land use changes in China Natural and human drivers of land use changes in China Modelling land use change in China	3	Dong
10	**Consequences of land change: Ecological perspective** Earth greening Effects of land change on carbon cycle	6	Peng
11	**Consequences of land change: Climate perspective** Land–Climate interactions Climate effects of deforestation and afforestation	3	Peng
12	**Consequences of land change: Hydrological perspective** Impact of Land Use Change on water cycle Land change and water/food security	6	Cui
13	**Land use/management and sustainable development** Land related mitigation and adaptation response Land management and socioeconomic	6	Cui

	development		
14	**Student presentation** Presentations on final project	6	Dong/Feng/Cui
15	**Final Exam**	3	Dong
total		60	

Contents of the course

Section 1: Observation and monitoring of land change

1. Concepts of Land Change Science (LCS)
2. Current International Research Programs on LCS
3. Start-of-the-art and perspective in land change science
4. Existing land cover/use maps and their applications
5. Introduction of cloud computing platform (Google Earth Engine)
6. Introduction on main sensors (GF, Landsat, MODIS)
7. Reference data collection (Google Earth, Field Photos, and Visual Interpretation of images)
8. Land use mapping (machine learning; phenological approach; deep learning, etc)
9. Land change detection (CCDC, VCT, BFAST, LandTrendr, etc.)
10. Accuracy assessment

Section 2: Process and pattern of land change

1. Theme I: Agricultural land use change
2. Theme II: Deforestation and afforestation
3. Theme III: Urbanization
4. Theme IV: Global water dynamics

Section 3: Causes and driving factors of land change

1. Land use changes in China and Global perspective
2. Natural and human drivers of land use changes in China
3. Modelling land use change in China

Section 4: Consequence of land change

1. Consequences of land change: Ecological perspective
    a) Earth greening
    b) Effects of land change on carbon cycle
2. Consequences of land change: Climate perspective
    a) Land–Climate interactions
    b) Climate effects of deforestation and afforestation
3. Consequences of land change: Hydrological perspective
    a) Impact of Land Use Change on Hydrologic Processes
    b) Land change and water/food security
4. Land use/management and sustainable development
    a) Land related mitigation and adaptation response
    b) Land management and socioeconomic development

Textbook and any related course material:

1. Garik Gutman, 2012, LAND CHANGE SCIENCE:Observing, Monitoring and Understanding Trajectories of Change on the Earth's Surface

2. John R. Jenson, 2007, Remote Sensing of the Environment: An Earth Resource Perspective

3. Ten journal papers will be assigned for student's homework. Students can select five papers from the list we provide or through the Web of Science.

1) *Chen, C., Park, T., Wang, X.H., Piao, S.L., Xu, B.D., Chaturvedi, R.K., Fuchs, R., Brovkin, V., Ciais, P., Fensholt, R., Tommervik, H., Bala, G., Zhu, Z.C., Nemani, R.R., & Myneni, R.B. (2019). China and India lead in greening of the world through land-use management. Nature Sustainability, 2, 122-129*
2) *DeFries, R.S., Rudel, T., Uriarte, M., & Hansen, M. (2010). Deforestation driven by urban population growth and agricultural trade in the twenty-first century. Nature Geoscience, 3, 178-181*
3) *Foley, J.A., DeFries, R., Asner, G.P., Barford, C., Bonan, G., Carpenter, S.R., Chapin, F.S., Coe, M.T., Daily, G.C., & Gibbs, H.K. (2005). Global consequences of land use. Science, 309, 570-574*
4) *Hansen, M.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., Loveland, T.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O., & Townshend, J.R. (2013). High-resolution global maps of 21st-century forest cover change. Science, 342, 850-853*
5) *Luyssaert, S., Marie, G., Valade, A., Chen, Y.Y., Njakou Djomo, S., Ryder, J., Otto, J., Naudts, K., Lanso, A.S., Ghattas, J., & McGrath, M.J. (2018). Trade-offs in using European forests to meet climate objectives. Nature, 562, 259-262*
6) *Peng, S.S., Piao, S.L., Zeng, Z.Z., Ciais, P., Zhou, L.M., Li, L.Z.X., Myneni, R.B., Yin, Y., & Zeng, H. (2014). Afforestation in China cools local land surface temperature. Proc Natl Acad Sci U S A, 111, 2915-2919*
7) *Song, X.P., Hansen, M.C., Stehman, S.V., Potapov, P.V., Tyukavina, A., Vermote, E.F., & Townshend, J.R. (2018). Global land change from 1982 to 2016. Nature, 560, 639-643*
8) *Tucker, C.J., Townshend, J.R.G., & Goff, T.E. (1985). African Land-Cover Classification Using Satellite Data. Science, 227, 369-375*
9) *Turner, B.L., Lambin, E.F., & Reenberg, A. (2008). Land Change Science Special Feature: The emergence of land change science for global environmental change and sustainability (vol 104, pg 20666, 2007). Proc Natl Acad Sci U S A, 105, 2751-2751*
10) *Zou, Z., Xiao, X., Dong, J., Qin, Y., Doughty, R.B., Menarguez, M.A., Zhang, G., & Wang, J. (2018). Divergent trends of open-surface water body area in the contiguous United States from 1984 to 2016. Proceedings of the National Academy of Sciences, 201719275*

