

# **COURSE CATALOG**

**2022-2023 Autumn Semester**

**International College of UCAS**

**Online students**

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## 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.

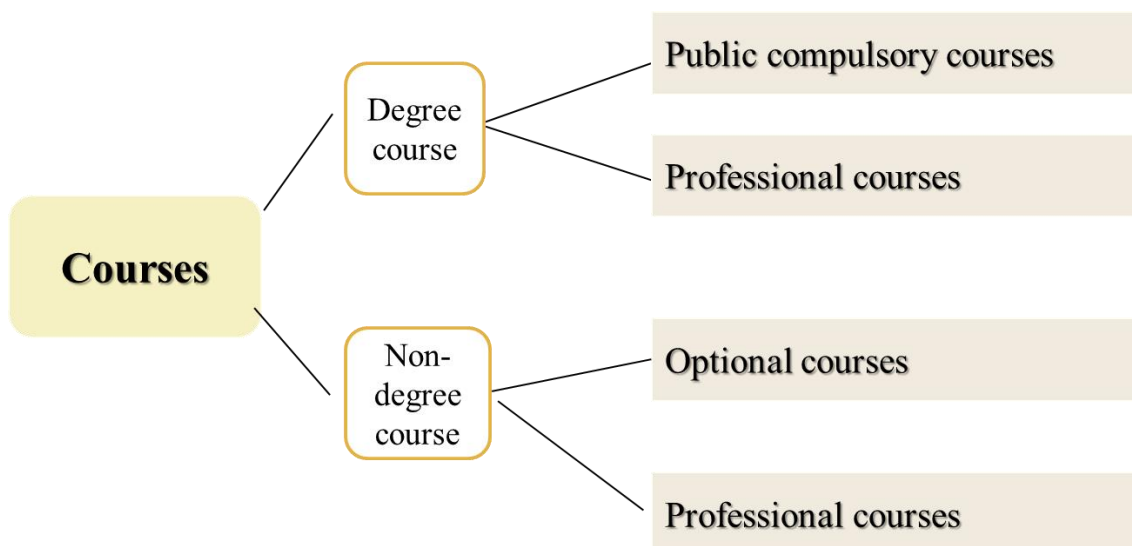
### 3. General Degree Requirements for MD-PhD Students

The requirement of UCAS for MD-PhD students is to get at least 38 credits before graduation. 12 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	7 credits	≥2 credits	≥12 credits	≥30 credits
PhD	7credits	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 or above;
- B. Got a bachelor's degree or master's degree which are taught in Chinese.

Students who apply for the course waiver need to login the following website and fill in the required information with relevant materials.

<https://ic-en.ucas.ac.cn/form/94>

Any question about course waiver please contact Ms. Season (dingdanni@ucas.ac.cn) before the end of September.

#### 4.2 Professional courses—Degree Courses and Non-degree Courses

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. 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 are Non-degree courses.

1. Research Ethics, Bioethics, & Survival Skills for A Research Career (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.

## 6. Course Selection System

This course selection system is for students registering professional courses online. 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.

**NOTE: The course selection system is just for collecting students' information. It is just the first step. Only after confirming with the teaching assistant can the course be selected successfully.**

**Website: <http://ic-courseucas.ac.cn/>**

**Username: Your Passport ID**

**Original password: 123456**

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

Date	Process
Aug.29-Sep.4	Register all courses online (except Elementary Chinese).
Sep.5	All courses start.
Sep.5-Sep.16	Students need to confirm the courses with assistant teachers of each course.
Jan. 6	All courses end.

## 7. Contact Information

Education Coordinator for Professional Courses:

- Phone: 010-82689050, Ms. Sophie
- E-mail: [hutian@ucas.ac.cn](mailto:hutian@ucas.ac.cn)

Education Coordinator for Public Courses:

- Phone: 010-82689050, Ms. Season
- E-mail: [dingdanni@ucas.ac.cn](mailto:dingdanni@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**

**<https://ic-en.ucas.ac.cn/post/alias/2022-08-25-160800-voov-meeting-installation-and-operation-guide>**

## 8. Professional Courses and Optional Courses List

Code	Name	Type	Hours	Credits	Professor in charge	Weeks	Date&Time	First Class Date	VooV Meeting	Assistant teacher's email
0710I0D01001H	Plant Physiology and Developmental Biology	Professional Courses	60	4	CHEN Youfa	3rd-19th	Monday (13:30-16:20)	Sep.5th	ID: 372-9461-8986 PW:220905	1412662705@qq.com
0710I0D01002H	Plant Molecular Biology and Genomics	Professional Courses	60	4	JING Haichun	3rd-18th	Friday(13:30-16:20)	Sep.9th	726-2651-6880	<a href="mailto:lucheng@ibcas.ac.cn">lucheng@ibcas.ac.cn</a>
0710I0D01003H	The Frontier of Genomics and Precision Medicine	Professional Courses	51	3	ZHANG Zhihua	3rd-19th	Friday(13:30-16:20)	Sep.9th	ID: 788-4751-1714 PW:202209	zhengsq@big.ac.cn
0710I0D01004H	Fundamental Immunology	Professional Courses	52	3	FANG Min	3rd-16th	Tuesday(13:30-15:10)&Friday(13:30-15:10)	Sep.6th	Tuesday:365-2622-7050 Friday:516-2710-8751	<a href="mailto:guguangl@163.com">guguangl@163.com</a>
0710I0D01005H	Model Animals in Developmental Biology	Professional Courses	60	4	YUAN Li	3rd-19th	Tuesday(13:30-16:20)	Sep.6th	ID:804-6777-6224 PW:906567	cailu18@mails.ucas.edu.cn
0710I0D01007H	Vector and human pathogen	Professional Courses	51	3	ZHENG Aihua	3rd-19th	Monday (13:30-16:20)	Sep.5th	ID:888-2152-7749 PW:666666	zhangxing@ucas.ac.cn
0708I0D01001H	Introduction to Geodynamics	Professional Courses	72	4.5	WANG Shimin	3rd-15th	Tuesday(13:30-16:20) &Thursday(13:30-16:20)	Sep.6th	Tuesday:693-7548-9818 Friday:770-6689-3439 PW:070810	791233395@qq.com



0706I0D0100 2H	Overview of Climate Change Sciences	Professional Courses	60	4	KANG Shichang	3rd-20th	Tuesday(13:30-16:20)	Sep.6th	ID:891-7876-5697 PW:220906	xin.wan@itpcas.ac.cn
0708I0D0100 2H	Earth System Science	Professional Courses	51	3	JIA Gensuo	4th-20th	Monday(13:30-16:20)	Sep. 12th	4th-11th weeks ID:761-5749-3078 PW:666888 12th-20th weeks ID:600-6471-5598	<a href="mailto:xiyan.xu@tea.ac.cn">xiyan.xu@tea.ac.cn</a> , <a href="mailto:utch5@qq.com">utch5@qq.com</a>
0702I0D0100 2H	Overview of Recent Development of Physics	Professional Courses	51	3	SHI Xinghua	3rd-18th	Thursday (13:30-16:20)	Sep.8th	ID:467-2665-3466 PW:408408	tianfl@nanoctr.cn
0805I0D0100 1H	Functional Nanostructures: Syntheses, Characterization and Device Application	Professional Courses	51	3	WEI Zhixiang	3rd-19th	Wednesday (13:30-16:20)	Sep.7th	ID: 389-5392-0396	<a href="mailto:wangqk2020@nanoctr.cn">wangqk2020@nanoctr.cn</a>
0703I0D0100 1H	Organometallic Chemistry and Catalysis-for doctors	Professional Courses	50	3	SUN Wenhua	3rd-20th	Monday(19:00-21:50)	Sep 5th	ID: 800-6970-7654 PW:802802	myanping@iccas.ac.cn
0703I0M0100 1H	Organometallic Chemistry-for masters	Professional Courses	50	3	SUN Wenhua	3rd-20th	Monday(13:30-16:20)	Sep 5th	ID: 727-4009-6196 PW:802802	myanping@iccas.ac.cn
0714I0D0100 1H	Data Mining	Professional Courses	60	4	LIU Ying	4th-20th	Wednesday (13:30-16:20)	Sep 14th	ID:976-5647-9810	renyihui18@mails.uca s.ac.cn

0710I0D0101 2H	Organelle Biology	Professional Courses	50	3	LIU Pingsheng	3rd-19th	Wednesday (13:30-16:20)	Sep. 7th	ID: 498-4329-8640 PW:202203	caozhenld@163.com
0805I0D0100 2H	Materials Production and Environmental Science	Professional Courses	60	4	DU Hao	3rd-19th	Monday(13:30-16:20)	Sep 5th	ID: 901-3002-9922 PW:0905	yqlv1314@163.com
0817I0D0100 4H	Multiphase Reactor Theory and Analysis	Professional Courses	51	3	LIU Xiaoxing	3rd-19th	Friday(13:30-16:20)	Sep.9th	ID: 937-7043-7448 PW:202209	guohui@ipe.ac.cn
0830I0D0100 3H	Environmental and Natural Resource Economics	Professional Courses	60	4	DENG Xiangzheng	3rd-18th	Thursday(19:00-21:50)	Sep.8th	ID:823-4600-6854	wangyifei1721@igsnr r.ac.cn
0830I0D0100 1H	Environmental Chemistry	Professional Courses	60	4	TIAN Zhenyu	3rd-17th	Wednesday (8:30-11:20)	Sep. 7th	ID:690-107-108	zhengzhihao@iet.cn
0830I0D0100 2H	Advanced Diagnostic Technologies of Chemical Reactions and Its Application	Professional Courses	60	4	TIAN Zhenyu	3rd-17th	Wednesday (13:30-16:20)	Sep. 7th	ID:676-5272-5468	zhengzhihao@iet.cn
0705I0D0100 2H	Remote Sensing Image Processing	Professional Courses	52	3.5	JIANG Xiaoguang	3rd-19th	Tuesday (13:30-16:20)	Sep 6th	ID:407-3004-5281 PW: 0906	huangcheng9960@12 6.com
0702I0D0100 1H	Advanced Quantum Mechanics	Professional Courses	45	3	QIAO Congfeng	3rd-17th	Tuesday (13:30-16:20)	Sep.6th	ID: 147-215-878 PW: 271828	<a href="mailto:yangmacheng17@mai&lt;br/&gt;ls.ucas.ac.cn">yangmacheng17@mai ls.ucas.ac.cn</a>
0704I0D0100 1H	Fundamentals of Modern Astronomy	Professional Courses	50	3	GOU Lijun	3rd-16th	Wednesday(13:30-16:20)	Sep. 7th	ID: 688-8718-9078 PW:666888	jacobfeng@bao.ac.cn

