目录

Course title
1.Nanotechnology for Solar Energy Utilization Applications
Instructor(s)-in-charge:
Prof. HE Tao
Course type:
Lecture
Course Assessment:
Four assignments: Exercise & Presentation
Grading Policy:
Typically 40% presentation, 40% exercise, 20% final
Course Prerequisites:
Materials physics, materials chemistry, solid state physics, semiconductor physics, physical chemistry, general chemistry
Catalog Description:

Because of concerns regarding energy security, environmental crisis, and the rising costs of fossil-fuel-based energy, there has been significant, resurgent interest in utilization of solar energy recently due to its clean nature and abundance of the source. Unfortunately, the utilization efficiency is still pretty low, which dramatically limits the wide use of solar energy. Nanotechnology may afford a solution to this. Thus, the major goal of this course is to provide the students general concepts and state-of-the-art developments in the field of nanotechnology for solar energy utilization. The course begins with a brief introduction of fundamentals of nanotechnology and solar energy. Then photon (light) management is discussed in detail, followed by a thorough description of conversion of light into electric energy (photovoltaics) and chemical energy (artificial photosynthesis). Detailed discussion of environmental remedy is covered too. Other applications such as thermoelectricity and thermochemistry are presented in the final session.

Schedule of the course

Section	Content	Hours
1	Chapter 1. Fundamentals of nanotechnology and solar energy Chapter 2. Optical properties of nanomaterials and nanostructures	3
2	Chapter 3. Light harvesting and conversion	3
3	Exercise I & Student presentation I	3
4	Chapter 4. Photovoltaic device physics on the nanoscale	3
5	Chapter 5. Inorganic photovoltaic devices	3
6	Chapter 6. Organic solar cells Chapter 7. Dye-sensitized & perovskite solar cells	3
7	Exercise II & Student presentation II	3
8	Chapter 8. Photosynthesis and bioenergy Chapter 9. Fundamentals of photocatalysis	3
9	Chapter 10. Water splitting	3
10	Chapter 11. Photoreduction of carbon dioxide	3
11	Chapter 12. Environmental remediation (organic pollutants, heavy metals, water purification, etc.)	3
12	Exercise III & Student presentation III	3
13	Chapter 13. Thermoelectricity	3

	Chapter 14. Thermochemistry	
14	**Chapter 15. Energy storage** **Chapter 16. Photodetection and imaging** **Chapter 17. Summary and outlook**	**3**
15	**Exercise IV & Student presentation IV**	**3**
Total		**50**

Textbook and related documents:
No specific textbooks, though the following ones are listed. More reading materials will be provided during the lecture.
Nanostructured and photoelectrochemical systems for solar photon conversion, Edited by Mary D. Archer and Arthur J. Nozik, Imperial College Press, London, 2009
Nanostructured materials for solar energy conversion, Edited by Tetsuo Soga, Elsevier Science, 2007
Nanotechnology for Photovoltaics, Edited by Loucas Tsakalakos, CRC Press, Boca Raton, 2010

Course title

2.Nano Electronic Materials

Instructor(s)-in-charge:
Prof. XIE Liming
Course type:
Lecture
Course Assessment:
Homework: 10 assignments
Grading Policy:
Typically 20% attendance, 20% in-class performance, 40% homework, 20% final.
Course Prerequisites:
Solid state physics, physical chemistry
Catalog Description:
This course will first give a general review on nano electronic materials, including structure, synthesis and properties. And then introduce typical nano electronic materials in details. The typical nano electronic materials include quantum dots, nanowires, carbon nanotubes, graphene, two-dimensional materials beyond graphene.
Schedule of the course

section	content	hours
1	Motivation and surface effect	4
2	Quantum confinement effect	4
3	Synthesis methods of nano electronic materials	4
4	Characterization methods	4
5	Characterization methods	4
6	Device fabrication techniques	4
7	Electrical measurement	4
8	Quantum dots	3
9	Nanowires	3
10	Carbon nanotubes	3
11	Graphene	3
12	Transition-metal dichalcogenides and Other 2D materials	3
13	Presentation skills and discussion	3
14	Presentations by students	3
15	Presentations by students	3
total		52

Textbook and any related course materials:

[1] Introduction to the Physics of Nanoelectronics, Edited by: S.G. Tan and M.B.A. Jalil, ISBN: 978-0-85709-511-4

[2] Fundamentals of Nanoelectronics, Edited by: George W. Hanson, ISBN-10: 0131957082

[3] Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques, Edited by: W. R. Fahrner, ISBN 3-540-22452-1

Expected level of proficiency from students entering the course:
Mathematics: strong
Physics: strong
Chemistry: strong

Course title

3.DNA Nanobiotechnology

Instructor(s)-in-charge:
Prof. Jian Zhao & Mengyuan Li
Course type:
Lecture
Course Assessment:
Homework: 3 assignments
Grading Policy:
Typically 13% attendances, 47% assignments, 40% final exam.
Course Prerequisites:
Biology, College Chemistry, College Materials, English
Catalog Description:
This course will focus on the concept, construction, and application of DNA nanobiotechnology, and particularly the impact of DNA nanobiotechnology on the diagnosis and drug delivery. Topics include of the basics of DNA nanobiotechnology, molecular diagnosis, and therapeutic applications. Through this course, you will understand how to apply DNA nanobiotechnology to diagnostic testing and pharmaceutical research. Prerequisites: Some background in biology or chemistry will be helpful. It will cover the following topics:
Schedule of the course

No.	content	hours	subsection	content	hours	
1	Introduction of DNA nanobiotechnology	6	1	DNA nanobiotechnology: synthesis and properties	3	Jian Zhao
			2	Functional DNA for biorecognition and targeting	3	
2	DNA nanobiotechnology for diagnosis	12	1	DNA nanobiotechnology for liquid biopsy	3	Mengyuan Li
			2	DNA nanobiotechnology for cellular imaging	3	
			3	DNA nanobiotechnology for in situ imaging in vivo	3	

			4	Flipped classroom	3	
3	DNA nanobiotechnology for drug delivery	15	1	DNA nanobiotechnology for delivery of small molecular drugs	3	Jian Zhao
			2	DNA nanobiotechnology for gene delivery	3	
			3	DNA nanobiotechnology for delivery of therapeutic proteins	3	
			4	DNA nanobiotechnology for delivery of multiple drugs	3	
			5	Flipped classroom	3	
4	DNA nanobiotechnology for theranostics	4	1	DNA nanobiotechnology for theranostics	3	Mengyuan Li
			2	Flipped classroom	1	
5	Final examination	3	1	Final examination	3	Jian Zhao

Textbook and any related course material:

No textbook, and there are some papers for reading:

[1] Nucleic Acid Nanotechnology, Editors by Jørgen Kjems, Elena Ferapontova, Kurt V. Gothel, Date: 10-19-2013, Press: Springer.

[2] DNA Nanotechnology From Structure to Functionality, Editors by Chunhai Fan and Yonggang Ke. Date: 09-08-2020, Press: Springer.

[3] DNA Nanotechnology For Bioanalysis: From Hybrid Dna Nanostructures to Functional Devices, Editors by Giuseppe Arrabito and Liqian Wang. Date: 09-25-2017, Press: World Scientific Publishing Europe Ltd.

[4] Nucleic Acid Nanotheranostics: Biomedical Applications, Editors by Manfred Ogris, and Haider Sami. Date: 02-26-2019, Press: Elsevier.

[5] Aptamers in Biotechnology, Editors by Katharina Urmann, and Johanna-Gabriela Walter. Date: 07-31-2020, Press: Springer.

[6] Nanotechnology for Nucleic Acid Delivery, Editors by Manfred Ogris, and Haider Sami. Date: 03-06-2019, Press: Humana.

[7] DNA Computing and Molecular Programming, Editors by Andrew Phillips, Peng Yin. Date: 07-21-2015, Press: Springer.

[8] DNA- and RNA-Based Computing Systems, Editors by Evgeny Katz. Date: 04-12-2021, Press: Wiley-VCH.

Course title

4.Physical Geography

Instructor(s):

Prof. XiaoMin Fang et al.

Course type:

Lecture

Catalog Description:

Physical Geography 2024 Spring semester is designed as an introduction course for research graduate students majored in the earth and environmental sciences. As a foundation in the study of geography, this course introduces the physical elements of the earth and the environment in which people live. The focus is on natural processes that create physical diversity on the earth, covering topics like weather and climate, vegetation and soils, landforms, ecosystems, their distribution and significance. This course is designed in an interactive way, combining basic theories and current research progress in several key fields. It enables the students to develop a broad understanding of geographic processes, and how human activity affects physical geography, especially in the Tibetan Plateau. The course is structured as a series of lectures with the topics listed as following:

Schedule of the course

Section	Content	Time
1	**Introduction of Physical Geography** 1.1 Brief introduction 1.2 The earth and its rotation 1.3 Coordination system 1.4 The earth in the solar system **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
2	**Global Energy Balance** 2.1 Insolation to the earth 2.2 Global energy system 2.3 Energy redistribution and climate change **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
3	**Winds and Global Circulation** 3.1 Air pressure, wind and cyclones-anticyclones 3.2 Wind circulation 3.3 Ocean circulation **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
4	**Weather Systems** 4.1 Air masses and fronts 4.2 Midlatitude anticyclones an cyclones 4.3 Tropic and equatorial weather systems **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
5	**Earth materials** 5.1 The structure of the earth 5.2 Earth materials and rocks **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
6	**Tectonics and Landforms** 61 Plate tectonics and global topography 6.2 Tectonic landforms 6.2 Volcanic activity and landforms **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7

7	**Air Temperature, Moisture and Precipitation** 7.1 Air temperature and vertical temperature structure 7.2Temperature change 7.3 Moisture and humidity 7.4 Precipitation formation and types **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
8	**Global Climates and Climate Change** 8.1 Climate and classification 8.2 Climate with latitude 8.3 climate change and causes 8.4 Mini-seminars: -student presentations and discussion **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
9	**Weathering and Mass Wasting** 9.1 Weathering 9.2 Mass Wasting **Freshwater of the Continents** 10.1 Hydrologic Cycle 10.2 Groundwater **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
10	10.3 Streamflow 10.4 Lakes 10.5 Hydrological Model 10.6 Water as a Natural Resource **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
11	**Landforms Made by Running Water** 11.1 Erosion, Transportation, and Deposition 11.2 Stream Gradation and Evolution 11.3 Fluvial Landforms 11.4 Fluvial Processes in an Arid Climate **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
12	**Global Biogeography and Biogeographic Process** 12.1 Global Natural Vegetation and Climatic Belts 12.2 Terrestrial Ecosystem-Components, structure and function 12.3 Energy and Matter Flow in Ecosystem 12.4 Biodiversity 12.5 Human Disturbance to Natural Ecosystem 12.6 Methods of Ecosystem Studies **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
13	**Global Soils** 13.1 The Nature of the Soil 13.2 Soil Chemistry 13.3 Soil Moisture 13.4 Soil Development 13.5 The Global Scope of Soils **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7
14	**Landforms Made by Wave and Wind** 14.1 The Work of Waves and Tides	Tue. 13:30-

	14.2 Coastal Landforms 14.3 Wind Action 14.4 Eolian Landforms **(After-school materials distribution)**	16:20 Class5-7
15	**Glacial and Periglacial Landforms** 15.1 Glaciers and Their Types 15.2 Glacial Processes and Their Landforms 15.3 Periglacial Processes and Landforms 15.4 Glaciations and Climatic Changes **(After-school materials distribution)**	Tue. 13:30- 16:20 Class5-7

Course title
5.Applications of Remote Sensing on Climate Change, Land Science and Severe Weather
Instructor(s)-in-charge:
Prof. QI Youcun & Prof. Haoming Chen
Course type:
Lecture
Course Schedule:
3hrs/week by instructor and 1 hour discussion through WeChat group chat.
Course Assessment:
Homework: 4 assignments
Grading Policy:
Typically 20% Attendance, 40% homework, 20% Oral Presentation, 20% final.
Course Prerequisites:
Remote Sensing, Climate Change, Land Science
Catalog Description:
This course introduces the fundamentals, commonly used methods, and applications of remote sensing, and emphasizes the use of remote sensing data for studying climate change, land use change and severe weather forecasting. Climate change and land use change are the most important components of global change studies. This course would provide a comprehensive examination of land use change in the context of global environmental change, together with a practical guide for interpreting satellite imagery in severe weather situations. We will first learn the basics of remote sensing and fundamentals essential for understanding severe weather following by the remote sensing data analyses methods. Then these knowledge and tools will be used to understand the climate and land use changes as well as to improve severe weather forecasting at regional, national, and global scales. We will better understand the global change issues by examining socioeconomic drivers and physical and biological impacts of land use change and climate change.
Schedule of the course

Section	Content	Instructor
1	Course Introduction, Introductory Lecture Concepts, principle	Youcun Qi
2	Course Introduction, Introductory Lecture Concepts, principle Basic of Remote Sensing Major Sensors for monitoring climate change	Youcun Qi
3	Basic of Remote Sensing	Youcun Qi

	Major Sensors for monitoring land use change Major Sensors for monitoring severe weather	
4	**Methods of data processing and analyses Remote sensing data processing, Data visualization**	**Youcun Qi**
5	**Remote Sensing of Climate Change Generating the remote sensing data Rainfall detection, Snow coverage and depth detection**	**Youcun Qi**
6	**Remote Sensing of Climate Change Existing climate data and the applications Data collection and Accuracy Assessment**	**Youcun Qi**
7	**Remote Sensing of Climate Change Snow coverage and depth monitoring**	**Youcun Qi**
8	**Remote Sensing of Climate Change Rainfall types and changes**	**Youcun Qi**
9	**Methods of data processing and analyses Land classification methods Machine learning, etc. Remote Sensing of Land use change Existing land use maps and the applications Land use mapping and change detection**	**Youcun Qi**
10	**Basic of Remote Sensing Major Sensors for monitoring severe weather Fundamentals in Satellite/Radar imagery and severe weather**	**Haoming Chen**
11	**Basic of Remote Sensing Basic information of radiances measured by satellites/Radar and its relationship with atmospheric dynamics**	**Haoming Chen**
12	**Methods of data processing and analyses Interpreting satellite/radar imagery Severe weather analyses**	**Haoming Chen**
13	**Remote Sensing of Severe weather Radar imagery analysis of main ingredients of severe weather situations**	**Haoming Chen**
14	**Remote Sensing of Severe weather Use of Radar imagery for assessing numerical prediction model behavior**	**Haoming Chen**
15	**Presentation of the Final Project, and Final Exam**	**Youcun Qi**

Contents of the course

Section 1: Basic of Remote Sensing

1. **Electromagnetic Radiation Principles**
2. **Elements of Visual Image Interpretation**
3. **Multispectral Remote Sensing Systems**
4. **Hyperspectral Remote Sensing Systems**
5. **Thermal Remote Sensing Systems**
6. **Active and Passive Microwave Remote Sensing**
7. **Basic of Remote Sensing for climate change**
8. **Major Sensors for monitoring climate change**
9. **Basic of Remote Sensing for land use change**
10. **Major Sensors for monitoring land use change**
11. **Fundamentals in Satellite imagery**
12. **Basic of satellite imagery in analyzing and predicting severe weather**

Section 2: Methods of data processing and analyses

13. **Methods of data processing and analyses**
14. **Data processing**
15. **Data visualization**
16. **Land classification methods**
17. **Machine learning, etc.**
18. **Interpreting satellite water vapor imagery**
19. **Severe weather analyses**

Section 3: Remote Sensing of Climate Change

20. **Generating the remote sensing data**
21. **Existing climate data and the applications**
22. **Data collection (Satellite, GPM, DPR)**
23. **Accuracy Assessment**
24. **Rainfall types and changes**
25. **Snow coverage and depth monitoring**

Section 4: Remote Sensing of Land Use Change

26. **Existing land use maps and the applications**
27. **Field Data Collection (Google Earth, Field Photos, and Visual Interpretation of images)**
28. **Land use mapping and change detection**
29. **Accuracy Assessment**
30. **Agricultural land use change**
31. **Forest changes monitoring**

Section 5: Remote Sensing of Severe Weather

32. **Interpretation of light and dark imagery features in satellite water vapor imagery**
33. **Potential vorticity thinking in severe weather**
34. **Operational use of the relationship between potential vorticity fields and water vapor imagery**
35. **Water vapor imagery analysis of main ingredients of severe weather**

situations

36. **Use of water vapor imagery for assessing numerical climate prediction model behavior and improving forecasts**

Textbook and any related course material:
1, John R. Jenson, 2007, Remote Sensing of the Environment: An Earth Resource Perspective

2, Christo G. Georgiev, Patrick Santurette, and Karine Maynard, 2016, Weather Analysis and Forecasting: Applying Satellite Water Vapor Imagery and Potential Vorticity Analysis, Second Edition

3, Five journal papers will be assigned for student's individual research project. Students can find these papers from the list we provide or through the Web of Science.

