COURSE CONTENT

Academic Year	AY2023-24	**Semester**	2
Course Coordinator			
Course Code	EN2712		
Course Title	Environmental Engineering Laboratory B		
Pre-requisites	Nil		
No of AUs	1		
Contact Hours	Lecture: 0 hrs; Tutorial: 0 hr; Lab: 30 hr.		
Proposal Date	12 September 2023		

Course Aims

The aim of this lab is to provide you with practical application experiences and an understanding of theories relating to areas in hydraulics and hydrology, and structures and mechanics. By completing ten lab sessions, you are able to appreciate typical applications of important concepts, which include Coagulation treatment, momentum equation, energy loss, unit hydrograph, load-deformation behaviour, bending stress distribution, and trial mix composition.

Intended Learning Outcomes (ILO)

Upon completion of the course, students should be able to:

(a) Carry out experiments and verify theories in ENV courses relating to hydraulics and hydrology, and structures and mechanics.
(b) Carry out investigative open-ended projects to include independent methodology to relate theories and principles to experimental results on various test apparatuses relating to above courses.
(c) Estimate percent uncertainty in experimental data and results.
(d) Analyse, interpret and infer from experimental data and results.
(e) Write a project report with professional and technical competency and clarity.

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1	Coagulation treatment of raw water using precipitation	-	3
2	Jet impact	-	3
3	Losses in pipe flow	-	3
4	The hydraulic jump phenomenon	-	3
5	The unit hydrograph method	-	3
6	Braced Member: Equilibrium and elasticity	-	3
7	Torsion	-	3
8	Beam bending	-	3
9	Concrete mixing, casting, demoulding and slump test	-	3
10	Tests on hardened concrete & tensile test of reinforcing bars	-	3
	Total:	-	30

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team / Individual	Assessment rubrics
Continuous assessment	(a),(b),(c),(d),(e)	CEE SLOs (a), (b), (d), (e), (i), (j) and (l).	100%	Team and Individual	Refer to Appendix 1
Total			100%		

* CEE SLO = Civil and Environmental Engineering Learning Outcomes (as per EAB Student Learning Outcomes (subset of 12 points))

a) Engineering knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
b) Problem Analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d) Investigation: Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i) Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l) Life-long Learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest.

Formative feedback

All reports submitted will be marked by tutors. They are kept in the lab for students' view.

Learning and Teaching approach

Class meets once per week over 3 or 6 hours (depending the lab sessions selected) to conduct experiments, collect data and complete reports.

Approach	How does this approach support students in achieving the learning outcomes?

Laboratory	In each session, the lab instructor first gives an introduction to the experiment, which includes relevant theory, experimental setup, and data analysis. Then technical staff shows main steps for conducting the experiment and collecting data. Finally, the students formed in groups conduct experiment, collect data, perform data analysis and write a report. This helps students to achieve one or more of the outcomes as they need to work as a group for experimental setup, data sampling and processing.
Individual and group report	Group reports are submitted for 9 labs. To run experiments, the class is organized into several groups, each having 3-5 students. Each group conducts experiment, collect data, perform analysis and complete a report within a 3-hour session. This helps students to achieve one or more of the outcomes as they need to work together for data analysis and report-writing. Individual reports are submitted only for 1 pre-arranged lab, within two weeks from the date of the lab attended. This helps students to achieve one or more of the outcomes as they need to do self-study and research, on individual basis, for a lab-specified topic.

Reading and References

Beyond the laboratory manual, reference materials are also provided/recommended by instructors.

Course Policies and Student Responsibilities

Students must abide by the lab protocols and regulations shared during the safety briefings at all times.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning If you are uncertain of the definitions of any of these terms, you should go to the Academic Integrity Handbook for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

The instructors comprise several PhD students, who are selected through an interview.

Planned Weekly Schedule

- Lab starts from week 2 and ends in week 11.
- Each week, there are two sessions available for students to attend.
- Each lab is repeated twice.

Week	Topic	Course LO	Readings/ Activities
2	Coagulation treatment of raw water using precipitation	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
3	Jet impact	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
4	Losses in pipe flow	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
5	The hydraulic jump phenomenon	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
6	The unit hydrograph method	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
7	Braced Member: Equilibrium and elasticity	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
8	Torsion	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
9	Beam bending	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
10	Concrete mixing, casting, demoulding and slump test	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing
11	Tests on hardened concrete & tensile test of reinforcing bars	(a),(b),(c),(d),(e)	Manual, Experiment, Data analysis, Discussion, Report-writing

Appendix 1: Assessment Rubric

	Performance Level/Criteria			
Performance Indicators/ Course LO Tested	**Outstanding: 4**	**Good: 3**	**Average, meet expectation: 2**	**Below expectations: 1**
Carry out experiments and verify theories /LO(a) and (b)	Excellent ability in understanding key concepts/theories involved in the experiment	Good ability in understanding key concepts/theories involved in the experiment	Ability in understanding key concepts/theories involved in the experiment	Unable to understand key concepts/theories involved in the experiment
Estimate uncertainties and analyse data /LO(c) and (d)	Excellent ability in estimating uncertainties and performing data analysis	Good Ability in estimating uncertainties and performing data analysis	Ability in estimating uncertainties and performing data analysis	Unable to estimate uncertainties and analyse data
Write a report/LO(e)	Excellent ability in presenting results and completing a report	Good Ability in presenting results and completing a report	Ability in presenting results and completing a report	Unable to present results and complete a report