0812I0D0100 1H	Intelligent Software Engineering	Professional Courses	60	4	LUO Tiejian	3rd-17th	Monday (14:00-17:00)	Sep 5th	ID:344-4175-1966 PW:220905	wanghao184@mails.u cas.ac.cn
0812I0D0100 2H	Data Science	Professional Courses	60	4	LUO Tiejian	3rd-17th	Wednesday (13:30-16:20)	Sep 7th	ID:771-2354-8563 PW:2297	<a href="mailto:luffy.lcc@gmail.com">luffy.lcc@gmail.com</a>
0812I0D0200 1H	MATLAB with Applications to Mathematics, Science, Engineering, and Finance	Professional Courses	45	2	LUO Cuicui	3rd-17th	Tuesday (19:00-21:50)	Sep. 6th	ID: 545-2823-5793 PW:739826	<a href="mailto:zongkai19@mails.uca&lt;br/&gt;s.ac.cn">zongkai19@mails.uca s.ac.cn</a>
0805I0D0100 3H	Fundamentals and frontier of Materials Science	Professional Courses	60	4	ZHANG Guangjin	3rd-18th	Wednesday (13:30-16:20)	Sep. 7th	ID: 933-5903-4406	wanghai20@mails. ucas.ac.cn
0817I0D0100 6H	Chemical Process Safety	Professional Courses	60	4	YANG Ning	3rd-18th	Wednesday (19:00-21:50)	Sep. 7th	ID: 863-6124-8874	zhangjingchang@ipe. ac.cn
0830I0D0100 4H	Advanced Physical/Chemical Water Treatment	Professional Courses	60	4	LIU Chao	3rd-12th	Tuesday (13:30-16:20)& Thursday (13:30-16:20)	Sep. 6th	ID:763-4134-8294 PW:189522	<a href="mailto:2819706935@qq.com">2819706935@qq.com</a>
0830I0D0100 5H	Water Chemistry	Professional Courses	60	4	LIU Chao	3rd-12th	Tuesday (19:00-21:50)&Thursday(1 9:00-21:50)	Sep. 6th	ID:673-9328-8683 Password:189522	15638510670@163.co m

0705I0D0100 5H	Eco-Environmental Informatics	Professional Courses	69	5	YUE Tianxiang	8th-19th	Monday (13:30-16:20),&Friday (13:30-16:20)	Oct. 10th	Monday: 802-9909-6609; Friday: 979-7483-6357	lisb@lreis.ac.cn
0705I0D0100 4H	Land Change Science	Professional Courses	60	4	DONG Jinwei	3rd-18th	Thursday (13:30-16:20)	Sep. 8th	ID: 833-8655-5717	<a href="mailto:chenxi0760@igsnr.ac.cn">chenxi0760@igsnr.ac.cn</a>
0705I0D0100 6H	Development Geography	Professional Courses	60	4	DENG Xiangzheng	3rd-18th	Tuesday(19:00-21:50)	Sep. 6th	ID:563-3241-5497	pengl.18b@igsnr.ac.cn
0705I0D0100 3H	Geographic Information Systems-A	Professional Courses	51	3.5	SONG Xianfeng	3rd-19th	Wednesday (13:30-16:20)	Sep. 7th	ID:754-9599-8345 PW:2210	hujinghao20@mailsucas.ac.cn
0705I0D0100 8H	Geographic Information Systems-B	Professional Courses	51	3.5	ZHOU Xiang	3rd-19th	Thursday(18:10-21:00)	Sep. 8th	ZOOM Meeting ID: 771 603 9997 PW:106367	wangjin01@radi.ac.cn

## 9. Optional Courses List

Code	Name	Hours	Credits	Type	Professors	Weeks	Time	First Class	VooV Meeting(Online)	Assistant teacher
010105DGX0 01H-01	Research Ethics, Bioethics, & Survival Skills for A Research Career	30	1	Optional course	ZENG Changqing	10th-19th	Fri.13:30-16:20	Oct.28th	ID: 573-4233-7668	juanli@big.ac.cn
050200DGX0 02H-01	Scientific Writing	40	1	Optional course	YU Hua	3rd-15th	Thur. 13:30-16:20	Sep.8th	ID: 327-6704-6839 PW: 0901	zhouyingkun15@ mails.ucas.ac.cn
050200DGX0 02H-02	Scientific Writing	40	1	Optional course	PENG Gong	3rd-15th	Tue.19:00-21:50	Sep.6th	ID: 625-9782-2157 PW: 0906	15364516734@1 63.com
050200DGX0 02H-03	Scientific Writing	40	1	Optional course	HONG Lei	3rd-15th	Thur. 13:30-16:20	Sep.8th	ID: 697-1578-8801	liujing201@mails .ucas.ac.cn
050200DGX0 02H-04	Scientific Writing	40	1	Optional course	CHEN Nianning	3rd-15th	Tue. 13:30-16:20	Sep.6th	ID: 845-1528-4198 PW: 0906	13716825057@1 63.com
050200DGX0 02H-05	Scientific Writing	40	1	Optional course	PENG Gong	3rd-15th	Mon. 13:30-16:20	Sep.5th	ID: 743-3473-8839 PW: 0905	15364516734@1 63.com
050200DGX0 03H	Public Speaking	40	1	Optional course	MENG Yanli	3rd-15th	Wed.9:20-12:10	Sep.7th	ID: 332-3711-9062 PW: 220907	caimengqi21@ma ils.ucas.ac.cn

## 10. Public Compulsory Courses List

Class No.	Code	Name	Hours	Credits	Professors	Weeks	Date&Time	First Class	VooV Meeting ID	Assistant teacher
Y-1	050102DGB0 02H-1	Elementary Chinese1、2	128/12 8	2	LIU Xiaomeng	3rd-18th	Mon.(8:30-12:10)	Sep.5th	400-1642-5914	joe06082000@163.com
							Tue. (8:30-12:10)			
							Thur.(8:30-12:10)		363-8171-5756	
							Fri. (8:30-12:10)			
Y-2	050102DGB0 02H-2	Elementary Chinese1、2	128/12 8	2	HE Fei	3rd-18th	Mon.(8:30-12:10)	Sep.5th	395-1299-6658	mengzhilv221@126.com
							Tue. (8:30-12:10)			
							Thur.(8:30-12:10)		428-6529-7653	
							Fri. (8:30-12:10)			
Y-3	050102DGB0 02H-3	Elementary Chinese1、2	128/12 8	2	LI Ya	3rd-18th	Mon.(8:30-12:10)	Sep.5th	972-1349-8197	xiaoying796@163.com
							Tue. (8:30-12:10)			
							Thur.(8:30-12:10)		538-5083-8150	
							Fri. (8:30-12:10)			
Y-4	050102DGB0 02H-4	Elementary Chinese1、2	128/12 8	2	LI Ran	3rd-18th	Mon.(8:30-12:10)	Sep.5th	607-7635-9454	liran1008@126.com
							Tue. (8:30-12:10)			
							Thur.(8:30-12:10)		704-4855-2250	
							Fri. (8:30-12:10)			
Y-5	050102DGB0 02H-5	Elementary Chinese1、2	128/12 8	2	LUO Lei	3rd-18th	Mon.(8:30-12:10)	Sep.5th	462-5669-4410	1585368900@qq.com
							Tue. (8:30-12:10)			
							Thur.(8:30-12:10)		823-9414-3162	
							Fri. (8:30-12:10)			
Y-6	050102DGB0 02H-6	Elementary Chinese1、2	128/12 8	2	LUO Wei	3rd-18th	Mon.(8:30-12:10)	Sep.5th	665-8117-7603	luowei_official@163.com
							Tue. (8:30-12:10)			
							Thur.(8:30-12:10)		775-3608-8650	
							Fri. (8:30-12:10)			
Y-7	050102DGB0 02H-7	Elementary Chinese1、2	128/12 8	2	LI Shengnan	3rd-18th	Mon.(8:30-12:10)	Sep.5th	680-2758-2204	shengnan0626@126.com
							Tue. (8:30-12:10)			

