

C1B: Fundamentals of Environmental Science

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Credits and contact hours : 3 credits, 48 hours

Course Schedule: Lectures: Monday, Wednesday (11.00 – 11.50); and Labs: Thursday (2:00 – 5:00pm)

Course exemption test: 13 August 2013: 11.00 – 12.00

Course Description:

This course will introduce students to 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 such as water resources unsustainability, pollution, soil degradation, climate change, biodiversity loss, and loss of ecosystem services (the last two will be covered in depth 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 divided into two modules:

Module 1: Theory of environmental processes (20 hours)

1. Earth as a Biogeochemical System (2)
2. Atmosphere, Lithosphere and Biosphere (2)
3. Carbon cycles (2)
4. Water Cycle (4)
5. Nitrogen cycle (2)
6. Soil Properties and Processes (3)
7. The physics and chemistry of air and water pollution (4)
8. Physics of climate - land-ocean-atmosphere linkages (3)

Module 2: Sustainability science, links between environment processes and wellbeing (10 hours)

1. Introduction to sustainability science (2)
2. Agriculture production and food security (2)
3. Water resources development, use and sustainability (2)
4. Pollution and human-health (2)
5. Climate Change and impacts on human survival (2)

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:

Assessments based on:

1. Classroom participation/contribution to discussions (10%)
2. 5 Written assignments (20%)
3. 5 Laboratory exercises and viva (20%)
4. 2 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., August 12 (11.00 – 11.50)	Lec-1	Introduction to course, earth as a biogeochemical system	Jagdish
	Tue., August 13 (11.00 – 12.00)		Course Competency Test (optional)	
	Wed., August 14 (11.00 - 11.50)	Lec-2	Biogeochemical cycles and thermodynamic principles	Jagdish
	Fri., August 16 (14.00-15.30)	Lec 3, 4	Introduction to composition, evolution and processes of the atmosphere, lithosphere and biosphere	Jagdish
2	Mon., August 19 (11.00 – 11.50)	Lec-5	Understanding stocks, flows and feedbacks	Veena
	Wed., August 21 (11.00 – 11.50)	Lec-6	Understanding stocks, flows and feedbacks	Veena
	Thu., August 22 (14.00 – 17.00)	Lab-1	STELLA - modeling stocks and flows (Lab exercise-1)	Veena
3	Mon., August 26 (11.00 – 11.50)	Lec-7	Carbon cycle	Jagdish
	Wed., August 28 (11.00 – 11.50)	Lec-8	Carbon cycle (Lecture assignment 1: BGC and Carbon cycle)	Jagdish
	Thu., August 29 (14.00 – 17.00)	Lab-2	Above ground carbon estimation	Jagdish
4	Mon., September 02 (11.00 – 11.50)	Lec-9	Water cycle	Jagdish
	Wed., September 04 (11.00 – 11.50)	Lec-10	Water cycle	Shrini
	Thu., September 05 (14.00 – 17.00)	Lab-3	Catchment delineation and toposheet reading (Lab exercise-2)	Veena (Shrini)
5	Wed., September 11 (11.00 – 11.50)	Lec-11	Water cycle	Shrini

