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

Course Overview

Expected Implementation in Academic Year	AY 2021-2022
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
Course Author Email	clhlee@ntu.edu.sg
Course Title	Bridge Engineering
Course Code	CV4104
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	CV3011 Reinforced Concrete Design & CV 3012 Steel Design
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

The objective is to equip the students with a thorough understanding of the behavior and design of bridges. Various applied loads, such as truck load, impact, horizontal braking forces, wind loads are discussed thoroughly. Background to design equations for different types of bridges and relevant modern research will also be discussed to provide the students with solid understanding of the topics covered.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Demonstrate fundamental knowledge of design and construction of bridges.
ILO 2	Determine the load-carrying capacity of various types of bridges.
ILO 3	Evaluate the basic issues that have to be addressed in selecting an appropriate structural form and develop a coherent concept design for a bridges.
ILO 4	Analyze and design short and medium span bridges, with confidence using existing codes of practice.
ILO 5	Select appropriate load and analysis models for quantifying the structural behavior of bridges
ILO 6	Discuss Bridge maintenance including inspection and rehabilitation

Course Content

S/N	Topic	Lecture Hours	Tutorial Hours
1	History of bridge-building; types of bridges; Materials for modern bridges	2	1
2	Loads on bridges	4	2
3	Serviceability criteria – deflection and fatigue	2	1
4	Reinforced Concrete Bridges	6	3
6	Plate Girder Bridges Design. Design Aids	4	2
7	Prestressed Concrete Bridges	6	3
8	Bridge Aesthetics, Inspection, Rehabilitation	2	1
	Total hours	26	13

Reading and References (if applicable)

1. Clark, L A, “Concrete bridge design to BS 5400”, Construction Press, 1983 [TG335.C593]
2. Bangash, M. Y. H. “Prototype bridge structures: analysis and design”, Thomas Telford, 1999 [TG300.B216]
3. Bennett, David, “The architecture of bridge design”, Thomas Telford, 1997 [TG300.A674]
4. Xanthakos, Petros P, “Bridge substructure and foundation design”, Prentice Hall, 1995 [TG320.X2]
5. Ponnuswamy, S. “Bridge engineering”, Tata McGraw-Hill, 1989 [TG145.P797]

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	History of bridge-building; types of bridges; Materials for modern bridges	1		In-person	Lectures
2	Loads on bridges – standard truck and lane loading. Impact loads.	2		In-person	Tutorial and lectures
3	Longitudinal and centrifugal forces. Wind and seismic loads. Thermal loads	3		In-person	Tutorial and lectures
4	Serviceability criteria – deflection and fatigue	4		In-person	Tutorial and lectures
5	Reinforced Concrete Bridges	4		In-person	Tutorial and lectures
6	Slab bridges – longitudinally reinforced bridges	5		In-person	Tutorial and lectures
7	Slab-Stringer Bridge Design continued. T-Beam	5		In-person	Tutorial and lectures
8	Plate Girder Bridges – general approach.	5		In-person	Tutorial and lectures
9	Plate Girder Bridges continued	5		In-person	Tutorial and lectures
10	Prestressed Concrete Bridges	5		In-person	Tutorial and lectures

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
11	Prestressed Concrete Bridges	5		In-person	Tutorial and lectures
12	Prestressed Concrete Bridges continued. Box girder bridges	6		In-person	Tutorial and lectures
13	Bridge maintenance including inspection and rehabilitation	6		In-person	Tutorial and lectures

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Weekly lectures to enable students to have the necessary knowledge to achieve the learning outcomes
Tutorial	Weekly tutorials to get students to practice and hone their ability to achieve the learning outcomes

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam(Final Examination)	1-6	CIV SLOs a, b, e,	60		Individual	Holistic	Relational
2	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 1 (CA1): Quiz 1)	1,2,3	CIV SLOs a, b, e,	20		Individual	Analytic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(CA2: Quiz 2)	4,5	CIV SLOs a, b, e,	20		Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

EAB SLO stands for the Engineering Accreditation Board Student Learning Outcomes. The list is below:

Engineering knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
Problem Analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
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
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.
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.
Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
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.
Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
Life-long Learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Formative Feedback

1. Feedback will be through the dissemination of the student's performance in quizzes as well as review of the quiz questions in class.
2. Additional channel will be through individual consultation initiated by students on their particular learning needs.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Critical Thinking	Intermediate
Design Thinking	Intermediate
Systems Thinking	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)

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct. The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of your mental health and wellbeing. These policies and codes concerning students can be found in the following link.

Policy (Absenteeism)

Policy (Others, if applicable)

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Last Updated By: YANG En-Hua