6th Semester

COURSE UNIT DESCRIPTION

Course Title :	Course-No. :	Semester :
Remote Sensing and Satellite Image Processing.	**TF 6001/TF 6101**	**6th**
Course Type :	Hours/Weeks/SS	Number of credits
Lecture **Laboratory**	**4** **2**	**7**

Lecturer: Dr. Maria Kouli, Adjunct Professor.

Institute/Department: TEI-Technological Educational Institute of Crete, Department of Enviromental and Natural Resources Engineering.

Course Description:

Introduction to Remote Sensing. Fundamentals for Electromagnetic Spectrum. Aerial Photography. Operational remote sensing systems (platforms and sensors), data acquisition techniques, atmospheric effects and corrections. Radiometric calibration. Geometric distortions and corrections. Principle of microwave remote sensing. Image spectral and spatial enhancement techniques (i.e. histogram processing, color composites, spectral signatures, spatial filtering, classification techniques, indices, etc.). Retrieval of albedo and land surface temperature. Fundamentals for photo-interpretation. A number of case studies are used to show the application of satellite remote sensing in different environmental applications (meteorological, agricultural, cultural, seismic, volcano, fires, vegetation, hydrology, etc.).

Course Outline:

- Fundamental concepts of Remote Sensing. Theoretical, technical and historical perspectives of Remote Sensing. History of remote sensing.
- Photogrammetry. Elements of Aerial Photography. Parallax, scale, registration of images, types of aerial photographs.
- Sensor types. Multispectral Scanners, Optical sensors, photographic systems, radar (energetic) sensors, thermal sensors, CCDs, hypespectral imaging devices.
- Satellite Systems – A review: Nimbus, SpaceShuttle, Landsat, SPOT, GMS, Insat, UARS, Ikonos, Quickbird, Goes, Meteor, Meteosat, NOAA, TERRA/ASTER, SeaWiFS, MODIS. Generations and recording devices.

- The Electromagnetic Spectrum – spectral bands. Properties of spectral bands. Radiation, transmittance, absorption, and reflectance. Spectral signatures.
- Planck's Blackbody radiation Law, The Wien Displacement Law.
- Color & False Color imagery. RGB imagery. Interpretation of images.
- Image Processing – Preprocessing (radiometric, atmospheric and geometric corrections), histogram processing, contrast stretching, density slicing.
- Spatial Filtering, principal components analysis (PCA), Ratios, Vegetation Index,
- Classification techniques. Unsupervised Classification - Supervised Classification (Classification techniques: Minimum Distance Classification, Maximum Likelihood, Classification
- Remote sensing and GIS applications and examples. Large-scale reconnaissance. Vegetation Applications - Forest Applications; Ecological Damage, cultivations, crops. Application of remote sensing in the Greek public sector.

Laboratory Outline:

- Introduction to Remote Sensing and to Electromagnetic Spectrum theory.
- Introduction to Erdas Imagine 8.5.
- Geometric Correction- Resampling techniques.
- Properties of satellite images – photo-interpretation.
- Image Mosaics.
- Histogram processing.
- Spatial Filtering.
- Color composites.
- Spectral signatures.
- Classification techniques.
- Principal Component Analysis, indices.

Bibliography:

Course

1. Photo-interpretation – Remote Sensing, 2003, Miliaressis, G., ION Editions, Athens, (ISBN: 960-411-297-X).
2. Introduction to Geographic Information Systems and to Remote Sensing, 2000, Vol.2, N.G., Giahoudi-Gianouli Editions, Thessalonica, (ISBN: 960-7425-309-8).
3. Remote Sensing and Digital Image Processing Notes, 2007, Kouli, M., Chania.
4. Remote Sensing and Satellite Image Processing, 1999, Mertikas, S., ION Editions.
5. NASA, "The Remote Sensing Tutorial", http://rst.gsfc.nasa.gov/Front/tofc.html
6. Canada Centre for Remote Sensing, "Tutorial: Fundamentals of Remote Sensing" http://www.ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php

Laboratory

1. Photo-interpretation and Remote Sensing Laboratory Exercises, 2003 Miliaressis, G., ION Editions, Athens.
2. Remote Sensing and Digital Image Processing Laboratory Notes, 2007, Kouli, M., Alexakis, D., Chania.

Teaching method: Lectures, supported by transparencies, computer and video demonstrations.

Assessment: Theory: Independent research work (optional projects) (20%) and final examination (80%).

Laboratory: Students presence in class (20%), final examination.

COURSE UNIT DESCRIPTION

Course Title :	Course-No. :	Semester :
Renewable Energy II	**TF 6002/TF 6102**	**6th**
Course Type :	Hours/Weeks/SS	Number of credits
Lecture – Laboratory	**4+2 / 10**	

Lecturer: Vourdoubas Ioannis

Institute/Department: TEI-Technological Educational Institute of Crete, Department of Enviromental and Natural Resources Engineering.