							Thur.(8:30-12:10)		675-2692-0870	
							Fri. (8:30-12:10)			
Y-8	050102DGB0 02H-8	Elementary Chinese1、2	128/12 8	2	QI Bopeng	3rd-18th	Mon.(8:30-12:10)	Sep.5th	777-8779-6909	790158532@qq.co m
						Tue. (8:30-12:10)				
						Thur.(8:30-12:10)			605-5425-2667	
						Fri. (8:30-12:10)				
X-1	050102DGB0 01H-1	China Panorama	48	2	JIANG Hong'en	3rd-18th	Fri.13:30-16:20	Sep.9th	969-8628-0787	nongkuangyuan19 @mails.ucas.ac.cn
X-2	050102DGB0 01H-2	China Panorama	48	2	Chen Tianjia	3rd-18th	Mon.13:30-16:20	Sep.5th	282-535-532	549862048@qq.co m
X-3	050102DGB0 01H-3	China Panorama	48	2	LUO Wugan	3rd-18th	Fri.19:00-21:50	Sep.9th	664-4148-9121	wangxiaoting18@ mails.ucas.ac.cn
X-4	050102DGB0 01H-4	China Panorama	48	2	ZHU Jian	3rd-18th	Thur.13:30-16:20	Sep.8th	884-3392-9212	jzhu@ucas.ac.cn
X-5	050102DGB0 01H-5	China Panorama	48	2	YANG Yimin	3rd-18th	Mon.19:00-21:50	Sep.5th	363-4283-6956	xusiwen19@mails. ucas.ac.cn
X-6	050102DGB0 01H-6	China Panorama	48	2	CHU Guofei	3rd-18th	Wed.13:30-16:20	Sep.7th	838-1096-3092	liyu18221071196@ 163.com
X-7	050102DGB0 01H-7	China Panorama	48	2	CAO Zhihong	3rd-18th	Wed.9:20-12:10	Sep.7th	828-5224-5064	244091995@qq.co m
X-8	050102DGB0 01H-8	China Panorama	48	2	LAN Li	3rd-18th	Tue.13:30-16:20	Sep.6th	636-5298-8116	panyitong@aliyun. com
A-1	120500MGB0 11H-1	Academic Morality and Writing Norms	20	1	YE Qing	3rd-9th	Mon.19:00-21:50	Sep.5th	933-3903-5696	caosihe20@mails.u cas.ac.cn
A-2	120500MGB0 11H-2	Academic Morality and Writing Norms	20	1	YE Qing	3rd-9th	Tue.19:00-21:50	Sep.6th	871-5552-7693	caosihe20@mails.u cas.ac.cn
A-3	120500MGB0 11H-3	Academic Morality and Writing Norms	20	1	YU Jun	3rd-9th	Mon.14:20-17:10	Sep.5th	983-4487-7429	maijialin@big.ac.c n

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A-4	120500MGB0 11H-4	Academic Morality and Writing Norms	20	1	LAN Li	3rd-9th	Mon.14:20-17:10	Sep.5th	849-9332-7331	panyitong@aliyun. com
A-5	120500MGB0 11H-5	Academic Morality and Writing Norms	20	1	LI Zhihong	3rd-9th	Wed.19:00-21:50	Sep.7th	813-7236-1667	xuyier21@mails.uc as.ac.cn
A-6	120500MGB0 11H-6	Academic Morality and Writing Norms	20	1	LI Zhihong	3rd-9th	Thur.19:00-21:50	Sep.8th	472-8855-7465	wangjiao20@mails .ucas.ac.cn



## 2022—2023 学年秋季学期(Autumn Semester)校历

年度 year	2022																		2023	
月份 month	八月 (Aug)	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)	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2
星期二 (Tue)	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3
星期三 (Wed)	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4
星期四 (Thu)	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5
星期五 (Fri)	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6
星期六 (Sat)	27	3	10 中秋	17	24	1 国 庆节	8	15	22	29	5	12	19	26	3	10	17	24	31	7
星期日 (Sun)	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1 元 旦	8
说 明	1、Courses in International College start from Sep. 5 <sup>th</sup>																			

## Course Syllabus

### 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****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**

<b>Section</b>	<b>Content</b>	<b>Hours</b>	<b>Tutor</b>
1	The Gene, Genome and Epigenome in Plants, Plant Sciences and <i>Science</i> 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 Modifications

### 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 Molecular 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 VIII*, Benjamin Lewin.
3. *Genomics of tropical crop plants*: Moore PH, Ming DR. Springer, 2008.
4. *Plant Genomics: Methods and Protocols*. Daryl J. Somers DJ, Peter Langridge, J.P. Gust. Humana Press Inc. 2011.
5. *Plant Genomics: Methods and Protocols*. Busch. Humana Press Inc. 2017.

**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 chromatin. 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 talk about computational cancer biology, but with a highlight on the implication of computational analysis in solving practical problems 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 variants, 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 resource and	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****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	<b>Introduction of Immunology</b> 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	<b>Innate Immunity</b> Features of Innate Immune Recognition; Components of the Innate Immune System; The Intersection of Innate and Adaptive Immunity	4	Prof. Min Fang
3	<b>NK cell development and function</b> General properties of NK cells; NK cell development and differentiation; NK cells in	4	Prof. Min Fang

	anti-viral immunity; Memory NK cells		
4	<b>Immunoglobulins and B lymphocytes</b> 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	<b>T lymphocytes</b> 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	<b>Major Histocompatibility Complex (MHC) Molecules and Antigen Presentation</b> MHC Structure, Function, and Genetics; Cell Biology of Antigen Processing and Presentation.	4	Prof. Min Fang
7	<b>Immunity to infectious Agents</b> The Immune Responses to Parasites and bacteria; Immunity to Viruses; Vaccines; Research case study.	4	Prof. Min Fang
8	<b>Immunologic Tolerance and Autoimmunity</b> 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	<b>Immunity to Tumors</b> 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	<b>Hypersensitivity Disorders and Allergy</b> 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	<b>The Immune system in Disease</b> Systemic Autoimmunity; Transplantation Immunology; Overview of immunodeficiency diseases; Congenital immunodeficiencies; Acquired immunodeficiencies	4	Assoc Prof. Xuefeng Duan
12	<b>Immunity in the mucosal system</b> Overview of the mucosal system; The mucosal immune system; Immunity in the mucosal system; Mucosal diseases; Vaccine design	4	Prof. Min Fang
13	<b>Students Final Presentation</b> 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 <i>Drosophila</i> development and genes that pattern the <i>Drosophila</i> body plan
7	Early amphibian development
8	Early zebrafish development
9	Early development in chickens
10	Early mammalian development
11	Early development in <i>C. elegans</i>
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****Vector and human pathogen****Instructor(s)-in-charge:**

*Prof. Aihua Zheng*

*Prof. Zhen Zou*

**Course type:**

*Lecture*

**Course Schedule:**

*Monday Afternoon, from 13:30-16:20.*

*Date: Sep-5th, Sep-12th, Sep-19th, Sep-26th, Oct-3rd, Oct-10th, Oct-17th, Oct-24th, Oct-31st, Nov-7th, Nov-14th, Nov-21st, Nov-28th, Dec-5th, Dec-12th, Dec-19th, Dec-26th.*

**Course Assessment:**

*Exam in the last section*

**Grading Policy:**

*Exam scores*

**Course Prerequisites:**

*Without*

**Catalog Description:**

*This course will introduce the principle of molecular entomology and microbiology. In the first part, we will introduce the importance of insect transmitted diseases and their impact on human health, economy and safety. In the second part, we will discuss several kinds of important human pathogens including the bacteria, plasmodium, and particularly virus. The basic knowledges of virus isolation, virus structure, virus life cycle will be provided in this course. In the third part, we will discuss several important aspects of molecular entomology such as metabolism, endocrinology, immunity, and their relations to the transmission of pathogens. During this course, the progress and application of some of the hottest technologies including CRISPR-Cas9 and deep sequencing will also be discussed.*

**Schedule of the course**

section	Content	Lecturer	Date
1	Introduction to vector biology and human pathogens	Aihua Zheng	Sep-5th
2	Genomes and genetics/virus life cycle	Aihua Zheng	Sep-12th
3	Virus structure	Aihua Zheng	Sep-19th
4	Virus receptor and entry	Aihua Zheng	Sep-26th
5	Virus replication, transcription and assembly	Aihua Zheng	Oct-3rd
6	Tick biology and tick-borne disease	Aihua Zheng	Oct-10th
7	Infection basics and acute infection	Aihua Zheng	Oct-17th
8	Immunology	Aihua Zheng	Oct- 24th
9	Deep sequencing and genome biology	Zhen Zou	Oct-31st
10	Basic of pathogenesis/HIV	Aihua Zheng	Nov- 7th
11	Vaccine	Aihua Zheng	Nov-14th
12	Animal migration and epidemic	Aihua Zheng	Nov-21st
13	Insect vectors transmitting human and plant pathogens	Zhen Zou	Nov-28th
14	Interactions between insect vectors and pathogens	Zhen Zou	Dec- 5th
15	Emerging virus/virus evolution	Aihua Zheng	Dec-12th
16	Coronavirus and COVID-19	Aihua Zheng	Dec-19th
17	Exam	Xing Zhang	Dec-26th

**Textbook and any related course material:**

David M. Knipe, Peter Howley (2013) Fields Virology , 6th edition, Lippincott Williams & Wilkins.

Michael G. Rossmann, Venigalla B. Rao (2012), Viral Molecular Machines, Springer.

Marc J. Klowden (2007) Physiological Systems in Insects. 2<sup>nd</sup> Ed. Elsevier Inc. (One



annotated version permitted to publish in PRC)

Reg Chapman (1997) *The Insects Structure and Function* 4<sup>th</sup> Ed. University Press, Cambridge, UK.

Lawrence I. Gilbert (2012) *Insect Biochemistry and Molecular Biology*. Academic Press, London, UK.