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 datasets.

Course title
6.Development Geography
Instructor(s)-in-charge:
Prof. DENG Xiangzheng & Prof. DONG Jinwei & Associate Prof. SONG Wei & Associate Prof. WU Feng
Course type:
Lecture
Course Schedule:
3hrs/week by instructor
Course Assessment:

Homework: 4 assignments；student presentation

Grading Policy:
Typically 30% homework, 30% student presentation, 40% final.
Course Prerequisites:
NULL
Catalog Description:
Development geography is a subdiscipline of geography that studies human development and quality of life. Based on geography, development geography integrates disciplines such as management, economics, ecology, etc., and has the characteristics of integrity and interdisciplinary. Development Geography facilitates a more integrated understanding of development and places development problems within the context of the global economy and society. Its topics cover the concepts, theories and approaches, and development trend etc., which ranges from population and culture to agricultural and industrial development. Specifically, the contents of the courses include the concepts and progress of development geography, overview of geographical development differences; and specific analysis of geographical distribution and differences in income inequality and poverty, population, education and health, culture, resource and environment carrying capacity, rural and agricultural development, urban and industrial development, and the regional differences of globalization and international and regional development, etc. Further, case studies will be presented to highlight the possible solutions, as well as the problems, at local, national and international levels.
Schedule of the course

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

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

Contents of the course

Section 1: Understanding Development Geography

37. Concepts and progress of development geography

(1) Concepts, discipline classification and development of geography

(2) Overview of geographical research and development

(3) Concepts relating to geography

(4) Tools applied in geography

38. Overview of development geography

(1) Concepts and research objects of development geography

(2) Role of development geography in geography

(3) Theories in development geography

(4) Theoretical and practical significance of development geography

(5) Research prospects in development geography

39. Overview of geographical differences in regional development geography

(1) Indicators for geographic regional development differences measure

(2) Geographic regional development differences in China

(3) Development differences between developing and developed countries
(4) Reasons for regional development difference and the theoretical origins

Section 2: Social and Economic Development

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

Section 3: Environmental and Rural-Urban Development

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

Section 4: Globalization, trade and regional development

47. Review on globalization and regionalization development

(1) Role of globalization on geography development

(2) Current international geographical differences

(3) Status of China in the globalization process

(4) Policy choice of developing countries in the process of globalization

48. International trade, cooperation and regional development

(1) Theory of international trade for the development of the geographical environment

(2) International cooperation organizations and institutions

(3) Geopolitics and protectionism

(4) Trade policy comparison between countries

49. The balance of payments, financial stability and regional development

(1) International financial stability for the role of regional development

(2) Balance of payments deficit and trade war

(3) Effects of the global financial crisis on developing countries

(4) Financial system reform and promoting the development of regional policy

50. The national cases: China, Brazil and India

(1) National development in the future

(2) Chinas development present situation and the future

(3) Brazils development present situation and the future

(4) Indias development present situation and the future

Textbook and any related course material:

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

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

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

Expected level of proficiency from students entering the course:

Geography: Medium

Economics: Primary

Course title

8.Remote sensing cloud computing and scientific analysis

Instructor(s)-in-charge:

Prof. Jinwei Dong & Assoc Prof. Dongjie Fu

Course type:

Lecture

Course Schedule:

6.25hrs/week by instructors. 26 hrs in total by Prof. Jinwei Dong; 24 hrs in total by Assoc Prof. Dongjie Fu.

Course Assessment:

Homework: 1 presentation

Grading Policy:

Typically 40% presentation, 20% attendances; 40% final exam.

Course Prerequisites:

Geology, environment, climatology, ecology

Catalog Description:

This course aims to enable students to understand the relevant foundation and cutting-edge progress of remote sensing cloud computing technology and application. Through theoretical teaching, computer practice and typical research cases, students can have a deeper understanding of the application of remote sensing cloud computing platform in the mining and analysis of massive remote sensing data. The purpose is to enable students to master the ability to conduct rapid data analysis on relevant scientific issues in the research field, and will lay the foundation for the research. Prior to taking this course, students need to have basic GIS and imagery process skills. Besides, students should think carefully about how they can apply their knowledge to the research relevant to them. And in the end of the course, students will be expected to have quantitative problem-solving skills and might entail working with small land cover/use maps. It will cover the following topics:

Schedule of the course

section	content	hours	
1	What is Remote Sensing Cloud Computing?	3	Prof. Jinwei Dong
2	State-of-the-art and Perspective of Remote Sensing Cloud Computing platform: Google Earth Engine (GEE)	3	Assoc Prof. Dongjie Fu
3	State-of-the-art and Perspective of Remote Sensing Cloud Computing platforms: PIE-Engine and Microsoft Plenary Computer	3	Assoc Prof. Dongjie Fu
4	Student Presentation: questions and potential solutions using PIE-Engine and GEE	3	Assoc Prof. Dongjie Fu
5	Feature, Feature Collection and FeatureView	3	Assoc Prof. Dongjie Fu
6	Image and Image Collection	3	Prof. Jinwei Dong

7	Reducers: the way to aggregate data over time, space, bands, arrays and other data structures in PIE-Engine and GEE	3	Prof. Jinwei Dong
8	Machine Learning in PIE-Engine and GEE	3	Prof. Jinwei Dong
9	Specialized Algorithms in PIE-Engine and GEE: Landsat Algorithms, Sentinel-1 Algorithms, Resampling and Reducing Resolution	3	Prof. Jinwei Dong
10	Applications on Land Cover and Land use Changes: Process in land cover/use data products; Land information extraction in different topics such as cropland, forest and urban land	3	Assoc Prof. Dongjie Fu
11	Applications on Land Cover and Land use Changes: Land information extraction in different topics such as water and grassland; Validation of land cover/use data	3	Assoc Prof. Dongjie Fu
12	Applications on Land Cover and Land use Changes: Field reference data collection	3	Assoc Prof. Dongjie Fu
13	Applications on Land Cover and Land use Changes: Thematic land cover (oil palm, mangrove, rice) mapping	3	Assoc Prof. Dongjie Fu
14	Applications on Ecological monitoring and assessment: Smoothing interpolation of vegetation index; Extraction and simulation of vegetation phenological information	3	Prof. Jinwei Dong
15	Applications on Ecological monitoring and assessment: Simulation of GPP and evapotranspiration; Agricultural drought monitoring	3	Prof. Jinwei Dong
16	Student presentation: presentations on final project	3	Prof. Jinwei Dong
17	Final Exam	2	Prof. Jinwei Dong

Contents of the course

Section 1: Basics of Remote Sensing Cloud computing

1. What is Remote Sensing Cloud Computing;

2. State-of-the-art and Perspective of Remote Sensing Cloud Computing platform: Google Earth Engine (GEE);

3. State-of-the-art and Perspective of Remote Sensing Cloud Computing platforms: PIE-Engine and Microsoft Plenary Computer;

4. Student Presentation: questions and potential solutions using PIE-Engine and GEE;

Section 2: Practice of Remote Sensing Cloud computing

1. Feature, Feature Collection and FeatureView;

2. Image and Image Collection;

3. Feature and Feature Collection;

4. Reducers: the way to aggregate data over time, space, bands, arrays and other data structures in PIE-Engine and GEE;

5. Machine Learning in PIE-Engine and GEE;

6. Specialized Algorithms in PIE-Engine and GEE: Landsat Algorithms, Sentinel-1 Algorithms, Resampling and Reducing Resolution;

Section 3: Applications of Remote Sensing Cloud computing

1. Applications on Land Cover and Land use Changes: Process in land cover /use data products; Land information extraction in different topics such as cropland, forest and urban land;

2. Applications on Land Cover and Land use Changes: Land information extraction in different topics such as water and grassland; Validation of land cover/use data;

3. Applications on Land Cover and Land use Changes: Field reference data collection;

4. Applications on Land Cover and Land use Changes: Thematic land cover (oil palm, mangrove, rice) mapping;

5. Applications on Ecological monitoring and assessment: Smoothing interpolation of vegetation index; Extraction and simulation of vegetation phenological information;

6. Applications on Ecological monitoring and assessment: Simulation of GPP and evapotranspiration; Agricultural drought monitoring;

7. Student presentation: presentations on final project;

8. Final exam.

Textbook and any related course material:

Jinwei Dong. Remote sensing cloud computing and scientific analysis: applications and practices.

Expected level of proficiency from students entering the course:

For masters and doctoral students in the fields of geology, environment, climate and ecology

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Course title

9.Geospatial Data Processing with Python

Instructor(s)-in-charge:
Prof. Xianfeng Song
Course type:
Lecture
Course Schedule:
6hrs/week by instructor.
Course Assessment:
Homework: 4 assignments
Grading Policy:
Typically 40% homework, 20% attendances; 40% examination.
Course Prerequisites:
Geographic Information System, Remote Sensing
Catalog Description:
Geospatial analysis that focuses on data analysis in a geographical or geospatial aspect, is widely used in geoscience related domain. This course introduces Python for geodata reading, writing and handling, geo-statistics, machine learning and geo-visualization by taking full advantages of most popular geo-computing libraries in Python. It intends to help students learn to code with Python and gain advanced geo-processing skills from programming experiences.
Schedule of the course

section	content	hours	
1	Python essentials: the basic concepts and features of the Python language, and object-oriented programming	6	Xianfeng Song
2	Geospatial data handling: Geodata reading and writing, map projection and geometric transformation, elementary spatial analysis, and geodata visualization	15	Xianfeng Song
3	Geospatial analysis and spatial dependence: Geo-statistics, surface interpolation and approximation	9	Xianfeng Song
4	Machine learning and spatial modelling: Clustering, classification and optimization modelling.	15	Xianfeng Song
5	Putting things together: Integrating python scripts into a GUI App and packing them into a binary executable	5	Xianfeng Song

total		**50**	

Contents of the course

Section 1: Python essentials

1.1 Python syntax

Data types, expressions, statements, control flow tools, functions, modules and packages

1.2 Advanced components

Files, errors and exceptions, object-oriented programming

Section 2: Geospatial data handling

2.1 Geodata reading and writing by geopandas, rasterio and numpy

Reading and writing spatial data (shape, geotiff, netcdf4), working with multidimensional array

2.2 Interactive geodata visualization by matplotlib and Cartopy

Figure definition, graph and chart plotting, geodata mapping (raster, vector)

2.3 Map projection and geometric transformation by pyproj4 and osr

Map projection, geometric transformation, image warping

2.4 Elementary spatial analysis by shapely

Geometry and measures, spatial relationship, overlay analysis

2.5 Rasterization and vectorization by rasterio and skimage

Conversion between raster data and vector data, thinning and skeletonization

Section 3: Geospatial analysis and spatial dependence

3.1 Statistics

Sampling distributions (normal distribution, gamma distribution, etc.), statistical tests (parametric t-test, nonparametric Mann-Whitney U test, etc.)

3.2 Geostatistics

Spatial dependence (spatial autocorrelation), spatial weights, measuring spatial dependence (Moran, G-statistics, LISA), spatial regression (geographically weighted regression

3.3 Surface interpolation and approximation

Delaunay triangulation, surface interpolation or approximation from scattered data points

Section 4: Machine learning and spatial modelling

4.1 Clustering

K-means, hierarchical clustering, agglomerative clustering, Mean Shift, DBSCAN, regionalization analysis (Max-P, AZP)

4.2 Classification

Gaussian naive Bayes, support vector classification, decision trees, ensemble methods

4.3 Regression

linear regression (OLS, RANSAC), non-linear regression (SVR, gradient boosting regression), using statistical intervals to assess system performance

4.4 Machine learning pipeline

Data preprocessing, model selection, model training, model evaluation and

validation
4.5 Optimization modeling
Definition of optimization problems and their solution using cvxopt/pygmo or networkx
Section 5: Putting things together
5.1 Integrating Python scripts into a GUI App by PyQt5
5.2 Packing Python scripts into a binary executable

Textbook and any related course material:
Geoprocessing with Python, Chris Garrard, 2016, Manning Publications. ISBN 9781617292149
Learning Geospatial Analysis with Python, 3rd Edition, Joel Lawhead, 2019, Packt Publishing. ISBN 9781789959277
Geospatial Analysis: a comprehensive guide to principles, techniques and software tools, 6th Edition, Edited by Michael J de Smith, Michael F Goodchild, Paul A longley, 2018, ISBN 978-1-912556-05-2
Expected level of proficiency from students entering the course:
Geographic information system or remote sensing: strong
Programming skills: basic

Course title

10.Thermal infrared remote sensing

Instructor(s)-in-charge:
Prof. Hua Wu & Assoc. Prof. Li Ni
Course type:
Lecture
Course Schedule:
6hrs/week by instructors. 25 hrs in total by Prof. Hua Wu; 15 hrs in total by Assoc. Prof. Li Ni.
Course Assessment:
None
Grading Policy:
20% attendances; 80% final examination.
Course Prerequisites:
Remote Sensing
Catalog Description:
This course is designed as an introductory course in thermal infrared remote sensing for students in Earth Science or Remote Sensing. This course focuses on the study and discussion of the basic theory and methods of thermal infrared remote sensing. It mainly includes the radiative transfer mechanism of infrared remote sensing, atmospheric effect correction, and land surface temperature and emissivity separation and retrieval. This course emphasizes both theory and practice by arranging computer practice that corresponds to the theoretical courses. Through the course, students will develop a comprehensive understanding of the theory and methods of remote sensing retrieval of land surface temperature and emissivity. It will cover the following topics:
Schedule of the course

section	content	hours	
1	Overview of Thermal Infrared Remote Sensing Introduction to thermal infrared remote sensing; Thermal infrared remote sensing properties; Basic concepts and laws.	3	Prof. Hua Wu
2	Radiance Calibration Overview of thermal infrared remote sensing calibration; Pre-launch laboratory and on-board calibration methods; Field calibration and cross-calibration methods.	3	Prof. Hua Wu
3	Atmospheric Effect Correction Radiative transfer equation (RTE);	3	Prof. Hua Wu

	Atmospheric effect on thermal infrared radiation signal; Correction methods for thermal infrared atmospheric effect.		
4	**Basic Infrared Remote Sensing Image Processing (Computer Practice) Reading of thermal infrared satellite products; Geometry and radiation processing; Radiance to brightness temperature processing.**	**3**	**Assoc. Prof. Li Ni**
5	**Land Surface Emissivity Retrieval Definition of land surface emissivity; Land surface emissivity retrieval methods.**	**3**	**Prof. Hua Wu**
6	**Radiation Transfer Model Exercise (Computer Practice) Introduction of MODTRAN; MODTRAN basic usage; MODTRAN result processing.**	**3**	**Assoc. Prof. Li Ni**
7	**Land Surface Temperature Retrieval (1) Definition of land surface temperature; Single-channel land surface temperature retrieval method; Two-channel temperature retrieval method.**	**3**	**Prof. Hua Wu**
8	**Atmospheric Effect Correction (Computer Practice) Channel atmospheric transmittance, upward radiance, and downward radiance estimation; Atmospheric effect correction for satellite images.**	**3**	**Assoc. Prof. Li Ni**
9	**Land Surface Temperature Retrieval (2) Multi-angle retrieval method; Multi-channel retrieval method; Hyperspectral retrieval method.**	**3**	**Prof. Hua Wu**
10	**Land Surface Emissivity Retrieval (Computer Practice) Classification-based emissivity retrieval; NDVI-based emissivity retrieval.**	**3**	**Assoc. Prof. Li Ni**
11	**Land Surface Temperature and Land Surface Emissivity Validation Instrument and measurement for**	**3**	**Prof. Hua Wu**

	thermal infrared; Land surface temperature validation methods; Land surface emissivity validation methods.		
12	**Land Surface Temperature Retrieval (Computer Practice) Single channel method in practice; Two-channel method in practice.**	**3**	**Assoc. Prof. Li Ni**
13	**Development and Prospect Research challenges and issues; Prospect in thermal infrared remote sensing.**	**2**	**Prof. Hua Wu**
14	**Final Examination**	**2**	**Prof. Hua Wu**
total		**40**	