Course Description:

Introduction to the solar and wind energy. Methods and measurements for calculating wind energy potential. Weibull distribution and wind rose. Wind profile, roughness length, turbulence and wind shear. Vertical and horizontal wind turbines components (rotor characteristics, blade design, generators, tower design) and characteristics. Power from wind and power curves. Solar energy, direct, diffuse and total solar radiation. Instrumentation for measuring solar energy. Active solar systems, Solar collectors technology, efficiency, energy balance. F-chart method. Passive solar systems for heating, cooling and daylighting. Estimation of thermal and cooling load, natural ventilation techniques, solar chimneys. Photovoltaic (PV) cells technology. I-V curves, open circuit voltage, short circuit current and photovoltaics efficiency. PV module and arrays. Stand alone PV systems. Case studies.

Course Outline:

1. Introduction to the wind energy.

2. Wind turbine technology.
3. Power from wind.
4. Active solar systems – Solar collectors
5. Biofuels
6. Fuel cells
7. Hydropower and pump storage systems
8. EU energy directives
9. PV technology
10. PV systems
11. Energy storage

Laboratory Outline:

10 Exercises following the theory

- Applications of renewables in hotels
- Amorphus and crystalline PVs
- Characteristic curves of Photovoltaics
- Photovoltaic pump
- Hydrogen production with electrolysis
- Proton exchange membrane fuel cell
- Alcaline fuel cell
- Sterling engine
- Storage of electric power in battery
- Heat flow

Bibliography:

- Kreith F, West R.E, CRC Handbook on Energy Efficiency, ISBN 0-8493-2514-5, CRC Press, 1997.
- Kaldelis I. Kavvadias K., Computational Applications of Renewable Energy Sources, 2001 (in Greek).

Teaching method: Lectures (4 hours per week), experimental exercises (2 hours per week).

Assessment: Theory: midterm test (optional, 40%), final examination (100%).

Laboratory: homework (40%), final examination (100%).

COURSE UNIT DESCRIPTION

Course Title :	Course-No. :	Semester :
Atmospheric Pollution	**TF 6004/TF 6104**	**6th**
Course Type :	Hours/Weeks/SS	Number of credits
Lectures and **Laboratory experiments**	**2 /15/SS** **2 /15/SS**	**5**

Lecturer: Dr. Eleftheria Katsivela, Associate Professor

Institute/Department: TEI-Technological Educational Institute of Crete, Department of Enviromental and Natural Resources Engineering.

Course Description:

Scope of this course is to provide to students all necessary knowledge related to atmospheric pollution. In particular, the course provides fundamental background to the role of trace constituents (gaseous and particulate pollutants) to phenomena ranging from urban photochemical smog and acid deposition, to stratospheric ozone depletion and to potential climate change. The topics covered by Atmospheric Pollution are linked to the laboratory experiments, which include determination of primary and secondary pollutants as well as simulation of the effects of air pollution to humans and the environment. This course in combination with the course of the 7th semester “Air Quality Control Technologies” gives integrated knowledge in the field of air pollution and its control technologies.

Course Outline:

- Introduction to the Atmospheric Pollution:

History of Air Pollution, Problem Identification, Definitions, Legal Limits (European and Greek Legislation, World Health Organization)

- The Atmosphere :

Layers, Pressure, Temperature, Units of measurement, Atmospheric Composition

- Pollutant Dispersion:

Lapse Rate, Atmospheric Stability, Inversion Layer, Plume Rise, Pollution Transport, Scales of Atmospheric Pollution

- Atmospheric Chemistry:

Primary and secondary pollutants, Lifetimes, Overview of Atmospheric Chemical Compounds

- Atmospheric Radiation and Photochemistry:

Chemical Kinetics, Electromagnetic Spectrum, Photo-dissociation, Direct Reaction, Fluorescence, Collision Deactivation, Ionization

- Carbon-Containing Compounds

Sources, Carbon Geochemical Cycle, Carbon Dioxide, Carbon Monoxide, Health Effects

- 'Greenhouse' Effect :

Formation, Greenhouse Gases, Climate Change

- Volatile Organic Compounds and **P**hotochemical Smog:

Methane & Non Methane Volatile Organic Compounds, Sources, Atmospheric Methane Oxidation, Health Effects

- Nitrogen oxides and Nitrogen-Containing Compounds

Sources, Nitrogen Atmospheric Cycle, Chemical Reactions, Health Effects

- **P**hotochemical Smog:

Photooxidation of VOCs, Formation of PAN, Formation of tropospheric O_3, Impact on Humans, Plants, Animals

- Halogen-Containing Compounds and Stratospheric Ozone Depletion:

CFCs, HCFCs, HFCs, PFCs, Chemical Reactions, Impact on Humans, Plants, Animals

- Sulfur dioxide and Sulfur-Containing Compounds:

Sources, Sulfur Atmospheric Cycle, Chemical Reactions, Health Effects

- Acid Precipitation:

Wet-Dry, sources, Impact on Humans, Plants, Animals, Buildings

- Particulate Matter (Aerosols):

Sources, Composition, Heavy Metals, Asbestos, Sizes of Atmospheric Particles, Distribution-Classification, Health Effects

Laboratory outline

Determination of primary air pollutants

- Determination of nitrogen oxides
- Determination of sulfur dioxide
- Determination of chloride
- Determination of ammonia
- Determination of volatile organic compounds
- Measurement of oxygen, methane, carbon dioxide, carbon monoxide, and nitrogen monoxide by a portable gas analyzer
- Measurement of inhalable particulate matter

Determination of secondary air pollutants

- Determination of tropospheric ozone

Atmospheric pollution effects into environment

- Simulation of acid precipitation its effects into natural environment

Field trip

- Field trip to the Thermo-Electric Power Station of Xylokamara in Chania, which is operated by the Public Power Corporation. Measurement of primary air pollutants.

Bibliography:

Course

1. J. H. Seinfeld, S. N. Pandis (2006). Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, Wiley-Interscience, New York, ISBN: 0-471-72017-8.
2. **2.** R. M. Harrison (2001). Pollution: Causes, Effects and Control, Royal Society of Chemistry,– ISBN: 0-85404-621-6, Chapters 7-12.

Laboratory

1. J. P. Lodge, Jr. 1989. Methods of Air Sampling and Analysis, Lewis Publishers Inc., Michigan, USA

Teaching method: Lectures, supported by transparencies. Laboratory experiments.

Assessment: Theory: midterm test (optional, 40%), final examination.

Laboratory: homework (20%), final examination (80%).

Course Title :	Course-No. :	Semester :
Environmental Geotechnology	**TF 6005/TF 6105**	**6th**
Course Type :	Hours/Weeks/SS	Number of credits
Lecture – Laboratory	**2+2 / 10**	**8**

Lecturer: Dr. Kokkinou Eleni, Ass. Professor

Institute/Department: TEI-Technological Educational Institute of Crete, Department of Enviromental and Natural Resources Engineering.

Course Description:

Introduction. Definition. Development of Environmental Geotechnology. Aims of Environmental Geotechnology. Environmental Cycles and Their Interaction with Geotechnology. Man-Made Environment. Nature of Soil and Environment. Soil Mineralogy. Structural Units of Soils. Size and Shape Measurements. Hydraulic Conductivity and Mass Transport Phenomena. Capillarity. Hydraulic Conductivity. Infiltration, Percolation and Retention. Mass Transport Phenomena. Contaminant transport in soil-water-bedrock systems. Soil-Water Suction and Diffusivity. Moisture Migration. Diffusion Phenomena. Water Movement in Vadose Zone and Groundwater Recharge. Advection - Dispersion Transport and Models. Environmental Geophysics: The course treats theoretical aspects behind various geophysical exploration methods and, in particular, the practical use and evaluation of these methods in environmental studies. Methods treated include: gravity and magnetic surveying, electrical, electromagnetic and GPR techniques, magnetic susceptibility and thermomagnetism for detecting heavy metals in soils - case studies. Geophysical borehole logging techniques are also described. Waste management and contaminant remediation techniques.

Course Outline:

- Introduction. What is Environmental Geotechnology.
- Sources of Pollution
- Soil and Environment
- Hydraulic Conductivity and Mass Transport Phenomena
- Surface Geophysics in environmental characterisation
- Gravity and Magnetic methods
- Electrical Resistivity methods
- Electromagnetic and GPR methods
- Magnetic Susceptibility and Thermomagnetism
- Waste management and contaminant remediation techniques

Laboratory Outline:

- Exercises following the theory

Bibliography:

1. Groundwater, Hydraulics and Pollutant transport by Randall J. Charbeneau, Prentice Hall, 2000.
2. **Geoenvironmental Sustainability** by Raymond N. Yong, Catherine N. Mulligan, and Masaharu Fukue, 2006.
3. **Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate, and Mitigation (New Directions in Civil Engineering)** by Raymond N. Yong, 2000).
4. Chin David, Water Resources, Prentice Hall 2000.
5. **Geoenvironment 2000: Characterization, Containment, Remediation, and Performance in Environmental Geotechnics 2 vol. set (Geotechnical Special Publication, No)** by American Society of Civil Engineers Geot, American Society of Civil Engineers Envi, Y. B. Acar, and David E. Daniel, 1995).
6. **Groundwater and Ecosystems (Nato Science Series: IV: Earth and Environmental Sciences)** by Alper Baba, Ken W.F. Howard, and Orhan Gunduz 2006).
7. Environmental and engineering geophysics. P.V. Sharma. Cambridge University Press.