**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****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 2022 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 climate system changed
			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	Background
			Warming patterns
			Climate extremes
			Tropical storms
6	Changes in the Cryosphere	6	Introduction to the cryosphere
			Global importance of the cryosphere
			Changes in the cryosphere
			Impacts and risks of cryospheric change
7	Changes in Hydrological Cycle	6	Hydrological (water) cycle
			Surface and tropospheric humidity
			Clouds
			Precipitation
			Evapotranspiration
			Streamflow and runoff
8	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
9	Mitigation and Adaptation of Climate Change	3	Mitigation approaches
			International policies for mitigation
			Adaptation under sustainable development
10	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
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 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	<i>Introduction to Remote Sensing</i>	<i>September 14</i>	<i>-Ch.1,3</i>	
2	<i>Image Processing/RS Applications</i>	<i>September 21</i>		
3	<i>Remote Sensing for Disaster Management</i>	<i>September 28</i>		
4	<i>Remote Sensing of Vegetation- Spectral/Temporal Characteristics, Indices, and Change Detection</i>	<i>October 12</i>	<i>-Ch.11,12</i>	<i>Assignment-1 due by beginning of class</i>
5	<i>Remote Sensing of Water, Soil, and Urban Areas</i>	<i>October 19</i>	<i>-Ch.13,14</i>	
6	<i>Students presentation (<b>Offline presentation</b>)</i>	<i>October 26</i>		
7	<i>Students presentation (<b>Online presentation</b>)</i>	<i>November 2</i>		
8	<i>Students presentation (<b>Online presentation</b>)</i>	<i>November 9</i>		<i>Assignment-2 due by beginning of class</i>

#### 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<sup>1,2</sup> (10pt bold centered)**

<sup>1</sup> *Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, China*

<sup>2</sup> *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 YOUR 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. CHALLENGES 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. Kuettnner, 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. 29<sup>th</sup> Intern. Conf. on Alpine Meteorology*, Chambéry, France, 261-264.

**Course title****Earth System Science Part II-Earth System Dynamics****Instructor(s)-in-charge:***Prof. JIA Gensuo***Course type:***Lecture***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 in 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
1	Spatial patterns and temporal variability of the Earth system (1)	3
2	Spatial patterns and temporal variability of the Earth system (2)	3
3	Heterogeneity and connectivity of the Earth system	3
4	Human dominated changes in global environment	3
5	Land surface and terrestrial ecosystem processes	3
6	Interactive changes of land-use, ecosystem, and climate	3
7	Disaster risks under changing climate	3

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8	Earth observation of global environmental change	3
9	Science-policy forum: towards a sustainable Earth system	3
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****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:*

*The Standard Model of particle physics*

*-- Introduction to elementary particles*

*-- The symmetry principles*

*--Gauge interactions between elementary particles*

*-- Electroweak interaction, the Higgs mechanism*

*-- Gravitation and relativity*

*The standard model of cosmology*

*-- Introduction to Cosmology*

*-- Evolution of the Universe, the Friedmann equation*

*-- Thermal history of the Universe*

*-- The origin of matter*

*Connecting the particle physics and Cosmology*

*-- Dark matter problem*

*-- Dark matter detection*

**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, microfluidics	4
7	Presentation, Lab tour	4
total		28

**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: Light-emitting diode and field-effect transistors	6

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 nanomaterials: 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 Applications*

*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****Organometallic Chemistry and Catalysis-for Doctors****Instructor(s)-in-charge:**

*Prof. SUN Wenhua & Associate Prof. MA Yanping*

**Course type:**

*Lecture*

**Course Schedule:**

*3hrs/week by instructors.*

**Course Assessment:**

*Homework: 15 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	Definition & Scope of Organometallic chemistry Interests in OM chemistry and OM products in life 18 electron rule and in OM
2	Coordination chemistry: from complex to coordination by Nobel Laureate Werner Coordination Number, ligand Number and Dentate Number Importance of Coordination Cores in Natural Enzymes One Hundred Years of Vitamins —A Success Story of the Natural Sciences Syntheses of Vitamin C
3	Alkali Metal Organometallics: Li, Na, K, Rb, Cs; preparation, reactivity and structures Alkaline Earth Metal Organometallics: Be, Mg, Ca, Sr, Ba; preparation, reactivity and structures Unusual lithium precatalysts to the ROP of rac-lactide

	Biodegradable poly(caprolactone)
4	Zinc, Cadmium, and Mercury Organometallics: properties and applications Stoichiometric reactions Zirconocene-Promoted Organic Methodologies Monsanto Acetic Acid Process
5	Special topic on application of Organometallics Oxidative coupling of unsaturated substrates based on the Reaction Chemistry of Zirconocene Complexes Selective cleavage of C–H, C–C and C–X bonds catalyzed by transition-metal compounds towards Synthesis of Cyclic Compounds CO <sub>2</sub> Activation and Transformation
6	Organometallics of the Boron Group: Transmetallation, reactions and uncommon bonding Aluminium organometallics: Cyclopentadienylaluminium, reactivity, structures Aluminum(I) diketimines
7	Organometallics of the Carbon Group: Synthesis, reactivity, bondings Compounds of Low-valent Silicon: Silyl Anions, Cyclosilanes, Silicocene, Silylenes, Silyl radicals and silyl cations Lead Compounds: synthesis and Structures of Lead Compounds, Toxicity of tin(IV) reagents Cyclopentadienyltin(II) compounds Cyclopentadienyllead Derivatives
8	Organometallics of Transition Metals Various ligands Electron counting and coordination geometries Types of metallocene complexes Nobel Prize in Chemistry 2019 and discussion Semi-test
9	Metal Hydrides; Bonding in metal hydrides; Preparation of TM carbonyl hydrides; General points about oxidative addition; Experimental identification; Importance of TM metal-carbon bonds; Metal-alkyl complexes – history; bonding and stability
10	Metal-Alkyl Complexes: Stability of TM-alkyls vs. MG-alkyls, 8 Essential OM Reaction Steps; Preparation of stable TM-alkyl complexes; Strategies for blocking $\beta$ -H elimination Preparation and reaction of Metal-Alkyl Complexes And the application of the 8 Essential OM Reaction Metal-Alkyl Complexes: Stability of TM-alkyls vs. MG-alkyls, 8 Essential OM Reaction Steps; Preparation of stable TM-alkyl complexes; Strategies for blocking $\beta$ -H elimination Preparation and reaction of Metal-Alkyl Complexes And the application of the 8 Essential OM Reaction Metal-Alkyl Complexes: Stability of TM-alkyls vs. MG-alkyls, 8 Essential OM Reaction Steps; Preparation of stable TM-alkyl complexes; Strategies for blocking $\beta$ -H elimination Preparation and reaction of Metal-Alkyl Complexes

	And the application of the 8 Essential OM Reaction
11	Metal alkene (olefin) complexes: bonding, preparation, and reactions Metal alkyne complexes: bonding, preparation, and reactions Their applications
12	TRANSITION METAL-CARBON MULTIPLE BONDS: Metal carbenes – in organic synthesis and polymerisation; Metal carbenes Fischer versus Schrock: synthesis, reactivity; Metal carbenes – spectroscopic features of metal carbenes; Synthesis of metal carbenes – low oxidation state metal carbenes; Synthesis of metal carbenes – high oxidation state metal carbenes; Reactivity of metal carbene complexes; Conversion of a Fischer carbene to a Schrock carbene
13	Basics of Organometallics; Historical Background in Organometallics; Charges and corresponding coordination numbers for typical ligands; Relationships between oxidation states and d <sub>n</sub> configurations; Electron Count on the basis of the 18 electron rule; Crystal Field Splitting; Relating the Colors of Coordination Complexes to the Spectrochemical Series; Phosphine Ligands; Coordination & Dissociation
14	CATALYSIS INTRODUCTION AND DESCRIPTIONS; Mode of Action of a Catalyst; Catalyst Performance; Homogeneous versus Heterogeneous Catalysis; Important Examples of Heterogeneous Catalysis; Heterogeneous catalysis; Important Examples of Homogeneous Catalysis; Reasons for industrial preference for Heterogeneous Catalysis; Methods For Studying Catalysis; Hydrogenation & Hydroformylation; ACETIC ACID
15	CO ETHYLENE COPOLYMERISATION; CO/alkene Copolymerisation; CO/C <sub>2</sub> H <sub>4</sub> Copolymerisation; Mechanism; Propagation; OLEFIN OLIGOMERISATION; Industrial processes
16	OLEFIN POLYMERISATION; RING OPENING POLYMERISATION
17	Final test

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****Organometallic Chemistry-for masters****Instructor(s)-in-charge:**

*Prof. SUN Wenhua & Associate Prof. MA Yanping*

**Course type:**

*Lecture*

**Course Schedule:**

*3hrs/week by instructors.*

**Course Assessment:**

*Homework: 15 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	Definition & Scope of Organometallic chemistry Interests in OM chemistry 18 electron rule and in OM
2	Coordination chemistry: from complex to coordination by Nobel Laureate Werner Coordination Number, ligand Number and Dentate Number Importance of Coordination Cores in Natural Enzymes One Hundred Years of Vitamins —A Success Story of the Natural Sciences
3	Alkali Metal Organometallics: Li, Na, K, Rb, Cs; preparation, reactivity and structures Alkaline Earth Metal Organometallics: Be, Mg, Ca, Sr, Ba; preparation, reactivity and structures
4	Zinc, Cadmium, and Mercury Organometallics: properties and applications Stoichiometric reactions Zirconocene-Promoted Organic Methodologies

