NANYANG TECHNOLOGICAL UNIVERSITY

COURSE CONTENT

Academic Year	2019-2020	**Semester**	2
Course Coordinator	A/P LIE SENG TJHEN		
Course Code	CV3012		
Course Title	Steel Design		
Pre-requisites	CV2011 – Structural Analysis		
No of AUs	3		
Contact Hours	Total: 39 Hours (Lecture: 26 hours; Tutorial: 13 hours)		
Proposal Date	30 June 2019		

Course Aims

This course aims to:

i) develop an understanding of Limit State Design as applied to structural steel members and connections based on the Eurocode 3 – Design of Steel Structures with Singapore Annexes;

ii) equip students in applying the knowledge learned to design standard steel beams, columns, and connections commonly found in steel structures.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) should be able to:

1. Determine the basis of design, ultimate and serviceability limit states, actions and its combinations, characteristic values and partial factors.
2. Carry out cross-section classification of standard hot-rolled and welded sections.
3. Perform design procedures for fully restraint beams under in-plane bending; obtain moment and shear resistances; and calculate serviceability deflection check.
4. Perform design procedures for unstrained beams; calculate elastic critical moment, buckling resistances, imperfection factors; and check lateral-torsional buckling resistance using three alternative approaches.
5. Check web bearing and buckling resistances of beams under transverse actions.
6. Analyse the behaviour of compression members, Euler buckling, effective lengths, non-dimensional slenderness, buckling curves; and calculate buckling resistance of a column under axial compression.
7. Perform design procedures for columns under axial compression and nominal moments in simple frame construction.
8. Perform design procedures for columns under axial compression and large moments in continuous construction using two alternative methods of getting the interaction factors.
9. Analyse roof truss and lattice girder construction; use simplified rules to design angle, channel and T-section members.
10. Describe the basic concepts of joint design in structural steelwork, and commonly used bolted and welded connections.
11. Analyse pinned and moment connections, beam-to-column connections using non-

preloaded and preloaded bolts and beam-to-beam splices.

12. Calculate minimum fillet welds sizes used in welded connections; check baseplate, plain and block shear resistances.
13. Take into count buildability, serviceability and maintainability plans in the design.

Course Content

S/N	Topic	Lecture Hours	Tutorial Hours
1	Introduction, material properties, limit state design, loading, section classifications.	2	1
2	Behaviour of compression members, local and overall buckling, column slenderness and effective length concept.	2	1
3	Design of laterally restrained beams.	3	1
4	Design of lateral-torsional buckling of unrestrained beams.	3	1
5	Introduction and design of column in simple structures.	2	1
6	Simplified and more exact methods for members with axial force and moments.	3	2
7	Introduction to lattice roof construction and simplified rules for lattice truss members.	2	1
8	Introduction and basic concepts of joints design.	3	1
9	Simple beam-to-beam and beam-to-column connections.	3	2
10	Introduction to moment connections of bolted end plate connections, beam and column splices.	3	2
	Total:	26	13

Assessment (includes both continuous and summative assessment)

Components	Course LO tested	Related programme SLO or graduate attributes	Weighting	Team/ Individual	Assessment Rubrics
1. Final Examination	All	a, b, c, d, g	60%	Individual	
2. Continuous Assessment 1 : Quiz 1: To design a fully restraint or unrestraint beam	1, 2, 3, 4	a, b, c, d, e, g, j	20%	Individual	Appendix 1
3. Continuous Assessment 2 Quiz 2: To design a column in simple frame construction	5, 6	a, b, c, d, e, g, j	20%	Individual	Appendix 1
Total			100%		

*CVE SLOs = Student Learning Outcome For Civil Engineering Progamme (Per BEng Civil Engineering Accreditation)

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.

k) **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to work, as a member and leader in a multidisciplinary team.

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 context of technological evolution.

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. We encourage you to initiate an individual consultation sessions on your particular learning needs.

Learning and Teaching Approach

Approach	**How does this approach support students in achieving the learning outcomes?**
Lectures	Weekly lectures to provide you with the specific knowledge and techniques to achieve the learning outcome stated above.
Tutorials	Weekly tutorials to enable you to apply the knowledge to solve structured problems. We encourage you to explore alternative approaches and techniques.
Quizzes	Two quizzes to test your understanding on the knowledge learned to design fully restraint beams, unrestrained beams and columns under nominal moments in simple frame construction.

Textbooks/References:

1. Lam, D., Ang, T.C. and Chiew, S.P., "Structural Steelwork: Design to Limit State Theory", 4th Edition, CRC Press, Taylor & Francis Group, London, UK, 2014.

2. Luís Simões da Silva, Rui Simões, Helena Gervásio and Graham Couchman, "Eurocode 3: Design of Steel Structures – Part 1-1: General Rules and Rules for Buildings", U.K. Edition, ECCS and Ernst & Sohn, 2014.

3. Gardner, L. and Nethercot, D.A., "Designers' Guide to Eurocode 3: Design of Steel Structures – Designers' Guide to EN 1993-1-1 Eurocode 3: Design of Steel Structures General Rules and Rules for Buildings", Thomas Telford, London, UK, 2005.