Expected level of proficiency from students entering the course:

Prior to taking this course, students need to have basic GIS and imagery process skills, the final project will require quantitative problem solving skills and might entail working with small land cover/use maps.

Course title

Data Mining

Instructor(s)-in-charge:

Prof. LIU Ying

Course type:

Lecture

Course Schedule:

Mondays 13:30-15:10 pm & Wednesdays 13:30-15:10 pm

Course Assessment:

Homework: 2 assignments, 1 project

Grading Policy:

Typically 30% homework, 30% project, 40% final.

Course Prerequisites:

data structure, computer algorithms, programming, database

Catalog Description:

The goal of the course is to provide the students with knowledge and hands-on experience in developing data mining algorithms and applications. Firstly, the course will introduce the motivation of data mining techniques. Then, present the principles and major classic algorithms in data mining. Next, the course will introduce some successful applications to the students. Finally, big data and the most recent techniques will be introduced as well.

Schedule of the course

section	content	hours
1	Introduction	4
2	Data Warehouse	4
3	Data Preprocessing	4
4	Association Rules Mining	6
5	Classification	6
6	Clustering	6
7	Sequence Mining	2
8	Applications	6
9	Big Data Mining	12
10	Project Discussion & Demo	8
11	Review	2
total		60

Contents of the course:

Section 1: Introduction

Motivation, major issues, major applications, characteristics

Section 2: Data warehouse

Model, architecture, operations

Section 3: Data pre-processing

Data cleaning, data transformation, data reduction

Section4: Association rules

Apriori, FP-Growth, Partition, DIC, DHP, multi-level association rules, quantitative association rules, major applications

Section 5: Classification

Decision tree, Bayesian Classifier, Classification by backpropagation, KNN classifier, statistical prediction models, major applications

Section 6: Clustering

Partitioning methods, hierarchical methods, density-based methods, grid-based methods, major applications

Section 7. Sequence mining

GSP, SPADE

Section 8: Applications

Credit scoring, oil exploration, customer relationship management, cosmological simulation

Section 9:Big data mining

Big data, big data characteristics, big data mining techniques including high performance mining, Web mining, stream mining, graph mining, text mining, cloud mining, etc.

Section 10: Project Discussion & Demo

Students and the instructor discuss the course projects in class, and students present their work and make demonstrations.

Textbook and any related course material:

Data Mining, Concepts and Techniques. Jiawei Han and MichelineKamber, Morgan Kaufmann, 2006.

Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Addison-Wesley, 2006.

Research papers: to be announced in class

Course title

Organometallic Chemistry and Catalysis-for Doctors

Instructor(s)-in-charge:

Prof. SUN Wenhua

Course type:

Lecture

Course Schedule:

3hrs/week by instructor. 1 hr/week by teaching assistant.

Course Assessment:

Homework: 14 assignments

Grading Policy:

Typically 40% homework, 10% evaluation，30% for assessment (2 times, 15% each), 20% final. 5% plus to student presentation

Course Prerequisites:

General chemistry

Catalog Description:

Chemistry is the center of sciences, and organometallic chemistry is the useful tool for chemists to understand how organic molecules or groups interact with compounds of the inorganic elements. On the base of Organometallic Chemistry, the industries of chemical, petrochemical, pharmacy and organic materials have been continuously developing. A catalyst increases the rate of a reaction without being consumed and without changing the thermodynamics of the reaction, providing bases for modern chemical industries. With regard to Periodic Table of Elements, main group elements consisting of the s and p blocks and the transition elements of the d and f blocks would be discussed, respectively. Those organometallic compounds have been useful building blocks for nanoparticles and assembling materials. Importantly, organometallic compounds have been stoichiometric reagents and (pre)catalysts in tremendously industrial processes. Therefore organometallic chemistry and catalysis are the Capital Stone for scientists in chemistry, material science and industry.