5	<p>Special topic on application of Organometallics</p> <p>Oxidative coupling of unsaturated substrates based on the Reaction Chemistry of Zirconocene Complexes</p> <p>Selective cleavage of C–H, C–C and C–X bonds catalyzed by transition-metal compounds towards Synthesis of Cyclic Compounds</p> <p>CO<sub>2</sub> Activation and Transformation</p>
6	<p>Organometallics of the Boron Group: Transmetallation, reactions and uncommon bonding Aluminium organometallics: Cyclopentadienylaluminium, reactivity, structures</p>
7	<p>Organometallics of the Carbon Group: Synthesis, reactivity, bondings</p> <p>Compounds of Low-valent Silicon: Silyl Anions, Cyclosilanes, Silicocene, Silylenes, Silyl radicals and silyl cations</p> <p>Lead Compounds: synthesis and Structures of Lead Compounds, Toxicity of tin(IV) reagents Cyclopentadienyltin(II) compounds</p> <p>Cyclopentadienyllead Derivatives</p>
8	<p>Organometallics of Transition Metals</p> <p>Various ligands Electron counting and coordination geometries Types of metallocene complexes Nobel Prize in Chemistry 2019</p> <p>Semi-test</p>
9	<p>Metal Hydrides; Bonding in metal hydrides; Preparation of TM carbonyl hydrides; General points about oxidative addition; Experimental identification; Importance of TM metal-carbon bonds; Metal-alkyl complexes – history; bonding and stability</p>
10	<p>Metal-Alkyl Complexes: Stability of TM-alkyls vs. MG-alkyls, 8 Essential OM Reaction Steps; Preparation of stable TM-alkyl complexes; Strategies for blocking <math>\beta</math>-H elimination</p> <p>Preparation and reaction of Metal-Alkyl Complexes</p>
11	<p>Metal alkene(olefin)complexes: bonding,preparation,and reactions</p> <p>Metal alkyne complexes: bonding, preparation, and reactions</p>
12	<p>TRANSITION METAL-CARBON MULTIPLE BONDS: Metal carbenes – in organic synthesis and polymerisation; Metal carbenes Fischer versus Schrock: synthesis, reactivity;</p> <p>Metal carbenes – spectroscopic features of metal carbenes; Synthesis of metal carbenes – low oxidation state metal carbenes; Synthesis of metal carbenes – high oxidation state metal carbenes; Reactivity of metal carbene complexes; Conversion of a Fischer carbyne to a Schrock carbyne</p>
13	<p>Basics of Organometallics; Historical Background in Organometallics; Charges and corresponding coordination numbers for typical ligands; Relationships between oxidation states and dn configurations; Electron Count on the basis of the 18 electron rule; Crystal Field Splitting; Relating the Colors of Coordination Complexes to the Spectrochemical Series;Phosphine Ligands; Coordination &amp; Dissociation</p>
14	<p>CATALYSIS</p> <p>INTRODUCTION AND DESCRIPTIONS; Mode of Action of a</p>

	Catalyst; Catalyst Performance; Homogeneous versus Heterogeneous Catalysis; Important Examples of Heterogeneous Catalysis; Heterogeneous catalysis; Important Examples of Homogeneous Catalysis; Reasons for industrial preference for Heterogeneous Catalysis; Methods For Studying Catalysis; Hydrogenation & Hydroformylation; ACETIC ACID
15	CO ETHYLENE COPOLYMERISATION; CO/alkene Copolymerisation; CO/C <sub>2</sub> H <sub>4</sub> Copolymerisation; Mechanism; Propagation; OLEFIN OLIGOMERISATION; Industrial processes
16	OLEFIN POLYMERISATION; RING OPENING POLYMERISATION
17	Final test
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****Data Mining****Instructor(s)-in-charge:***Prof. LIU Ying***Course type:***Lecture***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

**Section 4: 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 Micheline Kamber, 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****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:**

- |  |            |
|--|------------|
| <b>1. Introduction</b>   | <b>3 h</b> |
| Definition   |            |
| Contents   |            |
| <b>2. Macromolecules</b>   | <b>3 h</b> |
| Functions  |            |
| Regulation   |            |
| Structure  |            |
| <b>3. Cellular Compartments</b>  | <b>3 h</b> |
| Cytoskeletons  |            |
| Organelles   |            |
| -Membrane-bound organelles   |            |
| -Non-membrane organelles   |            |
| <b>4. Cell Organelles and Human Health</b>   | <b>3 h</b> |
| <b>5. Discussion 1</b>   | <b>3 h</b> |
| 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. |            |
| <b>6. Metabolic Syndrome</b>   | <b>3 h</b> |
| Cardiovascular disease   |            |
| None alcoholic fatty liver disease   |            |
| <b>7. Introduction of Lipid Droplets</b>   | <b>3 h</b> |
| History  |            |
| Distributions  |            |
| Difference with lipoproteins and other cellular organelles                             |            |
| Recent progress  |            |
| Uncertainty and problems   |            |
| Future studies   |            |
| <b>8. Lipid Droplet Proteins</b>   | <b>3 h</b> |
| <b>Structural Proteins:</b>  |            |

- 
- 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****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 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	<p><b>The Economic Approach</b></p> <p>1.1 The Human–Environment Relationship:            -the role of economics;            -studying human behavior in a laboratory;            -the environment as an asset.</p> <p>1.2 Environmental Problems and Economic Efficiency:            -property rights and efficient market allocation;            -improperly designed property rights systems;            -the pursuit of efficiency.</p> <p>1.3 Externalities as a Source of Market Failure:            -public goods;            -imperfect market structures;            -government failure;            -an efficient role for government.</p>
2	<p><b>Evaluating Trade-Offs</b></p> <p>2.1 Normative Criteria for Decision Making:            -pollution control;            -preservation <i>versus</i> development;            -issues in benefit estimation.</p> <p>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.</p>

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

	7.3 Mini-seminars: -group discussion.
8	Student presentations and discussions
9	<b>Land Storable, Renewable Resources: Forests</b> 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	<b>Economics of Pollution Control</b> 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	<b>Course conclusion and discussion</b>
13	<b>Final Exam</b>
Total	

**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
<b>Total</b>	

**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
<b>Total</b>	

**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****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

#### **Section 7: Terrain Analysis**

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

#### **Section 8: 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****Advanced Quantum Mechanics****Credits: 3****Instructor(s)-in-charge:***Prof. Cong-Feng Qiao***Course type:***Lecture***Course Schedule:***From academic week 3 to week 17, 3 hrs per week.**Classtime: Tuesday (13:30-16:20)***Course Assessment:***Homework: 12+ assignments.***Grading Policy:***Total score includes 40% homework, 40% class test, 20% final exam.***Course Prerequisites:***Undergraduate degree in physics (BS) or equivalent.***Catalog Description:***This course includes four chapters plus two operational chapters of the Textbook: J. J. Sakurai and J. Napolitano, Modern Quantum Mechanics, 2nd edition (Addison – Wesley), (2010)**Chapters: 1) Fundamental Concepts; 2) Quantum Dynamics; 3) Theory of Angular Momentum; 4\*) Approximation Methods; 5\*) Scattering Theory; 6) Relativistic Quantum Mechanics. Note: \* for selective contents***Schedule of the course**

section	content	hours
1	(a) (b)	3
1	(b) (c)	3
2	(a) (b)	3
2	(b) (c)	3
2	(c) (d)	3
2	(d) (e)	3
3	(a)	3
3	(b)	3
3	(c) (d)	3
3	(d) (f)	3
6	(a)	3
6	(b)	3
6	(c)	3
review	And also selected topics	3
test		3
total		45

**Contents of the course****Section 1:**

## 1. Fundamental Concepts

- (a) Stern-Gerlach Experiments
- (b) Physical States, Observables, Uncertainty Relation, and Measurement
- (c) Wave Functions in Position and Momentum Space

Supplement-Linear Algebra

**Section 2:**

## 2. Quantum Dynamics

- (a) Time Evolution and Schrodinger Equation
- (b) Schrodinger Picture and Heisenberg Picture
- (c) Simple Harmonic Oscillator
- (d) Schrodinger's wave equation
- (e) Elementary Solutions to Schrodinger's Wave Equation

**Section 3:**

## 3. Theory of Angular Momentum

- (a) Rotation and Angular Momentum Commutation Relation
- (b) Spin 1/2 and Finite Rotation
- (c) Density Operator and Pure versus Mixed Ensembles
- (d) Eigenvalue and Eigenvectors of Angular momentum
- (e) Orbital Angular momentum
- (f) Addition of Angular momenta

**Section 4:**

## 4. Approximation Methods

- (a) Symmetries, Conservation Laws, and Degeneracies
- (b) Discrete Symmetries, Parity, or Space Inversion
- (c) The Time-Reversal Discrete Symmetry

**Section 5:**

## 5. Approximation Methods

- (a) Time-independent Perturbation Theory: Nondegenerate Case
- (b) Time-independent Perturbation Theory: The Degenerate Case
- (c) Hydrogen-Like Atoms: Fine structure the Zeeman Effect
- (d) Variational Methods

**Section 6:**

## 6. Relativistic Quantum Mechanics

- (a) Paths to Relativistic Quantum Mechanics
- (b) The Dirac Equation
- (c) Symmetries of the Dirac Equation

**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:**

3

**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****Intelligent Software Engineering****Instructor(s)-in-charge:***Prof. Tiejian Luo***Course type:***Lecture***Course Schedule:***3hrs/week by instructor. 60hrs in total.***Course Assessment:***Homework: 2 assignments and 1 project***Grading Policy:***Typically 60% homework, 40% project.***Course Prerequisites:***Data Structure, Database, Software Engineering***Catalog Description:**

*This course is a basic course for graduate students in computer science and technology. This course focuses on the new issues facing software engineering today and the development of new technologies to address these issues, including requirements engineering, software design, software processes, and software quality. Through this course, students will be able to fully understand the latest developments in software engineering today and enhance the ability to design actual systems.*

