Pollution Abatement and Management (Course Code: EVS304)

**Spring semester, 2019**

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| Coordinator | **Yogeeta Dahal** |
| Credits | 6 ECTS (Compulsory course), 60 in-class hours |
| Lecturers | **Yogeeta Dahal** (Environment and Climate Studies, The College of Natural Resources, Royal University of Bhutan)**Om Katel** (Environment and Climate Studies, The College of Natural Resources, Royal University of Bhutan) |
| Level | BSc |
| Host institution | **Department of Environment and Climate studies, College of Natural Resources, Royal University of Bhutan** |
| Course duration | September 01 – November 30, 2018 |

### Summary

*This 6 ECTS course covers the overview on pollution and environmental health, air pollution and management, water pollution and management, soil pollution and management, management of Industrial wastes, management of medical and hazardous wastes and waste minimization and management. This course also include current status of air pollution monitoring and assessment in Bhutan. Students will explore the air and water quality at various locations and during this process students will also be exposed to the various equipment that can be used in monitoring air and water quality. Students will also be exposed on how to manage the different pollutants and wastes.*

### Target student audiences

Final year BSc students.

### Prerequisites

None

### Aims and objectives

The main aim of this course is to provide a broad understanding on soil, water and air pollution including waste generation, their impacts and the management of wastes. Students will gain skills on waste management using different technologies and approaches.

### General learning outcomes:

By the end of the course, successful students will:

* Explain the impacts of pollution on environment
* Explainpollutants as environmental hazards
* Associate application of technologies to reduce soil, water and air pollution
* State the principles of waste management
* Describe the techniques and importance of sewage treatment plants
* Evaluate solid wastes management practices
* Apply different waste management techniques
* Conduct air quality test

### Overview of sessions and teaching methods

The course is delivered in three interactive methods such as lectures, practical, field assessment and laboratory report. The course starts with brief introduction to environmental health, water and air pollution and management of different types of wastes such as industrial and medical wastes. Subsequent sessions will combine lecture, laboratory experiment, video sessions, and field work and moderated class discussions.

### Course workload

The table below summarizes course workload distribution:

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| --- | --- | --- | --- |
| **Activities** | **Learning outcomes** | **Assessment** | **Estimated workload (hours)** |
| **In-class activities** |
| Lectures  | Understanding concepts of environmental health, indicators and tools to monitor environmental health.  | Class participation | 30 |
| Moderated pracical work | Understanding various policy and management contexts and common problems with regard to air and water pollution.  | Class participation and discussions | 40 |
| In-class assignments | Understanding tools and methods to assess and monitor environmental health.  | Class participation and presentation | 40 |
| **Independent work** |
| Group work:* Contribution to the case-study projects
 | Ability to operate equipment and generate data with regard to air and water quality. Ability to interpret data on environmental health.  | Quality of group assignments | 20 |
| Course group assignment | Ability to relate to specific situation and frame specific policy context in order to address the environmental problems.  | Quality of their presentation | 20 |
| ***Total*** |  |  | ***150*** |

### Grading

The students’ performance will be based on the following:

* Level of preparedness for participation in practical class and seminars (10 %) (from 100 % for proper lab record and to 0 % for completely ignoring practical class);
* Quality of the laboratory report and Presentation (40%)
* Quality of field visit report (40%)