Contents of the course

Section 1: Overview of Thermal Infrared Remote Sensing

1. **Introduction to thermal infrared remote sensing;**
2. **Thermal infrared remote sensing properties;**
3. **Basic concepts and laws.**

Section 2: Radiance Calibration

1. **Overview of thermal infrared remote sensing calibration;**
2. **Pre-launch laboratory and on-board calibration;**
3. **Field calibration and cross-calibration;**
4. **Computer Practice: Basic Infrared Remote Sensing Image Processing.**

Section 3: Atmospheric Effect Correction

1. **Radiative Transfer Equation (RTE).**
2. **Atmospheric effect on thermal infrared radiation signal;**
3. **Correction methods for thermal infrared atmospheric effect;**
4. **Computer Practice: Radiation transfer model exercise;**
5. **Computer Practice: Atmospheric effect correction.**

Section 4: Land Surface Emissivity Retrieval

1. **Definition of land surface emissivity;**
2. **Land surface emissivity retrieval methods;**
3. **Computer Practice: Land surface emissivity retrieval.**

Section5: Land Surface Temperature Retrieval

1. **Definition of land surface temperature;**
2. **Single-channel land surface temperature retrieval method;**
3. **Two-channel temperature retrieval method;**
4. **Multi-angle retrieval method;**
5. **Multi-channel retrieval method;**
6. **Hyperspectral retrieval method;**
7. **Computer Practice: Land surface temperature retrieval.**

Section6: Land Surface Temperature and Land Surface Emissivity Validation

1. **Instrument and measurement for thermal infrared;**
2. **Land surface temperature validation methods;**
3. **Land surface emissivity validation methods.**

Section 7: Development and Prospect

1. **Research challenges and issues;**
2. **Prospect in thermal infrared remote sensing.**

Textbook and any related course material:

Quantitative remote sensing in thermal infrared: Theory and Applications, Tang and Li, Springer, 2014

Expected level of proficiency from students entering the course:

Remote Sensing: basic

Course title

11.Climate Change

Instructor(s)-in-charge:
Prof. Dr.MA Yaoming
Course type:
Lecture
Catalog Description:
Climate Change spring semester is designed as an introductory course plus our research aspect in ITPCAS (Institute of Tibetan Plateau, Chinese Academy of Sciences) in the Climate Change for graduate students majored in Earth Sciences. This class is a synthesis of current knowledge of the climate system and past and present climates. It provides solid background information and includes critical assessments of issues that remain incompletely understood. There, it is up to the students to logically evaluate climate change issues presented daily by the media. This class will introduce related reference for climate researchers and students, especially for issues of climate change in Earth system. The class presents the basics surrounding climate change in a simple way while pointing out the complexity of climate data collection, processing, and interpretation. Our research aspect in ITPCAS will introduce climate change related topics, for example, land surface heat flux retrieves from in-situ data, satellite remote sensing data and numerical model; land surface model development and data assimilation; black carbon in the mountain glacier area; hydrological model and so on. All of these topics will enhance our theoretical questions about climate change, especially in the Tibetan Plateau.
The course is structured as a series of lectures and mini-seminars in which individual research cases are discussed with faculty tutors. It will cover the following topics:

Schedule of the course

Section	Content	hours
1 Prof. Yaoming Ma	Overview of Climate Change 1.1 Weather and climate 1.2 What do we mean by climate variability and climate change? 1.3 Connections, timescales and uncertainties 1.4 The big picture	3
2 Prof. Yaoming Ma	Radiation and the Earth's energy balance 2.1 Solar and terrestrial radiation 2.2 Solar variability 2.3 Summary	3
3 Prof. Yaoming Ma	The elements of the climate 3.1 The atmosphere and oceans in motion 3.2 Atmospheric circulation patterns 3.3 Radiation balance 3.4 The hydrological cycle 3.5 The biosphere 3.6 Sustained abnormal weather patterns 3.7 Atmosphere–ocean interactions	3

	3.8 The Great Ocean Conveyor **3.9 Summary**	
3" Prof. Yaoming Ma	**Climate Change review**	**3**
4 Prof. Baiqing Xu	**Evidence of climate change** **8.1 Peering into the abyss of time** **8.2 From greenhouse to icehouse** **8.3 Sea-level fluctuations** **8.4 The ice ages** **8.5 The end of the last ice age** **8.6 The Holocene climatic optimum** **8.7 Changes during times of recorded history** **8.8 The medieval climatic optimum** **8.9 The Little Ice Age** **8.10 The twentieth-century warming** **8.11 Concluding observations**	**3**
5 Prof. Baiqing Xu	**The natural causes of climate change** **6.1 Auto-variance and non-linearity** **6.2 Atmosphere–ocean interactions** **6.3 Ocean currents** **6.4 Volcanoes** **6.5 Sunspots and solar activity** **6.6 Tidal forces** **6.7 Orbital variations** **6.8 Continental drift** **6.9 Changes in atmospheric composition** **6.10 A belch from the deep** **6.11 Catastrophes and the 'nuclear winter'** **6.12 Summary**	**3**
6 Prof. Baiqing Xu	**Human activities** **7.1 Greenhouse gas emissions** **7.2 Dust and aerosols** **7.3 Desertification and deforestation** **7.4 The ozone hole** **7.5 Summary**	**3**
6" Prof. Baiqing Xu	**climate change review 2**	**3**
7 Prof. Lei Wang	**The measurement of climate change** **4.1 In situ instrumental observations** **4.2 Satellite measurements** **4.3 Re-analysis work** **4.4 Historical records** **4.5 Proxy measurements** **4.6 Dating** **4.7 Isotope age dating** **4.8 Summary**	**3**
8 Prof. Lei Wang	**Statistics, significance and cycles** **5.1 Time series, sampling and harmonic analysis** **5.2 Noise** **5.3 Measures of variability and significance**	**3**

	5.4 Smoothing **5.5 Wavelet analysis** **5.6 Multidimensional analysis** **5.7 Summary**	
9 Prof. Lei Wang	**Consequences of climate change** **9.1 Geological consequences** **9.2 Flora and fauna** **9.3 Mass extinctions** **9.4 Sea levels, ice sheets and glaciers** **9.5 Agriculture** **9.6 The historical implications of climatic variability** **9.7 Spread of diseases** **9.8 The economic impact of extreme weather events** **9.9 Summary**	**3**
9" Prof. Lei Wang	**climate change review 3**	**3**
10 Prof. Yimin Liu	**Modeling the climate** **10.1 Context of climate modeling** **10.2 Understanding climate change** **10.3 Climate modeling and weather forecasting** **10.4 Framework of climate models** **10.5 Climate model development**	**3**
11 Prof. Yimin Liu	**Climate Modeling, Projection and Uncertainties** **11.1 Coupled Model Inter-comparison Project (CMIP)** **11.2 Climate ensemble** **11.3 Modeling historical climate change** **11.4 Future climate projection** **11.5 Modeling biases and uncertainties** **11.6 Improving climate modeling over the TP** **11.7 TP cold bias and Asian summer monsoon Simulation**	**3**
12 Prof. Yimin Liu	**Role of the modelling on scientific understanding I monsoon climatology** **12.1 The concept of the monsoon thermal adaptation** **12.2 Thermal adaptation** **12.3 Impact of Land-sea distribution** **12.4 Impact of Tibetan Plateau & Iranian Plateau** **12.5 Thermal impacts or dynamic (isolation) impacts?**	**3**
12" Prof. Yimin Liu	**climate change review 4**	**3**
13 Prof. Lei Wang	**Hydrological modelling and its applications for integrated water resources management**	**3**
14 Prof. Yimin Liu	**Role of the modelling on scientific understanding II monsoon varibility** **13.1 Byweekly oscillation of the South Asian**	**3**

	Anticyclone **13.2 Impact of tropical cyclone on the seasonal evolution of the Asian summer monsoon** **13.3 Decadal change of East Asian summer monsoon and the Tibetan Plateau impact**	
15 Prof. Baiqing Xu	**Back carbon in the glacier area**	**3**
16 Prof. Yaoming Ma	**Land surface heat flux retrieve from in-situ data, remote sensing data and numerical model**	**3**
4 Professors	**climate change review 5**	**3**
Total		**64**

Course title

12.Plate Tectonics and Evolution of Tibetan Plateau

Instructor(s):
Prof. Lin Ding et al.
Course type:
Lecture
Catalog Description:

Plate tectonics is an integrated scientific theory that describes how the large-scale geologic structures on Earth are created as a result of Earth's plates movements. In plate tectonics, the lithosphere — Earth's strong, rigid outermost shell—is broken into many tectonic plates, which lie on top of the weaker, ductile asthenosphere. Due to the convection of the asthenosphere, the plates move relative to each other and interact along their boundaries, where they converge, diverge, or slip past one another. These interactions generate many phenomena, such as mountain building, large continents, wide and deep oceans, volcanoes and earthquakes. To begin our explanation of the key elements of plate tectonics theory, we will first learn about the physical and chemical structures of the earth, types of plate boundaries, subduction zones and other special locations on plates. We will see how continents break up, how they collide, what makes plates move, and their relationships with petrology, paleomagnetism and geodynamics.

We will then introduce the application of plate tectonics on Himalayan-Tibetan Orogen. The India-Eurasia collision is the most significant geological event throughout the Phanerozoic and eventually created the youngest and most spectacular Himalaya-Tibetan Orogen on Earth. During the continental collision, Indian continental lithosphere began to subduct beneath Eurasian continent and further induced large-scale deformation, magmatism and metamorphism. More importantly, the continental collision induced rapid uplift of the Himalaya-Tibetan Plateau. The uplift of the large and high elevations (>5000m) of the Tibetan Plateau has not only affected regional geomorphology and geographical environments of Asia, but also impacted on regional or even global climate change. Therefore, the Himalayan-Tibetan orogen provides an ideal natural laboratory to investigate the mountain building process in general. It will cover the following topics:

Schedule of the course

Section	Content	hours
1	**Plate tectonics and its developing history** **1. Introduction to Plate Tectonics** **2. The Structure of the Earth** **2.1 Three Layers** **2.2 Physical Properties** **2.3 Chemical Compositions** **3. Continental Drift** **3.1 Principal Observations** **3.2 The Implications** **4. Seafloor Spreading** **4.1 Seafloor Topography** **4.2 Age of the Seafloor** **4.3 Oceanic Ridge System**	8

	5. Accreting Plate Boundaries **5.1 Divergent Plate Boundaries** **5.2 Convergent Plate Boundaries** **5.3 Transform Plate Boundaries** **6. Subduction** **6.1 Distribution of Subduction zones** **6.2 Deep Structure of the Subduction Zones** **7. Continents** **7.1 The Growth of Continents** **7.2 Continental Margins** **8. Hotspots and Mantle Plumes** **8.1 Mantle Convection** **8.2 Surface Volcanisms** **8.3 Deep Origin of Mantle Plumes** **9. The Wilson Cycle** **9.1 Traditional Wilson Cycle Model** **9.2 The Implications** **10. Planetary Perspective** **10.1 The Early History** **10.2 Comparative Planetary**	
2	**Petrology and Plate Tectonics** **1. Introduction to Petrology and Plate Tectonics** **1.1 Material composition of the Earth** **1.2 What's the petrology?** **1.3 Research methods** **1.4 Plate Tectonics Review** **1.5 Rocks in plate boundaries** **1.6 Rocks in inner plate** **2. Igneous Petrology** **2.1 Fundamental concepts** **2.2 Common rocks** **2.3 Magma Generation** **2.4 Magmatism and Plate Tectonics** **3. Metamorphic Petrology:** **3.1Fundamental concepts** **3.2 Subduction-related "Paired metamorphic belts"** **3.3 P-T-t path and contributions to Plate tectonics** **4. Sedimentary Petrology:** **4.1 Fundamental concepts** **4.2 Common rocks** **4.3 "Bouma sequence" and "Galileo's free fall"** **4.4 "Facies" and Palaeoenvironments** **5. "Ophiolite"** **5.1 What's ophiolite?** **5.2 Contribution to the Tibetan Plateau**	**15**
3	**Paleomagnetism and Plate Tectonics** **1. Introduction to Geomagnetism** **1.1 Earth Magnetic Field** **1.2 History** **1.3 Study Fields**	**6**

	2. Basic Rock Magnetism **2.1 Magnetic Properties** **2.2 Magnetic Mineralogy** **2.3 Magnetic Domains** **2.4 Hysteresis** **2.5 Natural Remanent Magnetism (NRM)** **3. Sampling, Measurement, Analysis and Field Tests** **3.1 Collection of Paleomagnetic Samples** **3.2 Demagnetization Techniques** **3.3 Display and Bedding-tilt Correction** **3.4 Identification of Ferromagnetic Minerals** **3.5 The Fold Test** **3.6 Synfolding Magnetization** **3.7 Conglomerate Test** **3.8 Reversals Test** **3.9 Baked Contact and Consistency Tests** **3.10 Other Tests** **4. Magnetic Reversals and Inclination Shallowing** **4.1 Magnetic Reversals** **4.2 Paleomagnetic Geochronlogy** **4.3 Inclination Shallowing** **5. Plate Tectonics and Sea Floor Spreading** **5.1 Plate Tectonic Theory and Paleomagnetism** **5.2 Sea Floor Spreading Hypothesis and Paleomagnetism** **6. Paleomagnetic Poles and Paleogeographic Reconstruction** **6.1 Procedure for Pole Determination** **6.2 Types of Poles** **6.3 Sampling of Geomagnetic Secular Variation** **6.4 Paleogeographic Reconstruction** **7. Regional Tectonics-Collision and Shortening** **7.1 Evolution of the Tibetan Plateau and Tethys** **7.2 India-Asia Collision Time and Shortening** **7.3 Regional Tectonics-Regional Rotations** **7.4 Rotations of the NE Tibetan Plateau** **7.5 Rotations of the SE Tibetan Plateau** **7.6 Rotations of the Tibetan Plateau**	
4	**Fundamentals of geodynamics** **1. A brief introduction on geodynamics** **1.1 The deforming earth** **1.2 Plate tectonics: what it can tell us?** **1.3 What is geodynamics?** **1.4 What this course will tell you?** **2. Stress and strain in solids** **2.1 Force and stress** **2.2 Stress state in 2D and 3D** **2.3 Pressure in the deep interiors of the earth** **2.4 Strain** **2.5 Measurements of stress and strain** **3. Elasticity and flexure of the solid earth**	**15**

	3.1 Linear elasticity **3.2 Uniaxial stress and strain** **3.3 Plane stress and strain** **3.4 Pure and simple shear** **3.5 Bending and flexure of plate in two dimensions** **3.6 Flexure with basin and mountain tectonics** **4. Rock Rheology** **4.1 Diffusion creep** **4.2 Dislocation creep** **4.3 Temperature- and stress-dependent rheology** **4.4 Crustal rheology and viscoelasticity** **4.5 Mantle convection and plate motions** **5. Faulting** **5.1 Classification of Faults** **5.2 Mohr-circle theory** **5.3 Friction on faults** **5.4 Anderson theory of faulting** **5.5 Coulomb failure criterion and strength envelop** **5.6 Earthquake faulting** **6. Geodynamic remarks of on the Tibetan plateau** **6.1 Deformation from plate boundary to plate interior** **6.2 Decadal to millennia time-dependent deformation** **6.3 Available geodynamic models of the Tibetan plateau**	
5	**Plate Tectonic in Tibet Plateau** **1. Introduction of the Tibet plateau** **1.1 Why is the Himalayan-Tibetan orogen so wide?** **1.2 Why is the Tibetan Plateau so flat?** **1.3 Why are the boundarys so steep?** **1.4 Why is the Tibetan plateau just so high and no higher?** **2. Process of Gondwana split and Asian continent aggregation** **2.1 The Gondwana super continent** **2.2 The split of the Gondwana** **2.3 The suture zones and aggregation in Tibet** **3. India and Eurasia collision** **3.1 Methods to constrain the initial timing of collision** **3.2 History of research on the initial timing of Indian and Asian collision** **3.3 Deformation of the northern THS in the early collisional stage** **3.4 Foreland basin system** **3.5 Collision patterns and suturing processes between the Indian and Asian continents** **4. The Raising of Tibet plateau** **4.1 Index of paleoelevation** **4.2 The raising of Himalaya** **4.3 The raising of Tibet**	**6**
5	**Exam**	
Total		**50**

Course title

13.Nano-biology

Instructor(s)-in-charge:
Assoc. Prof. Chen Deliang
Course type:
Lecture
Course Assessment:
Each student is expected to give an oral presentation on a topic related to his/her own interest and to Nanobiology
Grading Policy:
30% assessment , 70% final exam (open book).
Course Prerequisites:
None.
Catalog Description:
Nanobiology is to understand the Biological Science in the nanometer scale. Targeting at graduate students in Biology, Chemistry, Physics and Engineering with interest in Biological Science, this course not only introduces the basic concepts, principles and techniques of Nanobiology, but also presents many of the lessons that may be learned from nature and how they are being applied to nanotechnology. Participants will be guided to discuss latest discoveries and hot topics, such as manipulating single molecules and protein design in related interdisciplinary fields.

