# 

# COURSE CATALOG

# 2020-2021 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. 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**

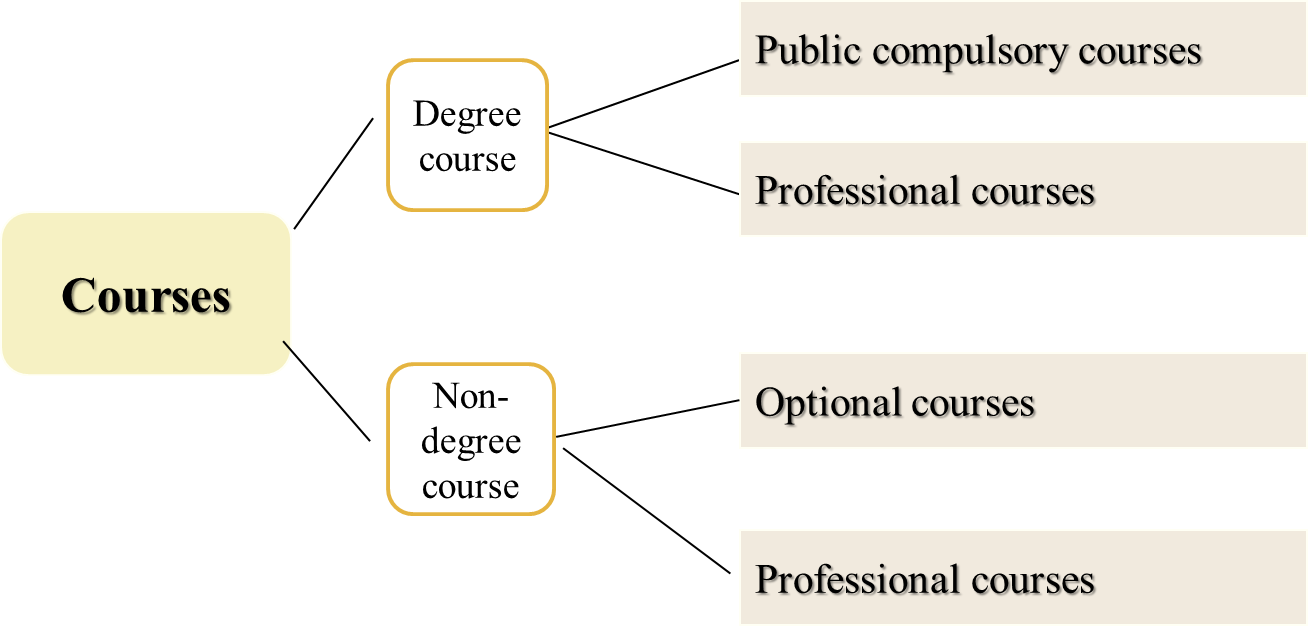
The requirement of UCAS for Masters is to get at least 30 credits before graduation. At least 13 credits should be from Professional Degree Courses. Every master student needs to take at least 2 credits from optional courses.

**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** | **6 credits** | **≥2 credits** | **≥13 credits** | **≥30 credits** |
| **PhD** | **6 credits** | **None** | **≥4 credits and ≥2 courses** | **≥9 credits** |
| **MD-PhD** | **12 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 (6 credits in total)—Degree Courses**

(1) Elementary Chinese-Reading and Writing (2 credits);

(2) China Panorama (2 credits);

(3) Elementary Chinese-Listening and Speaking (2 credits)-not available this semester

There are three Public compulsory courses which are Degree Courses for all international students. Only above two online courses are available in this semester. Elementary Chinese-Listening and Speaking (2 credits) will be available in next semester.

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.

A. Providing a certificate of HSK Level 3;

B. Got a bachelor’s degree or master’s degree which are taught in Chinese.

Students who apply for the course waiver need to contact Ms. Season (dingdanni@ucas.ac.cn) before the end of September.

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

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

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

**4.3 Optional courses—Non-degree Courses**

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

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

**5. Rules about courses results**

Students should drop out of the university under one of the following circumstances:

1、Master candidates who fail two degree courses within one semester and still fail one after relearning the courses, or fail three degree courses during the school years.

2、PhD candidates who fail one degree course and still fail after relearning the course, or fail two courses during their school years.

The Language courses and China Panorama are all Degree courses.

**6. Course Selection System**

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

**Website: http://ic-course.ucas.ac.cn/**

**Username: Your Passport ID**

**Original password: 123456**

**Just register the courses with “-for students online”**

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

|  |  |
| --- | --- |
| **Date** | **Process** |
| Sep.10-Sep.14 | Register professional courses online |
| Sep.14 | Courses start. |
| Sep.14-Sep.28 | Determine which professional courses you need to tell the teacher assistant to confirm it. |
| Sep.28-Sep.30 | Confirm your professional courses. (Important) |
| Jan. | Courses end. |

**7. Contact Information**

Education Coordinator for Professional Courses:

* Phone: 010-82680563, Ms. Sophie
* E-mail: [hutian@ucas.ac.cn](mailto:hutian@ucas.ac.cn)

Education Coordinator for Language Courses:

* Phone: 010-82680986, 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**

**Check the latest announcement please click here——**

**http://ic-en.ucas.ac.cn/category/announcement/page/1**

**8. Professional Courses and Optional Courses List**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Name** | **Hours/Credits** | **Type** | **Professors** | **Time** | **First Class Date** | **VooV Meeting(Online)** |
| 0702I0D01002H-online | Overview of Recent Development of Physics | 51/3 | Professional course | ZHOU Yufeng&SHI Xinghua | Thu. 13:30-16:20 | Sep.17 | ID:402 2521 5348 Code:408408 |
| 0703I0M01001H-online | Organometallic Chemistry | 50/3 | Professional course | SUN Wenhua | Mon. 13:30-16:20 | Sep.14 | ID:398 8543 0477  Code:209209 |
| 0704I0D01001H-online | Fundamentals of Modern Astronomy | 50/3 | Professional course | GOU Lijun&WANG Lan | Tue. 13:30-16:20 | Sep.15 | ID:877 954 7034  Code:013011 |
| 0705I0D01002H-online | Remote Sensing Image Processing | 52/3.5 | Professional course | JIANG Xiaoguang et al. | Tue.13:30-16:20 | Sep.15 | ID:450 482 087 |
| 0705I0D01003H-02-online | Geographic Information Systems | 51/3.5 | Professional course | ZHOU Xiang et al. | Fri. 13:30-16:20 | Sep.18 | **ZOOM** Meeting ID: 771 603 9997  Passcode: 106367 |
| 0705I0D01004H-online | Land Change Science | 60/4 | Professional course | DONG Jinwei et al. | Wed.13:30-16:20&Fri.13:30-16:20 | Sep.23 | ID:585 2782 7324 |
| 0705I0D01005H-online | Eco-Environmental Informatics | 69/5 | Professional course | YUE Tianxiang | Mon.13:30-16:20&Fri.13:30-16:20 | Oct.9 | Friday-ID:303 7731 6585;Monday-ID:835 7895 8376 |
| 0706I0D01002H-online | Overview of Climate Change Sciences | 60/4 | Professional course | KANG Shichang et al. | Tue.13:30-16:20 | Sep.15 | ID:576 4423 9542 |
| 0708I0D01001H-online | Introduction to Geodynamics | 72/4.5 | Professional course | WANG Shimin | Tue.13:10-16:00&Thu.13:10-16:00 | Oct.13 | Tuesday-ID:777 3045 8105.Code:070810;Thursday-ID:953 1522 3924.Code:070810 |
| 0708I0D01002H-online | Earth System Science | 51/3 | Professional course | CHEN Fang&JIA Gensuo | Mon.13:30-16:20 | Sep.14 | ID:175 569 037 Code:0914 |
| 0710I0D01001H-online | Plant Physiology and Developmental Biology | 60/4 | Professional course | CHENG Youfa&LE Jie | Mon.13:30-16:20 | Sep.14 | ID:397 995 307.  Code:200914 |
| 0710I0D01002H-online | Plant Molecular Biology and Genomics | 60/4 | Professional course | JING Haichun et.al. | Fri.13:30-16:20 | Sep.18 | ID:653 3400 6911.Code:0918 |
| 0710I0D01003H-online | The Frontier of Genomics and Precision Medicine | 60/4 | Professional course | SUN Yingli et al. | Wed.13:30-16:20 | Sep.16 | ID:229 195 476 |
| 0710I0D01004H-online | Fundamental Immunology | 52/3 | Professional course | FANG Min&DUAN Xuefeng | Tue13:30-16:20&Fr. 13:30-16:20 | Sep.15 | Tuesday-ID:854 481 991Code:654321;Friday-ID:350 7582 8469 |
| 0710I0D01005H-online | Model Animals in Developmental Biology | 60/4 | Professional course | YUAN Li | Tue.13:30-16:20 | Sep.15 | ID:317 9765 0380.  Code:915567 |
| 0710I0D01012H-online | Organelle Biology | 50/3 | Professional course | LIU Pingsheng | Wed.13:30-16:20 | Sep.16 | ID:109 065 191 |
| 0805I0D01001H-online | Functional Nanostructures: Syntheses, Characterization and Device Application | 50/3 | Professional course | WEI Zhixiang et al. | Wed.13:30-16:20 | Sep.16 | ID:379 7271 0786.  Code:666666 |
| 0805I0D01002H-online | Materials Production and Environmental Science | 60/4 | Professional course | DU Hao | Mon.13:30-16:20 | Sep.14 | ID:335 8718 0237.  Code:0914 |
| 0805I0D01003H-online | Fundamentals and frontier of Materials Science | 60/4 | Professional course | ZHANG Guangjin et al. | Thu. 13:30-16:20 | Sep.17 | ID:803 9788 4530 |
| 0812I0D01001H-online | Intelligent Software Engineering | 60/4 | Professional course | LUO Tiejian | Tue. 8:30-11:20 | Sep.15 | ID:297716447 Code:09151 |
| 0812I0D01002H-online | Data Science | 60/4 | Professional course | LUO Tiejian | Tue.13:30-16:20 | Sep.15 | ID:832960362 Code:09152 |
| 0817I0D01004H-online | Multiphase Reactor Theory and Analysis | 51/3 | Professional course | LIU Xiaoxing | Fri.13:30-16:20 | Sep.18 | ID:407 5339 6725 Code:20918 |
| 0817I0D01006H-online | Chemical Process Safety | 60/4 | Professional course | YANG Ning&GUAN Xiaoping | Tue.19:00-21:40&Fri.13:30-16:20 | Oct.13 | Tuesday-ID:828 7138 4324；Friday-ID:635 1695 9228 |
| 0830I0D01001H-online | Environmental Chemistry | 60/4 | Professional course | TIAN Zhenyu | Tue.8:30-11:20 | Sep.15 | ID:392 3311 9090  Code:2309 |
| 0830I0D01002H-online | Advanced Diagnostic Technologies of Chemical Reactions and Its Application | 60/4 | Professional course | TIAN Zhen | Tue.13:30-16:20 | Sep.15 | ID:392 3311 9090  Code:2309 |
| 0830I0D01003H-online | Environmental and Natural Resource Economics | 60/4 | Professional course | DENG Xiangzheng et al. | Tue.19:00-21:40&  Satur.19:00-21:40 | Sep.15 | Tuesday-ID:746 169 225,Code:20915;Saturday-ID:901 3954 3678,Code:200926 |
| 0830I0D01004H-online | Advanced Physical/Chemical Water Treatment | 60/4 | Professional course | LIU Chao et al. | Tue.13:30-16:20&Thu.13:30-16:20 | Sep.15 | ID:397 826 984 |
| 0812I0DGX001H-online | MATLAB with Applications to Mathematics, Science, Engineering, and Finance | 45/2 | Professional course | LUO Cuicui | Mon.18:30-22:00 | Sep.14 | ID:712 374 747  Code:200914 |
| 0703I0D01001H-online | Organometallic Chemistry and Catalysis | 50/3 | Professional course | SUN Wenhua | Mon.19:00-21:40 | Sep.14 | ID:618 8622 0009;  Code:209209 |
| 0714I0D01001H-online | Data Mining | 60/4 | Professional course | LIU Ying | Mon.13:30-15:10& Wed.13:30-15:10 | Sep.14 | Monday-ID: 675 5751 3355;Wednesday-ID: 371 8669 0472 |
| 010105DGX001H-01-online | Ethics in Scientific Research, Bioethics, & Survival Skills for A Research Career | 30/1 | Optional course | ZENG Changqing | Fri.13:30-16:20 | Oct.9 | ID:540 4923 4386 |
| 050200DGX002H-02-online | Scientific Writing | 40/1 | Optional course | PENG Gong | Tuesday 19:00-21:30 | Sep.16 | ID:375 1161 7187 |
| 050200DGX002H-03-online | Scientific Writing | 40/1 | Optional course | HONG Lei | Thu. 13:30-16:20 | Sep.17 | ID:62863318594  Code:202009 |
| 050200DGX002H-04-online | Scientific Writing | 40/1 | Optional course | CHEN Nianning | Tue. 8:30-11:20 | Sep.15 | ID:189 373 912  Code:915228 |
| 050200DGX003H-online | Public Speaking | 40/1 | Optional course | MENG Yanli | Tue. 13:30-16:20 | Sep.29 | ID:267 924 724.Code:200929 |

