

C1B: Fundamentals of Environmental Science: 2015 Semester 1

Instructors: Shrinivas Badiger (SB) – Course Coordinator (sbadiger@atree.org); Jagdish Krishnaswamy-JK (jagdish@atree.org); Priyanka Jamwal-PJ (priyanka.jamwal@atree.org); Veena Srinivasan-VS (veena.srinivasan@atree.org)

Guest Instructors: Dr. Sumetee Pahwa Gajjar (SPG); Dr. Milind Bunyan (MB)

Credits and contact hours: 3 credits, 48 hours.

Course Schedule: Lectures: Monday, Tuesday (11.00 – 11.50); Labs: Tuesday (14:00 – 17:00)

Course Description:

This course will introduce the fundamentals of environmental processes at global, regional and local scales using a biogeochemical framework. Apart from lectures on theory, the course will help students apply the concepts learned to real-world environmental problems. Students will learn by doing field, laboratory and computer exercises in environmental sciences. The theory portion of the course will focus on carbon, water and nitrogen cycles. Concepts of stocks, fluxes, and positive and negative feed-back mechanisms will be discussed for each biogeochemical cycle at various spatial scales. These concepts will be presented in the context of major environmental challenges facing us including water resources, agriculture, pollution, soil degradation, and climate change. Concepts related to biodiversity loss and ecosystem services will be covered in C1A.

The course will explore then topics in sustainability science in relation to the anthropogenic transformation of environmental processes using a variety of thematic lenses: resources (water), production sectors (agricultural systems), and environmental problems (climate change and water pollution).

Course Structure: The course is structured in two modules:

Module 1: Theory of environmental processes (23 hours)

Module 2: Sustainability science, links between environment processes and wellbeing (13 hours)

Text Books:

Biogeochemistry: An Analysis of Global Change. William H. Schlesinger. Academic Press. Second edition.

Module/topic specific readings will be suggested from peer-reviewed journal articles and popular articles.

Course evaluation: Final assessment of grades will be based on:

1. Classroom participation/contribution to discussions (10%)
2. Five written assignments (20%)
3. Five laboratory exercises and viva (20%)
4. Two quizzes (10% each; 1 hour) and Final examination (30%; 3 hours)

All lecture assignments and laboratory exercises are due for submission in one week. Final exam will be for 3 hours and will have a closed book section (1 hour) and an open book section (2 hours).

Course Schedule:

| Wk | Date | Lecture/ Lab | Topic | Instructor (Backup) |
|----|---------------------------------|-----------------|---------------------------------------------------------------------------------------------------|------------------------|
| 1 | Mon., Aug 10 (11.00 – 11.50) | Lec-1 | Introduction to the course, earth as a biogeochemical system | JK |
| | Tue., Aug 11 (11.00 – 12.00) | | Course competency test (optional) | Madhavi |
| | Tue., Aug 11 (14.00 – 17.00) | Lab-1 | Toposheet reading (Lab exercise-1) | MB/SB |
| 2 | Mon., Aug 17 (11.00-11.50) | Lec-2 | Biogeochemical cycles and thermodynamic principles | JK |
| | Tue., Aug 18 (11.00 – 11.50) | Lec-3 | Introduction to composition, evolution and processes of the atmosphere, lithosphere and biosphere | JK |
| | Tue., Aug 18 (14.00 – 17.00) | Lab-2 | Catchment delineation (Lab exercise-2) | SB |
| 3 | Mon., Aug 24 (11.00 – 11.50) | Lec-4 | Carbon cycle | JK |
| | Tue., Aug 25 (11.00 – 11.50) | Lec-5 | Carbon cycle | JK |
| | Tue., Aug 25 (14.00 – 17.00) | Lab-3 | Above ground carbon estimation | JK, SB |
| 4 | Mon., Aug 31 (11.00 – 11.50) | Lec-6 | Understanding stocks, flows and feedbacks | VS |
| | Tue., Sep 01 (11.00 – 11.50) | Lec-7 | Hydrological cycle – overview (Lecture assignment 1: BGC and Carbon cycle) | JK |
| | Tue., Sep 01 (14.00 – 17.00) | Lab-4 | STELLA - modeling stocks and flows | VS, SB |
| 5 | Mon., Sep 07 (11.00 – 11.50) | Lec-8 | Water – land surface processes | SB |
| | Tue., Sep 08 (11.00 – 11.50) | Lec-9 | Groundwater | VS/SB |
| | Tue., Sep 08 (14.00 – 17.00) | Lab-5 | Tank water balance exercise | SB |
| 6 | Mon., Sep 14 (11.00 – 11.50) | Lec-10 | Catchment hydrology | SB |
| | Tue., Sep 15 (11.00 – 11.50) | Lec-11 | Chemical kinetics | PJ |
| | Tue., Sep 15 (14.00 – 17.00) | Lab-6 | Catchment water balance exercise (Lab exercise-3) | SB |
| 7 | Mon., Sep 21 (11.00 – 11.50) | Lec-12 | Nitrogen cycle | PJ |
| | Tue., Sep 22 (11.00 – 11.50) | Lec-13 | Nitrogen cycle | PJ |
| | Tue., Sep 22 (14.00 – 17.00) | Lab-7 | Water quality lab: sample collection | PJ |

