University of Macau

Undergraduate Civil Engineering Programme

Coordinating Unit:	Department of Civil and Environmental Engineering, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	CIVL316	Year of Study:	3
Course Title:	Structures II		
Compulsory/Elective:	Compulsory		
Course Prerequisites:	CIVL314 Structure I		
Prerequisite Knowledge:	Analysis of statically determinate structures including to determine the members forces and deformations with the energy method, conjugate beam method and three moment equation. Influence lines for statically determinate structures.		
Duration:	One semester	Credit Units:	4
Class/Laboratory Schedule:	Three hours of lecture and two hours of tutorial per week.		
Laboratory/Software Usage:	Measurement of frames deflections in laboratory and application and development of computer code for structural analysis.		
Course Description:	This course covers the following topics: Applications of displacement methods: moment distribution, slope-deflection method and stiffness matrix method. Application of Muller-Breslau principle: influence lines of frames and beams. Plastic analysis of beams and frames and bounding theorems. Application of direct stiffness matrix methods: analysis of space trusses, beams, plane frames and space frames.		
Course Objectives:	1. To understand the principle of displacement methods. 2. To develop the computer code based on the direct stiffness methods. 3. To understand the effects of moving loads on indeterminate structures. 4. To understand the plastic theory of structures.		
Learning Outcomes (LO):	Upon completion of this course, students should be able to: 1. simply a real structural system into an ideal theoretical systems [POs:b,e,f,h,i]; 2. apply difference methods to analysis and determine the structural response of a indeterminate structural system [POs: a,e,j]; 3. develop a computer code with modern computing language for the structural analyses of plane truss, space truss, plane frames and space frames. 4. understand the algorithm of computer codes for structural analysis[POs: a,d,e,f,g,i,j,k,l]; 5. design experiments for the measurement of structural responses [POs: a,b,c,e,f,g];		
Texts & References: *(* recommended textbook(s))*	1. Kenneth M. Leet, Chia-Ming Uang, Anne M. Gilbert, Fundamentals of Structural Analysis, Third Edition, McGrawHill 2. Harry H. West, Louis F. Geschwindner, Fundamentals of Structural Analysis, Second Edition, Wiley 3. R. C. Coates, M. g. Coutie, F. K. Kong, Structural Analysis, Third Edition, Chapman and Hall. 4. A. Ghali and A. M. Neville, Structural Analysis, A unified classical and matrix approach, Fourth edition, E & FN SPON 5. S. P. Timoshenko, D. H. Young, Theory of Structures, McGrawHill		
Student Assessment:	• Two tests: 50%; • Programming 20% • One final examination: 30%		
Learning Outcome Assessment:	• Tests and final examination. • Course evaluation		

Pedagogical Methods:	☑ Lecture	☐ Service learning
	☐ Guest speakers	☐ Internship
	☐ Case study	☐ Field study
	☐ Role playing	☐ Company visits
	☐ Student presentation	☐ e-learning
	☐ Project	☑ Independent study
	☐ Simulation game	☑ Others: programming work
	☑ Exercises and problems	

Major Assessment Methods: For each Major Assessment Method below, please indicate the specific pedagogical methods involved (by putting a ✓ in the relevant box(es) on the right-hand side).	Case Study	Role Playing	Student Presentation	Individual project/paper	Group project/paper	Simulation Game	Exercises & problems	Service learning	Internship	Field Study	Company visits	Written examination	Oral examination	Others (please specify)
Class Participation/ Discussion (0%)														
Assignment(s) (0%)														
Test(s) (50%)												✓		
Examination (30%)												✓		
Others *(please specify)* Programming work (20 %)														✓
Course Web: (if any)														

Course Content: (topic outline)

Week no.	Topics	Assignment no.	LO no.
1	**Introduction of Displacement Method** Principles of displacement; displacements and forces vectors of a typical member; steps of using displacement method;Development of 12x12 General Stiffness Matrix	--	1
2,3,4	**Application of Stiffness Matrix Method for Plane truss and plane frame** Simplification of the general stiffness matrix into 2x2 plane truss stiffness matrix and 6x6 plane frame stiffness matrix; the steps of assembly based on equilibrium and compatibility; properties of the system stiffness matrix e.g. symmetry and banded; post processing of the solutions.	1	2,3,4
5,6	**Application of the Direct Stiffness Matrix Method** Introduction of the Matrix transformation from local to Global coordinate; general assembly skill; skill to make use of the symmetry and banded; equation solving e.g. Choleski's triangular decomposition method. Introduction of the programming technique	--	2,3,4
7,8	**Slope-deflection method** Derive the slope-deflection equation based on the 2D plane frame stiffness equation; assembly the slope-deflection equation of each member based on the moment equilibrium at the joints; introduction the idea of sway and shear equations.	2	2,3
9,10	**Moment Distribution Method** Derive the moment distribution factor and carry-over factors based on the slope-deflection method; introduction of the idea of balance and carry-over; introduction of the idea of sway and shear equations.	3	2,3
11,12	**Influence Line of indeterminate Structures** Construction of influence line by moment distribution method; application of the Muller-Breslau principle; live load pattern to maximize forces in multistory buildings	4	2,3
13,14	**Plastic analysis of structures** Plastic bending, collapse load and collapse mechanisms, upper boundand lower bound theorems, method of combined mechanisms.	5	2

Contribution to Program Outcomes:	

Program Outcomes	Contribution to POs[#] 5 ----------> 1 Significant Least				
	5	4	3	2	1
(a) apply knowledge of mathematics, science, and engineering	✓				
(b) design and conduct experiments, and analyze data				✓	
(c) design components, systems or processes in presence of constraints				✓	
(d) Function in a multi-disciplinary team			✓		
(e) Engineering problem solving	✓				
(f) Understand professional and ethical responsibility			✓		
(g) Communicate effectively			✓		
(h) Understand the impact of engineering solutions to the society			✓		
(i) Recognize the need and have the ability for lifelong learning		✓			
(j) Have knowledge of contemporary issues	✓				
(k) Apply the skills, techniques, modern engineering tools		✓			
(l) Apply the computer/IT tools relevant to the discipline	✓				
# Note 5: Significant contribution; 4: Supporting contribution; 3: Moderate contribution; 2: Marginal support; 1: Least support					

Course Instructor(s):	Prof. Iu Vai Pan