**9. Public Compulsory Courses List**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Class No.** | **Code** | **Name** | **Hours/Credits** | **Time** | **VooV Meeting**  **ID** | **Teachers** |
| Y-1 | 050102DGB002H-1 | Elementary Chinese-Reading and Writing | 128/2.0 | Mon.(8:30-12:10) | 497 9882 0577 | LIU Xiaomeng |
| Thur.(8:30-12:10) | 898 5663 2165 |
| 050102DGB001H-1 | China Panorama | 48/2.0 | Fri.13:30-16:20 | 408 3501 7219  Code: 532689 | JIANG Hong'en |
| Y-2 | 050102DGB002H-2 | Elementary Chinese-Reading and Writing | 128/2.0 | Mon.(8:30-12:10) | 601 8440 5768 | HE Fei |
| Thur.(8:30-12:10) | 575 8472 2098 |
| 050102DGB001H-2 | China Panorama | 48/2.0 | Mon.19:00-21:40 | 389 2528 2531  Code: 200914 | YE Qing |
| Y-3 | 050102DGB002H-3 | Elementary Chinese-Reading and Writing | 128/2.0 | Mon.(8:30-12:10) | 777 3238 7086 | LI Ya |
| Thur.(8:30-12:10) | 758 6643 1583 |
| 050102DGB001H-3 | China Panorama | 48/2.0 | Mon.19:00-21:40 | 979 4624 5152 | Chen Tianjia |
| Y-4 | 050102DGB002H-4 | Elementary Chinese-Reading and Writing | 128/2.0 | Mon.(8:30-12:10) | 676 6578 5651 | LI Ran |
| Thur.(8:30-12:10) | 812 8939 9502 |
| 050102DGB001H-4 | China Panorama | 48/2.0 | Fri.19:00-21:40 | 558 9249 1732  Code: 8888 | LUO Wugan |
| Y-5 | 050102DGB002H-5 | Elementary Chinese-Reading and Writing | 128/2.0 | Mon.(8:30-12:10) | 960 8474 4553 | LUO Lei |
| Thur.(8:30-12:10) | 652 4034 9701 |
| 050102DGB001H-5 | China Panorama | 48/2.0 | Tue.13:30-16:20 | 618 8798 0641  Code: 1026 | LAN Li |
| Y-6 | 050102DGB002H-6 | Elementary Chinese-Reading and Writing | 128/2.0 | Mon.(8:30-12:10) | 587 7649 7879 | LUO Wei |
| Thur.(8:30-12:10) | 595 7268 7448 |
| 050102DGB001H-6 | China Panorama | 48/2.0 | Wed.13:30-16:20 | 570 6470 5778  Code: 1027 | CHU Guofei |
| Y-7 | 050102DGB002H-7 | Elementary Chinese-Reading and Writing | 128/2.0 | Mon.(8:30-12:10) | 597 3888 5113 | WANG Lei |
| Thur.(8:30-12:10) | 437 1078 8956 |
| 050102DGB001H-7 | China Panorama | 48/2.0 | Thur. 13:30-16:20 | 880 2537 2655 | ZHU Jian |

**2020－2021学年秋季学期(Autumn Semester)校历**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **年度 year** | **2020** | | | | | | | | | | | | | | | | | **2021** | | |
| **月份 month** | **九月(Sep)** | | | **十月(Oct)** | | | | | **十一月(Nov)** | | | | **十二月(Dec)** | | | | | **一月(Jan)** | | |
| **周次 week** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **星期一（Mon）** | **7** | **14** | **21** | **28** | **5** | **12** | **19** | **26** | **2** | **9** | **16** | **23** | **30** | **7** | **14** | **21** | **28** | **4** | **11** | **18** |
| **星期二（Tue）** | **8** | **15** | **22** | **29** | **6** | **13** | **20** | **27** | **3** | **10** | **17** | **24** | **1** | **8** | **15** | **22** | **29** | **5** | **12** | **19** |
| **星期三（Wed）** | **9** | **16** | **23** | **30** | **7** | **14** | **21** | **28** | **4** | **11** | **18** | **25** | **2** | **9** | **16** | **23** | **30** | **6** | **13** | **20** |
| **星期四（Thu）** | **10** | **17** | **24** | **1国庆**  **中秋** | **8** | **15** | **22** | **29** | **5** | **12** | **19** | **26** | **3** | **10** | **17** | **24** | **31** | **7** | **14** | **21** |
| **星期五（Fri）** | **11** | **18** | **25** | **2** | **9** | **16** | **23** | **30** | **6** | **13** | **20** | **27** | **4** | **11** | **18** | **25** | **1**  **元旦** | **8** | **15** | **22** |
| **星期六（Sat）** | **12** | **19** | **26** | **3** | **10** | **17** | **24** | **31** | **7** | **14** | **21** | **28** | **5** | **12** | **19** | **26** | **2** | **9** | **16** | **23** |
| **星期日（Sun）** | **13** | **20** | **27** | **4** | **11** | **18** | **25** | **1** | **8** | **15** | **22** | **29** | **6** | **13** | **20** | **27** | **3** | **10** | **17** | **24** |
| **说 明** | **1、Autumn Semester starts from Sep. 7th.**  **2、Vocations: National Day lasts from Oct.1st-Oct.8th** | | | | | | | | | | | | | | | | | | | |

**Course Syllabus**

**Course title**

**Functional Nanostructure: Synthesis, Characterizations and Device Applications**

**Instructor(s)-in-charge:**

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

**Course type:**

*Lecture*

**Course Schedule:**

*3hrs/week by instructor*

**Course Assessment:**

*Homework: 16 assignments*

**Grading Policy:**

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

**Course Prerequisites:**

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

**Catalog Description:**

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

**Schedule of the course**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | | section | content | hours | | 1 | Introduction of Nanoscience and Technology | 3 | | 2 | Physics Basics | 3 | | 3 | Typical Nanostructures | 3 | | 4 | Growth Methods | 3 | | 5 | Characterizations of Nanostructures | 6 | | 6 | Organic electronics | 3 | | 7 | Applications of Nanostructures:  Water splitting and photodetection | 6 | | 8 | Applications of Nanostructures:  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 | 5 | | total |  | 50 | |

**Contents of the course**

1. Introduction of Nanoscience and Technology

* Definitions of Nanoscience and Nanotechnology
* Special properties of nanomateirals: size effect, specific surface effect, and quantum effect

2. Physics Basics

* Basics of Semiconductors: band theory, impurities and charge carriers, p-n junctions, photoelectric effect

3. Typical Nanostructures

* Quantum dots
* Nanowires and carbon nanotubes
* Two-dimensional materials

4. Growth Methods

* Vacuum science and technology (2 presentations)
* Chemical Vapor Deposition (CVD) and Metal Organics Chemical Vapor Deposition (MOCVD)
* Molecule Beam Epitaxy (MBE)

5. Characterizations of Nanostructures

* Spectroscopic Characterization: X-ray Diffraction (XRD), X-ray Photoelectron Spectroscopy (XPS), Raman Spectroscopy, Energy Dispersion X-ray Spectroscopy (EDS)
* Electron Microscopic Characterization: Scan Electron Microscope (SEM), Transmission Electron Microscope (TEM)

6. Organic electronics

* The discovery of organic conductor and semiconductor
* General properties of organic semiconductor and general applications of organic electronics

7. Applications of Nanostructures

* Water splitting
* Photodetection

8. Applications of Nanostructures: Light-emitting diode and field-effect transistors

* Preparation Methods
* Properties and Applications: Organic Field-Effect-Transistor (OFET), Organic Light Emitting Diode (OLED

9. Applications of Nanostructures: Spintronic devices and thermoelectric devices

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

10. Applications of Nanostructures: Photovoltaic devices

* Preparation Methods
* Properties and Applications: photovoltaic device based on various nano-material**s**

**Textbook and any related course material:**

*Low dimensional semiconductor structures: fundamental and device applications*

*Edited by Keith Barnham and Dimitri Vvedensky*

*Organic Electronics, Materials, Processing, Electronics, and Apllications*

*Edited by Franky So*

*Characterization of Materials, edited by Elton N. Kaufmann (editor-in-chief), Wiley-Interscience.*

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

*Mathematics: strong*

*Physics: strong*

*Chemistry: strong*

**Course title**

**Overview of Recent Development of Physics Part I**

**Instructor(s)-in-charge:**

*Prof. ZHOU Yufeng .*

**Course type:**

*Lecture*

**Catalog Description:**

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

*Overview of elementary particles physics and cosmology*

*The Standard Model of particle physics*

*-- history of elementary particles*

*-- the symmetry principle*

*-- gauge interactions between elementary particles*

*-- unification of electromagnetic and weak interactions*

*-- The Higgs boson*

*The standard model of cosmology*

*-- General relativity*

*-- the homogeneous and isotropic Universe*

*-- thermal history of the Universe*

*-- the original of matter in the Universe*

*Connecting the particle physics and Cosmology*

*-- dark matter problem*

*-- dark energy problem*

**Course title**

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

**Instructor(s)-in-charge:**

*Prof. SHI Xinghua*

**Course type:**

*Lecture*

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

**Email:** shixh@nanoctr.cn

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

**Pre-requisites and Co-requisites:** None

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

**Course Content:**

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

**The topics we will cover include:**

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

**Schedule of the course:**

|  |  |  |
| --- | --- | --- |
| section | content | hours |
| 1 | Introduction of the basic concepts of mechanics, the implications, Classical mechanics, Newtonian Mechanics | 4 |
| 2 | Lagrangian mechanics, elastic mechanics, entropic elasticity | 4 |
| 3 | Strength of materials, plastic mechanics, soil mechanics | 4 |
| 4 | Contact mechanics, fracture mechanics | 4 |
| 5 | Finite element method | 4 |
| 6 | Basic concepts of fluid mechanics, microfludics | 4 |
| 7 | Presentation, Lab tour | 4 |
| total |  | 28 |

**Course title**

**Organometallic Chemistry**

**Instructor(s)-in-charge:**

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

**Course type:**

*Lecture*

**Course Schedule:**

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

**Course Assessment:**

*Homework: 14 assignments*

**Grading Policy:**

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

**Course Prerequisites:**

*General chemistry*

**Catalog Description:**

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

**Schedule of the course**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  | | --- | --- | | section | content | | 1 | Organometallic Chemistry:  Definition & Scope  Periodic Table of Elements  *Evaluation regarding student background* | | 2 | Various ligands and their electrons contributions | | 3 | Alkali Metal Organometallics  Alkaline Earth Metal Organometallics | | 4 | Zinc, Cadmium, and Mercury organometallics  Stoichiometric reactions  *Tutorial assessment* | | 5 | Synthetic methodology oriented organometallic chemistry: A Practice | | 6 | Organometallics of the Boron Group  Organometallics of the Carbon group | | 7 | Transition metal Organometallics:  Common types of organometallic complexes; 16/18 ev; ligand types and behaviors and oxidation states | | 8 | Metal Carbonyl Complexes: Definition and types; from mononuclear to nanoparticles Industrial hydroformylation | | 9 | Organometallic compounds ligated by alkenes, dienes, and alkynes  Student presentations (Topic discussions) | | 10 | Metallocene and Arene complexes | | 11 | Sigma Complexes  *Tutorial assessment* | | 12 | Organometallic application: C-C and C-N cross couplings | | 13 | Industrial processes: ethylene oligomerization and olefin polymerization | | 14 | Student presentations (interpretation conceptual novelty to literature)  Q and A sessions | | 15 | **Open note test**  **(notebook and files within personal computer allowed, but not any text books)** | |  | | total |  | |