**Schedule of the course**

section	content	hours
1	Software Engineering Foundation	2
2	Software Process	6
3	Software Project Management	6
4	Software Requirements Engineering	6
5	Software Design Fundamentals	6
6	Software Development Technology	6
7	Software Testing	6
8	Software Evolution	6
9	Software Reliability Technology	6
10	Project Presentation	10
total		60

**Contents of the course**

Chapter 1 Software Engineering Foundation (Introduce the concept and development process of software engineering concepts, analyze the nature of software development, and introduce the organizational content structure of this course around the nature of software development);

Chapter 2 Software Process (The concept of software process model, software life cycle model, such as waterfall model, spiral model, agile development model, etc.);

Chapter 3 Software Project Management (software project management basic

concepts, project personnel and organization, product quality assurance, project management process and content, familiar with the project management process and related tools through curriculum practice, create curriculum practice projects);

Chapter 4 Software Requirements Engineering (Basic Concepts of Software Requirements, Software Requirements Engineering Processes and Methods, Software Requirements Models and Requirements Specification);

Chapter 5: Software Design Fundamentals (Basic Concepts and Principles of Software Design, Software Structure and Behavior Models, Software Architecture Concepts and Models, Software Architecture Design, Object-Oriented Design Methods, and UML);

Chapter 6 Software Development Technology (Agile Software Development Method, Software Reuse, Design Pattern, Application Framework, Component-Based Software Development Method);

Chapter 7 Software Testing (Software Verification and Validation, Software Testing Basics, Software Testing Types, Software Testing Activities, Software Testing Automation, Software Reliability Verification and Protection);

Chapter 8 Software Evolution (the goal and type of software maintenance, software maintenance process, legacy system evolution technology);

Chapter 9 Software Reliability Technology (Introduction to Formal Methods, Formal Language, Software Reliability Concepts and Challenges, Software Fault Tolerance Techniques)

**Textbook and any related course material:**

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



**Course title****Data Science****Instructor(s)-in-charge:***Prof. Tiejian Luo***Course type:***Lecture, Seminar***Course Schedule:***3hrs/week by instructor. 60hrs in total.***Course Assessment:***Homework: 3 assignments and 1 project***Grading Policy:***Typically 60% homework, 40% project.***Course Prerequisites:***Discrete Mathematics***Catalog Description:**

*This course is a professional seminar for graduate students in computer software and theory. Its purpose is to enable students to master the basic content of network science and understand its application fields. This course focuses on the common models of network science. The requirements for students are follows: Master the basic methods of network science including common models and algorithms; Master the main ideas of network modeling and network behavior analysis. This course enables computer graduate students to deeply grasp the scientific research trends in the direction of network science, the latest technology, and have a preliminary understanding of the application of different fields of network science. It is supposed to cultivate the research learning ability of graduate students, broaden their horizons, and lay a solid foundation for future research and application.*

**Schedule of the course**

section	content	hours
1	Introduction to Network Science	6
2	Basic concepts of network science	6
3	Main Issues in Network Science	6
4	Discussion on the research direction of network science	6
5	Network Communication Model in Network Science	6
6	Exercise Class	6
7	Project Presentation	6
8	Project Presentation	6
9	Project Presentation	6
10	Project Presentation	6
total		60

**Contents of the course**

### Topic 1: Introduction to Network Science

Basic concepts, development history, role and impact of network science

### Topic 2: Basic concepts of network science

Graph representation of the network, computer representation of the graph, path and connectivity, spanning tree and minimum spanning tree, bipartite graph and matching problem network topology properties (node degree, average path length, clustering coefficient, degree distribution, power law distribution)

### Topic 3: Main Issues in Network Science

Network science focuses on the scientific understanding of the quantitative and qualitative characteristics of complex networks. (1) structural complexity, (2) node complexity, (3) interaction between structure and nodes, and (4) interaction between networks.

### Topic 4: Discussion on the research direction of network science

Reveal and describe the topological properties of network systems and the appropriate methods to measure these properties; establish network models to help people understand the meaning and mechanism of these statistical properties; predict network behavior based on the nature of individual nodes and the structural nature of the entire network; Effective methods to improve existing network performance and design new networks is proposed.

### Topic 5: Network Communication Model in Network Science

Contagion model, propagation threshold analysis, communication impact analysis, complex network immunization strategies, etc.

### **Textbook and any related course material:**

Hongsong, Chen. Networks, Crowds, and Markets: Reasoning about a Highly Connected World, Easley, D. and Kleinberg, J., 2010

Stanford University: [Analysis of Networks MINING AND LEARNING WITH GRAPHS, Stanford](#)

Cornell University: [The Structure of Information Networks, Jon Kleinberg](#)

University of Southern California: [Structure and Dynamics of Networked Information, David Kempe](#)

University of Helsinki: [Information Networks, Panayiotis Tsaparas](#)

**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
1	Introduction to MATLAB	3
2	Plotting with MATLAB and Data Interpolation	3
3	Introduction to programming in MATLAB	9
4	Simulations and Optimization	6
5	MATLAB Applications to Statistics	6
6	MATLAB Applications to Finance	6
7	Machine Learning with MATLAB	6
8	Student presentation	3
9	Final Exam	3
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 differential 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*

*Statistics: moderate*

**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
<b>Total</b>		<b>60</b>

**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

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## **Contents of the course**

### **Section 1: Introduction to Chemical Process Safety**

1-1 Safety Programs, Engineering Ethics, Public Perceptions

1-2 Accident, Loss Statistics, Acceptable Risk and Seven Significant Disaster

### **Section 2: Toxicology**

2-1 Effects of Toxicants on Biological Organisms

2-2 Models for Dose and Response Curves

2-3 Relative Toxicity and Threshold Limit Values

### **Section 3: Industrial Hygiene**

3-1 Government Regulations

3-2 Industrial Hygiene: Anticipation, Identification, Evaluation and Control

### **Section 4: Source Models**

4-1 Flow of Gases, Vapors or Liquid through Holes or Pipes

4-2 Liquid Flashing, Pool Evaporation or Boiling

4-3 Realistic / Worst-Case Releases, and Conservative Analysis

### **Section 5: Toxic Release and Dispersion Models**

5-1 Neutrally Buoyant Dispersion Models and Dense Gas Dispersion Models

5-2 Toxic Effect Criteria and Release Mitigation

5-3 Effect of Release Momentum and Buoyancy

### **Section 6: Fires and Explosions**

6-1 Definitions, Concepts and Distinction between Fires and Explosions

6-2 The Fire Triangle, Autoignition, Auto-Oxidation, Adiabatic Compression

### **Section 7: Concepts to Prevent Fires and Explosions**

Concepts, Measures and Instruments for Preventing Fires and Explosions,

### **Section 8: Chemical Reactivity**

Commitment, Awareness, Identification and Control of Reactive Chemical Hazards

### **Section 9: Introduction to Reliefs**

Concepts, Definitions, Types and Characteristics of Reliefs

### **Section 10: Relief Sizing**

10-1 Reliefs of Spring-Operated, Rupture Disc, Pilot-Operated and Bucking-Pin

10-2 Two-Phase Flow during Runaway Reaction Relief Simplified Nomograph Method

10-3 Deflagration Venting for Dust and Vapor Explosions

### **Section 11: Hazards Identification**

Process Hazards Checklists, Hazards and Operability Studies, Safety Reviews...

### **Section 12: Risk Assessment**

12-1 Review of Probability Theory

12-2 Event Trees & Fault Trees, QRA & LOPA

### **Section 13: Safety Procedures and Designs**

13-1 Process Safety Hierarchy, Managing Safety and Best Practices

13-2 Procedures for Operating, Permits, Safety Reviews and Accident Investigations

13-3 Miscellaneous Designs for Fires, Explosions, Runaway Reactions, Handling Dusts

### **Section 14: Case Histories**

Static Electricity, Chemical Reactivity, System Designs, Procedures and Training

**Textbook and any related course material:**

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

**Expected level of proficiency from students entering the course:**

*Mathematics: intermediate*

*Chemistry: intermediate*



**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	Water Quality	6
3	Water treatment principle	12
4	Presentation	3
5	Physical Separation	12
6	Physical/Chemical Treatment	15
7	Disinfection products, distribution, and management	9
Total		60

**Contents of the course**

## Section 1: Introduction

- Introduction to Advanced Physical/Chemical Drinking Water Treatment

## Section 2: Water Quality

- Physical, chemical, and microbiological quality of water
- Water quality management strategy

## Section 3: Water Treatment Principles

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

Section 4: Presentation on research advances

Section 5: Physical Separation

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

Section 6: Physical/Chemical Treatment

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

Section 7: 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****Water Chemistry****Instructor(s)-in-charge:**

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

**Course type:**

*Lecture*

**Course Schedule:**

*6hrs/week by instructor*

**Course Assessment:**

*Homework: 5 assignments*

**Grading Policy:**

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

**Course Prerequisites:**

*General Chemistry, Physical Chemistry*

**Catalog Description:**

*Water Chemistry is a core course in the Environmental Science and Engineering program. It provides a thorough understanding of the fundamentals of water chemistry to our incoming cohorts of students. 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.*

**Schedule of the course**

Section	Content	Hours
1	Introduction	3
2	Chemical Reactivity, Reactions, and Equilibrium	6
3	Reaction Kinetics and Interpretation of Equilibrium	6
4	Acid-base Chemistry	9
5	Titrations and Buffers	3
6	Gas/liquid Equilibrium	3
7	Complexation, Dissolution, and Precipitation	9
8	Redox Chemistry	9
9	Adsorption Reactions	3
10	Photochemistry	6
11	Presentation	3
Total		60