4. Wald, F., Tan, K.H. and Chiew, S.P.,"Design of Steel Structures with Worked Examples to EN 1993-1-1 and EN 1993-1-8", Research Publishing, Singapore, 2011.

5. BS EN 1993-1-1:2005+A1:2014, Eurocode 3: Design of Steel Structures – Part 1-1: General Rules and Rules for Buildings, British Standards Institution, London, UK, 2014.

6. BS EN 1993-1-5:2006, Eurocode 3: Design of Steel Structures – Part 1-5: Plated Structural Elements, British Standards Institution, London, UK, 2006.

7. BS EN 1993-1-8:2005, Eurocode 3: Design of Steel Structures – Part 1-8: Design of Joints, British Standards Institution, London, UK, 2005.

8. SCI – P363, Design Data ("The Blue Book"), Steel Construction Institute, Ascot, UK, 2009.

Course Policies and Student Responsibilities

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.

http://www.ntu.edu.sg/SAO/Pages/Policies-concerning-students.aspx

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. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors AY2017/18

Instructor	Office Location	Phone	Email
A/P Lie Seng Tjhen	N1-01c-78	67905284	cstlie@ntu.edu.sg
Dr Teoh Bak Koon	N1-01b-46	67906936	bakkoon.teoh@ntu.edu.sg

Planned Weekly Schedule

Week	Topics	Course LO	Activities
1	Basis of design, ultimate and serviceability limit states, actions and combinations, characteristic values, partial factors, example on actions and effects on beam; local buckling & classification of cross-sections.	1	Lectures & Tutorial
2	In-plane bending of beams, shear and moment resistances of	2, 3	Lectures

	cross-sections, serviceability deflection check; design procedures for fully restraint beams.		& Tutorial
3	Lateral-torsional buckling, buckling resistances, beam curves, imperfection factors, elastic critical moment for lateral-torsional buckling; the three alternative methods to determine lateral-torsional buckling resistances; design procedures for unstrained beams.	4	Lectures & Tutorial
4	Behaviour of compression members, flexural buckling and non-dimensional slenderness, column curves, buckling resistances.	5	Lectures & Tutorial
5	Introduction to web bearing and buckling, stiff bearing length and effective length for resistance; design procedures for resistance of the webs under transverse forces.	5	Lectures & Tutorial
6	Section resistance, buckling resistance, Euler buckling, imperfection factor, buckling lengths and European buckling curves; design procedures for columns under axial force.	5,6	Lectures & Tutorial
7	Introduction to simple structures; column in simple structures with worked examples.	5,6	Lectures & Tutorial
8	General method design procedure of columns subjected to bending and axial compression.	6	Lectures & Tutorial
9	Comparison between the two alternative methods with examples.	6	Lectures & Tutorial
10	Introduction to roof truss and lattice girder construction; simplified rules for lattice truss members with worked examples.	7	Lectures & Tutorial
11	Baseplate design with worked examples; bolted and welded connections and concepts of joint design in structural steelwork.	8	Lectures & Tutorial
12	Introduction to moment connections - bolted end plate connections, beam and column splices; plain and block shear resistances.	9	Lectures & Tutorial
13	Introduction of fillet and welded connections; calculation of minimum weld leg length.	10	Lectures & Tutorial

Appendix 1: Assessment Criteria for Quizzes 1 and 2

Performance Level/Criteria					
Weighting	**Performance Indicators**	**Outstanding: 4**	**Good: 3**	**Average, meet expectation: 2**	**Below expectations: 1**

Technical Knowledge (70%)	***Identify appropriate design factors, parameters and apply design code***	Correct design factors and parameters used in design	Some inaccurate design factors and parameters used in design	Some incorrect design factors and parameters used in design	Many incorrect design factors and parameters used in design
	Apply correct design principles and methodology	Correct principles and methodology applied in design	some incorrect principles and methodology applied in design	Many incorrect principles and methodology applied in design	Design based on incorrect principles and methodology
Creativity and Innovativeness (20%)	***Propose cost-effective designs which meet client requirements***	Design is cost effective, meets client requirements, creative and innovative	Design is generally cost effective and meets client requirements	Design is lacking in cost effectiveness and in meeting client requirements	Design is not cost effective and does not meet client requirements
	Consider socio-economic and buildability in design	Design pays much attention to socio-economic and environmental sustainability	Design pays sufficient attention to socio-economic and environmental sustainability	Design pays little attention to socio-economic and environmental sustainability	No consideration for socio-economic and environmental sustainability in design
	Consider practicality of project implementation	Proposed design can be readily and practically implemented	Proposed design can be implemented with some challenges	Proposed design can be implemented with great difficulties	Proposed design cannot be implemented
Technical Communication (10%)	***Technical Drawing***	The technical drawing communicates the design details and concepts clearly and professionally	The technical drawing has the design details and concepts. There are several minor mistakes in the drawing which affects the clarity.	The technical drawing has the main design details and concepts and is comprehensible. However, there are quite a number of mistakes in the drawing.	There was no technical drawing OR that the technical drawing is unintelligible or plagiarised