Module Code	CE7S02
Module Name	Advanced Structural Analysis
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Module Coordinator: Assoc. Prof. Dermot O'Dwyer (dwodwyer@tcd.ie)
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	On successful completion of this module, students should be able to: LO1. Identify the appropriate differential equations and boundary conditions for analysing a range of structural analysis and solid mechanics problems. LO2. Implement the finite difference method to solve a range of continuum problems. LO3. Implement a basic beam-element finite element analysis. LO4. Implement a basic variational-based finite element analysis. LO5. Implement time-stepping algorithms and modal analysis algorithms to analyse structural dynamics problems. L06. Detail the assumptions and limitations underlying their analyses and quantify the errors/check for convergence. **Graduate Attributes: levels of attainment** To act responsibly - hoose an item. To think independently - hoose an item. To develop continuously - hoose an item. To communicate effectively - hoose an item.
Module Content	The Advanced Structural Analysis Module can be taken as a Level 9 course in a single year for 5 credits or as a Level 10 courses over two years for the total of 10 credits. The first year of the module is common to all students, in the second year Level 10 students who have completed the first year of the module will lead the work groups. The course will run throughout the first semester. The aim of the course is to develop the ability of postgraduate Engineering students to develop and implement non-trivial analysis and modelling algorithms. o Finite Difference analysis and solution of linear equations using relaxation methods.

[1] TEP Glossary

- Finite element analysis;
- Dynamic analysis of structures including modal analysis and time-stepping algorithms
- Variational calculus
- Convergence criteria and error bounding

Teaching and Learning Methods

The pedagogical approach taken in this course comprises problem-based learning. Throughout the course the students will work individually and in small groups tackling a range of engineering analysis problems. In some cases, the analysis problems may come directly from the students' research.
Each topic will be introduced with a number of lectures in which the key concepts are described briefly. The students will be given a series of purpose-written notes summarising the theory and will be directed to problem-specific texts. The students will be required to develop solutions to their assigned problems and deliver presentations on their experience of implementing their solutions.
The objective of the course is to ensure that students can implement the algorithms they develop, therefore the realisation of their solutions is a vital part of the course.
Students will be encouraged to develop their solutions using Python or any other programming language or system they are familiar with.

Assessment Details[2]
Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**
- **% of total**
- **Assessment due date**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
	Examination [3 hours]		40%	
	Continuous Assessment		60%	

Reassessment Requirements

[2] TEP Guidelines on Workload and Assessment

Contact Hours and Indicative Student Workload[2]	**Contact hours:** The contact hours comprise 24 timetabled hours, 12 hours lectures, 6 hours of group tutorial troubleshooting sessions and 6 hours of presentations. **Independent Study (preparation for course and review of materials):** Students who have not programmed before should prepare for the module by starting to learn Python – please contact the module coordinator for further advice. **Independent Study (preparation for assessment, incl. completion of assessment):**
Recommended Reading List	In addition to a series of purpose written notes that will be used to support the course the following standard texts are recommended reading: 1. The finite element methods for engineers, K.H. Heubner and E.A. Thornton, Wiley Inter-science , 1982 2. Structural Analysis; A Unified Classical and Matrix Approach: Amin Ghali, Adam Neville, TG Brown: Spon, 1997 *3.* Theory of Vibration with Applications by William T. Thomson, Taylor and Francis *4.* Theory of Elasticity (McGraw-Hill Classic Textbook Reissue Series) by S. P. Timonshenko and J.N. Goodier 5. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale, McGraw-Hill
Module Pre-requisite	Module participants are expected have completed an undergraduate degree in engineering, maths-physics or similar. Students should have a good understanding of mechanics of solids, structural analysis using stiffness method and should be familiar with differential equations.
Module Co-requisite	
Module Website	
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	NO
Module Approval Date	
Approved by	
Academic Start Year	1st September 2020
Academic Year of Date	2020/2021