Teaching method: Lectures (1 per week), experimental exercises (2 per week).

Assessment: Theory: midterm test (optional, 40%), final examination.

Laboratory: homework (30%), final examination.

COURSE UNIT DESCRIPTION

Course Title :	Course-No. :	Semester :
Agricultural Environment Control Technology	**TF 6006/TF 6106**	
Course Type :	Hours/Weeks/SS	Number of credits
Lecture – **Laboratory**	**2** **2**	**5**

Lecturer: Professor George Stavroulakis

Institute/Department: TEI-Technological Educational Institute of Crete, Department of Enviromental and Natural Resources Engineering.

Course Description:

The aim of the course is to educate the student about the soil management which is one of the basic factors of the agricultural environment. The knowledge of the soil qualitative and quantitative characteristics and the control of soil pathology combined with laboratory applications will provide the scientific background in order to manipulate the soil as a natural resource.

Course Outline:

Generally for the ground. The genesis and the development of grounds. The classification of grounds. Elements of mapping of grounds and evaluation of ground. The organic and inorganic components of ground. The water and the air of soil. The physical and chemical attributes of ground (mechanical constitution, structure, cohesiveness, ostensible and real special weight, porosity, colour, exchange of ions, pH, degree of saturation by bases, regulating faculty). Erosion of grounds (factors of creation and metres of antifouling protection). Pathogenicity of grounds (conditions of creation and improvement of pathogenic grounds).

Bibliography:

Soil science - N Polizopoulos

Soil science – N. Alexiadis

Soil science and soil pathology – K Sinanis

Teaching method:

Lectures, supported by transparencies and computer demonstrations. In the practical part student participate in laboratory exercises

Assessment:

Coursework (40%) and final examination (60%).

Teaching method: Lectures, supported by transparencies and computer demonstrations. In the practical part student participate in laboratory exercises.

Assessment: Coursework (40%) and final examination (60%).

COURSE UNIT DESCRIPTION

Course Title :	Course-No. :	Semester :
Natural Hazards	**TF6007/TF 6107**	**6th**
Course Type :	Hours/Weeks/SS	Number of credits
Lecture – Exercises	**2 LECTURE 2 EXERCISES**	**4**

Lecturer: Dr. Filippos Vallianatos, Professor.

Institute/Department: TEI-Technological Educational Institute of Crete, Department of Enviromental and Natural Resources Engineering.

Course Description:

In this course, we will explore several of the most pressing environmental issues as natural hazards are. We study the nature and distribution of risk from geo-physical processes focused on the most frequent of them in Greece as earthquakes, volcanism, landslides and erosion are. Focused on seismic and volcanic hazard we study their spatio-temporal evolution and their physics. A geographic study of hazards resulting from human interaction with the lithosphere, hydrosphere, atmosphere and biosphere will be also presented.

Course Outline:

- Definition and global distribution of natural hazards
- Theories of natural hazards research
- Extreme events including: Earthquakes, Tsunami, Slope stability / Landslides, Volcanoes.
- Earthquakes: generation, seismic wave propagation, location of events, microseismic results. Microzonation studies. Principles of engineering seismology
- Volcanoes: geophysical monitoring of volcanic activity. Volcanic Seismicity. Precursory effects.
- Statistics of Natural Hazards.
- Physics of Natural Hazards and their soatio-temporal evolution.
- Parameters for human response to natural hazards and relation to prediction
- Definition of risk analysis and discussion in the context of technological and occupational factors
- Levels of acceptable risk and relation to land-use planning
- Global trends in natural hazards risk; comparison of risk in developed and developing countries

Bibliography:

1. Blaikie, P., T. Cannon, I. Davis & B. Wisner: "At Risk: Natural Hazards, People's Vulnerability, and Disasters". New York: Routledge; 1994. pp. 298.
2. Patrick L. Abbott: "Natural Disasters". 2nd Edition. WCB/McGraw-Hill, 1999. pp. 397.
3. Coch, Nicholas K., Geohazards - Natural and Human. Prentice Hall, Englewood Cliffs, NJ.: 1995 pp. 1- 481.

Teaching method: Lectures-(2hours/week) , Exercises (2hours/week)

Assessment: Theory: midterm test (optional, 40%), final examination.