Schedule of the course

section	content
1	Organometallic Chemistry: Definition & Scope Introduction to Catalysis *Evaluation regarding student background*
2	Periodic Table of Elements Various ligands and their electrons contributions
3	Alkali Metal Organometallics Alkaline Earth Metal Organometallics
4	Zinc, Cadmium, and Mercury organometallics Stoichiometric reactions *Tutorial assessment*
5	Synthetic methodology oriented organometallic chemistry: A Practice

6	Organometallics of the Boron Group Organometallics of the Carbon group
7	Transition metal Organometallics: Common types of organometallic complexes; 16/18 ev; ligand types and behaviors and oxidation states
8	Metal Carbonyl Complexes: Definition and types; from mononuclear to nanoparticles Industrial hydroformylation
9	Organometallic compounds ligated by alkenes, dienes, and alkynes Student presentations (Topic discussions)
10	Metallocene and Arene complexes
11	Sigma Complexes Hydrogenation *Tutorial assessment*
12	Organometallic application: C-C and C-N cross couplings and new progresses
13	Industrial processes: ethylene oligomerization and olefin polymerization
14	Student presentations (interpretation conceptual novelty) Q and A sessions
15	**Open note test** **(notebook and books along with personal computer allowed, but no discussion)**
total	

Textbook and any related course material:

Organometallics and Catalysis: An Introduction Edited by Manfred Bochmann. Oxford University Press 2015.

THE ORGANO METALLIC CHEMISTRY OF THE TRANSITION METALS Sixth Edition, Edited by Robert H. Crabtree. John Wiley & Sons, Inc 2014.

Course title

Water chemistry

Instructor(s)-in-charge:
Prof. Liu Chao, etc
Course type:
Lecture
Teaching purpose:
This course details the quantitative treatment of chemical processes in aquatic systems such as lakes, oceans, rivers, estuaries, groundwaters, and wastewaters. It includes a brief review of chemical thermodynamics that is followed by discussion of acid-base, precipitation-dissolution, coordination , and reduction-oxidation reactions. Emphasis is on equilibrium calculations as a tool for understanding the variables that govern the chemical composition of aquatic systems and the fate of inorganic pollutants.
Outline content
Chapter 1 Basics of Aquatic Chemistry (3 class hours)
Section 1 Introduction
Section 2 Structure of water molecules and interactions among them
Section 3 Behavior of solutes in water; dissolution of salts
Section 4 Common approaches for expressing concentrations in environmental chemistry
Section 5 Summary
Chapter 2 Chemical Reactivity, Reactions, and Equilibrium (4 class hours)
Section 1 Overview
Section 2 Characterizing Chemical Reactivity
Section 3 Predicting Activity Coefficients from Knowledge of the Solution Composition
Section 4 The Activity as an Intensive Property; The Activity of Solids Dispersed in Water
Section 5 Models of Chemical Equilibrium
Section 6 Effect of Temperature on the Equilibrium Constant
Section 7 Combining Chemical Reactions
Chapter 3 Reaction Kinetics and the Kinetics-based Interpretation of Equilibrium (6 hours)
Section 1 A Molecular-level picture of an elementary reaction and factors that affect its rate
Section 2 Effect of temperature on reaction rate constants
Section 3 The kinetics of some important categories of environmental chemical reactions
Section 4 Kinetics of elementary chemical reactions
Section 5 Reaction reversibility and the definition of the equilibrium constant
Section 6 Effect of temperature on the equilibrium
Section 7 Combining chemical reactions: Kinetics and equilibrium constants of nonelementary reactions
Section 8 Experimental evaluation of reaction kinetics
Section 9 Rate-limiting steps and some classical, model reaction pathways
Section 10 Heterogeneous (phase-transfer) reactions

