ANAL H4501: Structural Analysis I

Module Title:	Structural Analysis I
Language of Instruction:	English

Credits:	10

NFQ Level:	8

Module Delivered In	2 programme(s)

Teaching & Learning Strategies:	Lectures Demonstrations Project work Practicals / Site visits Private study

Module Aim:	(1) To develop an understanding of the stress and strain behaviour of elastic and elastoplastic materials under axial, flexural and torsional loads. (2) To develop an understanding of basic structural concepts relevant to civil engineering structures. (3) To develop the skills required to analyse the force distributions on simple, encastre and continuous beams and plane trusses. (4) To develop an understanding of behaviour of struts (5) To introduce the concepts of real work, virtual work and strain energy and apply them to finding deflections and analysing statically indeterminate beams and trusses.

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Analyse the stresses and strains due to shear force and bending moment on a beam.
LO2	Analyse the stresses and strains due to torsion on circular shafts and rectangular beams.
LO3	Calculate the principal stresses on a section due to a combination of shear and normal stresses.
LO4	To explain the concept of buckling of struts and derive the Euler buckling formula for struts with pinned and encastre ends and to apply these concepts to real struts.
LO5	To analyse the distribution of shear force and bending moment on simply supported and continuous beams using Macauly's method
LO6	Apply the principles of statics to analyse the forces for statically determinate beams, trusses and simple statics problems
LO7	To apply the method of virtual work to calculate deflections and forces in beams and pin jointed structures.
LO8	To calculate the distribution of shear force and bending moment in continuous beams using moment distribution.
LO9	To calculate the distribution of shear force and bending moment in continuous beams using the slope deflection method.
LO10	Apply the principle of virtual work force method to resolve forces in statically indeterminate beams and trusses

Pre-requisite learning		
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*		
6804	ANAL H4501	Structural Analysis I
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*		
No incompatible modules listed		
Co-requisite Modules		
No Co-requisite modules listed		
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.*		
Bachelor of Engineering (Ordinary) in Civil Engineering		

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Module Content & Assessment

Indicative Content
Basic Strength of Materials: (i) Stresses and Strain (ii) Normal strain (iii) Shear strain (iv) Stress / Strain relationships (v) Stress concentrations a) Pure Bending of Beams (i) The Flexure formula (ii) 2nd moment of area (iii) Relationship between flexure and curvature (iv) Differential equation of flexure (v) Macauly's method (vi) Inelastic bending of beams (vii) Beams of two materials b) Shearing Stress in Beams (i) Relation between shear and bending moment (ii) Shear Flow (iii) Shearing Stress formula for beams (iv) Limitations of shearing stress formula (v) Shear centre c) Torsion (i) Torsion Force, Strain, Angle of twist (ii) The torsion formula for circular sections (iii) Torsional stress calculations (iv) Angle of twist of circular members (v) Thin walled tubes (vi) Thick walled tubes (vii) Solid noncircular members d) Compound Stresses (i) Superpositions (ii) Combined axial and flexural stresses (iii) The Dam problem (iv) Unsymmetrical bending e) Analysis of Plane Stress and Strain (i) Equations for the transformation of plane stress and plane strain (ii) Principle stresses and strains (iii) Maximum shearing stress and strain (iv) Mohr's circle of stresses and strain (v) Strain measurements rosettes (vi) Relationship between E, G and u f) Buckling and Related topics (i) Euler buckling theory of struts (ii) Real behaviour of Struts 1. Initial curvature 2. Eccentric loadings 3. Allowable stress in steel struts– Perry- Robertson formula (iii) The secant formula (iv) Southwell Plot
Basic structural concepts (a) Equilibrium, Actions and reactions (b) Linearity (c) Superposition (d) Compatibility (e) Determinancy (f) Geometric Stability (g) Influence coefficients
Statically determinate plane structures a) Problems in statics - equilibrium, friction, buoyancy b) Analysis of plane trusses c) Statically determinate beams
Energy Methods (a) Definition of complementary work and complementary energy (b) Strain energy and strain energy theorems (Castigliano)
Principle of virtual work a) Definition of Virtual Work and derivation of virtual work Theorems b) Application – Unit load method for deflections – Truss, cantilever, SS beam c) Forces in statically indeterminate structures – beams, trusses.
Stiffness (a) Stiffness Influence coefficients (b) Member stiffness and flexibility equations (c) Transformation of axes (d) Slope deflection method – continuous beams
Flexibility (a) Definition (b) Application of flexibility method to propped cantilever
Introduction to moment distribution. (a) Terminology and sign convention (b) Application of moment distribution to continuous beams
Time-independent and time-dependent behaviour (a) Elasticity (b) Plasticity (c) Viscoelasticity
Moment Area (a) First and second moment area theorems (b) Application to Simply Supported Beam, Continuous Beam, Cantilever Beam
Structures Laboratory a) Stress Strain plot for steel bar to failure. b) Deflection plot for simply supported beam, cantilever and continuous beams c) Strain measurements on beam using electronic rosettes d) Behaviour of struts e) Modulus of Rigidity f) Law of the Lever

Assessment Breakdown	%
Continuous Assessment	20.00%
Project	10.00%
Practical	10.00%
End of Module Formal Examination	60.00%

Continuous Assessment

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Examination	Term 1 Exam	1,2,5,6,7	10.00	n/a
Examination	Term 2 Exam	1,2,3,4,5,6,7,8,9,10	10.00	n/a

Project

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Project	Projects/ Assignments	1,2,3,4,5,7,8,9,10	10.00	n/a

Practical

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Practical/Skills Evaluation	Practical work	1,2,3,4,5	10.00	n/a

End of Module Formal Examination				
Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Formal Exam	Final	1,2,3,4,5,6,7,8,9,10	60.00	End-of-Semester

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

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Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	30 Weeks per Stage	4.00
Estimated Learner Hours	30 Weeks per Stage	5.00
	Total Hours	270.00

Module Delivered In

Programme Code	Programme	Semester	Delivery
CW_CMHCE_B	Bachelor of Engineering (Honours) in Civil Engineering - Ab Initio	5	Mandatory
CW_CMCEN_B	Bachelor of Engineering (Honours) in Civil Engineering - Add On	1	Mandatory