Subject Description Form

Subject Code	CSE30301
Subject Title	Structural Analysis
Credit Value	3
Level	3
Pre-requisites/ Exclusion	Pre-requisites: CSE20204 Advanced Structural Mechanics/ CSE19100 Mechanics of Materials or equivalent Exclusion: CSE301 Structural Analysis I
Objectives	(1) To enable students to correctly analyze skeletal structures through calculations; (2) To educate students to use commercial software for analyzing skeletal structures; (3) To educate students to collectively conduct experimental work on the displacement of simple structures; (4) To enable students to synthesize knowledge of loads, modeling, and structural analysis to design simple structures and evaluate structural performance.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Evaluate the displacements of skeletal structures with the principle of virtual work and establish influence lines; b. Calculate the response of skeletal structures using the flexibility method and stiffness methods; c. Conduct simple structural experiments; d. Analyze skeletal structures using commercial software packages; e. Present structural calculations logically and lucidly through the solution of structural analysis problems; f. Present logical and lucid reports on laboratory test results and computer analysis results.
Subject Synopsis/ Indicative Syllabus	1. <u>Principle of Virtual Work</u> (2 weeks) External work. Strain energy. Virtual work. Principle of virtual work: trusses, beams and frames. Calculation of displacement using the virtual work method. Maxwell's law of reciprocal displacements 2. <u>Flexibility Method</u> (3 weeks) Statical indeterminacy. Redundancy. Simultaneous equations of geometrical compatibility. Analysis of trusses, beams and frames. Effect of environmental changes. 3. <u>Stiffness Method</u> (3 weeks) Kinematic indeterminacy. Stiffness matrix. Simultaneous equations of equilibrium. Joint displacements. Determination of

internal forces and support reactions. Analysis of 2-D and 3-D structures.

4. Introduction to Finite Element Method (3 weeks)
   Finite elements. Discretization of structures. Displacement function. Node numbering scheme. Element stiffness matrix. Type of elements.

5. Influence Lines (2 weeks)
   Muller-Breslau's principle. Influence lines for simple trusses, beams and frames.

6. Laboratory and Project Work
   Loading test of a continuous beam. Influence lines of a continuous beam. Computer analysis of a plane frame.

Teaching/Learning Methodology

Fundamental concepts illustrated with examples are presented in the lectures. The students should review these and prepare themselves for the tutorials. The solution of tutorials will be discussed. In the laboratory the students would carry out experiments and use a commonly used computer software package to analyze a simple frame structure.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
1. Assignments and Lab	18	√	√	√	√	√	√
2. Mid-term Test	12	√	√				
3. Final Examination	70	√	√			√	
Total	100 %						

Students must pass the final examination and achieve a passing overall score/ grade to pass the subject.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The students will be assessed with three components, i.e., the laboratory session and assignment, a mid-term test, and an examination at the end of the semester. The students will be required to complete five assignments independently. The assignments are closely related to structural analysis methods and allow the students consolidate the understanding of the basic methods of structural

<table>
<tr><td></td><td colspan="2">analysis. The mid-term test is designed to check the students' learning outcome in solving simple problems. The homework and mid-term test are appropriate to achieve intended learning outcomes a and b. The students are required to attend the laboratory session and computer session and submit group laboratory reports. The laboratory session will enable students to acquire basic laboratory techniques, master the fundamental procedures of computer software package in structural analysis, and write report. The laboratory session and the report writing are best to achieve intended learning outcomes c, d and f. The final examination will emphasize on assessing students' basic concept of structural analysis, analytical methods of skeletal structures, and synthesis of structural analysis for structural design. It is appropriate to achieve intended learning outcomes a, b, c and e.</td></tr>
<tr><td rowspan="6">Student Study Effort Expected</td><td>Class contact:</td><td>Average hours per week</td></tr>
<tr><td>▪ Lectures / Tutorials / Laboratory</td><td>3 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Reading and Computer Project</td><td>3 Hrs.</td></tr>
<tr><td>▪ Completion of Assignments and Lab Reports</td><td>3 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>9 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">Hibbeler, R. C., Structural Analysis in SI Units, 10th Edition, Pearson Education, Inc., 2019.
Coates, R. C., Coutie, M. G. and Kong, F. K., Structural Analysis, 3rd edition, Chapman and Hall, London, 1988.
McCormac, J. C., Structural Analysis: A Classical and Matrix Approach, Addison Wesley, 1997.
Rao, S. S., The Finite Element Method in Engineering, Butterworth-Heinemann, 2011.</td></tr>
</table>