	Thu., September 12 (14.00 – 17.00)	Lab-4	Catchment water balance exercise	Shrini (Jagdish)
6	Mon., September 16 (11.00 – 11.50)	Lec-12	Soil properties and processes	Jagdish
	Wed., September 18 (11.00 – 11.50)	Lec-13	Soil properties and processes (Lec assignment 2: Water Cycle and Soils)	Jagdish
	Thu., September 19 (14.00 – 17.00)	Lab-5	Soil properties and water content lab (Lab exercise-3)	Jagdish (Shrini)
7	Mon., September 23 (11.00 – 11.50)	Lec-14	Nitrogen cycle	Jagdish
	Wed., September 25 (11.00 – 11.50)	Lec-15	Nitrogen cycle	Jagdish
	Thu., September 26 (14.00 – 17.00)	Lab-6	Water quality lab - sample collection field trip	Jagdish (Shrini)
8	Mon., September 30 (11.00 – 11.50)	Lec-16	QUIZ-1	
	Thu., October 03 (14.00 – 15.30)	Lec 17, 18 (1.5 hours)	The physics and chemistry of air and water pollution	Priyanka
9	Mon., October 07 (11.00 – 11.50)	Lec-19	The physics and chemistry of air and water pollution	Priyanka
	Wed., October 09 (11.00 – 11.50)	Lec-20	The physics and chemistry of air and water pollution (Lec assignment 3: N-cycle and pollution)	Priyanka
	Thu., October 10 (14.00 – 17.00)	Lab-7	Water quality lab – analysis	Priyanka (Pennan)
10	Wed., October 16 (11.00 – 11.50)	Lec-21	Physics of climate and climate change	Sharad
	Thu., October 17 (14.00 – 17.00)	Lab-8	Water Quality Analysis - BOD/DO Analysis, BOD Curve (Lab exercise 4)	Priyanka (Lab Asst.)
11	Mon., October 21 (11.00 – 11.50)	Lec-22	Physics of climate - land-ocean-atmosphere linkages	Jagdish
	Wed., October 23 (11.00 – 11.50)	Lec-23	Review of Module 1	All
	Thu., October 24 (14.00 – 17.00)	Lab-9	Stream discharge and pollutant flux measurement field trip (Lab exercise 5)	Priyanka (Lab Asst.)
12	Mon., October 28 (11.00 – 11.50)	Lec-24	QUIZ 2	
	Wed., October 30 (11.00 – 11.50)	Lec-25	Water and wastewater treatment	Priyanka
	Thu., October 31 (14.00 – 17.00)	Lab-10	Field Trip to IISc Wastewater Treatment and Recycling Plant	Priyanka (IISc Tech.)
13	Wed., November 06 (11.00 – 11.50)	Lec 26	Introduction to sustainability science	Sharad
	Thu., November 07 (14.00 – 14.50)	Lec 27	Introduction to sustainability science	Sharad
14	Mon., November 11 (11.00 – 11.50)	Lec-28	Agricultural systems – production and food security	Shrini
	Wed., November 13 (11.00 – 11.50)	Lec-29	Agricultural systems – production and food security	Shrini
	Thu., November 14	Documentary	Cadillac desert, Marc Reisner (1986)	

	(14.00 – 17.00)	screening		
15	Mon., November 18 (11.00 – 11.50)	Lec-30	Water resources sustainability – allocation, conflict, use, sustainability	Veena
	Wed., November 20 (11.00 – 11.50)	Lec-31	Water resources sustainability – allocation, conflict, use, sustainability (Lecture assignment 4: Ag and water security)	Veena
	Thu., November 21 (14.00 – 17.00)	Lab 11	Water and carbon foot-printing lab	Veena (Shrini)
16	Mon., November 25 (11.00 – 11.50)	Lec-32	Pollution and human health – links and risk assessment	Priyanka
	Wed., November 27 (11.00 – 11.50)	Lec-33	Pollution and human health – links and risk assessment	Priyanka
	Thu., November 28 (14.00 – 17.00)	Lab-12	Drinking water sample analysis and assessment of risks	Priyanka
17	Mon, December 02 (11.00 – 11.50)	Lec -34	Climate Change – direct and indirect impacts on humans	Jagdish
	Wed, December 04 (11.00 – 11.50)	Lec -35	Climate Change – direct and indirect impacts on humans (Lecture assignment 5: Pollution, Health and CC)	Veena
	Thu, December 05 (14.00 – 17.00)	Lab-13	Lab assignment viva	Priyanka (All)
18	Mon., December 10		Study week	Office Hours
	Tue., December 12		Study week	Office Hours
	Thu., December 13		Study week	Office Hours
19	Mon., December 16		Final Exam (3 hours)	