Schedule of the course

	Chapters	Sections	hours
1	Introduction to Nanobiology	Scope and Objects of Nanobiology; Historical Development of Nanobiology; The Unfamiliar World of Nanobiology: Its Unique Properties;	6
2	Structural Principles in Bio-nanomaterials	Building Block of Bio-nanomaterials; Protein Nanostructures; DNA Nanostructures; Lipid Nanostructures;	12
3	Functional Principles in Bio-nanomaterials	Information-Driven Nano-assembly; Bioenergetics; Chemical Transformation; Nano-transport;	10

4	**Frontier Topics in Nanobiology**	**Protein Design；** **Motor Nanodevice；** **Bio-nanocomputers；** **Bio-nanosensors；**	**12**
5	**Techniques and Approaches in Nanobiology**	**Nano-Imaging: STED, STORM, PALM;** **Nano-Manipulating: AFM, STM, OT, MT;** **Single Molecule Structure Determination: EM, X-ray diffraction;**	**10**
total			**50**

Textbook and any related course material

Bionanotechnology: lessons from nature; 1st edition

David S. Goodsell,

Wiley-Liss, Inc. 2004

References will be provided in class.

Course title

14.Molecular Entomology and Plant Pathology

Instructor(s)-in-charge:
Prof. Ge Siqin
Prof. LI Xiang-Dong
Prof. LIU Jun
Course type:
Lecture
Course Schedule:
3hrs/week by instructor.
Tuesday afternoons, from 13:30-16:20.
Course Assessment:
Quiz, exams, and home work
Grading Policy:
Final scores will be determined by 33.3%(LI),33.4%(Ge), and 33.3%(LIU).
Course Prerequisites:
Without
Catalog Description:
This course will cover the basis of modern agriculture biotechnology, molecular entomology and plant pathology. In the first part, we will explain the importance of insect science and its impact on agriculture, forest, and human health. We will also discuss several important aspects of molecular entomology such as systematics, metabolism, endocrinology, reproduction, locomotors system etc. The basic knowledge of insect physiology, molecular biology, and biochemistry, which were used to study entomology, will be provided during the class. The second part of the course will give students the general view of the history and development of plant pathology. Particularly, the concepts of plant innate immunity and plant epidemiology will be introduced and emphasized, including PAMPs triggered immunity, effector triggered immunity and basal defense of plants. In addition, plant pathogen isolation and identification and plant protection will be discussed in the course.

Schedule of the course

	Name	Hours	Contents
1	General introduction to entomology	3.0	Important Conception of entomology
			Classification and structure of insects
			Agricultural and Medical entomology
2	DNA synthesis, transcription, and translation	3.0	DNA synthesis and its application in entomology
			DNA transcription
			DNA translation
3	Insect transgenesis and comparative genomics	3.0	Insect transgenesis
			Comparative genomics
			functional genomics
			Review and Case studies

4	Molecular Systematics and Phylogeny	3.0	Molecular systematics
			Phylogeny
			intoduction to population genetics
5	Circulatory system, Endocrinology and Reproduction	3.0	Circulatory systems
			endocrinology
			reproduction
			First hour exam
6	Insect Locomotion	3.0	Insect muscle
			How insect fly
			How insect jump
7	Insect Nervous System	3.0	Neuron and glial cells
			Basic functioning
			Anatomy of the nervous system
			Controlling behavior
8	Insect Visual Signaling	3.0	Structure and function of compound eye
			Light adaptation of compound eye
			Perception of light signal
			Insect color and light production
9	Insect Chemical Communication	3.0	Structure of olfactory receptor
			Functions of pheromones
			Examples of pheromones in regulating insect behavior
10	Insect Mechanical Communication	3.0	Mechanoreception
			Producting sound and substrate vibration
			Second exam
11	Insect experiment	5	Insect specimen analysis
			Insect classification
			Insect dissection
12	Introduction to Plant Pathology	3.0	History of Plant Pathology
			Plant Pathology and human life
			Plant Disease:bacteria, fungi and virus
13	Plant basal defense	3.0	Non-host resistance
			Salicylic acid-mediated immune response
			Jasmonic acid-mediated immune response
14	PAMP-triggered immunity	3.0	Origin of immunity
			PAMPs and receptors
			PAMP-triggered immunity
15	Effector-triggered immunity	3.0	Effectors:structure,secretion and function
			Resistance proteins:structure,perception and evolution
			Effector-triggered immunity
16		3.0	Plant epidemiology

	Plant epidemiology and field managments		Disease occurrence and conditions
			Disease management and crop protection

Textbook and any related course material:

Marc J. Klowden (2007) Physiological Systems in Insects. 2nd Ed. Elsevier Inc. (One annotated version permitted to publish in PRC)

George N. Agrios (2005) Plant Pathology, Fifth Edition Acadmeic Press, London, UK.

Reg Chapman (1997) The Insects Structure and Function 4th Ed. University Press, Cambridge, UK.

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

Course title

15.Biochemistry

Instructor(s)-in-charge:
Prof. ZHONG Liangwei and Professor ZHANG Zhuqing
Course Type:
Lectures and project works
Course Assessment:
A written final examination and an oral presentation of a project work.
Grading Policy:
An open written final examination (60%), an oral presentation of a project work (30%) and attendance (10%).
Course Prerequisites:
A knowledge on organic chemistry.
Catalog Description:
Upon completion of the course, the students should: (1) be familiar with the basic properties and functions of amino acids and proteins, as well as the principle for protein separation, purification, identification; (2) know how to analyze enzyme activity, enzyme kinetics and protein-protein interaction; (3) understand protein synthesis, targeting and modifications; (4) understand the association of abnormal glucose, lipid and amino acid metabolism with diseases; (5) be able to explain connections among carbohydrate metabolism, lipid metabolism and amino acid metabolism; (6) be able to evaluate biochemical literatures and give an oral presentation.
Content
The course is divided into the following parts:

Introduction to Biochemistry (Professor ZHONG liangwei)

Section A – Amino acids and proteins (Professor ZHONG liangwei)
- **A1. Amino acids and proteins**
- **A2. Structures and functions of proteins**
- **A3. Purification of proteins**

Section B – Enzymes (Professor ZHONG Liangwei)
- **B1. Properties of enzymes**
- **B2. Factors affecting enzyme activity**
- **B3. Enzyme kinetics and inhibition**

Section C – Protein synthesis, targeting, modifications and folding (Professor ZHONG Liangwei and Professor ZHANG Zhuqing)
- **C1. Protein synthesis**
- **C2. Protein targeting**
- **C3. Protein modifications**
- **C4. Protein folding and protein structure prediction (Professor ZHANG Zhuqing)**
- **C5. Protein design and structure-based drug design (Professor ZHANG Zhuqing)**

Section D – Carbohydrate metabolism (Professor ZHONG Liangwei)
- **D1. Basic properties of carbohydrates**

D2. Metabolic pathways
D3. Digestion and absorption
D4. High glucose and oxidative stress

Section E – Lipid metabolism (Professor ZHONG Liangwei)
E1. Structure and roles of fatty acids
E2. Fatty acid breakdown and synthesis
E3. Cholesterol metabolism
E4. Lipoproteins

Section F – Nitrogen metabolism (Professor ZHONG Liangwei)
F1. Nitrogen fixation and assimilation
F2. Amino acid metabolism
F3. Urea cycle

Section G — Electron Transport and Oxidative Phosphorylation (Professor ZHONG Liangwei)
G1. The electron transport chains
G2. Oxidative phosphorylation.

Teaching Methods
- ✧ **The teaching includes lectures and project works.**
- ✧ **Project works encourage intensive reading of literatures, giving an oral presentation.**

Suggested Textbook, References and Link
- ✧ **Lehninger, Principles of Biochemistry, Sixth edition.**
- ✧ **Courseware updated in 2023.**
- ✧ **Research papers.**
- ✧ **Entrez Medline: http://www.ncbi.nlm.nih.gov/pubmed/**

Course title

16.Conservation Biology

Instructor(s)-in-charge:
Prof. JIANG Zhigang
Email: jiangzg@ioz.ac.cn

Course type:
Lectures, student presentations in "inverted classroom", prerecorded Reading Course for taking-home (Figure 1).

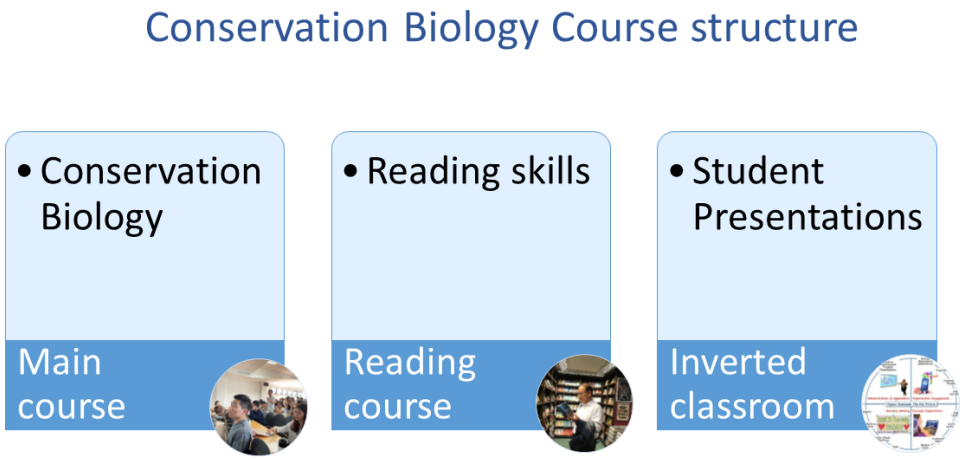

Figure 1 The course structure.

The course is divided into 15 modules, four-lecture hours in each module： 3-hour lecture by the instructor in classroom and one-hour pre-recorded reading course PPTs for the students to take home.
Student are required to write a maximin 2,000- word paper about his/her talk in the 2nd"Inverted Classroom"and handed the paper to the professor as his/her final exams at the end of course.

Course Schedule:
To be announced.

Course Assessment:
One-hour pre-recorded reading course PPTs for the students to take home each module.
Two preparations for the "inverted classroom"

Grading Policy:
40% inverted classroom presentations+ 50% final exam paper + 10% attendance.

Expected level of proficiency from the students entering the course:
University level education in Biology, Biological Technology or applied biology sciences like Agricultural Science, Forestry Science, Environmental Science, Aquatic and Oceanic Sciences, Medical and Vet Science as well as university level

education in Education Science and Management Science.

Teaching Assistant:
Associate Professor LIU Xuecong, email: xuecongliu@ucas,ac.cn

Catalog Description:
Conservation Biology is a science of protecting biodiversity, preventing human caused species extinctions and maintaining sustainable development and well-being and longtime existence of human society. Conservation Biology was established in mid-1990s in the United States of America, and it has fully grown into a main stream science since its' born. In this course, the professor will start a briefly review of the big history of human civilization, the biodiversity crisis and nascent of Conservation Biology, followed by introducing the concepts such as public goods and services, Veblon Effect, consumerism, and consumer behavior in modern society from behavioral economics perspective, and the professor will emphasize the needs of rethinking about the doctrines in the master piece of philosophy, Tao Te Ching, and social norms. Then the professor will talk about the history, scope, and missions as well as theoretic frames and practice measures of Conservation Biology.
In the following lectures, the professor will present the principles, methods, and characteristics of Conservation Biology, which now is transforming into a new science branch—Conservation Sciences. The professor will explore Animal welfare and animal rights from philosophy perspective, by tracing back to history for origin, and the schools, summarizing the main stream of development in the field. The students will be arranged to talk about the animal welfare, animal rights and conservation issues in their own words in the inverted classroom.

Species diversity is the core of biodiversity. The professor will introduce the evolution of species concept in biological science and its modern definition, will review the famous question in science: "How many species are there on Earth?", plus the Tree of Life. Then the professor will elaborate on the speciation and extinction of species and the last effort of reviving an extinct species—the emerging de-extinction protocol.
Global Change is an important issue and it is also a disputing issue. The professor will trace the development of the issue and talk about its impacts on conservation with examples form the Qinghai-Tibetan Plateau and the Arctic. Plausible mitigation measures of the impacts of global change, like zero carbon release, carbon emission trade, will be given. The professor will introduce the diverse landscapes, the sharply contrasting climate types, different habitats and rich fauna and flora in the country. A piece of BBC Wild China will be played in the classroom to aid the students to understand the fauna and flora in the country.

The professor will talk about the threatened wild species and degraded natural ecosystems in the country due to intensified human activities, land-cover change, environmental pollution, growing of human population plus the influence of global change. The professor will talk the legend of giant panda as an example of flagship species and talk about the down-listing of giant panda in China's Red List of Biodiversity in 2016, at same time introduce the IUCN Red List Criteria for Endangered Species and China's Red List of Vertebrate, with exercise in assessing species using the IUCN Red List Criteria for Endangered Species. The

professor will elaborate the biodiversity relevant international treaties like Convention on Biological Diversity (CBD), Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), which provide the international law environment for conservation and the country 's endeavor in implementation its commitments. Besides to conduct basic research in classifying, inventorying, and monitoring biodiversity, the scientists in country also carried out conservation researches to back up the commitments of the government to implementation of CBD and CITES, such as rescuing endangered species, reforesting the mountains, and combating desertification, as well as protecting habitat of wild species and maintaining ecosystem functioning and services. All these be covered in the course.

While reviewing the current development of Conservation Biology in the world, the professor will give case studies of China's endemic species; represent biomes and conservation practice to enrich the contents of course. Small population is a real problem in conservation, with practice in computer simulation, the students will understand the genetic problems in small populations. The professor with talk about Extinction Vortex, the genetic draft, the genetic purge, and the Population Variability Analyses (PVA) in the introduction to Conservation Genetics.

Agricultural diversity is a key to human well-being, the professor will talk about the animal and plant domestication in nascent human civilization, the Green Revolution and the crisis in crop and domestic animal breeds in modern society. In situ and ex situ conservation are two major approaches in preserving threatened species. The professor will explain why should we carry out ex situ conservation and how to carry out it, with examples from Saudi Arabia and China. The professor will introduce the translocation of endangered species and reintroduction of locally extinct species.

The professor will also introduce the protected areas (PAs) in terms of the IUCN definition such as, natural reserves, wildlife refuge, national parks, and nature parks, World Natural Heritage Sites, as well as the "Green for Grain", "Green for Grass" projects and Ecological Civilization perspective in China as examples of in situ conservation, and will review the "Half Earth" initiative and the development and analyze the achievements and shortfalls in management of PAs.

In the section of The Pandora's Box: Zoonosis and Conservation, the instructor will take the outbreak of COVID-19 as an example to shed lights on the new challenge in Conservation Biology. With case study, the professor will illustrate the emerging and reemerging of pandemic disease, particularly zoonosis- the wild animal human share disease and its threats to human society and wild animal populations.