Textbook and any related course material:

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

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

**Course title**

**Fundamentals of Modern Astronomy**

**Instructor(s)-in-charge:**

*Dr. Lijun Gou, Dr. Lan Wang*

**Teaching assistant:**

*Dr. Zhixia Shen (zshen@nao.cas.cn)*

**Course type:**

*Lecture*

**Course Schedule:**

*4hrs/week by instructors*

**Pre-requisites and Co-requisites**:

*None*

**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:**

• 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

**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 Essential Cosmic Perspective, 7 th(or 6 th) Edition by Bennett, Donahue, Schneider, & Voit; Pearson Press.*

**Course title**

**The Frontier of Genomics and Precision Medicine**

**Instructor(s)-in-charge:**

*Prof. Yingli Sun (Beijing Institute of Genomics, Chinese Academy of Sciences)*

*Prof. Zhihua Zhang (Beijing Institute of Genomics, Chinese Academy of Sciences)*

*Prof. Cheng Li (Peking University, School of Life Sciences)*

*Prof. Yibo Gao (Cancer Hospital, Chinese Academy of Medical Sciences)*

**Course type:**

*Lecture*

**Course Schedule:**

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

**Course Assessment:**

*Homework: 2 assignments*

**Grading Policy:**

*Attendance: 10% ,* *Homework: 30% ,* *Final examination: 60%*

**Course Prerequisites:**

*Molecular biology, Statistics, Computer programming*

**Catalog Description:**

*Epigenetics and chromatin structures, DNA replication and DNA damage, and response and repair of DNA damage in chromatin environment. The first section provides an introduction to the concept of “epigenetics” and the structures of chromatins. It covers chromatin remodeling and the modifications of DNA and histones, and their roles in chromatin structure maintenance and chromatin based signal transduction. For the second part, by studying of this section, student should know the principles of DNA replication and cellular checkpoint, understand how cells sense and repair damaged DNA. The third provides current understanding of how chromatin modifications or higher structures contribute to DNA damage response (DDR) in chromatin context, and in this section we will also discuss how DDR defects will contribute to cancer development.*

*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, including exploratory data analysis, linear regression, data dimension reduction and clustering. The course will discuss genomics literature and data, and use the R language programming environment for data analysis and graphing exercises.*

**Schedule of the course**

|  |  |
| --- | --- |
| section | content |
| 1 | Introduction to Molecular Biology and Genomics |
| 2 | DNA and DNA Replication |
| 3 | RNA,Transcription and RNA Processing |
| 4 | Protein and genetic codon |
| 5 | Regulation of gene expression |
| 6 | Research progress on Genomics |
| 7 | Introduction to R language and graphics |
| 8 | Linear regression and applications to genomics data |
| 9 | Transcription regulatory factor binding sites and human disease |
| 10 | Noncoding RNA and Human Disease |
| 11 | 3D genomics and human disease |
| 12 | Introduction to Gene Regulatory Network |
| 13 | Epigenetics and chromatin structures |
| 14 | DNA damage and DNA replication |
| 15 | Response and repair of DNA damage in chromatin environment |
| total |  |
|  |  |

**Contents of the course**

**Section 1: Introduction to Molecular Biology and Genomics**

**Section 2: DNA and DNA Replication**

1. Content and Structure of chromosome
2. Basic element and structure of DNA
3. DNA replication

**Section 3: RNA,Transcription and RNA Processing**

1. Transfer of Genetic Information: The Central Dogma
2. The Process of Gene Expression
3. Transcription in Prokaryotes
4. Transcription and RNA Processing in Eukaryotes
5. Interrupted Genes in Eukaryotes: Exons and Introns
6. Removal of Intron Sequences by RNA Splicing

**Section 4: Translation and Genetic Code**

1. Elements and process in Translation
2. Structure and function of protein
3. About Genetic code

**Section 5: Regulation of gene expression**

1. Gene expression refers to the process of gene transcription and Translation
2. Gene expression with temporal specificity and spatial specificity
3. Gene expression and regulation have a big difference between each other
4. Regulation of gene expression is necessary for the organism growth and development

**Section 6: Research progress on Genomics**

1. Genome Project
2. Single Cell Sequence
3. Epigenetics Research Progress
4. The Cancer Genome Atlas
5. Gene Detection with Genomic Technology

**Section 7: Introduction to R language and graphics**

1. Introduction to genomics data
2. Introduction to R language
3. Demo of R language
4. R syntax
5. R flow control
6. Use R to make graphs
7. Efficient programming in R

**Section 8: Linear regression and applications to genomics data**

1. Correlation and association
2. Continuous vs. discrete variables
3. Simple linear regression
4. Multiple linear regression
5. Selection of variables and model validation
6. Application examples to genomics data
7. Use linear regression in R

**Section 9:** Transcription regulatory factor binding sites and human disease

1. Basic principle of transcription;
2. Identification of transcription regulatory factor binding sites
3. Transcription regulatory factor binding sites and human disease
4. Promoter and enhancer identification methods

**Section 10:** Noncoding RNA and Human Disease

1. DNA methylation, histone Modification and Gene expression Regulation
2. Basic experimental techniques for Noncoding RNA
3. Noncoding RNA and Human Disease
4. Basic experimental techniques for 3D Genome

**Section11:** 3D genomics and human disease

1. Methods for recognition of Compartment A/B and TAD
2. Reconstruction of the 3D genomic structure
3. Chromatin loop identification methods based on multi-omics approach
4. 3D genomics and human disease

**Section 12:** Introduction to Gene Regulatory Network

1. Introduction to Gene Regulatory Network
2. Basic Concepts of population Genetics I
3. Basic Concepts of population Genetics II.
4. Application of population Genetics in Precision Medicine

**Section 13: Epigenetics and chromatin structures**

1. History and principles epigenetics
2. Chromatin structures
3. From histone to chromatin
4. Chromatin remodeling
5. Modifications of DNA and histones
6. Chromatin structure maintenance and chromatin based signal transduction

**Section 14: DNA damage and DNA replication**

1. The principles of DNA replication
2. DNA replication, replication fork stalling and collapse
3. Cell cycle and checkpoint
4. DNA damage response (DDR)
5. Different types of DNA damage
6. Damage sensing and signal transduction
7. Repair pathways

**Section 15: Response and repair of DNA damage in chromatin environment**

1. Chromatin remodeling and DDR
2. Histone modifications and DDR
3. Chromatin relaxation and compaction on DDR
4. How DDR defects will contribute to cancer development

**Textbook and any related course material:**

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/*](http://www-bcf.usc.edu/~gareth/ISL/)

**NOTE**: This book is only suggestive, not imperative.

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

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

*Mathematics and statistics: medium*

*Computer programming: medium*

*Molecular biology: medium*

*Genetics: entry level*

*Cell biology: entry level*

*Math: Basic calculation*

**Course title**

**Plant Molecular Biology**

**Instructor(s)-in-charge:**

*Profs. Hai-Chun Jing et al.*

**Course type:**

*Lecture*

**Course Schedule:**

*4hrs/week by instructors*

**Course Assessment:**

*Homework: 15 assignments*

**Grading Policy:**

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

**Course Prerequisites:**

*without*

**Catalog Description:**

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

**Schedule of the course**

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

**Contents of the course**

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

**1. The Gene**

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

**2. The Genome**

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

**3. The Epigenome**

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

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

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

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

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

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

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

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

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

**Textbook and any related course material**

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

*2. Genes Ⅷ, Benjamin* *Lewin.*

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

*4. Plant Genomics: Methods and Protocols.* [*Daryl*](http://search.dangdang.com/?key2=Daryl&medium=01&category_path=01.00.00.00.00.00)*J.*[*Somers*](http://search.dangdang.com/?key2=Somers&medium=01&category_path=01.00.00.00.00.00) *DJ,* [*PeterLangridge*](http://search.dangdang.com/?key2=PeterLangridge&medium=01&category_path=01.00.00.00.00.00)*,* [*J.P*](http://search.dangdang.com/?key2=J.P&medium=01&category_path=01.00.00.00.00.00)*.*[*Gust*](http://search.dangdang.com/?key2=Gust&medium=01&category_path=01.00.00.00.00.00)*.* [*Humana Press Inc.*](http://search.dangdang.com/?key3=Humana+Press+Inc.&medium=01&category_path=01.00.00.00.00.00)*2011.*

*5. Plant Genomics: Methods and Protocols. Busch.*[*Humana Press Inc.*](http://search.dangdang.com/?key3=Humana+Press+Inc.&medium=01&category_path=01.00.00.00.00.00) *2017.*

**Course title**

**Organelle Biology**

**Instructor(s)-in-charge:**

*Prof. Pingsheng Liu*

**Course type:**

*Lecture*

**Course Schedule:**

*See Schedule of the course (50 hours)*

**Course Assessment:**

*Homework: 7 assignments*

**Grading Policy:**

*70% homework, 30% classroom activities.*

**Course Prerequisites:**

*Without*

**Catalog Description:**

1. **Introduction 3 h**

Definition

Contents

1. **Macromolecules 3 h**

Functions

Regulation

Structure

1. **Cellular Compartments 3 h**

Cytoskeletons

Organelles

-Membrane-bound organelles

-Non-membrane organelles

1. **Cell Organelles and Human Health 3 h**
2. **Discussion 1 3 h**

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

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

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

1. **Metabolic Syndrome 3 h**

Cardiovascular disease

None alcoholic fatty liver disease

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

History

Distributions

Difference with lipoproteins and other cellular organelles

Recent progress

Uncertainty and problems

Future studies

1. **Lipid Droplet Proteins 3 h**

**Structural Proteins:**

PLINs

Oleosins

MPL, MLDP, MLDS, LDP, CLDPs

**Protein Composition:**

Lipid synthetic and catalytic

Membrane trafficking

Signaling

Protein degradation

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

Born/biogenesis/formation

Grow

Die/usage/degradation

1. **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.

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

Storage

Trafficking (movement and interaction with other cellular organelles)

Lipid synthesis

Signaling

Protein degradation

DNA protection

1. **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

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

Origin

Conserved properties

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

Isolation

Proteomics

Imaging

Fusion

Fission

Movement

Genetic screen

Artificial lipid droplets

1. **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.