Chapter 4 Acids and Bases, Part 1: Acid/Base Speciation and Exact Solutions to Acid/Base Problems (6 hours)
Section 1 The Dissociation of Water
Section 2 The Structure of Acids and Bases
Section 3 Strong and Weak Acids, Ka, and Conjugate Acids/Base
Section 4 A Brief Diversion: the Structure of Some Important Organic Acids and Bases
Section 5 Combining Acidity Reactions and the Definition of Basicity
Section 6 Acid/Base Speciation as a Function of pH; Diagrams of Log C Versus pH
Section 7 LOG C-pH Diagrams for Monoprotic Acids
Section 8 Effects of Nonideal Solute Behavior on Acid/Base Speciation
Section 9 LOG C-pH Diagrams for Multiprotic Acids
Section 10 Determining Species and Relevant Equations for Solving Equilibrium Problems
Section 11 Numerical Approaches for Solving Acid/Base Problems
Section 12 The pH of Solutions Containing Only Water and Strong Acids or Bases
Section 13 The pH of Ideal Solutions Containing Weak Acids and Bases
Section 14 A Simple Spreadsheet Analysis for Determining Acid/Base Speciation
Section 15 The pH and Speciation of Systems Containing Multiprotic Weak Acids and Bases
Section 16 Acid/Base Equilibria in Nonideal Solutions
Chapter 5 Acids and Bases, Part 2: Use of Log C-pH Diagrams and the TOTH Equation (3 hours)
Section 1 Graphical Solutions for Sets of Simultaneous Equations
Section 2 Using LOG C-pH Diagrams to Solve Weak Acid/Base Problems
Section 3 The Mass Balance on H (the TOTH Equation and Proton Condition)
Section 4 Defining the Composition of the System: Components, Species, and the System Tableau
Section 5 Expressing Input and Equilibrium Concentrations in Terms of Components; Component Mass Balances
Section 6 Identifying Dominant Species
Section 7 Comparison of Approaches for solving Acid/Base Problems
Chapter 6 Titrations and Buffers (5 hours)
Section 1 Introduction
Section 2 Reactions Occurring During a Titration: Qualitative considerations
Section 3 Quantitative Interpretation of Titration Data
Section 4 Using Visual MINTEQ to Simulate Titrations
Section 5 Titrations with Weak Acids or Bases
Section 6 The Effect of the Acidity of Water Titration Curves
Section 7 Titration of Solutions Containing Unknown Acids and Bases
Section 8 Titration Equivalence Points
Section 9 Alkalinity and Acidity
Section 10 Acid/Base Titrations of Natural Organic Matter
Section 11 Buffers
Chapter 7 Gas/liquid Equilibrium (3 hours)

Section 1 Introduction
Section 2 Basic concepts and terminology for gas/liquid equilibrium
Section 3 Effect of gas/liquid equilibration on gas-phase composition
Section 4 Factors affecting volatility and henry's constant
Section 5 Henry's law and aqueous-phase speciation
Section 6 CO2 dissolution, alkalinity, and acidity
Chapter 8 Complexation (5 hours)
Section 1 Introduction of metal complexes
Section 2 Complexes with hydroxide ions
Section 3 Log C-pH diagrams for dissolved metals
Section 4 Complexes with ligands other than water and hydroxide
Section 5 Mixed ligand complexes and chelating agents
Section 6 Metal speciation in systems containing complexing ligands
Section 7 Metal ion buffers
Section 8 Predominance area diagrams
Chapter 9 Precipitation and dissolution (4 hours)
Section 1 Introduction on the formation of solids containing metal ions
Section 2 The solubility product
Section 3 Precipitation of solids other than hydroxides
Section 4 Formation of nonhydroxo complexes in systems with solids
Section 5 Determining whether a solid will precipitate under given conditions
Section 6 Predominance area diagrams considering possible precipitation of solids
Chapter 10 Redox Chemistry (9 hours)
Section 1 Introduction
Section 2 The activity of free electrons; equilibrium constants for redox half-reactions
Section 3 Computing pe from species activities: the Nernst equation
Section 4 Combining redox reactions
Section 5 Redox speciation and logC-pe diagrams
Section 6 Summary of some key similarities between acid/base and redox systems
Section 7 Redox reactions involving exchange of both electrons and protons
Section 8 Computing equilibrium speciation in redox systems
Section 9 Oxidation and reduction of water
Section 10 Energy changes accompanying redox reactions
Section 11 Redox titrations and the geochemical redox sequence
Section 12 pe-pH predominance area diagrams
Section 13 Redox reactions and electrochemistry
Chapter 11 Adsorption Reactions (3 hours)
Section 1 Introduction of Adsorption Reactions
Section 2 Two views of the interface and adsorption equilibrium
Section 3 Quantitative representations of adsorption equilibrium: the adsorption isotherm
Section 4 Adsorption of ions in the presence of a surface electrical potential
Section 5 Surface precipitation
Section 6 Activated carbon adsorption
Chapter 12 Project presentation (3 hours)

Section 1 Project presentation

Chapter 13 Photochemistry (6 hours)

Section 1 Introduction

Section 2 Light fundamentals

Section 3 Measurement of light

Section 4 Photoreactions

Section 5 Photoreactants

Section 6 Photochemical reactions in atmospheric Waters

Section 7 Heterogeneous photochemistry

Section 8 Photochemistry in water treatment

Section 9 Research advances