Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	
Semester/Trimester/Others (specify approx. Start/End date)	
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
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Course Title	Water Resources Engineering
Course Code	CV2020
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	CV1012
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to introduce you to the basic principles of the hydraulics of open channel flows and topics of engineering hydrology. These are essential fundamentals for the design of water resources related projects and understanding of risk of hydrological events and magnitude of rainfall and runoff from a catchment.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Describe the fundamental knowledge of open channel hydraulics and perform resistance type equations to solve open channel flow problems under uniform flow conditions
ILO 2	Calculate changes of the water surface profiles subjected to transition problems using specific energy diagram
ILO 3	Evaluate hydraulics jumps using the momentum equation
ILO 4	Sketch and compute water surface profiles related to gradually varied flows
ILO 5	Describe a hydrologic cycle and its components and perform frequency analysis
ILO 6	Define a catchment and determine the effects of various factors on runoff hydrograph
ILO 7	Generate, synthesise, and predict runoff hydrographs using unit hydrograph
ILO 8	Perform reservoir/channel routing

Course Content

1. Steady uniform flow: Manning's equations and most efficient channel cross-section.
2. Specific energy diagram, critical flow condition, channel transitions and controls, and humps and contractions.
3. Momentum equation and hydraulic jump.
4. Steady non-uniform flow: characteristics and classification of gradually varied flow profiles, control sections.
5. Hydrologic cycle, precipitation, and probability in hydrology
6. Definition of catchment characteristic, runoff, and hydrograph
7. Unit hydrograph: derivation, synthesis, and applications
8. Flood routing: storage equation, reservoir and channel routing

Reading and References (if applicable)

Textbooks:

1. Franzini, J.B. and Finnemore, E.J., “Fluid Mechanics with Engineering Applications”, 10th Edition, McGraw-Hill, 2002.
2. Warren Viessman, Jr. and Gary L. Lewis (2012) "Introduction to Hydrology“, Pearson Singapore (Fifth Edition).

References:

1. Sturm, T. W., “Open Channel Hydraulics”. International Edition, 2nd Edition, McGraw-Hill 2010.
2. Chow, V.T. “Open Channel Hydraulics” McGraw Hill, New York, 1981 (Classical text).
3. Wilson, E.M., “Engineering Hydrology, 4th Edition, Macmillan, 1990

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Uniform Flow in Open Channels	1		In-person	3 lectures and 1 tutorial on Uniform Flow in Open Channels
2	Uniform Flow in Open Channels, Specific Energy and Transition Problems	1, 2		In-person	3 lectures and 1 tutorial on Uniform Flow in Open Channels, 4 lectures and 2 tutorial on Specific Energy and Transition Problems
3	Specific Energy and Transition Problems	2		In-person	4 lectures and 2 tutorial on Specific Energy and Transition Problems
4	Specific Energy and Transition Problems, Momentum Equations and Hydraulic Jumps	2		In-person	4 lectures and 2 tutorial on Specific Energy and Transition Problems, 3 lectures and 2 tutorials on Momentum Equations and Hydraulic Jumps

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
5	Momentum Equations and Hydraulic Jumps	3		In-person	3 lectures and 2 tutorials on Momentum Equations and Hydraulic Jumps
6	Gradually Varied Flows	4		In-person	3 lectures and 1 tutorial on Gradually Varied Flows
7	Quiz - CA1, Hydrologic Cycle and Probability in Hydrology	5		In-person	3 lectures and 1 tutorial on Gradually Varied Flows, 3 lectures 1 tutorial on Hydrologic Cycle and Probability in Hydrology
8	Hydrologic Cycle and Probability in Hydrology	5		In-person	3 lectures 1 tutorial on Hydrologic Cycle and Probability in Hydrology
9	Definition of Catchment Characteristic, Runoff, and Hydrograph	6		In-person	3 lectures 1 tutorial on Definition of catchment characteristi c, runoff, and hydrograph

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
10	Definition of Catchment Characteristic, Runoff, and Hydrograph, Unit Hydrograph	6	3 lectures 1 tutorial on Definition of catchment characteristic, runoff, and hydrograph, 4 lectures 2 tutorial on Unit Hydrograph	In-person	
11	Unit Hydrograph	7		In-person	4 lectures 2 tutorial on Unit Hydrograph
12	Unit Hydrograph, Flood Routing	8		In-person	3 lectures 2 tutorial on Flood Routing
13	Flood Routing, Quiz - CA2	8		In-person	3 lectures 2 tutorial on Flood Routing

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Formal lectures on the topics with in-class discussion
Tutorial	This helps you to achieve one or more of the outcomes as you would need to work on tutorial questions using the concepts and principles taught in lectures. (The class is split into groups for tutorials so that the instructor-student interaction can be more effective.)

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Others([final examination])	1, 2, 3, 4, 5, 6, 7, 8	CVE SLOs (2018) a, c, e, g, j	60	Team	Holistic	Relational
2	Continuous Assessment (CA): Others([quiz/test])	1, 2, 3, 4	CVE SLOs (2018) a, c, e, g, j	20	Team	Analytic	Multistructural
3	Continuous Assessment (CA): Others([quiz/test])	5, 6, 7, 8	CVE SLOs (2018) a, c, e, g, j	20	Team	Analytic	Multistructural

Description of Assessment Components (if applicable)

CVE SLOs (2018)
a) Engineering Knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and civil engineering specialisation to the solution of complex civil engineering problems.
b) Problem Analysis: Identify, formulate, research literature, and analyse complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) Design/development of Solutions: Design solutions for complex civil engineering problems and design system components or processes with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d) Investigation: Conduct investigations of complex problems using research-based knowledge and 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 civil engineering activities with an understanding of the limitations.
f) The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice. g) Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and the need for the sustainable development.
h) Ethics: Apply ethical principles and commit to professional and moral responsibilities in the civil engineering practice.
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 civil engineering activities with the engineering community and with society at large, be able to comprehend and write effective reports and design documentation, and make effective presentations.

Formative Feedback

The instructor(s) will provide feedback on your performance on the CA. Guidance will also be provided through active interactions during tutorial sessions and consultation meetings

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Creative Thinking	Intermediate
Curiosity	Basic
Problem Solving	Intermediate

Course Policy

Policy (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. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. 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. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

Policy (Absenteeism)

Policy (Others, if applicable)

You are advised to go through the class material and related texts before the lecture. You are also encouraged to share and deliberate on the challenges and difficulties of the tutorial exercises during the tutorials.

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