1. **Laboratory Visiting 5 h**

Visit of IBP CAS

Equipment of Cell Fractionation

Equipment of Proteomics

**Course material:**

*All references are listed in course ppt.*

*You are welcome to copy the ppt.*

**Course title**

**Fundamental Immunology**

**Instructor(s)-in-charge:**

*Prof. Min Fang & Assoc Prof. Xuefeng Duan*

**Course type:**

*Lecture*

**Course Schedule:**

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

**Course Assessment:**

*Homework: 6 assignments*

**Grading Policy:**

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

**Course Prerequisites:**

*Immunology, Cell Biology, Microbiology，Virology*

**Catalog Description:**

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

**Schedule of the course**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  | | --- | --- | --- | --- | | section | content | hours | Date | | 1 | **Introduction of Immunology**  Introduction to Immunology;  General Properties of Immune Responses;  Cells and Tissues of the Immune Systems;  The development stages of Immunology. | 4 | Prof. Min Fang | | 2 | **Innate Immunity**  Features of Innate Immune Recognition;  Components of the Innate Immune System;  The Intersection of Innate and Adaptive Immunity | 4 | Prof. Min Fang | | 3 | **NK cell development and function**  General properties of NK cells; NK cell development and differentiation; NK cells in anti-viral immunity; Memory NK cells | 4 | Prof. Min Fang | | 4 | **Immunoglobulins and B lymphocytes**  Immunoglobulins: Structure and Function; Antigen-antibody interactions and Monoclonal Antibody; B lymphocytes Development and Biology; B lymphocytes Signaling Mechanisms and Activation. | 4 | Prof. Min Fang | | 5 | **T lymphocytes**  T cell Antigen Receptors; T lymphocyte Signaling Mechanisms and Activation; Development of T cells; Peripheral T lymphocyte responses and Function. | 4 | Prof. Min Fang | | 6 | **Major Histocompatibility Complex (MHC) Molecules and Antigen Presentation**  MHC Structure, Function, and Genetics; Cell Biology of Antigen Processing and Presentation. | 4 | Prof. Min Fang | | 7 | **Immunity to infectious Agents**  The Immune Responses to Parasites and bacteria; Immunity to Viruses; Vaccines; Research case study. | 4 | Prof. Min Fang | | 8 | **Immunologic Tolerance and Autoimmunity**  B lymphocyte tolerance, and tolerance induced by foreign protein antigens; T lymphocyte tolerance; Mechanisms of autoimmunity; Advances in immunologic tolerance and autoimmunity | 4 | Assoc Prof. Xuefeng Duan | | 9 | **Immunity to Tumors**  Overview and tumor antigens; Immune responses to tumors and evasion of immune responses by tumors; Immunotherapy for tumors and the role of innate and adaptive immunity in promoting tumor growth; Advances in immunity to tumors | 4 | Assoc Prof. Xuefeng Duan | | 10 | **Hypersensitivity Disorders and Allergy**  Causes of hypersensitivity diseases; Mechanisms and classification of hypersensitivity; selected immunologic diseases: pathogenesis and therapeutic strategies; IgE-dependent allergic reactions; Allergic diseases in humans: pathogenesis and therapy; Advances in hypersensitivity and allergy | 4 | Assoc Prof. Xuefeng Duan | | 11 | **The Immune system in Disease**  Systemic Autoimmunity; Transplantation Immunology; Overview of immunodeficiency diseases; Congenital immunodeficiencies; Acquired immunodeficiencies | 4 | Assoc Prof. Xuefeng Duan | | 12 | **Immunity in the mucosal system**  Overview of the mucosal system; The mucosal immune system; Immunity in the mucosal system; Mucosal diseases; Vaccine design | 4 | Prof. Min Fang | | 13 | **Students Final Presentation**  3-5 minutes per student, the student can choose any topic in immunology and discuss their understanding and thoughts. | 4 | Prof. Min Fang | | total |  | 52 |  | |

**Contents of the course**

**Section 1: Introduction of Immunology and Innate Immunity**

1. Introduction of Immunology;

2. Cells and Tissues of the Immune Systems;

3. The development stages of Immunology

4. Features of Innate Immune Recognition;

5. Components of the Innate Immune System;

6. NK cells: General properties of NK cells; NK cell development and differentiation; NK cells in anti-viral immunity; Memory NK cells

**Section 2: Adaptive Immunity**

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

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

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

**Section 3: Specialized Immunity**

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

**Section 4: Immune Systems and Diseases**

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

2. Immunologic Tolerance and Autoimmunity: B lymphocyte tolerance, and tolerance induced by foreign protein antigens; T lymphocyte tolerance; Mechanisms of autoimmunity; Advances in immunologic tolerance and autoimmunity.

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

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

**Textbook and any related course material:**

*Cellular and Molecular Immunology, 8th Edition, Edited by Abul K .Abbas, Andrew H. Lichtman,*

*and Shiv Pillai*

*Fundamental Immunology, 7th Edition, Edited by Paul, William E.*

*Principles of Virology, 3rd Edition, Edited by S.J. Flint, L.W. Enquist, V.R. Racaniello, A.M. Skala*

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

*Cell Biology: strong*

*Immunology: basic*

*Virology: basic*

**Course title**

**Model Animals in Developmental Biology**

**Instructor:**

*Prof. YUAN Li*

**Course description:**

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

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

**Course type:**

*Lecture, mini-seminar, discussions*

**Notes:**

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

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

**Grading information:**

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

*Homework assignments: 20%*

*Discussion questions: 20%*

*Attendance: 10%*

*Final open-book examination: 50%*

**Schedule of the course**

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| |  |  | | --- | --- | | Chapter | Content | | 1 | Introduction to model animals in developmental biology | | 2 | Studying developmental biology – tools and techniques | | 3 | Introducing animal embryonic development | | 4 | Cell-cell communication in development | | 5 | Germ cells, fertilization and sex determination | | 6 | Early *Drosophila* development and genes that pattern the *Drosophila* body plan | | 7 | Early amphibian development | | 8 | Early zebrafish development | | 9 | Early development in chickens | | 10 | Early mammalian development | | 11 | Early development in *C. elegans* | | 12 | Development of the nervous system  Section 1: The Emergence of the Ectoderm: central nervous system and epidermis  Section 2: The neural crest cells and axonal specificity | | 13 | Organogenesis:  (1) Paraxial mesoderm: somitogenesis  (2) Intermediate mesoderm: the urogenital system | |  | Repetition;  Open-book examination | | Total |  | |

**Course title**

**Plant Physiology and Developmental Biology**

**Instructor(s)-in-charge:**

*Prof.* CHENG Youfa

**Course type:**

*Lecture, mini-seminar, discussions*

**Catalog Description:**

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

*It will cover the following topics:*

**Schedule of the course**

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

**Course title**

**Environmental and Natural Resource Economics**

**Instructor(s)-in-charge:**

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

**Course type:**

*Lecture*

**Course Schedule:**

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

**Catalog Description:**

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

**Schedule of the course**

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| |  |  | | --- | --- | | Section | Content | | 1 | **The Economic Approach**  1.1 The Human–Environment Relationship:  -the role of economics;  -studying human behavior in a laboratory;  -the environment as an asset.  1.2 Environmental Problems and Economic Efficiency:  -property rights and efficient market allocation;  -improperly designed property rights systems;  -the pursuit of efficiency.  1.3 Externalities as a Source of Market Failure:  -public goods;  -imperfect market structures;  -government failure;  -an efficient role for government. | | 2 | **Evaluating Trade-Offs**  2.1 Normative Criteria for Decision Making:  -pollution control;  -preservation *versus* development;  -issues in benefit estimation.  2.2 Approaches to Cost Estimation:  -the Treatment of Risk;  -distribution of benefits and costs;  -choosing the discount rate;  -divergence of social and private discount rates;  -cost-effectiveness analysis;  -impact analysis.  2.3 Valuing the Environment:  -identification of types of values of environment;  -classification of valuation methods;  -preference based models (stated preference, revealed preference, travel cost, hedonic property and wage, averting expenditure).  2.4 GIS based modeling works:  -examples and practices. | | 3 | **Dynamic Efficiency and Sustainable Development**  3.1 Efficiency vs Equality:  -a two-period model;  -defining intertemporal fairness;  -efficient allocations and sustainability criterion.  3.2 Sustainable Development:  -market allocations;  -efficiency and sustainability;  -trade and environment.  3.3 Environmental Policy for Sustainable Development:  -implications for environmental policy;  -depletable resource allocation;  -efficient intertemporal allocation;  -market allocation of depletable resource. | | 4 | Student presentations and discussions | | 5 | **Replenishable but Depletable Resources: Water**  5.1 The Potential for Water Scarcity:  -the efficient allocation of scarce water;  -water transfers;  -water markets;  -water prices;  -GIS and water resource.  5.2 Watershed based efficiency and cost-effectiveness:  -nature of water pollution problem;  -water pollution control.  5.3 Mini-seminars:  -group discussions | | 6 | **A Locationally Fixed, Multipurpose Resource: Land**  6.1 The Economics of Land Allocation:  -land use;  -land use conversion;  -examples and practices.  6.2 Efficiency of land use:  -sources of inefficient use and conversion;  -innovative market-based policy remedies;  -establishing property rights;  -transferable development rights.  6.3 Mini-seminars:  -group discussion. | | 7 | **Reproducible Private Property Resource: Agriculture and Food Security**  7.1 Global Scarcity and food security:  -outlook for the future;  -the role of agricultural policies;  -distribution of food resource.  7.2 Climate changes and food security:  -feast and famine cycles;  -examples and summary,  7.3 Mini-seminars:  -group discussion. | | 8 | Student presentations and discussions | | 9 | **Land Storable, Renewable Resources: Forests**  9.1 Sources of Inefficiency:  -perverse incentives for the landowner and nations;  -poverty and debt;  -sustainable forestry.  9.2 Public Policy:  -carbon sequestration credits;  -REDD.  9.3 Mini-seminars:  -group discussion. | | 10 | **Economics of Pollution Control**  10.1 The Efficient Allocation of pollution:  -a pollutant taxonomy;  -market allocation of pollution;  -efficient policy responses.  10.2 Policy Analysis:  -cost-effective policies for uniformly mixed fund pollutants:  -cost-effective policies for nonuniformly mixed surface pollutants:  -responses to changes in the regulatory environment;  -price volatility;  -instrument choice under uncertainty;  -product charges as an indirect form of environmental taxation.  10.3 Air Pollutions:  -conventional pollutants;  -cost-effectiveness of the command-and-control approach;  -innovative approaches;  -regional pollutants.  10.4 Mini-seminars:  -group discussion. | | 11 | Student presentations and discussions | | 12 | **Course conclusion and discussion** | | 13 | **Final Exam** | | Total |  | |

**Course title**

**Overview of Climate Change Sciences**

**Instructor(s)-in-charge:**

*Prof. KANG Shichang et al.*

**Course type:**

*Lecture*

**Grading Policy:**

*Part one: Attendance (20%)*

*Part two: Presentation (30%)*

*Part three: Final Exam (50%)*

**Catalog Description:**

*Climate Change Science 2020 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**

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| |  |  |  |  | | --- | --- | --- | --- | | Section | Content | hours | Type | | 1 | **Overview of Climate Change**  1.1 Weather, climate and climate System  1.2 What has hanged  1.3 Why has it changed  1.4 How will it change | 6 | Offline  &  Online | | 2 | **Paleo-climate Change**  2.1 Glacial and interglacial cycle  2.2 Holocene  2.3 Past 2000 yeas  2.4 Anthropocene | 6 | Offline  &  Online | | 3 | **Changes in Atmospheric Composition**  3.1 Aerosols and precursors  3.2 Short lived gases  3.3 Well mixed greenhouse gases  3.4 Toxic species | 6 | Offline  &  Online | |  | **Presentation and Discussion** | 3 | Online | | 4 | **Changes in Climate Extremes**  4.1 Temperature extremes  4.2 Precipitation extremes  4.3 Tropical storms | 3 | Offline  &  Online | | 5 | **Changes in Atmospheric Circulation**  5.1 Global atmospheric circulation  5.2 Stratospheric circulation  5.3 Mid to high latitude circulation (jets)  5.4 Tropical circulation (Hadly cycle, ENSO)  5.6 Monsoon system  5.7 Climate pattern | 6 | Offline  &  Online | | 6 | **Changes in the Cryosphere**  6.1 Glacier  6.2 Ice sheet  6.3 Permafrost  6.4 Seasonal snow  6.5 Sea ice  6.6 Other ice | 3 | Offline  &  Online | |  | **Presentation and Discussion** | 3 | Online | | 7 | **Changes in Hydrological Cycle**  7.1 Precipitation  7.2 Streamflow and runoff  7.3 Evapotranspiration including Pan Evaporation  7.4 Surface and tropospheric humidity  7.5 Clouds | 6 | Offline  &  Online | | 8 | **Modeling Climate Change and Prediction**  8.1 Aerosol and clouds  8.2 Anthropogenic and natural radiative forcing  8.3 Detection and attribution of climate change  8.4 CMIP5  8.5 Regional climate model  8.6 Climate change prediction | 6 | Offline  &  Online | | 9 | **Impacts,** **Vulnerability of Climate Change**  9.1 Assessment methods of impacts and vulnerability  9.2 Major fields of impacts and vulnerability  9.3 Major regions of impacts and vulnerability  9.4 Resilience in response to climate change | 3 | Offline  &  Online | | 10 | **Mitigation and Adaptation of Climate Change**  10.1 Mitigation approaches  10.2 International policies for mitigation  10.3 Adaptation under sustainable development | 3 | Offline  &  Online | | 12 | **Presentation and Discussion** | 6 | Online | | Total |  | 60 |  | |

