Mechanical and Manufacturing Engineering

Course Outline

Semester 2 2017

NAVL4410

SHIP STRUCTURES 2

Contents

1. Staff contact details

Contact details and consultation times for course convenor

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I am available for consultation by appointment, or can be reached by telephone or email.

Contact details and consultation times for additional lecturers/demonstrators/lab staff

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2. Important links

- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

3. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course, and involves three hours per week (h/w) of face-to-face contact.
The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

There is no parallel teaching in this course.

Contact hours

		Day	Time	Location
Module A FE Analysis	Lecture Demonstration	Wednesday Friday	11am-12noon 12noon-2pm	Goldstein G07 Ainsworth 203
Module B Structural Composites	Lecture and demonstration	Tuesday	3pm - 6pm	UNSWSB 205

Summary of the course

This course comprises two modules of equal credit:

Module A: Finite element methods and applications
This course will train you to analyze real world structural mechanics problems using the finite element method. You will be introduced to the mathematical basis of finite element analysis, on which nearly all structural analysis software is built. You will learn how to apply commercially available finite element software to solve real world engineering problems. The course will cater to the specific challenges of engineers across all mechanical disciplines. Any student wishing to extend their analysis skills should take this course.

Module B: Composite materials and structural applications
Introduces you to structural composite materials and their applications to ship structures.

Aims of the course

Module A:
The primary aim of this course is to train you to solve complex engineering structural mechanics problems with finite element analysis. The course will provide deep insight into the operation of finite element analysis software (currently ANSYS) by teaching you the underlying computational methods involved. You will be taught to execute a detailed finite element study including planning, modelling, meshing, solving, evaluating results and validating against real world data.

Module B:
The main objective of Module B of this course is to introduce you to structural composite materials and their application to ship structures. The module begins with a brief description of the constituents of structural composites, their physical properties and the common fabrication technology. This is followed by developing the methodologies to analyse composite panels and sandwich constructions under static and fatigue loads.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		EA Stage 1 Competencies
1.	Grasp the underlying mathematical background of Finite Element methods and learn and apply the various applications using commercial software	PE1.1-PE1.3, PE1.5, PE2.1-PE2.3, PE3.2
2.	Decide upon the most appropriate methods of implementation of FEA software to Static and Dynamic structural analysis and other disciplines	PE1.1-PE1.3, PE1.5,PE2.1-PE2.3, PE3.2
3.	Clear understanding of Properties of Structural composites, their advantages and limitations compared to conventional metallic materials	PE1.1-PE1.3, PE1.5, PE3.2, PE3.6
4.	Analyze the behavior of composite laminas and laminates under various types of loading and failure analysis	PE1.1-PE1.3, E1.5,PE2.1-PE2.3, PE3.2, PE3.6

4. Teaching strategies

Lectures in Module A are designed to give a summary of the fundamentals of finite elements and then emphasize hands-on applications of finite-element software for analysing the assignment problems.

Lectures in Module B are designed to give a clear understanding of the properties of structural composite materials, followed by analysis for stress, deformation and failure. A number of problems are solved in the class with your active participation.

5. Course schedule

MODULE A: FINITE ELEMENT ANALYSIS		
Week	**Lecture** (1 Hour)	**Demonstration** (2 Hours)
1	Introduction to FEA & ANSYS overview	Introduction to FEM
2	One dimensional FEA Linear spring explanation Elementary calculation & procedures in FE Stiffness matrix for truss element	Numerical Solution Procedure
3	Beam element, example, derivation Stiffness matrix Beam end releases	The Element Library
4	Assembly, application of boundary conditions, solutions etc. Setting up boundary conditions in ANSYS Analysis types including Thermal	Good FE Practice

5	2-D FEA 2D- element for stress analysis Triangular element for axisymmetric analysis Quadrilateral element for 2D-stress Isoparametric element	Buckling and Non-linear Analysis
6	Brick Element Solid Shell Compare Solid vs. Shell element results	Vibration and Transient Analysis
7	Interface with CAD Contact issues Modal analysis	
8	Non-linear large deflection analysis Material nonlinear	
9	Linear buckling	Advanced FE Topics
10		FEA in Industry

* Mesh refinement, solution time, convergence issues to be managed in various demonstrations

MODULE B: STRUCTURAL COMPOSITES	
Week	**Lecture** (3 Hours including Problem Solving)
1	Composites materials – classification and definitions
2	Fibres, matrices and interface
3	Geometrical aspects, volume fraction etc and fabrication technology
4	
5	Elastic properties of lamina
6	
7	Laminate theory and analysis
8	
9	
10	Failure theories of composite laminates
11	Sandwich construction
12	Fatigue and fracture of composites
13	Revision

There is no separate demonstration time for Module B. The demonstration when needed will be conducted during the lecture periods.