"Inverted Classroom". The part of the student oral presentations in the course lectures serve as "Inverted Classroom". The classroom is thus inverted that requires students to work independently before the presentations, to access materials in library, to read enhanced e-books, to search for reference and to discuss with other students on the Internet. Such a practice is a rearrangement of lectures to student presentations, which enhancing the students' power of learning. Each student in the course will have time to focus more on proactive project-based learning, working together to address localization or globalization challenges and other real-world issues to understand conservation.

There will be two Inverted Classrooms. The theme of the 1st Inverted Classroom is Animal Welfare and Conservation The whole class will have a class discussion

on the content of Animal Welfare and Bioethics taught by the professor in the previous lecture. The purpose of the presentation is to exercise everyone's abilities of logical thinking, induction and analysis, team spirit, material display and expression skills. In the 2nd inverted classroom, each student shall write a 2,000-words thesis of the topic he/she talked in 2nd inverted classroom with literature citation, which should be hand out as the open-air examination to the professor at the end of last lecture.

The professor and Teaching Assistant will guide the student presentation and will lead corresponding discussion in the inverted classroom. In the 1st Inverted Classroom, students work in groups, but in the 2nd inverted classroom, the students shall independently work out plan for learning and presentation of knowledge, while the professor and Teaching Assistant will adopt teaching and collaboration methods to meet the needs of students and facilitate their personalized learning and presentation. The goal of student presentation in Inverted Classroom is to let students learn more real know-how from their thesis and future career through practice.

Course Contents and Schedule

Lecture	Contents
1	1) The Big History of Conservation 2) Offline Reading in Conservation 1: Introduction
2	1) Principles, Ideas and Methods 2) Offline Reading in Conservation 2: Reading through the Internet
3	1) Animal Welfare, Animal Right and Conservation 2) Offline Reading in Conservation 3: Comprehensive Reading
4	1) 1st "inverted Classroom' Animal welfare and Conservation 2) Offline Reading in Conservation 4: Speed reading
5	1) Speciation, Extinction and De-Extinction 2) Offline Reading in Conservation 5: Intensive Reading
6	1) Population Monitoring and Conservation 2) Offline Reading in Conservation 6: Critical Reading
7	1) Global Change and its Impacts on Conservation 2) Offline Reading in Conservation 7: Learn to review
8	1) The Small Population Problem in Conservation

	2) Offline Reading in Conservation 8: Managing reference
9	**1) Criteria for Endangered Species and IUCN Red lists** **2) Offline Reading in Conservation 9: Summarizing and Reviewing**
10	**1) Ex-situ Conservation** **2) Offline Reading in Conservation 10: Learning writing from reading**
11	**1) Protected Areas** **2) Offline Reading in Conservation 11: Presenting What You Read**
12	**1) The Pandora's Box: Zoonosis and Conservation** **2) Offline Reading in Conservation 12: Preparing for Your Future**
13	**1) Inverted classroom: Student presentation I** **2) Offline Reading in Conservation 13: Understanding structure of action plans.**
14	**1）"Inverted Classroom"：Student Presentation II** **Student handout a paper of max. 2000 words about their talk as course paper.** **2） Offline Reading in Conservation 14: The Review Chapter and Thesis Format**
15	**Course paper：** **Students handout a paper of max. 2000 words (literature included) about the theme they talked as their course papers.** **Offline Reading in Conservation 15: Looking for grants and jobs to realize your dreams**

Contents of the course：

Lecture 1: The Big History of Conservation

(1) Course introduction
(2) Human civilization
(3) The biodiversity crisis
(4) The nascent of Conservation Biology
(5) Public goods, consumerism and consumer behavior
(6) Environment problems we confronted
(7) Rethink about Tao Te Ching and Social Norms
(8) The nascent of Conservation Biology

Lecture 2 Principles, Ideas and Methods in Conservation Science

(1) Mega biodiversity countries

(2) Biodiversity hot spots
(3) Physical geography of China
(4) Case study: Video BBC Wild China
(5) Vegetation: global vs. China
(6) Origin centers of crops in the world
(7) Crops, fruits, and garden plants native to the far east

Lecture 3 Animal Welfare, Animal Rights and Animal Protection

1 Start from the "cat slaughter" incident in Australia
2 Animal Welfare
3 Animal Rights
4 Animal Awareness
5 Bioethics
6 What shall we do?
7 Summary

Lecture 4 1st Inverted Classroom: Welfare and Conservation

Introduction "Scientists are curious and passionate and ready to argue".

The whole class will have a class discussion on the content of Animal Welfare and Bioethics taught by the professor. The purpose of the speech is to exercise everyone's logical thinking, induction and analysis, team spirit, material display and expression skills. Please let go of your thoughts, work together, explore boldly, and express bravely.

The three-lecture-hour discussion is arranged as follows:

The whole class is divided into 6 discussion groups, students can combine freely. The maximum number of students per group is n/6 (n is the number of students registered for the course); Each group will select one convener and one recorder. Students are welcome to apply voluntarily. If one group is full, please select another group.

The convenor of each group convents the members of the group, draws lots for a discussion topic, coordinates students to discuss, and prepare PPT reports. The recorder is responsible for keeping records.

Lecture 5 Speciation, Extinction and De-Extinction

(1) Evolution of species concept
(2) The Tree of Life
(3) How many species are there on Earth?
(4) Speciation
(5) Extinction of species
(6) The De-Extinction

Lecture 6 Population monitoring and conservation

(1) Factors affecting populations

1 r-/K- life history strategies
2 Population parameters

(2) Monitoring of populations

1 Direct counting method
2 Indirect monitoring methods
3 Population density and trend inference
4 Problems and countermeasures

(3) Conservation of populations

1 Population viability analysis
2 Wild population management and conservation

(4) Summary

Lecture 7 Global Change and its Impacts on Conservation

1. **Global change: what is happening now?**
2. **The evidence and arguments**
3. **Why the dispute?**
4. **Impacts of global change on conservation**

Lecture 8: The Small Population Problem in Conservation

1. **The small population problem**
2. **The Extinction Vortex**
3. **The inbreeding**
4. **The genetic draft**
5. **The genetic purge**
6. **The Population Variability Analyses (PVA)**
7. **The classroom practice Web PopGen® simulation**

Lecture 9: Criteria of Endangered Species and IUCN Red lists

1. **Criteria of endangered species**
2. **The Down-listing of giant panda in 2016**
3. **The legend of giant panda**
4. **IUCN Red List for Endangered Species**
5. **China's Red List for Vertebrates**

Lecture 10: Ex-situ Conservation

1. **Why ex situ conservation?**
2. **How to carry out ex situ conservation?**
3. **Case study: Wildlife Conservation Center in Saudi Arabic**
4. **Reintroduction of Saiga in China**
5. **Behavioral problems in captive bred animals**
6. **A synthesis: Captive Breeding of Giant Panda**
7. **Ex situ conservation of plants: Germplasm resource repository and botanical gardens**
8. **Artificial propagation of Dendrobium**

Lecture 11: Protected Areas

1. **The definition of Protected Areas (PAs) by IUCN**
2. **IUCN categories of PAs**
3. **The growth of PAs in the world and in China**
4. **The challenges in the PAs management**
5. **The conservation of migratory species: the example of Mongolian gazelle**
6. **The Half-Earth Initiative--How much land we can set aside?**

Lecture 12: The Pandora's Box: Zoonosis and Conservation

1. **The outbreak of COVID--19 in 2019**
2. **The diseases and zoonosis**
3. **Infectious disease and wildlife populations**
4. **The remerging and newly emerging diseases**
5. **Who opens the Pandora Box?**
6. **MERS, SARS, COVID-19, lessons so far for conservation…**
7. **AI, conservation and human future**
8. **Summary**

Lecture 13: Inverted classroom: Student presentation I

Lecture 14: Inverted classroom: Student presentation II

Lecture 15: Each student writes a course paper about the theme they talked in Student Presentation Exam.

The topics for the presentations by student in the 1st inverted classroom

Topics for group discussion:
Group 1 Animal rights issues
Question 1.1: Do animals have rights?
Question 1.2: What rights do animals have, if any?
Question 1.3 If animals have no rights, do we have a responsibility towards them?
Question 1.4: If we have a responsibility to animals, what kind of responsibility is it?
Group 2 Animal farming issues
Question 2.1: Which animals can be farmed?
Question 2.2: What might be the differences in attitudes towards animals between livestock producers and urban consumers of animal products?
Question 2.3: Why can animals be raised for meat but not for fur?
Group 3 Animal welfare issues
Question 3.1: Is there a difference between the welfare of wild and domestic animals?
Question 3.2: Are humans driving other species to extinction or are we driving other species to depend on us for survival?
Group 4 Cat/Mouse problem
Question 4.1: Do you love cats?
If love, why? If not, why not?
Question 4.2: Do you love rats?
If love, why? If not, why not?
Question 4.3: Do you love all animals/wild animals?
If not, then, why not?
Group 5 Vegetarian questions
Question 5.1: Why is it OK to eat plants?
Q5.2: Can vegetarian /vegan diet satisfy human nutrition?
Question 5.3: Should people's dietary wishes be respected?
Question 5.4: Is artificial meat the solution for the future of meat for human consumption?
Group 6 Animal experiments
Question 6.1: Do you approve of the use of live animals for pharmaceutical, physiological, and psychological experiments?
Question 6.2: If not, what if new vaccines and drugs need to be tested in case of diseases common to humans and animals?

Notes for students:
Everyone in the classroom is encouraged fully express their opinions, which are not right or wrong; If members of a group do not want to publicly express their opinions, they can ask to vote anonymously, and report the voting results in the presentation;
The convenor or representatives of each group presents the results of the discussion on behalf of the group and answer the questions. Each group gave a 15-minute report and 5-minute questioning time. After one group finishes its presentation, the other 5 groups shall give a score of the presentation of the group's presentation along with the teachers.

The criteria for evaluation of the presentation:
Logic of argument, and expression. 30 points
Source of information: the origin of the information on the PPT should be

properly cites. 20 points
PPT design, like the letter size, templates, and the visual aids such as diagrams, illustrations, or photos use to aid the audience understand the presentation. 20 points
Time limit, it's important to observe time when attending meetings or appointments, especially for the students. 20 points. One point should be deducted from the score one minute more the speaker talks. Thus, the presenter is encouraged to rehearsal the presentation before the class.
Question answering. 10 points

The average score of the presentation of a group= 50% of the teacher's score + 50% of the scores from other 5 student groups
The average score of each group is the score of the members of the group, that is, the score of every member of a group is the same.

The outlines for the presentations by students in the 2nd inverted classroom
Choosing one of the following topics, each student should give a 15-min presentation with his/her own PPTs, plus 3-min questions and comments by professors and his/her peer.

Topics for student presentations:
a) My future study area.
b) A hot domain/A new advance in conservation science
c) I discovered something worth of further study.
The key points in your presentation:
For Topic a) My future study area, you should talk about the following points:

- **The back ground of the literature searching (What are current-status of the field and how do you find the reference to the recent development?)**
- **The maintain discovery in the field (Talking about key literature in the field)**
- **The weakness in methodology, the knowledge gap in the field. or your plan to work on the issue in foreseeable future**

For Topic b) A hot domain/A new advance in science, you should talk about the following points:

- **The back ground of the literature searching (How do you find the topic?)**
- **The maintain discovery in the field (Talking about key literature in the field)**
- **The weakness in methodology, the knowledge gap in the field. or your comment of the development in the field.**

For Topic c) I discovered something worth of further study in conservation/science, you should talk about the following points:

- **How did you find the issue in reading?)**
- **The general introduction to the discovery**
- **Why do you think it is a hot topic? What is the likely impact on society or scientific work in foreseeable future?**

The final mark of the student will be 10% attendance and 40% the 1st presentation + 40% in 2nd presentation and final exam, which will be an open-class exam.

In all cases, plagiarism is prohibited, once found a punishment will be applied.

Reading Skills for Students in Conservation Science
The outlines
The plan to give the Reading Skills for Students in Conservation Science in the course Conservation Biology is introduced below. Each part of the following 15 parts will be given as take-home of each lecture.

Part I General introduction

I.I Why?

- **Knowledge building/Learning**
- **Master the skill of critical reading**
- **The needs of self-taught**
- **The impacts of large language models**

I.II How?

- **Comprehensive reading**
- **Intensive reading**
- **Critical reading**

I.III What?

- **Scientific literature**
- **Science media**
- **Popular science**

Part II Reading through the Internet

- **The Knowledge Explosion**
- **The Internet Revolution**
- **Impact of AI on knowledge assimilation**
- **A convenient, efficient, and prevalent way**
- **Knowledge mining from the internet**

Part III Comprehensive reading

- **For academic learning**
- **For general interests**
- **For leisure (time-killing)**

Part IV Speed reading

- **How get the main ideas of what you read?**
- **The abstracts and summaries**
- **The tables and figures**
- **The topic sentences**
- **Building your vocabulary**

Part V Intensive reading

- **Learning the methodology**
- **Master the new advances**
- **Discover new direction for study**

Part VI Critical reading

- **Learn to ask questions**
- **Learn to be critic**
- **Find out the key points from a paper or a book**

Part VII Learn to review

- **What is the aim of the manuscript?**
- **Is the problem worth of study?**
- **What is the question/working hypothesis/the goal in the study?**
- **How did the authors test the hypothesis or achieve the goal stated?**

- **What did the authors find?**
- **Did author(s) discuss the implication and problems associated with the study?**
- **Is the author(s) read the current relevant literature for the study?**

Part VIII Managing reference

- **Download the reference**
- **Keeping taking notes**
- **Using a reference management tool**

Part IX Summarizing and Reviewing

- **Be prepared for your thesis/dissertation**
- **A literature review for your study topic**
- **The general review chapter(s) for your thesis/dissertation**

Part X Learning writing from reading

- **A good scientist is also a good writer**
- **Learn writing from reading**
- **Take a writing course, starting from writing a sentence …**

Part XI Presentation of what you read

- **Writing an outline**
- **Design your PPT**
- **Practice**
- **Be concise, confident, clear, remember the time limit is a key issue**

Part XII Preparing for your future

- **What career are there in conservation?**
- **What are your interests?**
- **Where is the information?**
- **Be prepared, always**

Part XIII Understanding structure of action plans

Part XVI The Review Chapter and Thesis Format

Part XV Looking for grants and jobs to realize your dreams

Textbook and any related course material:

Gaston, K. J. 1996. Biodiversity: A Biology of Numbers and Differences. Oxford: Blackwell Science.

Hannah L. 2012. Saving a Million Species: Extinction Risk from Climate Change. Washington, DC: Island Press.

Jeon Y. 2012. Journey to the Ecosystem of the DMZ and CCL. Seoul: Korea National Park Serves, Ministry of Environment.

Jiang, Z. 2016. The deterministic effect of the CITES and nominal impacts of social norms on global wildlife trade. RE: "Collective Action: Social norms as solutions" Science 354:42-43.

http://science.sciencemag.org/content/354/6308/42.e-letters.