**Course title**

**Earth System Science Part I-Introduction to Remote Sensing**

**Instructor(s)-in-charge:**

*Prof. Fang Chen*

**Course type:**

*Lecture*

**Course Schedule:**

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

*September 14, 2020 September 21, 2020 September 28, 2020*

*October 12, 2020 October 19, 2020 October 26, 2020*

*November 2, 2020 November 9, 2020*

**Course Assessment:**

*Homework: 2 assignments*

**Grading Policy:**

*The grading for this course will be based on:*

*- Participation (30% of grade)*

*- Assignments (30% of grade)*

*-Short presentation (20% of grade)*

*-Comprehensive final exam (20% of grade)*

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

**Course Prerequisites:**

*This course does not have any pre-requisites.*

**Catalog Description:**

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

*Writing Assignments*

1. *Assignment-1-- Write a short (3-4 page) paper on* ***a topic of your understanding of remote sensing*** *related to the class subject matter. DUE in class, October 12.*
2. *Assignment-2-- Write a short (3-4 page) paper on the topic of* ***the use of remote sensing for disaster management****. DUE in class, November 9.*

**Keys to Success:**

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

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

**Schedule of the course**

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

**Textbook and any related course material:**

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

**Essay Template**

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

**First Author1,2 (10pt bold centered)**

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

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

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

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

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

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

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

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

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

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

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

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

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

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| Test Table | Column 1 | Column 2 | Column 3 | Column 4 |
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**Figure 1** Two photos of polar bears. Left: Figure explanation; Right: Figure explanation (9pt)

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

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

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

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

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

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

**6. SUBMISSION OF ESSAY**

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

Surname Firstname (You Student ID).doc

***Acknowledgements:*** *(9pt italics)*

*I thank all …*

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

Bougeault, P., P, Binder, A. Buzzi, R. Dirks, R. Houze, J. Kuettner, R. B. Smith, R. Steinacker, and H. Volkert, 2001: the

MAP Special Observing Period. *Bull. Amer. Meteorol. Soc.* **82**, 433-462.

Schwitalla, T., G. Zangl, H. S. Bauer, and V. Wulfineyer, 2007: Convective initiation in the Black Forest region in high-

resolution MM5 simulations. *Proc. 29th Intern. Conf. on Alpine Meterology*, Chambery, France, 261-264.

**Course title**

**Earth System Science Part II-Earth System Dynamics**

**Instructor(s)-in-charge:**

*Prof. JIA Gensuo*

**Course type:**

*Lecture*

**Course Schedule:**

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

**Course Assessment:**

*Homework: 4 assignments*

**Grading Policy:**

*The grading for this course will be based on:*

*- Participation (30% of grade)*

*- Assignments (40% of grade)*

*-Comprehensive final exam (30% of grade)*

**Course Prerequisites:**

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

**Catalog Description:**

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

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  | | --- | --- | --- | --- | | section | content | hours | Date | | 1 | Spatial patterns and temporal variability of the Earth system (1) | 3 | November 16 | | 2 | Spatial patterns and temporal variability of the Earth system (2) | 3 | November 23 | | 3 | Heterogeneity and connectivity of the Earth system | 3 | November 30 | | 4 | Human dominated changes in global environment | 3 | December 7 | | 5 | Land surface and terrestrial ecosystem processes | 3 | December 14 | | 6 | Interactive changes of land-use, ecosystem, and climate | 3 | December 21 | | 7 | Disaster risks under changing climate | 3 | December 28 | | 8 | Earth observation of global environmental change | 3 | January 4 | | 9 | Science-policy forum: towards a sustainable Earth system | 3 | January 11 | | total |  | 27 |  | |

**Textbook and any related course material:**

*Steffen, W., A. Sanderson. P.D. Tyson, et al. 2004*

*Global Change and the Earth System*

*Springer. 336 pp*

*Shugart, H.H. and F.I. Woodward. 2011.*

*Global Change and the Terrestrial Biosphere: Achievements and Challenges,*

*Wiley-Blackwell Press, Oxford. 242 pp*

*Relevant science journals:*

[*http://jiong.tea.ac.cn/Journals.html*](http://jiong.tea.ac.cn/Journals.html)

[*Global and Planetary Change*](http://www.sciencedirect.com/science/journal/09218181)*, 0921-8181*

[*Global Change Biology*](http://www.blackwell-synergy.com/servlet/useragent?func=showIssues&code=gcb)*, 1354-1013*

[*Global Ecology and Biogeography*](http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291466-8238/issues)*, 0960-7447*

[*Global Environmental Change - Human and Policy Dimensions*](http://www.sciencedirect.com/science/journal/09593780)*, 0959-3780*

**Course title**

**Introduction to Geodynamics**

**Instructor(s)-in-charge:**

*Prof. WANG Shimin*

**Course type:**

*Lecture*

**Course Schedule:**

*6 hrs/week by instructor.*

**Course Assignments:**

*Homework: 9 assignments*

**Grading Policy:**

*10% class attendance, 50% 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**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  | | --- | --- | --- | --- | | section | content | hours | Week | | 1 | Plate tectonics | 12 | 7,8 | | 2 | Stress and strain in solids | 6 | 9 | | 3 | Elasticity and flexure | 6 | 10 | | 4 | Heat transfer | 12 | 11,12 | | 5 | Gravity | 6 | 13 | | 6 | Fluid mechanics | 12 | 14,15 | | 7 | Rock rheology | 6 | 16 | | 8 | Faulting | 6 | 17 | | 9 | Flows in porous media | 6 | 18 | | total |  | 72 |  | |

**Contents of the course**

**Section 1: Plate tectonics**

1. Origin of the theory of plate tectonics
2. Types of plate boundary
3. Plate motion models
4. Comparative Planetology

**Section 2: Stress and strain in solids**

1. Concepts of stress and strain
2. Measurements of crustal stress and strain

**Section 3: Elasticity and flexure**

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

**Section 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

**Section 5: Gravity**

1. Fundamentals of gravity
2. Gravity anomalies

**Section 6: Fluid mechanics**

1. Solutions to simple fluid flow problems and applications in geosciences
2. Stokes flows and mantle plume modeling
3. Thermal convection
4. Simple models for mantle convection

**Section 7: Rock rheology**

1. Microscopic mechanisms for rock rheology
2. Rock viscosity
3. Rock viscoelasticity and plasticity

**Section 8: Faulting**

1. Types of faulting
2. Frictional laws for faulting
3. Fault elastic rebound and earthquake
4. Solutions to simple faulting problems

**Section 9: Flows in porous media**

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

**Textbook:**

*Geodynamics, D.L. Turcotte & J. Schubert, 3rd Edition, Cambridge University Press, 2014.*

**Course title**

**Materials Production and Environmental Sciences**

**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**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  | | --- | --- | | 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**

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| |  |  | | --- | --- | | section | content | | 1 | Mole balances and conversion | | 2 | Rate laws | | 3 | Preliminary Reactor design | | 4 | Distribution of residence time | | 5 | Gas-solid Fluidized Bed---A General Review | | 6 | General introduce of powder/granular assembly | | 7 | particle characterization and fluid (particle)-particle interaction | | 8 | Dense Fluidization 1 | | 9 | Dense fluidization 2 | | 10 | CFB & Design Criteria | | 11 | Mass and heat transfer | | 12 | Application of Fluidization Bed Reactors | | 13 | Numerical simulations of multiphase reactors 1 | | 14 | Numerical simulations of multiphase reactors 2 | | total |  | |

**Textbook and any related course material:**

Fogler H. Scott, Elements of Chemical Reaction Engineering (Fourth edition), 2006

Fan Liang-Shi, Zhu Chao, Principles of gas-solid flows, 1998

Kunii, D., Levenspiel, O. Fluidization Engineering. Butterworth-Heinemann. 1991.

Davidson, J. F., Harrison, D. Fluidization. Academic Press. 1971.

Kwauk, M. Fast Fluidization. Advances in Chemical Engineering Vol. 20., Academic Press. 1994.

Grace, J. et al. Fluidized Beds. Multiphase Flow Handbook. Taylor & Francis. 2006.

Some materials are selected and cited from latest journal papers.