### Course schedule

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| --- | --- | --- | --- |
| **Day** | **Time** | **Topic** | **Lecturer** |
| September 17 Monday | 09:15 – 12:15 | Overview on pollution and environmental healthTypes and emerging environmental pollutants Principles and practice of pollution managementRoles and functions of various agencies in environmental protectionEnvironmental quality guidelines, standards and Environmental health and human health | Yogeeta Dahal |
| September 25 Tuesday | 09:15 – 12:15 | Air pollution and managementAmbient and Indoor air quality and its related exposure risks Current status of air pollution monitoring and assessment in Bhutan | Yogeeta Dahal |
| September 26 Wednesday | 13:15 – 16:15 | Water pollution and managementConcept on surface water and ground water pollutionClassification of water pollutants Water quality standards and safety levels | Yogeeta Dahal |
| September 28 Friday | 13:15 – 16:15 | Water quality parameter measurementsWater pollution prevention and control measuresIndustrial and agricultural wastewater treatment | Yogeeta Dahal |
| October 01, Monday | 09:15 – 12:15 | Soil pollution and managementComposition and properties of organic and inorganic pollutants  | Yogeeta Dahal |
| October 03, Wednesday | 13:15 – 16:15 | Fate and behaviour of organic and inorganic pollutants Remediation (bioremediation, phytoremediation, mycoremediation)Case studies on management of soil pollution | Yogeeta Dahal |
| October 05 Friday | 13:15 – 16:15 | Management of Industrial wastesEffect of industrial waste water on ecosystems Waste management approachesRegulation of wastes | Yogeeta Dahal |
| October 09 Tuesday | 09:15 – 12:15 | Waste collection and re-cyclingWaste water treatmentRemoval ofsolids, oil and grease, biodegradable organics, acids and alkalis, and toxic materials  | Yogeeta Dahal |
| October 11, Thursday | 13:15 – 16:15 | Management of Medical and Hazardous wastesDefinition and category of medical and hazardous wastes; Medical waste management; Household hazardous wastes; Hazardous waste management | Yogeeta Dahal |
| October 16, Tuesday | 09:15 – 12:15 | Selective incineration and pyrolysisPaper mills and textile industry waste managementApplication of microbial enzyme for detoxification and degradation of wastesConstructed wetland | Yogeeta Dahal |
| October 19 Friday | 13:15 – 16:15 | Waste minimization and managementEnvironmental regulation and lawsMunicipal solid waste management using resource recovery conceptConcept of waste segregation, biodegradable and non-biodegradableConcept of reduce, reuse and recycleCircular economy.  | Om Katel |
| October 30 Tuesday | 13:15-16:15 | - Reports by assignment groups | Om Katel |

### Course assignments

Course assignments will constitute a project:

* Assignment #1 (mostly in-class) – a understanding of concepts and development of protocol for practical
* Assignment #2 (mostly in laboratory) – generating quality data with regard to air and water pollution management.
* Assignment #3 – Field report from a field excursion.

To complete the assignments the class will be divided into several groups. **Assignment #1** will help students to understand the scope of the problem, understand the concepts and prepare protocols for experiments to be conducted in the laboratory. (ppts and oral presentations will be used during the class).

**Assignment #2** will link Assignment #1, where students will test the equipment and generate data using air and water samples.

**Assignment #3** is based on the previous assignments and student will use the knowledge and skills learnt in the class to apply in the field and generate real time data. The group work output will be in the form of a laboratory report and presentations.

### Literature

* Kumar, A. (2003). *Environment, pollution and management*. Darya Ganj, New Delhi: A.P.H. Publishing Corporation
* Mishra, P.C. (2009). *Fundamentals of air and water pollution*. Darya Ganj, New Delhi: A.P.H. Publishing Corporation
* Mishra, S.G.(2009). *Soil pollution*. Darya Ganj, New Delhi: A.P.H. Publishing Corporation
* Mishra, S.R. (2009). *Assessment of water pollution*. Darya Ganj, New Delhi: A.P.H. Publishing Corporation
* Yo,H.M. (2005). *Environmental toxicology: Biological and health effects of pollutants* (2nd Ed.). Florida, USA: CRC PRESS LLC
* Kaza, S., Yao,L., Bhada-Tata,P., &Woerden,F.V. (2018). *What a waste 2.0: A global snapshot of solid waste management to 2050*. Washington DC, World Bank
* Krupa, V.S. ( 1997). *Air pollution, people and plants: An introduction*. Minnesota, USA: APS
	+ Press
* RGOB. (2009). Waste prevention and management act of Bhutan. Thimphu
* Saxena, M.M. (1995). *Environmental analysis: Water, soil and air*. Agro Botanical
	+ Publishers