Jiang, Z. 2016. The responsibility and readiness of young conservation scientists. E-letter to P. Gluckman. The science–policy interface. Science 353: 969.

http://science.sciencemag.org/content/353/6303/969.e-letters

Jiang, Z. 2002. Key Topics in Biodiversity and its Conservation, an English

training book for UNDP/UNEP/GEF Biodiversity Support Program for the Northwest and East Central Asia Region.
McCord, E. L. 2012. The Value of Species. New Haven: Yale University Press.
Novacek, M.J. 2001. The Biodiversity Crisis. New York: The New Press.
Primack, R. B. 2010. Essentials of Conservation Biology. 5th ed. Sinauer Associates, Inc. Sunderland, USA.
Stearns, B. P. and Stearns S. N. 1999. Watch, from the Edge of Extinction. New Haven: Yale University Press.
Wilson, E. O. 2001. The Diversity of Life. London: Penguin Books. [Twice winner of Pulitzer Price]

Video BBC Wild China

Course title

17.Introduction to Epigenetics and RNA silencing

Instructor(s)-in-charge:
Prof. Xiaoming Zhang , Prof. Xianhui Wang & Prof. Weiqiang Qian
Course type:
Lecture
Course Schedule:
4hrs/week by instructors. 44 hrs in total by Prof. Min Fang; 8 hrs in total by Prof. Xianhui Wang; 8 hrs in total by Prof. Weiqiang Qian.
Course Assessment:
mini-tests in each section
Grading Policy:
mini-tests scores
Course Prerequisites:
Without
Catalog Description:
Epigenetics and RNA silencing are two of the hottest topics in the past two decades. Epigenetics is the study of heritable changes in gene expression that do not change DNA sequence. RNA silencing is a general regulation mechanism in eukaryotes that regulates gene expression by 20-30 nt sRNAs in transcription or post-transcription levels. In this Epigenetics, we will introduce how DNA methylation, histone modification, chromatin remodeling, long non-coding RNAs and RNA modification regulate gene expression in eukaryotes. In the second part, we will study RNA silencing on sRNA generation, amplification, loading, action, turnover, and function. The most popular technologies used in Epigenetic studies and non-coding RNAs will also be discussed.
This course not only will provide students the basic concepts of RNA silencing and Epigenetics, but also will provide student the requisite methods in these two fields. At the same time, we will share the students a story in RNA silencing or Epigenetic fields in each class. These stories include but not limit to: Transgenic technology, Cross-kingdom RNA silencing, anti-viral function of RNA silencing, X-inactivation, Transgenerational epigenetic inheritance, Imprinting, disease, Honey bee epigenome, and flowing. After the course, the students should understand the biogenesis and function of small RNAs, lncRNAs, the difference between genetic and epigenetic regulation and how to study projects relate to Epigenetics and RNA silencing:
Schedule of the course

section	content	hours	
1	Introduction to Epigenetics and RNA silencing	4	Prof. Xiaoming Zhang
2	Histone modification / X-inactivation	4	Prof. Xiaoming Zhang
3	Histone variation / Epigenetics regulation in disease	4	Prof. Xiaoming

			Zhang
4	**Chromatin remodeling / Epigenetics in flowering**	**4**	**Prof. Xiaoming Zhang**
5	**DNA methylation-establishment and maintenance / Imprinting**	**4**	**Prof. Weiqiang Qian**
6	**DNA demethylation / Molecular tools to study DNA methylation**	**4**	**Prof. Weiqiang Qian**
7	**Transgenerational epigenetic inheritance**	**4**	**Prof. Xianhui Wang**
8	**Honey bee epigenome**	**4**	**Prof. Xianhui Wang**
9	**sRNA processing / RNA amplification and loading / RNA silencing function in plant immunity to virus**	**4**	**Prof. Xiaoming Zhang**
10	**Target recognition and action of sRNAs / Popular tools to study RNAi**	**4**	**Prof. Xiaoming Zhang**
11	**The modification and degradation of sRNAs / Animal virus and RNA silencing**	**4**	**Prof. Xiaoming Zhang**
12	**The movement of RNA silencing / Cross-kingdom RNAi**	**4**	**Prof. Xiaoming Zhang**
13	**The application of RNA silencing in research, human health and crop production**	**4**	**Prof. Xiaoming Zhang**
14	**Long non-coding RNA, Circular RNA and RNA modifications**	**4**	**Prof. Xiaoming Zhang**
15	**Bioinformatics tools to study RNA silencing and Epigenetic**	**4**	**Prof. Xiaoming Zhang**
total		**60**	

Textbook and any related course material:

C. David Allis, Marie-Laure Caparros, Thomas Jenuwein, Danny Reinberg (2015) Epigenetics，2nd Ed, CSHL press.

Narendra Tuteja, Sarvajeet Singh Gill (2013) Plant Acclimation to Environmental Stress, Springer.

Kenneth Alan Howard (2013) RNA Interference from Biology to Therapeutics (Advances in Delivery Science and Technology), Springer.

Tamas Dalmay (2017), Plant Gene Silencing: Mechanisms and Applications, CABI press.

Expected level of proficiency from students entering the course:
Molecular Biology: basic
Cell Biology: basic

Course title

18.Nanobiological Sensing and Detection

Instructor(s)-in-charge:
Prof. Lele Li
Course type:
Lecture
Course Assessment:
Homework: 7 assignments
Grading Policy:
Assignments 50%, Final 30%, Attendance 20%
Course Prerequisites:
College Chemistry, College Materials, English.
Catalog Description:

Biosensing and imaging using nanomaterials and nanotechnology has the potential to revolutionize scientific research and medical diagnostics. This course will focus on the principles, construction, and application of Nano-biosensing and imaging systems, and particularly the impact of nanotechnology on the development of biosensors. The course will be started with an introduction of the solid background on the nano-biological sensors, bioimaging, nanomaterials and nanotechnology, biorecognition units, biomarkers, and disease diagnostics. Then, examples of biosensing and imaging systems created from various nanomaterials are introduced, including fluorescent/luminescent nanoparticles, magnetic nanoparticles, carbon nanomaterials, gold nanoparticles, porous materials, and DNA nanostructures, with a distinct emphasis on the need to tailor nanosensor designs to specific biotargets. The topic of cancer-specific nano-biosensors will also be addressed and discussed to provide deep insight into the recent advances of using nano-biosensors for disease diagnostics and therapy.

Schedule of the course

No.	content	hours
1	Introduction of nano-biosensing and imaging technology	3
2	Nanostructured materials used for construction of biosensing and imaging systems	3
3	Surface functionalization of nanomaterials with biorecognition unit	3
4	Principles of biosensing and imaging design for overcoming biological barriers	3
5	Quantum dots-based fluorescent biosensing and imaging	3
6	Lanthanide ions-doped nanomaterials for luminescent biosensing and imaging	3
7	Fluorescent biosensors based on aggregation-induced emission	3
8	Flipped classroom: Fluorescent nanoparticles for biosensing and imaging	3
9	DNA nanotechnology for biosensing and imaging	3
10	Flipped classroom: DNA nanotechnology for biosensing and imaging	3
11	Mesoporous silica-based biosensing and imaging	3
12	Metal-organic frameworks-based biosensing and imaging	3
13	Flipped classroom: Porous nanoparticles for biosensing and	3

	imaging	
14	**Magnetic nanomaterials-based biosensing and imaging**	**3**
15	**Gold nanomaterials-based biosensing and imaging**	**3**
16	**Carbon nanomaterials-based biosensing and imaging**	**3**
17	**Flipped classroom: Metal- and carbon-based nanomaterials for biosensing and imaging**	**3**
18	**Theranostics: Integration of Bioimaging with Therapy**	**3**
19	**Theranostics: Integration of Bioimaging with Therapy**	**3**
20	**Final exam**	**3**
total		**60**

Textbook and any related course material:

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

Course title

19.Integrative Systematic Biology

Instructor(s)-in-charge:
Prof. ZHU Chao-Dong, Dr. LUO A-Rong, Dr. Douglas CHESTERS
Course type:
Lecture
Course Schedule:
4hrs/week by instructor.
Course Assessment:
Homework: 3 assignments, presentations
Grading Policy:
Typically 40% homework, 40% presentations, 20% final.
Course Prerequisites:
Basic knowledge in general biology and molecular biology.
Catalog Description:
This course offers an introduction to Integrative Systematic Biology, generally including four sections. The first section covers topics aiming at the foundation of systematic biology – species classification, such as traditional morphological taxonomy, morphometrics, graphic analysis, and molecular species delimitation. The second section then targets the systematics of classified species via both molecular sequences and morphological characters. With this section, students will be knowledgeable of molecular models accounting for molecular evolution, advances in phylogenomic research, methods for estimating evolutionary timescales of the Tree of Life, and so on. The third section focuses on advanced topics including ancestral trait reconstruction, species diversify and diversification rates, co-evolution between species groups, evolutionary hypotheses, and so on. The fourth section provides demos which would teach students important techniques in this field, such as R programming, statistics analyses, and tree reconstruction.

Schedule of the course

Section	Content	Hours	Sections	Content
1	Systematics Foundations	3	1	Evolutionary Biology
			2	Tree of Life
			3	Classification and Phylogeny
			4	Biodiversity Macroevolution
2	Molecular Systematics	3	1	Species Delimitation
			2	Species Interactions
3	Molecular Phylogenetics and Phylogenomics	3	1	Phylogenetics Trees
			2	Tree Thinking

			3	Molecular Phylogenetics
			4	Phylogenetic Data
			5	Phylogenetic Methods
			6	Phylogenomics
			7	Gene Tree and Species Tree
4	Species Theories and Molecular Species Delimitation	3	1	Available Species Concepts
			2	Hypotheses of Speciation
			3	Controversies of species
			4	Recent developments of the species concept
			5	Molecular Species Delimitation and Case Studies
5	Molecular Ecology Background	3	1	Molecular Markers
			2	DNA Taxonomy and DNA Barcoding
			3	Metabarcoding
			4	Genetics in Biogeography
6	Applied DNA Barcoding	3	1	Phylogenetics for Molecular Ecology
			2	Integrating Omics with DNA Barcodes
			3	Multi-Faceted Molecular Profiling
7	Student Presentation	3	1	Student Presentation
8	Student Presentation	3	1	Student Presentation
9	Student Presentation	3	1	Student Presentation
10	Phylogeography and Conservation	3	1	Case Studies
11	Phylogenetics in the Era of Big Data	3	1	Synthesis Phylogenetics
			2	Tree of life for Insects
12	Molecular Clock and Estimating Evolutionary Timescales	3	1	Bayesian Phylogenetic Analysis
			2	Markov Chain Monte Carlo Sampling
			3	The Molecular Evolutionary Clock
			4	Estimating Evolutionary Timescales

			5	Framework of Bayesian Molecular Clock Dating
			6	Molecular Clock Dating with BEAST 2
13	Final Examination	3	1	Final Examination

Textbook and any related course material:
The Phylogenetic Handbook: A Practical Approach to Phylogenetic Analysis and Hypothesis Testing, edited by Philippe Lemey, Marco Salemi, and Anne-Mieke Vandamme, 2009, Cambridge University Press;
Phylogenetics in the Genomic Era, edited by Celine Scornavacca, Frédéric Delsuc, Nicolas Galtier, 2020, No commercial publisher, Authors open access book, hal-02535070.
The Molecular Evolutionary Clock: Theory and Practice, edited by Simon YW Ho, 2020, Springer.
Expected level of proficiency from students entering the course:
Biology: strong
Mathematics: competent

Course title

20.Global Change Ecology

Instructor(s)-in-charge:
Prof. WANG Tao et al.
Course type:
Lecture
Grading Policy:
The grading for this course will be based on:
- Participation (30% of grade)
- Report (70% 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 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 prior to the due date. Each student should be expected to give a report at the end of the course.**
Course Prerequisites:
This course does not have any pre-requisites.
Catalog Description:
This course is designed as an introductory course in ecology for graduate students majored in Earth Sciences. The class is intended to provide an introduction to main ecological processes, with particular attention to the responses of these processes to global change at local, regional, and global scales. It will also introduce the basic principles of local field measurement techniques, remote sensing, and land surface modeling in relation to carbon and nitrogen cycles. The course is structured as a series of lectures in which individual research cases are discussed with faculty tutors. It will cover the following topics:
Schedule of the course

Section	Content	hours
1	Introduction of global change ecology	4
2	Plant ecophysiological response 2.1 Concepts 2.2 Methods - controlled experiment and stable isotope record 2.3 Responses to elevated CO2 and nitrogen availability 2.4 Responses to warming and drought 2.5 Impacts of multiple factors and their interaction	8
3	Responses of terrestrial ecosystems 3.1 Forests 3.1.1 Cambial activity and wood structure of trees 3.1.2 Elevational and latitudinal distribution of forests 3.1.3 Global change and forest growth 3.2 Grasslands 3.2.1 Plant phenology 3.2.2 Plant composition and diversity 3.2.3 Plant production and decomposition 3.2.4 Greenhouse gas fluxes 3.2.5 Carbon sequestration 3.3 micro-organisms	24

	3.3.1 The origin and evolution of microorganims **3.3.2 Classification of microorganims** **3.3.3 The role of microorganims in the response of terrestrial ecosystems to climate change** **3.3.4 Methods: controlled microcosms experiments and field investigation** **3.3.5 Methods to study the microbial ecology** **3.3.6 Responses to warming, precipitation and drought** **3.3.7 Responses to eCO2 and N availability (GeoChip or high throughput seq)**	
4	**Regional and global responses** **4.1 Approaches: Satellite observations** **4.2 Approaches: Land surface modeling** **4.3 Terrestrial vegetation dynamics** **4.4 Carbon cycle** **4.5 Nitrogen cycle**	**20**
5	**Mitigation and adaption** **5.1 Concepts** **5.2 Land use and reduce of GHG emissions** **5.3 Accounting methodology of GHG reduction and monitoring** **5.4 Carbon trade**	**4**
Total		**60**

Course title:

21.Plant Physiology and Ecology

Instructor:
Associate Prof. Laiye Qu
Course type: Lecture
Course Assessment:
None
Grading Policy:
Registration (17% of the final score)
one report (50% of the final score)
one quiz (33% of the final score)
Course Prerequisites:
None
Catalog Description:
This course will introduce the plant physiological mechanisms that underlie ecological observation under the changing environment. The course will mainly introduce some general knowledge of photosynthesis, plant water relations, mineral nutrients, growth and allocation, symbiosis associations, and plant-soil interaction. Some general research methods and some basic statistical analysis and statistical plotting also will be introduced.
Schedule of the course

No.	Objectives	Remarks
1.	General Introduction	
2.	Plant adaption	
3.	Photosynthesis	
4.	Respiration	
5.	Plant water relations	
6.	Mineral nutrients	
7.	Nitrogen	
8.	Decomposition	
9.	Phosphorus	Report
10.	Mycorrhiza	
11.	Multiple relationship	
12.	Growth and allocation	
13.	Restoration	
14.	Succession	
15.	Plant-soil feedback	
16.	General discussion	
17	Examination	Presentation

Course title

22.Applied Statistics

Instructor(s)-in-charge:
Assoc. Prof. Qian WANG Email: wangqian@ucas.ac.cn
Course type:
Lecture
Grading Policy:
Participation+in-class quiz (30%), Homework (40%), Project (30%)
Catalog Description:
This course is an introduction to applied statistics and data analysis. Topics are chosen from descriptive measures, sampling and sampling distribution, estimation and confidence interval, hypothesis test, linear regression, ANOVA, goodness-of-fit and contingency analysis. Data analysis is difficult without some computing tools and the course will introduce some statistical computing with Excel.
Contents and Schedule of the course

Section	Contents	Hours
1. Introduction	● What is statistics? ● Process of statistical study ● Key definitions ● Data types	**5**
2. Data Collection	● Data sources: Primary/Secondary ● Data collection methods: Survey/Observation/Experiment ● Issues in data collection ● Sampling techniques: Probability/Nonprobability ● Sampling errors	**8**
3. Descriptive Statistics	● Graphical presentation of data: Categorical/Numerical ● Measures of data: Center/Variation/Shape ● Covariance & correlation coefficient	**5**
4. Estimation	● Introduction of statistical inference ● Sampling distribution ● Point estimation ● Confidence intervals: one population/two populations ● Determine sample size	**6**
5. Hypothesis Testing	● Introduction ● Null Hypothesis and Alternative Hypothesis ● Type I Error and Type II Error ● Test on one populations: mean/proportion/variance	**5**

	• Test on two populations	
6. Goodness-of-fit: Chi-square test	• Chi-square test of proportion for Multinomial Experiment • Chi-square test of independence • Chi-square test of distribution	3
7. Linear Regression	• Relationships between variables and regression • Simple linear regression • Residual analysis • Multiple linear regression: Collinearity • Model building: Nonlinear/Categorical variables/Variable selection • Common Mistakes in Regression • Logistic regression	9
8. ANOVA	• Introduction • One-way ANOVA • Randomized Blocks ANOVA • Two-way ANOVA	6
9. Presentations	• Project Presentations and Final Review	3

Textbook and any related course material:

1. **David Spiegelhalter. The art of Statisitcs: Learning from Data. Penguin Random House, UK, 2019.**
2. **Roxy Peck. Statistics: Learning from Data. Cengage Learning, 2017.**
3. **Pawel Lewicki and Thomas Hill. Statistics: Methods and Applications. Springer, 2006.**
4. **Ajit C. Tamhane and Dorothy D. Dunlop. Statistics and Data Analysis: From Elementary to Intermediate. Prentice Hall, 2000.**

Course title

23.Fundamental for Internet of Things and Its Applications

Instructor(s)-in-charge:
Prof. Weidong Yi
Course type:
Lecture
Course Schedule:
3hrs/week by instructor. 1 hr/week by teaching assistant.
Course Assessment:
Homework: 6 assignments
Grading Policy:
Typically 30% homework, 40% final exam, 30% final project
Course Prerequisites:
None
Catalog Description:
This course provides an introduction to the fundamental concepts and principles of internet of things (IoT)and a survey of its applications at different areas. The course is broken into four parts. In Part One, Introduction, which provides an overview of IoT applications, sensor nodes, and basic system structure,different node architectures and discusses in detail the sensing and processing subsystems as well as communication interfaces. Part Two, Basic Architectural Framework, which provides a detailed discussion of protocols and algorithms used at different network protocol layers in sensor systems. Part Three, Node and Network Management, which discusses several additional techniques and presents solutions for a variety of challenges, including power management techniques, concept of time synchronization and an overview of several synchronization strategies, a variety of localization strategies and compares their trade-offs. Security challenges and defenses against attacks on sensor networks of IoT are discussed in the part. Part Four, Applications, which provides cases study for applications in IoT, including applications for environmental monitoring , structure health monitoring, traffic control, precision agriculture, smart city , smart health-care etc.
Schedule of the course

section	content
1	Motivation for an Internet of Things
2	Node Architecture of IoT
3	Operating System for IoT
4	Physical Layer
5	Medium Access Control
6	Network Layer
7	Power Management
8	Time Synchronization
9	Localization
10	Security

11	**Applications**
12	**Student presentation**
13	**Final Exam**
total	

Contents of the course

1. **Motivation for an Internet of Things**
   - (1) **Definitions and Background**
   - (2) **Challenges and Constrains**
2. **Node Architecture of IoT**
   - (1) **The Sensing Subsystem**
   - (2) **The Processor Subsystem**
   - (3) **Communication Interfaces**
   - (4) **Prototypes**
3. **Operating System for IoT**
   - (1) **Functional Aspects**
   - (2) **Nonfunctional Aspects**
   - (3) **Prototypes**
4. **Physical Layer**
   - (1) **Basic Components**
   - (2) **Source Encoding**
   - (3) **Channel Encoding**
   - (4) **Modulation**
5. **Medium Access Control**
   - (1) **Wireless MAC protocols**
   - (2) **Characteristics of MAC Protocols in Sensor Network of IoT**
   - (3) **Contention-Free MAC Protocols**
   - (4) **Contention-Based MAC Protocols**
   - (5) **Hybrid MAC Protocols**
6. **Network Layer**
   - (1) **Routing Metrics**
   - (2) **Flooding and Gossiping**
   - (3) **Data-Centric Routing**
   - (4) **On-Demand Routing**
7. **Power Management**
   - (1) **Local Power Management Aspects**
   - (2) **Dynamic Power Management**
   - (3) **Conceptual Architecture**
8. **Time Synchronization**
   - (1) **Basic of Time Synchronization**
   - (2) **Time Synchronization Protocols**
9. **Localization**
   - (1) **Ranging techniques**
   - (2) **Range-Based Localization**

(3) Rang-Free Localization
(4) Event-Driven Localization

10. Security
    (1) Fundamentals of Networks Security
    (2) Security Attacks in IoT
    (3) Protocols and Mechanisms for Security
11. Applications

Textbook and any related course material:

1. Waltenegus Dargie and Christian Poellabauer, Fundamentals of Wireless Sensor Networks, 2010, John Wiley& Sons Ltd

2. Course Reader (Selected Reference Papers)

Expected level of proficiency from students entering the course:

None

Course title

24.Computer Vision and Machine Learning

Instructor(s)-in-charge:
Prof. Weiqiang Wang
Course type:
Lecture
Course Schedule:
4hrs/week by instructors. 40 hrs in total by Prof. Weiqiang Wang
Course Assessment:
Homework: 6 assignments
Grading Policy:
Typically 50% homework, 10% attendances; 40% final exam
Course Prerequisites:

advanced mathematics, linear algebra，probability theory and statistics

if image processing is learned, it is preferred but not required.
Catalog Description:
This course focuses on the basic principles and methods of machine vision and machine learning. The content includes: image forming visual principle, image filtering theory, color, texture and shape feature description, edge detection and region segmentation, stereoscopic vision, pattern learning and object classification, deep learning theory and its application in visual problems. Through the study of this course, it is hoped that students can master the basic theories and methods of computer vision and modern deep machine learning, and have an understanding of the current research status and main methods in this field, so as to provide theoretical basis and practical ability for further research on this subject.
Schedule of the course

section	content	hours	
1	Introduction and Course Review	2	Prof. Weiqiang Wang
2	Geometric Model and Calibration of Camera	7	Prof. Weiqiang Wang
3	Light and Shadow	4	Prof. Weiqiang Wang
4	Linear filtering	2	Prof. Weiqiang Wang
5	Local image features	2	Prof. Weiqiang Wang
6	Texture	3	Prof. Weiqiang Wang
7	Stereoscopic vision	5	Prof. Min Fang
8	Neural networks	2	Prof. Weiqiang Wang

9	**Clustering-based segmentation**	**3**	**Prof. Weiqiang Wang**
10	**Grouping and model fitting**	**3**	**Prof. Weiqiang Wang**
11	**Convolutional neural networks and semantic segmentation**	**3**	**Prof. Weiqiang Wang**
12	**Modern Object detection**	**2**	**Prof. Weiqiang Wang**
13	**Final exam**	**2**	**Prof. Weiqiang Wang**
total		**40**	

Contents of the course

Section 1: Introduction and Course Review

Section 2: Geometric Model and Calibration of Camera

1. **image imaging (pinhole perspective, weak perspective, camera with lens, human eyes)**
2. **internal and external parameters**
3. **geometric calibration of camera**

Section 3: Light and Shadow

1. **pixel brightness**
2. **shadow estimation**
3. **shape of a shadow image**

Section 4: Linear filtering

1. **linear filtering and convolution**
2. **shift-invariant linear systems**
3. **spatial frequency and Fourier transform**
4. **sampling and aliasing**
5. **filters and templates**
6. **technology: normalization of correlation and detection modes**
7. **technology: scale and image pyramid**

Section 5: Local image features

1. **calculate the image gradient**
2. **characterization of image gradient**
3. **find corner points and establish neighbors**

Section 6: Texture

1. **local texture characterization using filters**
2. **texture characterization by pooling texture primitives**
3. **texture synthesis and filling of holes in the image**
4. **restore shape from texture**

Section 7: Stereoscopic vision

1. **geometric properties and polar constraints of binocular cameras (polar geometry, eigenmatrix, basic matrix)**
2. **binocular reconstruction**

3. **human stereoscopic vision**
4. **use of multiple cameras**

Section 8: Neural networks

1. **overview of neural networks**
2. **back propagation network and BP learning algorithm**
3. **Big data and deep learning**

Section 9: Clustering-based segmentation

1. **human vision: grouping and gestalt principles**
2. **important applications**
3. **image segmentation based on pixel clustering**
4. **segmentation, clustering and graph theory**

Section 10: Grouping and model fitting

1. **Hough transform and fit the line and plane**
2. **Robustness (m-estimation method, RANSAC: search normal)**
3. **The probability model was used for fitting**

Section 11: Convolutional neural networks and semantic segmentation

1. **Convolutional neural network and tricks**
2. **2. Semantic segmentation and implementations of deep neural networks**

Section 12: Modern Object detection

1. **Convolutional neural networks**
2. **object detection based on deep networks**

Section 13: Final examination

Textbook and any related course material:

1. David a. Forsyth, Jean Ponce, computer vision - A modern approach (2nd Ed.), electronic industry press, June 2017

2. Ian，Goodfellow， Yoshua，Bengio，"Deep learning". MIT press, 2016.

3. Some classic papers related to the course

Expected level of proficiency from students entering the course:
advanced mathematics, basic

linear algebra，basic

probability theory and statistics, basic
image processing, basic

Course title

25.Chemical Reaction Engineering

Instructor(s)-in-charge:
Prof. Li Chunshan, Prof. Xu Baohua, Associate Prof. Li Minjie
Course type:
Lecture
Course Schedule:
4 hrs/week: 3 hrs. lecture by Instructors, 1 hr. Offline Reading Course.
Course Assessment:
Homework: 6 assignments, will be given after each class, extensive literature reading is expected.
Grading Policy:
Assignments 30%, Final 70%
Course Prerequisites:
College Chemistry, College Mathematics, English.
Catalog Description:
The course is mainly focusing on the essentials of kinetics, catalysis and chemical reactor engineering. The main issue of chemical reaction engineering is to analyze the physical chemistry of sub-processes in a reactor by a mathematical model method. Each process is expressed as an appropriate mathematical expression, thereby providing the analytical solution or numerical solution. Various typical reaction types and the proper reactor design theory will be introduced.
Schedule of the course 20×3

Section	Content		Hours
1	Introduction of Chemical Reaction Engineering	Concept of chemical reaction engineering	1
		Chemical reaction engineering and safety	2
		Chemical reaction engineering application	1 (Offline Course)
2	Homogeneous Reaction Kinetics	Concentration-Dependent term of a rate equation	1
		Temperature-Dependent term of a rate equation	2
		Searching for a mechanism	1 (Offline Course)
		Predictability of reaction rate from theory	2
3	The Kinetics of Gas-Solid Phase Catalysis	Introduction to catalysis	0.5
		Comparison between homogeneous and heterogeneous catalysis	0.5
		Catalysts composition	1 (Offline Course)

		Catalyst deactivation and regeneration	**1**
		Steps in gas-solids catalysis	**2**
		Adsorption at the gas-solids interface	**1.5**
		Adsorption modes	**1.5**
		Process for establishing kinetic models	**2 (Offline Course)**
4	**Macro-Kinetics of Gas-Solid Phase Catalysis**	**Transport and reaction at phase boundaries**	**1**
		The diffusion of gas in solid particles	**1**
		The distribution of gas concentration and temperature in solid particles.	**1**
		The correlation of the macroscopic reaction rate	**1 (Offline Course)**
5	**Autoclave Type and Homogeneous Tubular Reactor**	**Types of ideal reactors**	**1.5**
		Autoclave type reactor	**1.5**
		Homogeneous tubular reactor	**1 (Offline Course)**
6	**Gas-Solid Phase Catalytic Reaction Fixed Bed Reactor**	**Main types of fixed bed catalytic reactor**	**1.5**
		Physical parameters of fixed bed reactor	**1.5**
		Mass transfer and heat transfer in fixed bed reactor	**1 (Offline Course)**
7	**Gas-Solid Phase Catalytic Reaction Fluidized Bed Reactor**	**Concept of fluidized bed reactor**	**1**
		Fluidization phenomenon	**2**
		Geldart classification of solids	**1 (Offline Course)**
8	**Gas-Liquid Reaction and Bubbling Reactor**	**Theory sketch**	**2**
		Mass transfer with irreversible and reversible reactions	**2**
9	**The Gas-Liquid Reaction Process and the Reactor**	**Mass transfer theories**	**2**
		Key multiphase reactors	**2 (Offline Course)**
10	**Liquid-Solid Reaction and Fluid Bed Reactor**	**liquid-solid reaction process**	**3**
		Application of fluidized bed reactor	**1 (Offline Course)**
11		**Types of gas-liquid-solid Reactors**	**2**
		Macroscopic reaction kinetics	**2**

	Gas-Liquid-Solid Reaction Engineering	Application examples	2
		Discussion and prospect	2 (Offline Course)
12	Safety of chemical reaction process and Design of reactor	General rules of safety	1
		Examples of chemical reaction process safety	2
		Reactor design	1 (Offline Course)

Textbook and any related course material:

1. **Reaction Engineering, 李绍芬，2019.01，化学工业出版社**
2. **Multi-Phase Chemical Reaction Engineering and Technology，金涌，2006.05，清华大学出版社**
3. **Chemical Reaction Engineering, Octave Levenspiel, 1998.08, Wiley.**
4. **Concepts of Modern Catalysis and Kinetics, Ib Chorkendorff, Hans Niemantsverdriet, 2003.10, Wiley.**
5. **Fundamentals of chemical reaction engineering, Mark Davis and Robert Davis, 2003, McGraw-Hill (MHP)**

Course title

26.Green Chemistry and Engineering

Instructor(s)-in-charge:
Prof. Zhang, Guangjin,
Course type:
Lecture
Course Assessment:
Homework: 14 assignments, presentations
Grading Policy:
Assignments literature report 40%, Final Report 40%, Attendance 20%
Course Prerequisites:
Familiar with the basic knowledge of Chemistry, Thermodynamics.
Catalog Description:
The purpose of this course includes: Increase the interest to Chemistry and Chemical Engineering, extend scope of knowledge, make the idea of "Green" into mind. Knowing the basic knowledge of green chemistry and engineering, the definition, developments, theory and some examples; Getting the ideas on how to develop a green process and can applied the learned knowledge in your further research works. The topics include basic principles of green chemistry, task of green chemistry, Catalysis and Green Chemistry. Biocatalysis, Photo/electrical Catalysis, Solid catalyst, Acid and base, Ionic liquid and other non-organic solvents, Chemical separation, Alternate Energy sources, New synthetic route, Functional materials, Design of safe and harmless chemicals.

Schedule of the course

section	content	Hours
1	Green Chemistry: a general review	Class teaching 3h+literature reporting 1h
2	Task of green chemistry	Class teaching 3h+literature reporting 1h
3	Green chemistry and catalysis	Class teaching 3h+literature reporting 1h
4	biocatalysis	Class teaching 3h+literature reporting 1h
5	Photo-catalysis	Class teaching 3h+literature reporting 1h
6	Electro-catalysis	Class teaching 3h+literature reporting 1h
7	Solid catalyst, Acid and Base	Class teaching 3h+literature reporting 1h
8	Ionic liquid and other non-organic solvents	Class teaching

		3h+literature reporting 1h
9	**Chemical separation**	**Class teaching 3h+literature reporting 1h**
10	**Working without organic solvent**	**Class teaching 3h+literature reporting 1h**
11	**Agrochemicals**	**Class teaching 3h+literature reporting 1h**
12	**Sustainable materials**	**Class teaching 3h+literature reporting 1h**
13	**Design of safe and harmless chemicals**	**Class teaching 3h+literature reporting 1h**
14	**chemistry of long wear**	**Class teaching 3h+literature reporting 1h**
15	**examination**	**4**
Total		**60**

Textbook and any related course material:

Mukesh Doble, Green Chemistry and Processes,elsevier, 2009,
Albert Matlack, Introduction to Green Chemistry, CRC Press, 2012

Course title

27.Energy Chemistry and Energy Chemical Industry

Instructor(s)-in-charge:
Prof. Li, Songgeng, Associate prof, Fan, Chuigang
Course type:
Lecture
Course Assessment:
Homework: 10 assignments
Grading Policy:
Assignments 40%, Final 40%, Attendance 20%
Course Prerequisites:
Familiar with the basic knowledge of Chemistry, Thermodynamics, and Flow and Transport Process.
Catalog Description:
This course covers the fundamentals of energy conversion in thermomechanical, thermochemical, electrochemical, and photoelectric processes with emphasis on efficiency, environmental impact and performance. The topics include coal utilization, petro chemistry, bio-energy, fuel cell, battery and some new energy resources like hydrogen, solar, etc. Systems utilizing fossil fuels, renewable resources and hydrogen over a range of sizes and scales are discussed. Different forms of energy storage and transmission are also involved in this course. It is expected that after taking this course, students will be familiar with basic chemistry principles on energy processing, and most common energy processing technologies together with some environmental issues related.
Schedule of the course

section	content	hours
1	Energy chemistry: a general review	4
2	Coal conversion: part I : pyrolysis and gasification	4
3	Coal conversion: part II: liquefaction and combustion	4
4	Petroleum processing	4
5	Processing technologies for natural gas and unconventional hydrocarbon resources	4
6	Bioenergy: fundamentals and application I	4
7	Bioenergy: fundamentals and application II	4
8	Pollutants formation and control in energy conversions	4
9	Solar energy: basic principles, direct utilization, photoelectric conversion, chemical conversion	4
10	Hydrogen: features of hydrogen, storage tech. applications and relative technologies.	4
11	Fuel cell: overview, fundamentals, AFC, PEMFC, DMFC,SOFC, flow cell, others	4
12	Geothermal utilization	4
13	Wind energy and Ocean energy:	4
14	Energy storage technologies I : Batteries	4
15	Energy storage technologies II: Other technologies	4
Total		60