**Course title**

**Environmental Chemistry**

**Instructor(s)-in-charge:**

*Prof. TIAN Zhen-Yu*

**Course type:**

*Lecture*

**Course Schedule:**

*Listed in the table below.*

**Course Assessment:**

*Homework: 10 assignments*

**Grading Policy:**

*Assignments 40%, Final 40%, Attendance 20%*

**Course Prerequisites:**

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

**Catalog Description:**

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

**Schedule of the course**

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

**Contents of the course**

**Section 1: Environmental Science, technology and chemistry**

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

**Section 2: Environmental chemical analysis**

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

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

**Contents of the course**

**Section 1: Diagnostic technologies**

1. Introduction of the diagnostic technologies

2. Classical methods

3. Spectrophotometric methods

4. Electrochemical methods of analysis

5. Chromatography

6. Mass spectrometry

**Section 2: Applications in homogeneous and heterogeneous systems**

7. Gas-phase reactions

8. Liquid-phase reactions

9. Surface reactions

10. Coupling with theoretical calculations

11. Comparison with modeling results

**Textbook and any related course material:**

*1) Robert J. Cotter, Time of flight mass spectrometry, Washington, DC, 1993.*

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

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

*Chemistry: college chemistry*

**Course title**

**Geographic Information Systems**

**Instructor(s)-in-charge:**

*Prof. ZHOU Xiang et al.*

**Course type:**

*Lecture*

**Course Schedule:**

*3hrs/week by instructor*

**Course Assessment:**

*Homework: 3 assignments*

**Grading Policy:**

*Typically 50% homework, 50% final.*

**Course Prerequisites:**

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

**Catalog Description:**

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

**Schedule of the course**

| Hours | Section | Content |
| --- | --- | --- |
| 3 | An Introduction to GIS | **Keys：**  1. What is GIS  2. Contents of GIS  3.Applications of GIS  referPPT: PPT\1 - An Introduction to GIS.pdf  **Hand-onTasks：**  1、Introduction to ArcCatalog  2、Introduction to ArcMap  referhand-on\lab1\_instructions.pdf |
| 3 | Coordinate Systems | **Keys：**  1. Geographic Coordinate System  2. Map Projection and Commonly Used Projections  3.Projected Coordinate Systems  4.Options for Coordinate Systems in GIS  referPPT: PPT\3 - Geodesy, Datums, Map Projections and Coordinate Systems.pdf  **Hand-onTasks：**  1.Project from a Geographic to a Projected Coordinate System  2 Import a Coordinate System  3.Projet Using a Predefined Coordinate System  referhand-on\lab3\_instructions.pdf |
| 3 | Geo-data Organization (vector) | **Keys：**  **Vector:**  1. Representation of Spatial Features: point\line\polygon  2. Georelational Data Model:Coverage\Shape  3. Object-Based Data Model: Geodatabase  referPPT: PPT\2 - Data Models.pdf; PPT\lecture1.pdf; PPT\lecture4.pptx ; PPT\struct.ppt  **Hand-onTasks：**  1.Examine and view the Data File Structure of Coverage and Shape  2 Create File Geodatabase, Feature Dateset and Feature Class  3. Convection between shape/coverage and Geodatabase  referhand-on\lab2\_instructions.pdf |
| 3 | Geo-data Organization ( raster) | **Keys：**  **Raster:**  1.Elements of the Raster Data Model  2.Satellite Images,DEM and Other Types of Raster Data  3.Data Conversion and Integration  referPPT: PPT\2 - Data Models.pdf; PPT\lecture1.pdf; PPT\lecture4.pptx ; PPT\struct.ppt  **Hand-onTasks：**  1.View a satellite Image and view a Land Cover Image  2.Convert Vector Data to Raster Data  referhand-on\lab2\_instructions.pdf |
| 3 | Spatial Data Acquisition | **Keys：**  1. Existing GIS Data  2. Conversion of Existing Data  3.Creating of New Data  referPPT:  **Hand-onTasks：**  1.Download RS data  2.Digitize on Screen  3.Add XY Data  4.Kmz Files and Display in Google Earth  referhand-on\chapter\_6.pdf |
| 3 | Geometric Transformation | **Keys：**  1. Geometric Transformation  2. Root Mean Square (RMS) Error  3. Interpretation of RMS Errors on Digitized  Maps  4. Resampling of Pixel Values  referPPT:  **Hand-onTasks：**  1.Georeference and Rectify a Scanned Map  2. Perform Image to Map Transformation |
| 3 | Attribute Data Management | **Keys：**  1. Attribute Data in GIS  2. Joint, Relates and Relationship Classes  3. Manipulation of Fields and Attribute Data  referPPT: PPT\8 - Attribute Data and Tables.pdf PPT\4 - Maps, Data Entry, Editing, and Output.pdf  **Hand-onTasks：**  1. Use Validation Rule for Entering Attribute Data  2. Join Tables\ Relate Tables  3. Create New Attribute by Data Classification  4. Create New Attribute by Data Computation  referhand-on\lab8\_instructions.pdf |
| 3 | Cartography and GIS Mapping | **Keys：**  1.Cartographic Representation  2.Types of Quantitative maps  3.Map Design  4.Map Production  referPPT: PPT\8 - Attribute Data and Tables.pdf PPT\4 - Maps, Data Entry, Editing, and Output.pdf  **Hand-onTasks：**  1. Make a Choropleth Map  2. Use Graduated Symbols, Line Symbols, Highway Shield Symbols, and Text Symbols  referhand-on\lab8\_instructions.pdf |
| 3 | Data Exploration | **Keys：**  1.Data Exploration  2.Map-Based Data Manipulation  3.Attribute Data Query  4. Spatial Data Query  5.Raster Data Query  **Hand-onTasks：**  1. Select Features by Location  2. Make Dynamic Chart  3. Query Attribute Data from a Joint Table  4. Query Attribute Data from a Relational Database  5. Combine Spatial and Attribute Data Queries  6.Perform Spatial Join  7. Query Raster Data |
| 3 | Vector Data Analysis | **Keys：**  1.Buffering  2.Overlay  3.Distance Measurement  4.Pattern Analysis  5.Feature Manipulation  **Hand-onTasks：**  1.Perform Buffering and Overlay  2.Overlay Multicomponent Polygons  3.Perform Areal Interpolation  4.Compute General and Local G-Statistics  5.Perform Select and Clip  6.Perform Dissolve |
| 3 | Raster Data Analysis | **Keys：**  1 Data Analysis Environment  2 Local Operations  3 Neighborhood Operations  4 Zonal Operations  5 Physical Distance Measure Operations  6 Other Raster Data Operations  7 Map Algebra  8 Comparison of Vector- and Raster-Based Data Analysis  **Hand-onTasks：**  1. Perform a Local Operation  2. Perform a Combine Operation  3. Perform a Neighborhood Operation  4. Perform a Zonal Operation  5. Measure Physical Distances  6. Perform Extract by Attributes and by Mask  7.Run Map Algebra |
| 3 | Terrain | **Keys：**  1 Data for Terrain Mapping and Analysis  2 Terrain Mapping  3 Slope and Aspect  4 Surface Curvature  5 Raster Versus TIN  refer：PPT\11 - Terrain Analysis.pdf  **Hand-onTasks：**  1. Use DEM for Terrain Mapping  2. Derive Slope, Aspect,and Curvature from DEM  3.Build and Display a TIN  4. Convert LiDAR Data to Raster |
| 3 | Viewshed and Watershed Analysis | **Keys：**  1. Viewshed Analysis  2.Parameters of Viewshed Analysis  3.Applications of Viewshed Analysis  4.Watershed Analysis  5.Applications of Watershed Analysis  refer：PPT\11 - Terrain Analysis.pdf  **Hand-onTasks：**  1.Perform Viewshed Analysis  2.Create a New Lookout Shapefile for Viewshed Analysis  3.Delineate Areawide Watersheds |
| 3 | Spatial Interpolation | **Keys：**  1.Elements of Spatial Interpolation  2.Global Methods  3.Local Methods  4.Kriging  5.Comparison of Spatial Interpolation Methods  refer：PPT\12 - Spatial Estimation Interpolation Prediction and Core Area Delineation.pdf  **Hand-onTasks：**  1. Use Trend Surface Model for Interpolation  2.Compute Kernel Density Estimation  3.Use IDW for Interpolation  4.Use Ordinary Kriging for Interpolation  5.Use Universal Kriging for Interpolation |
| 3 | Least Cost Path and Network Analysis | **Keys：**  1.Least-Cost Path Analysis  2.Applications of Least-Cost Path Analysis  3.Network  4.Assembly of a Network  5.Network Analysis  **Hand-onTasks：**  1.Compute the Least Accumulative Cost Distance  2. Compute the Path Distance  3.Run Shortest Path Analysis  4.Build a Geodatabase Network Dataset  5.Find Closest Facility  6.Find Service Area |
| 3 | GIS Models and Modeling | **Keys：**  1.Basic Elements of GIS Modeling  2.Binary Models  3.Index Models  4.Regression Models  5.Process Models  refer：PPT\13 - Spatial Models and Modeling.pdf  **Hand-onTasks：**  1.Build a Vector-Based Binary Model  2.Build a Raster-Based Binary Model  3.Build a Vector-Based Index Model  4.Build a Raster-Based Index Model |

**Textbook and any related course material:**

*Introduction to Geographic Information Systems, 8th Edition, 2016*

*Edited by Kang-tsung Chang.*

*Geospatial Analysis: a comprehensive guide to principles, techniques and software tools, 6th Edition, 2018*

[*http://www.spatialanalysisonline.com/HTML/index.html*](http://www.spatialanalysisonline.com/HTML/index.html)

*Edited by Michael J de Smith, Michael F Goodchild, Paul A longley*

*Geospatial Analysis: a comprehensive guide to principles, techniques and software tools), 3rd Edition, 2007*

*Edited by Michael J de Smith, Michael F Goodchild, Paul A longley*

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

*Geosciences: strong*

*Computer Sciences: middle*

**Invitation ID\_UCAS\_GIS(Prof. Xiang Zhou)\_Week1**

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

Topic: **UCAS\_GIS(Prof. Xiang Zhou)\_Week1**

Time: **Sep 18, 2020 13:00** **Beijing(UTC+8)**

<Zoom Software test: from 13:00 to 13:30 >

Join Zoom Meeting

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

Meeting ID: **771 603 9997**

Passcode: **106367**

One tap mobile

+13462487799,,7716039997#,,,,,,0#,,106367# US (Houston)

+14086380968,,7716039997#,,,,,,0#,,106367# US (San Jose)

Dial by your location

+1 346 248 7799 US (Houston)

+1 408 638 0968 US (San Jose)

+1 646 876 9923 US (New York)

+1 669 900 6833 US (San Jose)

+1 8186657236(Voxbone) US (Los Angeles)

+1 253 215 8782 US (Tacoma)

+1 301 715 8592 US (Germantown)

+1 312 626 6799 US (Chicago)

Meeting ID: 771 603 9997

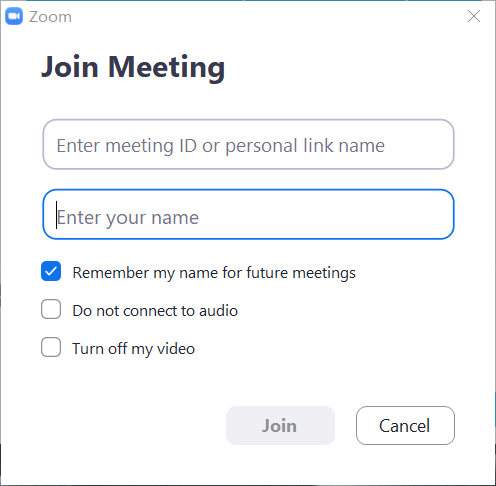
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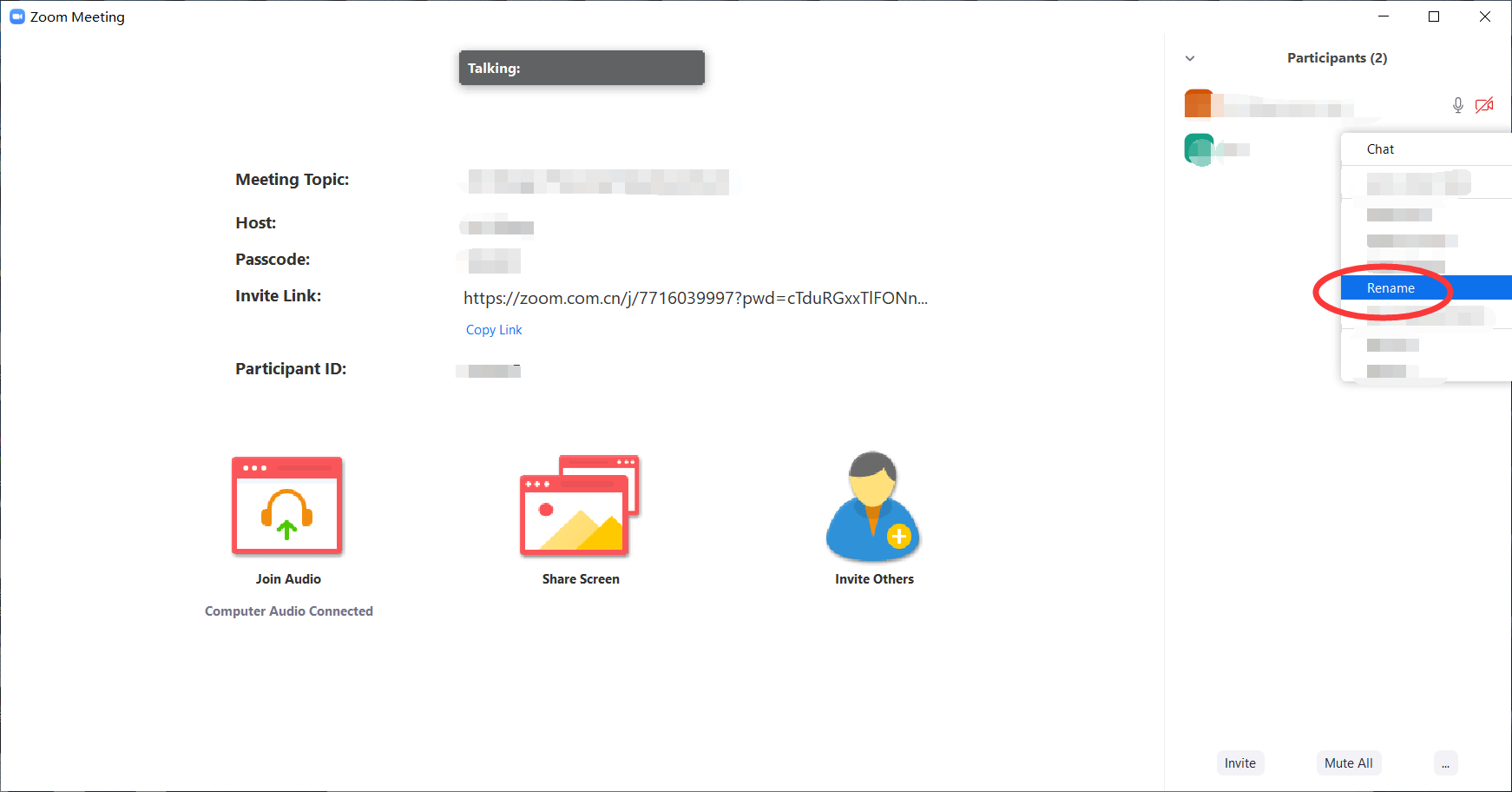
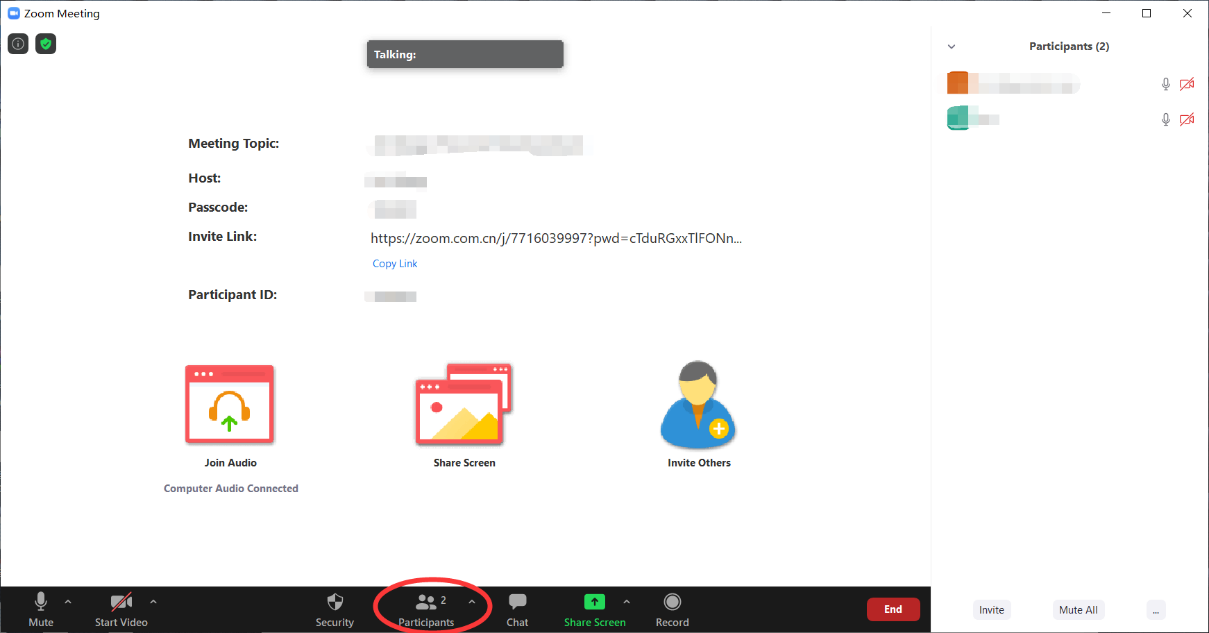
Find your local number: <https://zoom.com.cn/u/ibdOCLZAH2>