**Contents of the course****Section 1: Basics of Aquatic Chemistry**

- Introduction

- Structure of water molecules and interactions among them
- Behavior of solutes in water; dissolution of salts
- Approaches for expressing concentrations

## **Section 2: Chemical Reactivity, Reactions, and Equilibrium**

- Characterizing Chemical Reactivity
- Predicting Activity Coefficients
- The Activity as an Intensive Property; The Activity of Solids Dispersed in Water
- Models of Chemical Equilibrium
- Effect of Temperature on the Equilibrium Constant

## **Section 3: Reaction Kinetics and Interpretation of Equilibrium**

- A Molecular-level picture of an elementary reaction
- Effect of temperature on reaction rate constants
- Kinetics of elementary chemical reactions
- Reaction reversibility and the definition of the equilibrium constant
- Effect of temperature on the equilibrium
- Kinetics and equilibrium constants of nonelementary reactions
- Experimental evaluation of reaction kinetics
- Rate-limiting steps and some classical, model reaction pathways
- Heterogeneous (phase-transfer) reactions

## **Section 4: Acids and Bases**

- Acid/Base Speciation and Exact Solutions to Acid/Base Problems
- Use of Log C-pH Diagrams and the TOTH Equation

## **Section 5: Titrations and Buffers**

- Introduction
- Reactions Occurring During a Titration: Qualitative considerations
- Quantitative Interpretation of Titration Data
- Alkalinity and Acidity
- Buffers

## **Section 6: Gas/liquid Equilibrium**

- Basic concepts
- Henry's law and aqueous-phase speciation
- CO<sub>2</sub> dissolution, alkalinity, and acidity

## **Section 7: Complexation, Dissolution, and Precipitation**

- Introduction of metal complexes
- Complexes with hydroxide ions and other ligands
- Log C-pH diagrams for dissolved metals
- Predominance area diagrams
- Introduction on the formation of solids containing metal ions
- Precipitation of solids other than hydroxides
- Determining whether a solid will precipitate under given conditions
- Predominance area diagrams considering possible precipitation of solids

## **Section 8: Redox Chemistry**

- Introduction

- Computing pe from species activities: the Nernst equation
- Redox speciation and logC-pe diagrams
- Redox reactions involving exchange of both electrons and protons
- Computing equilibrium speciation in redox systems
- Energy changes accompanying redox reactions
- Redox titrations and the geochemical redox sequence
- pe-pH predominance area diagrams
- Redox reactions and electrochemistry

### **Section 9: Adsorption Reactions**

- The adsorption isotherm
- Adsorption of ions in the presence of a surface electrical potential
- Surface precipitation
- Activated carbon adsorption

### **Section 10: Photochemistry**

- Light fundamentals
- Photoreactions and reactants
- Photochemical reactions in atmospheric waters
- Heterogeneous photochemistry
- Photochemistry in water treatment

### **Section 11: Presentation on research advances**

#### **Textbook and any related course material:**

*Mark Benjamin, Water Chemistry, Second Edition*

*Stumm, Werner, and James J. Morgan. Aquatic Chemistry. New York, NY: Wiley-Interscience, 1996. ISBN: 0471511854.*

*Anderson, G. W. Thermodynamics of Natural Systems. New York, NY: Wiley-Interscience, 2005. ISBN: 0521847729.*

#### **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
	<b>Summary &amp; final examination</b>	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****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:**

*4hrs/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**

<b>section</b>	<b>content</b>	<b>hours</b>	<b>Instructor</b>
1	<b>Course Introduction, Introductory Lecture</b> 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	<b>Observation and monitoring of land change</b> Introduction of cloud computing platform	3	Dong

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

	Land related mitigation and adaptation response Land management and socioeconomic development		
15	<b>Student presentation</b> Presentations on final project	6	Dong/Feng/Cui
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****Development Geography****Instructor(s)-in-charge:**

*Prof. DENG Xiangzheng & Prof. DONG Jinwei & Associate Prof. SONG Wei & Associate Prof. WU Feng*

**Course type:**

*Lecture*

**Course Schedule:**

*3hrs/week by instructor*

**Course Assessment:**

*Homework: 4 assignments; student presentation*

**Grading Policy:**

*Typically 30% homework, 30% student presentation, 40% final.*

**Course Prerequisites:**

*NULL*

**Catalog Description:**

*Development geography is a subdiscipline of geography that studies human development and quality of life. Based on geography, development geography integrates disciplines such as management, economics, ecology, etc., and has the characteristics of integrity and interdisciplinary. Development Geography facilitates a more integrated understanding of development and places development problems within the context of the global economy and society. Its topics cover the concepts, theories and approaches, and development trend etc., which ranges from population and culture to agricultural and industrial development. Specifically, the contents of the courses include the concepts and progress of development geography, overview of geographical development differences; and specific analysis of geographical distribution and differences in income inequality and poverty, population, education and health, culture, resource and environment carrying capacity, rural and agricultural development, urban and industrial development, and the regional differences of globalization and international and regional development, etc. Further, case studies will be presented to highlight the possible solutions, as well as the problems, at local, national and international levels.*

**Schedule of the course**

Section	Content	Hours
1	Concepts and progress of development geography	3
2	Overview of development geography	3
3	Overview of geographical differences in regional development geography	6
4	Income inequality and poverty	3
5	Geographical distribution of population in China	3

6	Land use policy and management in China	3
7	Agriculture and food security in China	3
8	Student presentation and discussions	3
9	Resource and environmental carrying capacity and regional differences	6
10	Geographic development differences in rural areas and agriculture	3
11	Geographic development differences in cities and industry	3
12	Student presentation and discussions	3
13	Review on globalization and regionalization development	3
14	International trade, cooperation and regional development	3
15	The balance of payments, financial stability and regional development	3
16	The national cases: China, Brazil and India	3
17	Student presentation and discussions	3
18	Exam	3
Total		60

## Contents of the course

### Section 1: Understanding Development Geography

1. Concepts and progress of development geography
  - (1) Concepts, discipline classification and development of geography
  - (2) Overview of geographical research and development
  - (3) Concepts relating to geography
  - (4) Tools applied in geography
2. Overview of development geography
  - (1) Concepts and research objects of development geography
  - (2) Role of development geography in geography
  - (3) Theories in development geography
  - (4) Theoretical and practical significance of development geography
  - (5) Research prospects in development geography
3. Overview of geographical differences in regional development geography
  - (1) Indicators for geographic regional development differences measure
  - (2) Geographic regional development differences in China
  - (3) Development differences between developing and developed countries
  - (4) Reasons for regional development difference and the theoretical origins

### Section 2: Social and Economic Development

4. Income inequality and poverty

- (1) Fundamentals of income inequality and poverty
- (2) Measurement and representation of income inequality
- (3) Measurement and representation of poverty
- (4) Policies to address income inequality and poverty
5. Geographical distribution of population in China
  - (1) Characteristics of population growth
  - (2) Characteristics of population structure
  - (3) Spatial and geographical distribution of population
  - (4) Population growth and migration policy
6. Land use policy and management in China
  - (1) Evolution of land use policies in China
  - (2) Effectiveness and impacts of major land use policies in China
  - (3) Discussion on land system reform
7. Agriculture and food security in China
  - (1) Role of agriculture and food security
  - (2) Spatial distribution of agricultural production and regional difference
  - (3) Reform of agricultural policies

### **Section 3: Environmental and Rural-Urban Development**

8. Resource and environmental carrying capacity and regional differences
  - (1) The effect of environmental protection and ecological civilization construction on geographical development
  - (2) Measurement and characterization of environmental capacity and resources and environmental carrying capacity
  - (3) Measurement and characterization of ecological development efficiency
  - (4) Research on the convergence of regional economic development
  - (5) Ecological civilization construction and sustainable development strategic spatial layout
  - (6) Transformation path and policy choices in underdeveloped areas
9. Geographic development differences in rural areas and agriculture
  - (1) The role of cities and industry in geographic development
  - (2) Urbanization process and spatial distribution differences
  - (3) Industrial development status and spatial distribution differences
  - (4) Urbanization development and industrial reform policies
10. Geographic development differences in cities and industry
  - (1) The role of cities and industry in geographic development
  - (2) Urbanization process and spatial distribution differences
  - (3) Industrial development status and spatial distribution differences
  - (4) Urbanization development and industrial reform policies

### **Section 4: Globalization, trade and regional development**

11. Review on globalization and regionalization development
  - (1) Role of globalization on geography development
  - (2) Current international geographical differences
  - (3) Status of China in the globalization process
  - (4) Policy choice of developing countries in the process of globalization



12. International trade, cooperation and regional development
  - (1) Theory of international trade for the development of the geographical environment
  - (2) International cooperation organizations and institutions
  - (3) Geopolitics and protectionism
  - (4) Trade policy comparison between countries
13. The balance of payments, financial stability and regional development
  - (1) International financial stability for the role of regional development
  - (2) Balance of payments deficit and trade war
  - (3) Effects of the global financial crisis on developing countries
  - (4) Financial system reform and promoting the development of regional policy
14. The national cases: China, Brazil and India
  - (1) National development in the future
  - (2) China's development present situation and the future
  - (3) Brazil's development present situation and the future
  - (4) India's development present situation and the future

**Textbook and any related course material:**

*Hodder, R. (2000). Development Geography. Psychology Press.*

*Potter, R., Conway, D., Evans, R., & Lloyd-Evans, S. (2012). Key Concepts in Development Geography. Sage Publications.*

*Lawson, V. (2014). Making Development Geography. Routledge.*

**Expected level of proficiency from students entering the course:**

*Geography: Medium*

*Economics: Primary*

**Course title****Geographic Information Systems A****Credits/Hours:***3.5 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	Nature of Geographic data	2
2	Coordinate Systems	
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 B****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**

