



SECOND SEMESTER 2020-21

Course Handout Part II

Date: 19.01.2021

In addition to Part – I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No.	: BIO F216
Course Title	: WATER, SANITATION AND SOLID WASTE MANAGEMENT
Instructor-in-charge	: P. SANKAR GANESH
Instructor	: P. Sankar Ganesh

1. Scope of the course:

Anthropogenic disturbances to this planet have increased tremendously in the last three decades. Some of the earth's elements, including the aquatic ecosystem have reached the saturation level. Hence there is an urgent requirement to treat the existing pollutants and those that would be produced in the future. This fact has also been realized by United Nations through the Sustainable Development Goal No. 6, which focuses to ensure availability and sustainable management of water and sanitation for all. This course is aligned with the above environmental issues their solutions.

2. Objective of the course:

Objective of this course is to impart knowledge on household water treatment systems and safe storage of treated water, planning and designing sanitation systems and technologies, which includes introduction to faecal sludge management and municipal solid waste management with a special focus on developing countries.

3. Course description:

This course will consist of the following four modules:

- Module 1: Municipal Solid Waste Management in Developing Countries
- Module 2: Planning and Design of Sanitation Systems and Technologies
- Module 3: Introduction to Household Water Treatment and Safe Storage
- Module 4: Introduction to Faecal sludge management

4. Text books (TB):

1. Faecal Sludge Management, Systems Approach for Implementation and Operation, Linda Strande, Mariska Ronteltap, Damir Brdjanovic, IWA Publishing, 2014.

2. Solid Waste Management in Developing Countries C. Zurbrügg (2002) A primer and introduction to the main issues related to solid waste management in developing countries.

5. Course Plan:

Module 1: Municipal Solid Waste Management in Developing Countries (To be covered in January, 2021)

Courseera: <https://www.coursera.org/learn/solid-waste-management>

YouTube: <https://www.youtube.com/channel/UCkXdyAGKs9dakJlqjD5vfw>

Learning goals:

- Understand the different steps required for appropriate management of solid waste and also the principal challenges that exist in developing countries
- Understand the governmental aspects linked to solid waste management networks
- Understand the basis of different organic waste treatment technologies
- Know evaluation and planning methods concerning the management of solid waste

- **Introduction to Solid Waste Management in Developing countries**

The course begins with an overview of current waste situation in developing countries. We will introduce Integrated Sustainable Waste Management (ISWM) framework that provides a general overview of SWM systems and will guide us through this course. The modules of this first week deal with the physical components of a SWM system.

- **Introduction to SWM in Developing countries**

On the second week, the course will elaborate on the governance aspects also referred as the “soft” aspects of a SWM system. Different stakeholders as well as legislative issues and financial mechanisms will be explained.

- **Organic waste treatment technologies**

Week three will focus on the treatment of organic waste. Students will learn the basics of two very common organic waste treatment technologies: composting and anaerobic digestion. Study case examples and some practical exercises will be presented in order to get a better understanding of the underpinning reactions and conditions needed for each treatment process.

- **Organic waste treatment technologies**

Week four will elaborate further on organic waste treatment technologies. Common treatments used in developing countries such as vermicomposting or open burning will be explained. Furthermore, technologies which are either mainly used in developed countries or are still being researched will also be presented. Students will understand the shortcomings and challenges of implementing these western technologies in developing countries.

- **Assessment and planning methods for SWM**

During the last week, the modules will focus on strategic aspects of SWM. Methods on how to integrate organic waste management into the municipal SWM system will be explained. A standardized method to evaluate and compare systems in regard of their SWM will also be presented as well as relevance of waste on climate change. Finally, some reflections about future of waste management will be discussed. The course will end with a wrap up module which will also serve as preparation for exam.

Module 2: Planning and Design of Sanitation Systems and Technologies (To be covered in February, 2021)

Coursera: <https://www.coursera.org/learn/sanitation>

YouTube: <https://www.youtube.com/channel/UCgHWg270mPystle5rVFOvCA/featured>

Learning goals:

- A. Discern different methods of sanitation planning at the city and neighbourhood levels and understand why an enabling environment is essential
- B. Link the systematic approach of urban sanitation to different functional groups
- C. Evaluate the pros and cons of different treatment methods
- D. Discern sanitation solutions in their contexts, as well as different treatment options
- E. Analyze different diagnostic and analytical tools concerning institutional and financial arrangements, behaviour changes, security planning in terms of sanitary measures and the flow of faecal matter

- **Introduction to sanitation planning & systems approach**

The course will begin with an overview of why sanitation is important for human health and environmental protection, especially in urban areas. This is followed by a presentation of the importance of the Enabling Environment. It will then review existing state-of-the-art environmental sanitation planning approaches (Sanitation 21, CLUES, CLTS) that are currently being used in international development.

- **Sanitation systems & technologies**

In the second week, after presenting different sanitation planning frameworks you will learn about the systems approach to environmental sanitation – the key terminology and concepts and why systems’ thinking is crucial for urban environmental sanitation.

- **Sanitation systems & technologies**

The focus of week 3 is on a detailed overview of different sanitation systems, from simple single pit system to more complex centralised treatment systems. The main treatment processes are then reviewed in detail, highlighting advantages and disadvantages of each.

- **Urban sanitation solutions - Case studies**

In the fourth week we’ll present case studies from Africa and Asia showing different sanitation solutions from neighbourhood to national scale.