Please fill in your real name, when you are **[Joining a meeting]**;

Or use **[Participants]🡪 [Rename]** to give your real name.

So that the teacher can count your class attendance.





For **every week's online class**, we need a screenshot with all the students' faces on.

Please **[Start Video]** for a few seconds, when the teacher asks you to do that.

Enjoy your online class time and good luck for you!

**Course title**

**Data Science**

**Instructor(s)-in-charge:**

*Prof.* Tiejian Luo

**Course type:**

*Lecture, 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**

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| |  |  |  | | --- | --- | --- | | 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](https://web.stanford.edu/class/cs224w/)

Cornell University：[The Structure of Information Networks, Jon Kleinberg](http://www.cs.cornell.edu/Courses/cs6850/2008fa/)

University of Southern California：[Structure and Dynamics of Networked Information, David Kempe](http://david-kempe.com/)

University of Helsinki：[Information Networks, Panayiotis Tsaparas](http://www.cs.helsinki.fi/u/tsaparas/InformationNetworks/)

**Course title**

**Advanced 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**

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| |  |  |  | | --- | --- | --- | | 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**

**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**

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| |  |  |  | | --- | --- | --- | | chapter | content | hours | | 1-2 | Remote Sensing overview  Introduction to ENVI | 4 | | 3-4 | Image Display and Management  Coordinate Systems | 4 | | 5-6 | Image Subset  Image Registration | 4 | | 7-8 | Image Geometric Correction  Image Mosaicking | 4 | |  | Homework 1 |  | | 9-10 | Image Registration Workflow  Image Orthorectification | 4 | | 11-12 | Band Math  Image Fusion | 4 | | 13-14 | Image Supervised Classification  Image Unsupervised Classification | 4 | | 15-16 | Image Classification with Decision Tree Classifier  Post Classification | 4 | |  | Homework 2 |  | | 17-18 | Radiometric Calibration  Atmospheric Correction | 4 | | 19-20 | Vegetation Analysis  Spectral Analysis | 4 | | 21-22 | Terrain Analysis and Visualization DEM extraction of Stereo Tie Points | 4 | | 23-24 | Spatial Change Analysis  Temporal Change Analysis | 4 | |  | Homework 3 |  | |  | Exam | 4 | | Total |  | 52 | |

**Contents of the course**

**Section 1: The Basic Operation of Image**

1 Remote Sensing overview

2 Introduction to ENVI

3 Image Display and Management

4 Coordinate Systems

5 Image Subset

**Section 2: Image Registration and Geometric Correction**

6 Image Registration

7 Image Geometric Correction

8 Image Mosaicking

9 Image Registration Workflow

10 Image Orthorectification

**Section 3: Band Math and Image Fusion**

11 Band Math

12 Image Fusion

**Section 4: Image Classification**

13 Image Supervised Classification

14 Image Unsupervised Classification

15 Image Classification with Decision Tree Classifier

16 Post Classification

**Section 5:** Radiometric Correction

17 Radiometric Calibration

18 Atmospheric Correction

**Section 6: Vegetation Analysis and Spectral Analysis**

19 Vegetation Analysis

20 Spectral Analysis

**Section7: Terrain Analysis**

21 Terrain Analysis and Visualization

22 DEM extraction of Stereo Tie Points

**Section8:** Remote Sensing Dynamic Monitoring

23 Spatial Change Analysis

24 Temporal Change Analysis

**Textbook and any related course material:**

*Introduction to ENVI Analytics, Revised for Print January, 2016*

*ENVI User’s Guide*

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

*Remote Sensing: strong*

*Geosciences: middle*

*Computer Sciences: middle*

**Course title**

**Fundamentals and Frontier of Materials Science**

**Instructor(s)-in-charge:**

*Prof. Zhang, Guangjin,*

*Prof. Han Yongsheng*

*Prof. Yang Jun*

**Course type:**

*Lecture*

**Course Assessment:**

*Homework: 10 assignments, presentations*

**Grading Policy:**

*Assignments 40%, Final 40%, Attendance 20%*

**Course Prerequisites:**

*The basic knowledge of materials science, chemistry, crystallization.*

**Catalog Description:**

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

**Schedule of the course**

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

**Course title**

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

**Instructor(s)-in-charge:**

*Dr. LUO CUI CUI*

**Course type:**

*Lecture*

**Course Schedule:**

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

**Course Assessment:**

*Homework: 2 assignments, 1 final project*

**Grading Policy:**

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

**Course Prerequisites:**

*Calculus, Linear Algebra, Probability and Statistics*

**Catalog Description:**

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

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

**Contents of the course**

**Section 1: Introduction to MATLAB and Basic Data Types**

1. Introduction to MATLAB
2. Basic data types and operators

**Section 2: Plotting with MATLAB**

1. Plotting with MATLAB
2. Data Interpolation

**Section 3: Introduction to programming in MATLAB**

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

**Section 4: Simulations and Optimization**

1. Simulations
2. Linear programming
3. Quadratic programming

**Section 5: MATLAB Applications to Statistics**

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

**Section 6: MATLAB Applications to Finance**

1. Weiner processes, stochastic 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/*](https://www.mathworks.com/help/)

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

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

*Mathematics: moderate*

*Statisticss: moderate*

**Course title**

**Scientific Writing**

**Objectives**

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

**Main Contents**

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

**Teaching Approaches**

*Class instruction*

**Textbooks and Reference Books**

*1. Grace Canseco. Inside Academic Writing: Understanding Audience and Becoming Part of an Academic Community, Ann Arbor University of Michigan Press, 2010.*

*2. Robert A. Day and Barbara Gastel. How to Write and Publish a Scientific Paper (Sixth Edition), Peking University Press, 2012.*

*3. John M. Swales and Christine B. Feak. Academic Writing for Graduate Students: Essential Tasks and Skills (3rd Edition), University of Michigan Press, 2012.*

**Course title**

**Public Speaking**

**Instructor(s)-in-charge:**

*Associate Prof. Meng Yanli*

**Course type:**

*Lecture and seminar combined*

**Course Schedule:**

*3hrs/week by instructor*

**Course Assessment:**

*Assignment and public speeches made by students*

**Grading Policy:**

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

**Course Prerequisites:**

*no*

**Catalog Description:**

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

**Schedule of the course**

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| |  |  |  |  | | --- | --- | --- | --- | | Session | Content | Hours | Date | | 1 | Introduction to public speaking | 3 | 9.29 | | 2 | Delivering the speech  Preparing for your first speech | 3 | 10.6 | | 3 | Introductory speech presentation  Comments and discussion | 3 | 10.13 | | 4 | Selecting a topic and a purpose | 3 | 10.20 | | 5 | Analyzing the audience |  | 10.27 | | 6 | Supporting your ideas | 3 | 11.3 | | 7 | Outlining the speech  Organizing the body of the speech | 3 | 11.10 | | 8 | Beginning and ending the speech | 3 | 11.17 | | 9 | Using language | 3 | 11.24 | | 10 | Using visual aids, Speaking to inform | 3 | 12.1 | | 11 | Presentation of informative speeches | 3 | 12.8 | | 12 | Speaking to persuade | 3 | 12.15 | | 13 | Presentation of persuasive speeches | 3 | 12.22 | | total |  | 39 | 13 weeks | |

**Contents of the course**

**Session 1: Overview of public speaking**

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

**Session 2: Delivering the speech**

1. Principles of effective speech delivery

2. Sample analysis and practice students’ delivery skills

**Session 3: Introductory speech presentation**

1. Students’ presentation of introductory speeches

2. Comments and discussion

**Session 4: Selecting a topic and a purpose**

1. Selecting a topic

2. Determine general purpose, specific purpose

3. Phrase the central idea

**Session 5: Analyzing the audience**

1. What is audience-centredness?

2. Factors in audience analysis

3. Exercise and sample analysis

**Session 6: Supporting your ideas**

1. Types of supporting materials

2. Tips in using supporting materials in a speech

3. Exercise and sample analysis

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

1. Outlining the speech

1.1 Drafting a speech outline for your manuscript

1.2 Drafting a speaking outline for your delivery

1.3 Exercise and sample analysis

2. Organizing the body of the speech

2.1 The concept of strategic structure

2.2 Methods of organization

2.3 Use of connectives to smooth the progression of ideas

2.4 Exercise and sample analysis

**Session 8: Beginning and ending the speech**

1 The four objectives of an effective speech introduction

2 Tips for creating an effective speech introduction

3 The two objectives of an effective speech conclusion

4 Tips for creating an effective speech conclusion

5 Exercise and sample analysis

**Session 9: Using language**

1 Criteria of using English in public speaking

2 Rhetorical devices and exercises

3 Sample analysis

**Session 10 Using visual aids, Speaking to inform**

1. Using visual aids

1.1 Types of visual aids

1.2 Tips of creating and presenting visual aids

1.3 Exercise and sample analysis

2. Speaking to inform

2.1. Types of informative speeches

2.2 Tips for informatie speaking

2.3 Exercise and sample analysis

**Session 11: Presentation of informative speeches**

1. Students’ presentation of informative speeches

2. Comments and discussion

**Session 12: Speaking to persuade**

1.Methods of persuasion

2. Tips for persuasive speaking

3. Exercise and sample analysis

**Session 13: Presentation of persuasive speeches**

1. Students’ presentation of persuasive speeches

2. Comments and discussion

**Textbook and any related course material:**

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

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

*English language: strong*

**Course title**

**Advanced Physical/Chemical Water Treatment**

**Instructor(s)-in-charge:**

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

**Course type:**

*Lecture*

**Course Schedule:**

*4hrs/week by instructor.*

**Course Assessment:**

*Homework: 5 assignments*

**Grading Policy:**

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

**Course Prerequisites:**

*General Chemistry,*

**Catalog Description:**

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

**Schedule of the course**

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

**Contents of the course**

Part 1: Water Quality

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

Part 2: Water Treatment Principles

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

Part 3: Physical Separation

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

Part 4: Physical/Chemical Treatment

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

Part 5: Disinfection products, distribution, and management

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

**Textbook and any related course material:**

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

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

*Mathematics: strong*

*Chemistry: strong*

**Course title**

**Eco-Environmental Informatics**

**Instructor(s)-in-charge:**

*Prof. TianXiang Yue et al.*

**Course type:**

*Lecture, including offline and online discussions*

**Course Schedule:**

*6hrs/week*

**Course Assessment:**

*Homework: 4 assignments*

**Grading Policy/Scores:**

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

**Course Prerequisites:**

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

**Catalog Description:**

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

**Schedule of the course**

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| |  |  |  | | --- | --- | --- | | Section | Content | Hours | | 1 | General introduction to eco-environmental informatics | 3 | | 2 | Data and information sources | 3 | | 3 | Methods and theory: fundamental theorem, scale transformation, spatial interpolation, data fusion and model-data assimilation, including lab tours for 3 hours | 15 | | 4 | Surface modelling of climatic change including lab tours for 3 hours | 15 | | 5 | Surface modelling of ecosystems and biodiversity, including lab tours for 3 hours | 12 | | 6 | Surface modelling of soil properties, including lab tours for 3 hours | 15 | |  | **Summary & final examination** | 6 | | Total |  | 69 | |