Week	Chapter	Content	Hours	Homework
3 <sup>rd</sup>	Chp1: An Introduction to GIS	<b>Keys:</b> 1. What is GIS 2. Contents of GIS 3. Applications of GIS <b>Hand-on Tasks:</b> 1. Introduction to ArcCatalog 2. Introduction to ArcMap	3	
4 <sup>th</sup>	Chp2: Coordinate Systems	<b>Keys:</b> 1. Geographic Coordinate System 2. Map Projection and Commonly Used Projections 3. Projected Coordinate Systems 4. Options for Coordinate Systems in GIS <b>Hand-on Tasks:</b> 1. Project from a Geographic to a Projected Coordinate System 2. Import a Coordinate System 3. Project Using a Predefined Coordinate System	3	
5 <sup>th</sup>	Chp3: Geo-data	<b>Keys:</b> 1. Representation of Spatial Features: point\line\polygon	3	

Week	Chapter	Content	Hours	Homework
	Organization (vector)	2. Georelational Data Model: Coverage\Shape 3. Object-Based Data Model: Geodatabase <b>Hand-on Tasks:</b> 1. Examine and view the Data File Structure of Coverage and Shape 2. Create File Geodatabase, Feature Datasets and Feature Class 3. Conversion between shape/coverage and Geodatabase		
6 <sup>th</sup>	Chp4: Geo-data Organization (raster)	<b>Keys:</b> 1. Elements of the Raster Data Model 2. Satellite Images, DEM and Other Types of Raster Data 3. Data Conversion and Integration <b>Hand-on Tasks:</b> 1. View a satellite Image and view a Land Cover Image 2. Convert Vector Data to Raster Data	3	
7 <sup>th</sup>	Chp5: Attribute Data Management	<b>Keys:</b> 1. Attribute Data in GIS 2. Join, Relates and Relationship Classes 3. Manipulation of Fields and Attribute Data <b>Hand-on Tasks:</b> 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	3	
8 <sup>th</sup>	Chp6: Spatial Data Acquisition	<b>Keys:</b> 1. Existing GIS Data 2. Conversion of Existing Data 3. Creating of New Data <b>Hand-on Tasks:</b> 1. Download RS data 2. Digitize on Screen 3. Add XY Data 4. Kmz Files and Display in Google Earth	3	

Week	Chapter	Content	Hours	Homework
9 <sup>th</sup>	Chp7: Geometric Transformation	<b>Keys:</b> 1. Geometric Transformation 2. Root Mean Square (RMS) Error 3. Interpretation of RMS Errors on Digitized Maps 4. Resampling of Pixel Values <b>Hand-on Tasks:</b> 1. Georeference and Rectify a Scanned Map 2. Perform Image to Map Transformation	3	
10 <sup>th</sup>	Ch8: Cartography and GIS Mapping	<b>Keys:</b> 1. Cartographic Representation 2. Types of Quantitative maps 3. Map Design 4. Map Production <b>Hand-on Tasks:</b> 1. Make a Choropleth Map 2. Use Graduated Symbols, Line Symbols, Highway Shield Symbols, and Text Symbols	3	Homework 1
11 <sup>th</sup>	Chp9: Data Exploration	<b>Keys:</b> 1. Data Exploration 2. Map-Based Data Manipulation 3. Attribute Data Query 4. Spatial Data Query 5. Raster Data Query <b>Hand-on Tasks:</b> 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	
12 <sup>th</sup>	Chp10: Vector Data Analysis	<b>Keys:</b> 1. Buffering 2. Overlay 3. Distance Measurement 4. Pattern Analysis 5. Feature Manipulation <b>Hand-on Tasks:</b> 1. Perform Buffering and Overlay	3	Homework 2

Week	Chapter	Content	Hours	Homework
		2.Overlay Multicomponent Polygons 3.Perform Areal Interpolation 4.Compute General and Local G-Statistics 5.Perform Select and Clip 6.Perform Dissolve		
13 <sup>th</sup>	Chp11: Raster Data Analysis	<b>Keys:</b> 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 <b>Hand-on Tasks:</b> 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	
14 <sup>th</sup>	Chp12: Terrain	<b>Keys:</b> 1. Data for Terrain Mapping and Analysis 2. Terrain Mapping 3. Slope and Aspect 4. Surface Curvature 5. Raster Versus TIN <b>Hand-on Tasks:</b> 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	
15 <sup>th</sup>	Chp13: Viewshed and Watershed Analysis	<b>Keys:</b> 1. Viewshed Analysis 2. Parameters of Viewshed Analysis 3. Applications of Viewshed Analysis 4. Watershed Analysis	3	Homework 3

Week	Chapter	Content	Hours	Homework
		5.Applications of Watershed Analysis <b>Hand-on Tasks:</b> 1.Perform Viewshed Analysis 2.Create a New Lookout Shapefile for Viewshed Analysis 3.Delineate Areawide Watersheds		
16 <sup>th</sup>	Chp14: Spatial Interpolation	<b>Keys:</b> 1.Elements of Spatial Interpolation 2.Global Methods 3.Local Methods 4.Kriging 5.Comparison of Spatial Interpolation Methods <b>Hand-on Tasks:</b> 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	
17 <sup>th</sup>	Chp15: Least Cost Path and Network Analysis	<b>Keys:</b> 1.Least-Cost Path Analysis 2.Applications of Least-Cost Path Analysis 3.Network 4.Assembly of a Network 5.Network Analysis <b>Hand-on Tasks:</b> 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	
18 <sup>th</sup>	Chp16: GIS Models and Modeling	<b>Keys:</b> 1.Basic Elements of GIS Modeling 2.Binary Models 3.Index Models 4.Regression Models 5.Process Models <b>Hand-on Tasks:</b>	3	



Week	Chapter	Content	Hours	Homework
		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		
19 <sup>th</sup>	Exam	Exam	3	
Total			51	

**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-B (Prof. Xiang Zhou)**

Online Class Tool: **Zoom** Client(V5.2.1)

Topic: **UCAS\_GIS-B (Prof. Xiang Zhou)**

Time: **Thursday, 18:10-21:00 (Beijing Time, UTC+8), from Sep. 8<sup>th</sup> to Dec. 29<sup>th</sup>, 2022**

<Zoom Software test: from 18:00 to 18:10>

Join Zoom Meeting

<https://zoom.com.cn/j/7716039997?pwd=cTduRGxxTlFONndvNHljSWN1c3RYUT09>

Meeting ID: **771 603 9997**

Passcode: **106367**

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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

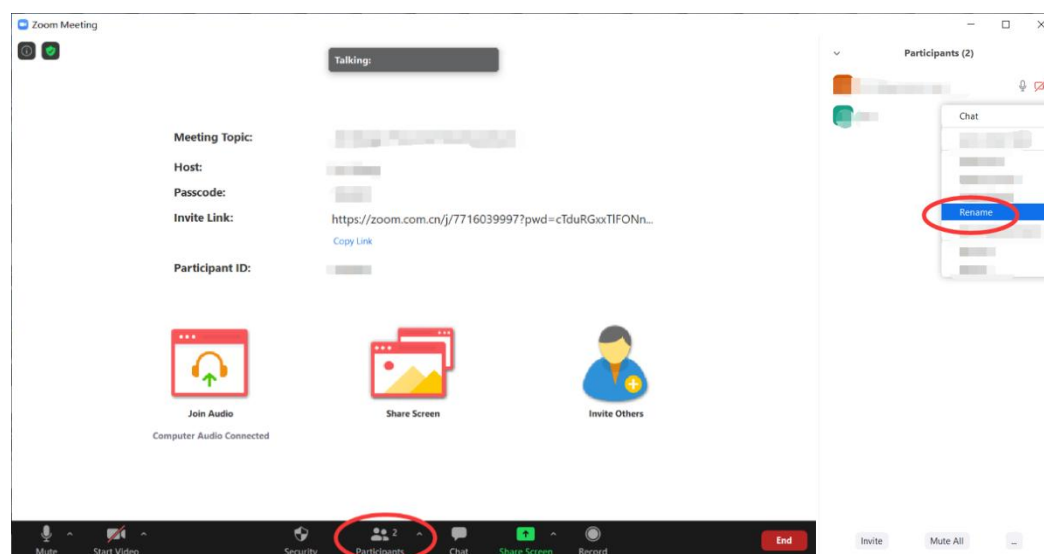
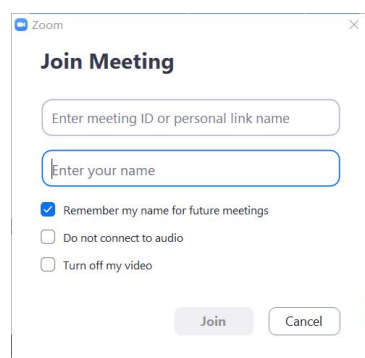
Passcode: 106367

Find your local number: <https://zoom.com.cn/j/7716039997?pwd=cTduRGxhTlFONn..>

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****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% Attendance, 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, organizing 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	9.7
2	Delivering the speech Preparing for your first speech	3	9.14
3	Introductory speech presentation Comments and discussion	3	9.21
4	Selecting a topic and a purpose	3	9.28
5	Analyzing the audience		10.5
6	Supporting your ideas	3	10.12
7	Outlining the speech Organizing the body of the speech	3	10.19
8	Beginning and ending the speech	3	10.26
9	Using language	3	11.2
10	Using visual aids, Speaking to inform	3	11.9
11	Presentation of informative speeches	3	11.16
12	Speaking to persuade	3	11.23
13	Presentation of persuasive speeches	4	11.30

total		40	13 weeks
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## 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 informative 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*