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| 8 | Mon., Sep 28 (11.00 – 11.50) | Lec-14 | QUIZ- 1 | |
| | Tue., Sep 29 (11.00 – 11.50) | Lec-15 | The physics and chemistry of air and water pollution | PJ |
| | Tue., Sep 29 (14.00 – 17.00) | Lab-8 | Water quality lab: testing and analysis | PJ |
| 9 | Mon., Oct 05 (11.00 – 11.50) | Lec-16 | The physics and chemistry of air and water pollution (Lecture assignment 2: Carbon and Water Cycle) | PJ |
| | Tue., Oct 06 (11.00 – 11.50) | Lec-17 | Soil properties and processes | JK |
| | Tue., Oct 06 (14.00 – 17.00) | Lab-9 | Soil properties and water content lab (Lab exercise-4) | JK, SB |
| 10 | Mon., Oct 12 | Holiday | | |
| | Tue., Oct 13 (11.00 – 11.50) | Lec-18 | Soil erosion and sediment transport | SB |
| | Tue., Oct 13 (14.00 – 17.00) | Lec-19 | Overview of water and wastewater treatment (Lecture assignment 3: N-cycle and pollution) | PJ |
| 11 | Mon., Oct 19 (11.00 – 11.50) | Lec-20 | Water quality modelling | PJ |
| | Tue., Oct 20 (11.00 – 11.50) | Lec-21 | Physics of climate-land-ocean-atmosphere linkages | JK |
| | Tue., Oct 20 (14.00 – 17.00) | Lab-11 | Water Quality Analysis - BOD/DO Analysis, BOD Curve | PJ |
| 12 | Mon., Oct 26 (11.00 – 11.50) | Lec-22 | Physics of climate and climate change | ?VS?/?JK? |
| | Tue., Oct 27 (11.00 – 11.50) | Lec-23 | QUIZ-2 | |
| | Tue., Oct 27 (14.00 – 17.00) | Lab-12 | Stream discharge and pollutant flux measurement field trip (Lab exercise 5) | PJ, SB |
| 13 | Mon., Nov 02 (11.00 – 11.50) | Lec-24 | Introduction to sustainability science | SPG |
| | Tue., Nov 03 (11.00 – 11.50) | Lec-25 | Pollution and human health – links and risk assessment | PJ |
| | Tue., Nov 03 (14.00 – 16.00) | Lec-26, 27 | Pollution and human health – links and risk assessment (Lecture assignment 4: Pollution, Health and CC) | PJ |
| 15 | Mon., Nov 09 (11.00 – 11.50) | Lec-28 | Sustainability in Agriculture – food production and security | SB |
| | Tue., Nov 10 (11.00 – 11.50) | Lec-29 | Sustainability in Agriculture – food production and security | SB |
| | Tue., Nov 10 (14.00 – 17.00) | Lec-30, 31 | Documentary screening and discussion | |

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| 16 | Mon., Nov 16 (11.00 – 11.50) | Lec-32 | Water resources sustainability – allocation, conflict, use, sustainability | VS |
| | Tue., Nov 17 (11.00 – 11.50) | Lec-33 | Water resources sustainability – allocation, conflict, use, sustainability (Lecture assignment 5: Ag and water security) | VS |
| | Tue., Nov 17 (14.00 – 17.00) | Lab-13 | Water and carbon foot-print lab | VS, SB |
| 17 | Mon., Nov 23 (11.00 – 11.50) | Lec-34 | Forest Ecosystem: production and sustainability | MB |
| | Tue., Nov 24 (11.00 – 11.50) | Lec-35 | Climate change impacts on humans | SPG |
| | Tue., Nov 24 (14.00 – 17.00) | | Lab Viva | PJ, VS, SB |
| 18 | Mon., Nov 30 | Lec-36 | Climate change impacts on humans | SPG |
| | Tue., Dec 01 | | | |
| 19 | Mon., Dec 07 | | | |
| | Tue., Dec 08 | 10.00 – 13.00 | Final Examination | |