Textbook and any related course material:

Ripudaman Malhotra, Fossil Energy, Springer, 2013,
Handbook of Alternative Fuel Technologies, CRC Taylor & Francis, 2015

Giafranco Pistoia, Battery Operated Devices and Systems，Elsevier, 2009

Course title

28.Fluidization and Multiphase Flow

Instructor(s)-in-charge:
Prof. LI Fei, Associate Prof. CHEN Yanpei
Course type:
Lecture
Course Schedule:
4 hours/week: 3 hours lecture by Instructors; 1 hour offline literature reading and discussion.
Course Assessment:
Homework: 2 home exercises are to be solved individually. 2 course assignments are to be solved in groups of 2-3 students and extensive literature reading is expected.
Grading Policy:
Assignments 40%, Final 40%, Attendance 20%
Course Prerequisites:
Principle of Chemical Engineering
Catalog Description:
This course will provide comprehensive knowledge of fluidization and multiphase flow with fundamentals and applications related to chemical engineering and energy conversion. A student who has met the objectives of the course will be able to:

- **Understand the flow regime of gas-solid flow and state of the art of research and application**
- **Manage basic calculations and solve practical problems related to fluidization**
- **Overview the modeling approached**
- **Design a fluidized bed reactor with preliminary requirement**
- **Understand the progress of the Multiphase Flow experiment**

Schedule of the course

section	content	hours
1	Fluidization phenomena and history; multiphase flow-history and development	Class teaching 3h +Literature reading and discussion 1h
2	Particle characterization; single particle motion; response time	Class teaching 3h +Literature reading and discussion 1h
3	Flow regime diagram; criteria of transition; particulate and aggregative fluidization; stability analysis	Class teaching 3h +Literature reading and discussion 1h
4	Bubbling fluidization; bubble dynamics	Class teaching 3h +Literature reading and discussion 1h
5	Distributor design; entrainment and elutriation	Class teaching 3h +Literature reading and

		discussion 1h
6	**Scale-up and scale-down of fluidized bed**	**Class teaching 3h +Literature reading and discussion 1h**
7	**Circulating fluidized bed; choking phenomena and prediction; generalized fluidization and downer**	**Class teaching 3h +Literature reading and discussion 1h**
8	**Cyclone and separator design; mass and heat transfer**	**Class teaching 3h +Literature reading and discussion 1h**
9	**Particle-fluid mass transfer and heat transfer; wall-to-bed heat transfer**	**Class teaching 3h**
10	**Introduction to multiphase fluid dynamics; multiphase flow models; continuum modeling and scale separation; two-fluid model (TFM)**	**Class teaching 3h**
11	**Introduction to multiphase flow experiment; multiphase flow diagnostic techniques**	**Class teaching 3h +Literature reading and discussion 1h**
12	**Progress of multiphase flow experiment**	**Class teaching 3h +Literature reading and discussion 1h**
13	**Installation of CFD software package; Introduction to the user interface of the software, functions, and models**	**Class teaching 3h +Simulation and discussion 1h**
14	**Introduction to the basic process of CFD simulation – take bubbling bed simulation as an example**	**Class teaching 3h +Simulation and discussion 1h**
15	**Advanced application of CFD software: implementation of personalized functions -- CFB riser simulation**	**Class teaching 3h +Simulation and discussion 1h**
16	**Final test**	**2**
total		**60**

Textbook and any related course material:

The textbook mainly refers to:

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

Electronic course reading materials will be provided before each class. The following references are recommended, including:

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

Gidaspow, D. Multiphase Flow and Fluidization, Academic Press, 1994.

Patankar, S. V. Numerical heat transfer and fluid flow, Taylor & Francis, 1980.

Course title

29.Analytical Chemistry and Measurement Application

Instructor(s)-in-charge:
Prof. Huiyu Dong & Assoc Prof. Weiwei Ben
Course type:
Lecture
Course Schedule:
3hrs/week by instructors. 32 hrs in total by Prof. Huiyu Dong; 18 hrs in total by Assoc Prof. Weiwei Ben.
Course Assessment:
Open-book examination
Grading Policy:
Typically 50% homework; 50% final presentation.
Course Prerequisites:
Not required
Catalog Description:
This course gives an introduction to analytical chemistry and an overview of important analytical methods and their range of application within detection of inorganic and organic compounds. Theory provides the learner with exposure to various laboratory analytical principles used in processing laboratory specimens and the application of theory with selected laboratory procedures. The learner will study spectrophotometry, reflectance photometry, chromatography, osmometry, electrophoresis, immunochemistry, general electricity, electrodes and basic automation.

Schedule of the course

section	content	hours	
1	Introduction What Is Analytical Science? Qualitative and Quantitative Analysis; The Analytical Process; Analyze Versus Determine.	3	Prof. Huiyu Dong
2	Basic Tools and Operations Laboratory Materials and Reagents; Volumetric Glassware; Preparation of Standard Solutions; Laboratory Safety.	3	Prof. Huiyu Dong
3	Quality Assurance and Method Validation Validation of Analytical Methods; Quality Assurance; Laboratory Accreditation;	3	Prof. Huiyu Dong

	Electronic Records and Electronic Signatures.		
4	**Stoichiometric Calculations Expressions of Analytical Results; Volumetric Analysis; Volumetric Calculations; Weight Relationships.**	**3**	**Prof. Huiyu Dong**
5	**Acid–Base Titrations Acid–Base Equilibria; The Charge Balance Method; Using a Spreadsheet to Perform Titration; Titration.**	**3**	**Prof. Huiyu Dong**
6	**Complexometric Reactions and Titrations Complexes and Formation Constants; Chelates: EDTA—The Ultimate Titrating Agent for Metals; Detection of the End Point: Indicators; Other Uses of Complexes.**	**3**	**Prof. Huiyu Dong**
7	**Precipitation Reactions and Titrations Effect of Acidity on Solubility of Precipitates; Mass Balance Approach for Multiple Equilibria; Effect of Complexation on Solubility: Conditional Solubility Product; Precipitation Titrations.**	**3**	**Prof. Huiyu Dong**
8	**Electrochemical Cells and Electrode Potentials Redox Reactions; Electrochemical Cells; Formal Potential; Limitations of Electrode Potentials.**	**3**	**Prof. Huiyu Dong**
9	**Redox and Potentiometric Titrations Balance the Reduction–Oxidation Reaction; Calculating Redox Titration Curves; Visual Detection of the End Point; Titrations Involving Iodine.**	**3**	**Prof. Huiyu Dong**
10	**Spectrochemical Methods Interaction of Electromagnetic Radiation with Matter; Electronic Spectra and Molecular**	**3**	**Prof. Huiyu Dong**

	Structure; **Spectrometric Instrumentation;** **Application.**		
11	**Atomic Spectrometric Methods** **Flame Emission Spectrometry and Atomic Absorption Spectrometry;** **Atomic Emission Spectrometry and Atomic Fluorescence Spectrometry;** **Application Cases.**	**3**	**Assoc Prof. Weiwei Ben**
12	**Sample Preparation** **Extraction of Metals;** **Solid Phase Extraction;** **Micro-extraction;** **Application Cases.**	**3**	**Assoc Prof. Weiwei Ben**
13	**Gas Chromatography** **Principles;** **Columns and Detectors;** **Operating Points;** **Application Cases.**	**3**	**Assoc Prof. Weiwei Ben**
14	**Liquid Chromatography** **High-Performance Liquid Chromatography;** **Equipment for HPLC;** **Application Cases.**	**3**	**Assoc Prof. Weiwei Ben**
15	**Mass Spectrometry** **Principles;** **Gas Chromatography–Mass Spectrometry;** **Liquid Chromatography–Mass Spectrometry;** **Application Cases.**	**3**	**Assoc Prof. Weiwei Ben**
16	**Review and Discussion** **Review for Spectrometry and Chromatography;** **Group Discussion and Presentation.**	**3**	**Assoc Prof. Weiwei Ben**
17	**Final presentation**	**2**	**Prof. Huiyu Dong**
Total		**50**	

Contents of the course

Section 1: Introduction and Basic methods

1. What Is Analytical Science? Qualitative and Quantitative Analysis; The Analytical Process; Analyze Versus Determine.

2. Basic Tools and Operations：Laboratory Materials and Reagents; Volumetric Glassware; Preparation of Standard Solutions; Laboratory Safety.

3. Quality Assurance and Method Validation: Validation of Analytical Methods; Quality Assurance; Laboratory Accreditation; Electronic Records and Electronic Signatures

4. Stoichiometric Calculations: Expressions of Analytical Results; Volumetric Analysis; Volumetric Calculations; Weight Relationships.

Section 2: Titrations

1. Acid–Base Titrations: Acid–Base Equilibria; The Charge Balance Method; Using a Spreadsheet to Perform Titration; Titration.

2. Complexometric Reactions and Titrations: Complexes and Formation Constants; Chelates: EDTA—The Ultimate Titrating Agent for Metals; Detection of the End Point: Indicators; Other Uses of Complexes.

3. Precipitation Reactions and Titrations: Effect of Acidity on Solubility of Precipitates; Mass Balance Approach for Multiple Equilibria; Effect of Complexation on Solubility: Conditional Solubility Product; Precipitation Titrations.

4. Electrochemical Cells and Electrode Potentials: Redox Reactions; Electrochemical Cells; Formal Potential; Limitations of Electrode Potentials.

5. Redox and Potentiometric Titrations: Balance the Reduction–Oxidation Reaction; Calculating Redox Titration Curves; Visual Detection of the End Point; Titrations Involving Iodine.

Section 3: Spectrochemical Methods

1. Spectrochemical Measurements: Interaction of Electromagnetic Radiation with Matter; Electronic Spectra and Molecular Structure; Spectrometric Instrumentation; Application.

2. Atomic Spectrometric Methods: Flame Emission Spectrometry and Atomic Absorption Spectrometry; Atomic Emission Spectrometry and Atomic Fluorescence Spectrometry; Application Cases.

3. Sample Preparation: Extraction of Metals; Solid Phase Extraction; Micro-extraction; Application Cases.

4. Gas Chromatography: Principles; Columns and Detectors; Operating Points; Application Cases.

5. Liquid Chromatography: High-Performance Liquid Chromatography; Equipment for HPLC; Application Cases.

6. Mass Spectrometry: Principles; Gas Chromatography–Mass Spectrometry; Liquid Chromatography–Mass Spectrometry; Application Cases.

Textbook and any related course material:

Analytical chemistry. Seventh edition, Gary D. Christian, Purnendu K. Dasgupta, Kevin A. Schug.

ISBN 978-0-470-88757-8, QD101.2.C57 2014

Expected level of proficiency from students entering the course:
Chemistry: basic
Course title

29. Academic Communication for International Conferences

As a public selective course, this course aims to help students understand communicative skills and report techniques to communicate their academic opinions and exchange information in the context of international conferences. The course will provide opportunities to practice and improve students' seminar discussion and academic presentation abilities.

General course for both MS students and PhD candidates

一、授课方式

课堂讲授为主

Primarily class instruction

二、Schedule of the course

大纲章次	章名称	章学时	大纲小节次	小节名称
1	**Course introduction**	**3**	**1**	**Course introduction**
			2	**Communication skills in academic context**
			3	**Academic speaking style**
2	**Interview for academic purposes**	**3**	**1**	**Preparation for academic interview**
			2	**Interview listening and discussing**
3	**Seminar discussion**	**3**	**1**	**Introduction to seminar discussion**
			2	**Seminar discussion skills**
			3	**Seminar discussion practice**
4	**Discussing with examples**	**3**	**1**	**Mind mapping**
			2	**Using proper examples in seminar discussion**
			3	**Exemplification practice**
5	**Discussing with comparison and contrast**	**3**	**1**	**Using comparison and contrast**
			2	**Comparison and contrast practice**
			3	**Listening and speaking practice**
6	**Discussing with cause-effect**	**3**	**1**	**Persuasive reasoning**
			2	**Cause-effect practice**
			3	**Listening and speaking practice**
7	**Introducing your presentation**	**3**	**1**	**Ways to begin an academic presentation**
			2	**Sequencing your presentation**
			3	**Writing out your academic presentation**

8	**Integrating different opinions**	**3**	**1**	**Ways to report literature review**
			2	**Listening and speaking practice**
9	**Describing procedures**	**3**	**1**	**Describing procedures**
			2	**Listening and speaking practice**
10	**Reporting your data**	**3**	**1**	**Reporting your results**
			2	**Using visuals properly**
			3	**Listening and speaking practice**
11	**Interpreting your findings**	**3**	**1**	**Interpreting research findings**
			2	**Listening and speaking practice**
12	**Making your reports impressive**	**3**	**1**	**Telling an academic story**
			2	**Using effective language**
			3	**Listening and speaking practice**
13	**Final examination**	**4**	**1**	**Final oral examination**

Course title

29. Skills in making academic presentations

The purpose of this course is to improve your skills of writing and making effective academic presentations, with special emphasis on presentations at academic conferences. The principles you learn in this class will benefit you in your academic career. The course will introduce major principles and strategies in making academic presentations, including introduction, research purpose, methodology, results, conclusion, question and answer, using visual aids, 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

大纲章次	章名称	章学时	授课教师	大纲小节次	小节名称	节学时
1	Introduction to academic presentation	3	0017658	1	Course overview	1
			0017658	2	Basic principles of academic presentation	1
			0017658	3	How to begin your presentation	1
2	Literature review	3	0017658	1	Principles of presenting literature review	1
			0017658	2	Sample analysis	1
			0017658	3	Practice students' skills in preparing literature review	1
3	Methodology	3	0017658	1	Principles of presenting methodology	2
			0017658	2	Sample analysis	1
4	Results and discussion	3	0017658	1	Principles of presenting Results and discussion	1
			0017658	2	Sample analysis	1
			0017658	3	Practice students' skills in preparing results and discussion	1
5	Conclusion	3	0017658	1	Principles of presenting Conclusion	1
			0017658	2	Sample analysis	1
			0017658	3	Practice students' skills in preparing Conclusion	1

6	Questions and answers	3	0017658	1	Types of questions the audience may raise	1
			0017658	2	Tips in answering questions	1
			0017658	3	Practice Q&A	1
7	Using visual aids	3	0017658	1	Criteria of using English in public speaking	1
			0017658	2	Rhetorical devices and exercises	1
			0017658	3	Sample analysis	1
8	Logical development, signposts and transitions	3	0017658	1	Using visual aids	1.5
			0017658	2	Speaking to inform	1.5
9	Attracting audience attention	3	0017658	1	Students' presentation of informative speeches	2
			0017658	2	Comments and discussion	1
10	Pronunciation and intonation	3	0017658	1	Methods of persuasion	1
			0017658	2	Tips for persuasive speaking	1
			0017658	3	Exercise and sample analysis	1
11	Designing Conference Posters	3	0017658	1	Principles of designing posters	1
			0017658	2	Sample analysis	2
12	Chairing an International Conference	3	0017658	1	What do chairs do and say?	1
			0017658	2	Sample analysis	2
13	Model international academic conference	4	0017658	1	Students' presentation of academic presentations	3
			0017658	2	Comments and discussion	1

二、考核方式

其他：出勤（10%）+ 课堂表现（10%）+作业（30%）+演讲（20%）+模拟学术会议（30%）

Attendance（10%）+ class participation（10%）+ assignment（30%）+ presentations（20%）+ model academic conference（30%）

三 教材 textbook

Adrian Wallwork. 2016.English for Presentations at International Conferences (2nd edition). Springer International Publishing.