**Contents of the course**

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

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

**Section 2:** **Data and information sources** **(ZeMeng FAN)**

1. Ground observations data
2. Remote sensing data
3. Statistical data
4. Documentary data
5. Social data
6. Simulated data

**Section 3: Methods and theories (TianXiang YUE)**

1. Background
2. The fundamental theorem for eco-environmental surface modelling
3. Spatial interpolation
4. Up-scaling
5. Down-scaling
6. Data fusion
7. Model-data assimilation
8. Lab tours

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

1. Methods and models
2. Change trends and scenarios of climate variables
3. Understanding the climate events
4. Impacts of climate change on ecosystems
5. Lab tours

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

1. Change trends and scenarios of terrestrial ecosystems
2. Change trends and scenarios of land cover scenarios
3. Spatial modelling of biodiversity
4. Lab tours

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

1. Methods and models
2. Mapping soil properties combined with environmental information
3. Mapping soil compositional data
4. Mapping soil compositional data combined with environmental information
5. Lab tours

**Summary & Review** would be on December 21, 2020

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

**Textbook and any related course material:**

*Surface modelling: High accuracy and high speed methods, written by TianXiang Yue*

*Ecological informatics, edited by Friedrich Recknagel and William Michener*

*Environmental Informatics and Modeling, edited by Mikko Kolehmainen and Kostas Karatzas*

**Course title**

**Chemical Process Safety**

**Instructor(s)-in-charge:**

*Prof. YANG Ning, Associate Prof. Xiaoping Guan*

**Course type:**

*Lecture*

**Course Schedule:**

*2hrs/week by instructor. 1 hr/week by teaching assistant.*

**Course Assessment:**

*Homework: 6 assignments*

**Grading Policy:**

*Typically 60% homework, 40% final.*

**Course Prerequisites:**

*general chemistry, chemical reaction engineering*

**Catalog Description:**

*The primary objective of this course is to present the important technical fundamentals and case studies of chemical process safety, and help students to understand the concepts and apply them accordingly. The application requires a significant quantity of fundamental knowledge and technology, integrating different aspects of knowledge on chemistry, chemical engineering and fluid mechanics. This course then aims to provide the base by integrating and applying these various aspects of knowledge in chemical process safety.*

**Schedule of the course**

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

**Contents of the course**

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

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

**Section 2: Toxicology**

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

**Section 3: Industrial Hygiene**

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

**Section 4: Source Models**

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

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

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

**Section 6: Fires and Explosions**

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

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

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

**Section 8: Chemical Reactivity**

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

**Section 9: Introduction to Reliefs**

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

**Section 10: Relief Sizing**

10-1 Conventional Spring-Operated Reliefs in Liquid Service 10-2 Conventional Spring-Operated Reliefs in Vapor or Gas Service 10-3 Rupture Disc Reliefs in Liquid Service 10-4 Rupture Disc Reliefs in Vapor or Gas Service 10-5 Two-Phase Flow during Runaway Reaction Relief Simplified Nomograph Method 10-6 Pilot-Operated and Bucking-Pin Reliefs 10-7 Deflagration Venting for Dust and Vapor Explosions

**Section 11: Hazards Identification**

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

**Section 12: Risk Assessment**

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

**Section 13: Safety Procedures and Designs**

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

**Section 14: Case Histories**

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

**Textbook and any related course material:**

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

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

*Mathematics: intermediate*

*Chemistry: intermediate*

**Course title**

**Land Change Science**

**Instructor(s)-in-charge:**

*Prof. DONG Jinwei, Prof. FENG Min, Prof. CUI Huijuan, and Prof. PENG Shushi*

**Course type:**

*Lecture*

**Course Schedule:**

*8hrs/week by instructor.*

**Course Assessment:**

*Homework: 5 assignments and 1 final project*

**Grading Policy:**

*Typically 20% Attendance, 30% homework, 30% Oral Presentation, 20% final.*

**Course Prerequisites:**

*Geography, Geoinformatics, Remote Sensing*

**Catalog Description:**

*Land cover and land use change is a fundamental component of global environmental change and sustainability research, so called land change science (LCS) which is considering as an increasingly important interdisciplinary science. This course introduces the emerged land change science, including 1) observation and monitoring, 2) process and pattern, 3) causes and driving factors, and 4) consequences of land cover and land use changes from regional to global scales. The course will be organized from the four topics of LCS as following: The observation and monitoring of land use changes will introduce basics of remote sensing like widely-used sensors, and also cover the cutting-edge algorithms of land classification and the application of the planetary-scale geospatial analysis platform (e.g., Google Earth Engine); The causes of land use changes will be analyzed by considering both natural and human drivers using case studies across the world, and also using a comprehensive review of land change modeling which will help an understanding of the land change process; The process and pattern of rapid land use change in China since Reform and Opening-up will be introduced; The ecological, climate, hydrological consequences of land use changes (e.g., deforestation, afforestation, land reclamation, urbanization) from the classic and highly-cited studies will be discussed in the classes.*

**Schedule of the course**

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| |  |  |  |  | | --- | --- | --- | --- | | **section** | **content** | **hours** | **Instructor** | | 1 | **Course Introduction, Introductory Lecture**  Concepts of Land Change Science (LCS)  Current International Research Programs on LCS  State-of-the-art and perspective of LCS  Existing global land cover/use maps and their applications | 3 | Dong | | 2 | **Observation and monitoring of land change**  Introduction of cloud computing platform (Google Earth Engine)  Introduction on main sensors (GF, Landsat, MODIS) | 6 | Dong | | 3 | **Observation and monitoring of land change**  Field data collection (field photos, apps, & visual interpretation)  Accuracy Assessment | 3 | Feng | | 5 | **Observation and monitoring of land change**  Land cover classification (machine learning; phenological approach; deep learning)  Land change detection (CCDC, VCT, BFAST, LandTrendr) | 6 | Feng | | 6 | **Process and pattern of land change**  Theme I: Agricultural land use change  Theme II: Deforestation and afforestation | 3 | Dong | | 7 | **Process and pattern of land change**  Theme III: Urbanization  Theme IV: Surface water dynamics | 3 | Feng | | 8 | **Student presentation**  Literature review and topic selection for final project | 3 | Dong/Feng/Cui | | 9 | **Causes and driving factors of Land change: China and Global perspective**  Land use changes in China  Natural and human drivers of land use changes in China  Modelling land use change in China | 3 | Dong | | 10 | **Consequences of land change: Ecological perspective**  Earth greening  Effects of land change on carbon cycle | 6 | Peng | | 11 | **Consequences of land change: Climate perspective**  Land–Climate interactions  Climate effects of deforestation and afforestation | 3 | Peng | | 12 | **Consequences of land change: Hydrological perspective**  Impact of Land Use Change on water cycle  Land change and water/food security | 6 | Cui | | 13 | **Land use/management and sustainable development**  Land related mitigation and adaptation response  Land management and socioeconomic development | 6 | Cui | | 14 | **Student presentation**  Presentations on final project | 6 | Dong/Feng/Cui | | 15 | **Final Exam** | 3 | Dong | | total |  | 60 |  | |

**Contents of the course**

**Section 1: Observation and monitoring of land change**

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

**Section 2: Process and pattern of land change**

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

**Section 3: Causes and driving factors of land change**

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

**Textbook and any related course material:**

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

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

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

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

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

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

**Course title**

**Data Mining**

**Instructor(s)-in-charge:**

*Prof. LIU Ying*

**Course type:**

*Lecture*

**Course Schedule:**

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

**Course Assessment:**

*Homework: 2 assignments, 1 project*

**Grading Policy:**

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

**Course Prerequisites:**

*data structure, computer algorithms, programming, database*

**Catalog Description:**

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

**Schedule of the course**

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

**Contents of the course:**

**Section 1: Introduction**

Motivation, major issues, major applications, characteristics

**Section 2: Data warehouse**

Model, architecture, operations

**Section 3: Data pre-processing**

Data cleaning, data transformation, data reduction

**Section4: Association rules** Apriori, FP-Growth, Partition, DIC, DHP, multi-level association rules, quantitative association rules, major applications  
**Section 5: Classification**  
 Decision tree, Bayesian Classifier, Classification by backpropagation, KNN classifier, statistical prediction models, major applications  
**Section 6: Clustering**  
 Partitioning methods, hierarchical methods, density-based methods, grid-based methods, major applications

**Section 7. Sequence mining**

GSP, SPADE

**Section 8: Applications**

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

**Section 9:Big data mining**

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

**Section 10: Project Discussion & Demo**

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

**Textbook and any related course material:**

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

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

Research papers: to be announced in class

**Course title**

**Organometallic Chemistry and Catalysis-for Doctors**

**Instructor(s)-in-charge:**

*Prof. SUN Wenhua*

**Course type:**

*Lecture*

**Course Schedule:**

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

**Course Assessment:**

*Homework: 14 assignments*

**Grading Policy:**

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

**Course Prerequisites:**

*General chemistry*

**Catalog Description:**

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

**Schedule of the course**

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| |  |  | | --- | --- | | section | content | | 1 | Organometallic Chemistry:  Definition & Scope  Introduction to Catalysis  *Evaluation regarding student background* | | 2 | Periodic Table of Elements  Various ligands and their electrons contributions | | 3 | Alkali Metal Organometallics  Alkaline Earth Metal Organometallics | | 4 | Zinc, Cadmium, and Mercury organometallics  Stoichiometric reactions  *Tutorial assessment* | | 5 | Synthetic methodology oriented organometallic chemistry: A Practice | | 6 | Organometallics of the Boron Group  Organometallics of the Carbon group | | 7 | Transition metal Organometallics:  Common types of organometallic complexes; 16/18 ev; ligand types and behaviors and oxidation states | | 8 | Metal Carbonyl Complexes: Definition and types; from mononuclear to nanoparticles Industrial hydroformylation | | 9 | Organometallic compounds ligated by alkenes, dienes, and alkynes  Student presentations (Topic discussions) | | 10 | Metallocene and Arene complexes | | 11 | Sigma Complexes  Hydrogenation  *Tutorial assessment* | | 12 | Organometallic application: C-C and C-N cross couplings and new progresses | | 13 | Industrial processes: ethylene oligomerization and olefin polymerization | | 14 | Student presentations (interpretation conceptual novelty)  Q and A sessions | | 15 | **Open note test**  **(notebook and books along with personal computer allowed, but no discussion)** | |  | | total |  | |

Textbook and any related course material:

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

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