- **Urban sanitation tools**

Week 5 presents various urban sanitation tools, such as excreta flow diagrams (SFDs) or sanitation safety planning. Followed by a series of modules from World Bank Water & Sanitation Programme covering topics of urban sanitation.

Module 3: Introduction to Household Water Treatment and Safe Storage (To be covered in March, 2021)

Coursera: <https://www.coursera.org/learn/water-treatment>

YouTube: https://www.youtube.com/channel/UC4_qoddqxeh0JZJXpsuVP9g

Learning goals:

- A. Understand the basis for sludge contamination of drinking water
- B. Understand the household level treatment and safe storage of water (HWTS)
- C. Discern the principal techniques and processes of water treatment
- D. Understand the different approaches that comprise successful implementation of HWTS
- E. Understand the different approaches that allow for the evaluation of the implementation of HWTS

▪ **Introduction to Household water treatment and safe storage**

The course begins with a review of the public health impacts of unsafe drinking water. We define physical, chemical, and microbial aspects of drinking water quality and present the major classes of pathogens. Information about pathways for faecal contamination of drinking water are followed by an introduction to the concept of HWTS and the principal technologies.

▪ **HWTS treatment options**

After identifying and discussing the problem of water contamination in the first week, we focus during week 2 and 3 on potential solution methods. We refer first to the standards of safe drinking water and improved drinking water, and discuss ways to prevent microbial contamination through water source protection and household hygiene. Week 2 focuses on sedimentation and different kinds of filtration.

▪ **HWTS treatment options**

In week 3 we continue with potential solution methods by focusing on heat, ultraviolet radiation, chemical disinfection. Specific modules are provided to cover safe storage and the combination of solution methods.

▪ **Implementation strategies for HWTS**

There is no single standard strategy for successful HWTS implementation. During week 4 we analyze therefore different approaches that have been successfully applied. We highlight key components which make programs more likely to succeed. We ask the questions, what is required for the most vulnerable populations use HWTS correctly and consistently over the long-term? In separate modules we consider the special case of HWTS in emergency response and provide information about the role of government bodies.

▪ **Assessing the impact of HWTS**

During fifth week, we present different approaches to assess impact of HWTS and highlight challenges of measuring HWTS impact. The course ends with a wrap-up module, which serves as well as preparation for the final exam.

Module 4: Introduction to Faecal Sludge Management (To be covered in April, 2021)

Coursera: <https://www.coursera.org/learn/faecalsludge>

YouTube: https://www.youtube.com/channel/UCA6q0XkRVIRpjD8_Sv0QK9w

Learning goals:

- A. Understand importance of faecal sludge management, and lacks and weaknesses of faecal sludge service chain
 - B. Understand the fundamentals of faecal sludge management
 - C. Integrate the information necessary to analyse and select among technologies of faecal sludge treatment
 - D. Know how to design well-functioning treatment technologies
 - E. Analyze the management and planning approaches that lead to sustainable solutions
 - F. Know research and innovations in terms of technology
- **An introduction to FSM**

This first week of this course includes an overview of what faecal sludge is, and the importance of an integrated approach to faecal sludge management. It provides an introduction to what is currently lacking, weak links in the service chain, and also presents positive examples of what is working.
 - **Overview of fundamentals for design and selection of treatment technologies**

The second week of this course is based on an integrated engineering design approach, and will introduce fundamentals and required information for design and selection of technologies, including objectives, mechanisms, quantification and characterization. It also includes collection and transport of faecal sludge to treatment.
 - **Treatment technologies for faecal sludge**

The third week of this course focuses on engineering aspects of how to size and properly operate faecal sludge treatment technologies.
 - **Integrated approach to FSM**

Sanitation solutions do not rely on technology alone, and are prone to failure if an integrated planning approach that includes stakeholder involvement and the development of appropriate institutional, management and financial arrangements are not implemented. Presented in week 4 is the full picture, in addition to technology, that needs to be considered for sustainable solutions

▪ **Innovations in FSM**

Faecal sludge management is a relatively new and rapidly growing field. As a result, many solutions are not yet fully developed, which has to be carefully considered in technology implementation. Week 5 will focus on current research and innovations in technologies, to provide an understanding of the most up-to-date options, and what needs to be considered for further development and implementation.

6. Evaluation scheme:

Evaluation component	Duration	Weightage %	Date and time	Nature of the Component*
Mid Semester Examination	1.5 Hrs	30	04/03/2021 1:30 to 3:00 PM	OB
Quiz/ Class work	Diverse	30	Continuous Evaluation	OB
Comprehensive examination	2 Hrs	40	11/05/2021 AN	OB

*OB: Open book

§Class work: Presentation/Group Discussion/Comprehension/Practical Sessions, etc.

7. Chamber consultation hour:

To be announced.

8. Grading policy:

Award of grades will be guided in general by the histogram of marks. Decision on border line cases will be taken based on individual's sincerity, student's regularity in attending classes, and the section instructor's assessment of the student.

9. Make-up policy:

Make-up for Mid semester examination will be given only in genuine (medical emergency) cases of absence. If the absence is anticipated, before the examination, prior permission of the Instructor-in-charge is necessary. Request for make-up should reach the Instructor-in-charge at the earliest. Make-up for class tests/ quizzes and assignments are not given. Also refer to Clause 4.07 of BITS *Academic Regulations* for more details.

10. Notices:

All notices/ announcements regarding this course shall be displayed in Course Management System (CMS).

11. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Prof. P. Sankar Ganesh
Instructor In-charge
BIO F216