The schedules shown may be subject to change at short notice to suit exigencies.

6. Assessment

Module A

Assessment task	Mark	Weight	Learning outcomes assessed	Assessment criteria*	Due date**	Assessments returned
Assignment 1	20	10	1, 2	Frame analysis using 2D elements	Week 4	Week 5
Assignment 2	20	10	1, 2	FE Analysis and experimental validation	Week 8	Week 10
Assignment 3	30	15	1, 2	Advanced FE analysis, Fatigue life	Week 12	Week 13
Final exam	30	15	1, 2	Questions on theoretical aspects of FEA	TBC	
TOTAL	**100**	**50%**				

***** The actual Assignment will be provided by the Demonstrator via Moodle.
****** Submission on due dates should also be via Moodle.

Module B

Following the lectures on a topic, you will be given assignments; some of these are individual, and some are for groups. The assignments are of increasing difficulty; some are hand calculations, and others will need finite-element software and/or Matlab.

Assessment task	Mark	Weight	Learning outcomes assessed	Assessment criteria	Due date	Assessments returned
Assignment 1	5	2.5%	3, 4	Mass/Volume fractions	Week 3	Week 4
Assignment 2	5	2.5%	3, 4	Analysis of Lamina	Week 5	Week 6
Assignment 3	10	5%	3, 4	Analysis of Laminates	Week 8	Week 10
Assignment 4	10	5%	3, 4	Performance analysis	Week 10	Week 11
Assignment 5	10	5%	3, 4	Failure analysis	Week 12	Week 13
Final exam	60	30%	3, 4	All content	TBC	
TOTAL	**100**	**50%**				

In order to pass the course, you must achieve an overall mark of at least 50%.

Assignments

Assignments for Module B will be handed out as hard copy in class, and may be available on the Moodle website in case you miss the hand-out in class.

Presentation

All submissions should have a standard School cover sheet which is available from this course's Moodle page.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work. Presenting them clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

Assignments are due on the scheduled day of the class in the week nominated above. Assignments should, preferably, be submitted direct to the lecturer or demonstrator in class. They may, alternatively, be lodged in the NAVL assignment submissions box opposite the School office by 1700 on the due date.

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor before the due date. Special consideration for assessment tasks of 20% or greater must be processed through https://student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Marking

The following criteria will be used to grade assignments:

For report-style assignments the following criteria will be used:

- Identification of key facts and the integration of those facts in a logical development.
- Clarity of communication—this includes development of a clear and orderly structure and the highlighting of core arguments.
- Sentences in clear and plain English—this includes correct grammar, spelling and punctuation.
- Correct referencing in accordance with the prescribed citation and style guide.

All other assignments involve numerical calculations, for which the following criteria will be used:

- Accuracy of numerical answers.
- All working shown (see Presentation above).

- Use of diagrams, where appropriate, to support or illustrate the calculations.
- Use of graphs, where appropriate, to support or illustrate the calculations.
- Use of tables, where appropriate, to support or shorten the calculations.
- Neatness

Examinations

There will be two final exams for this subject - one 2-hour examination in Module A and one 3-hour examination in Module B. These examinations will be held during exam week and will cover all materials in each module for the whole semester.

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2

For further information on exams, please see the Exams section on the intranet.

Calculators

You will need to provide your own calculator, of a make and model approved by UNSW, for the examinations. The list of approved calculators is shown at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see the School intranet, and the information on UNSW's Special Consideration page.

7. Attendance

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the School intranet and the UNSW attendance page for more information.

8. Expected resources for students

Module A
Course notes will be distributed in lecture classes & available on the Moodle website.

Textbook

Cook, R.D., Malkus, D.S., Plesha, M.E. and Witt, R.J. (2002), Concepts and Applications of Finite Element Analysis, Fourth Edition, Wiley.

Finite element programs

The School has licenses for ANSYS. Geometry may be created in ANSYS or in CATIAv5 or Pro/ENGINEER.

Additional materials provided in Moodle

The Moodle website will be used to distribute notes, assignments and grades. The announcements tool will be used to answer general questions, correct errors that may appear from time to time in assignments and handouts and alert of any known traps in the modelling process.

Recommended Internet sites

There are many websites giving lectures and guidance for finite element modeling. These are maintained by the software developers. For example: www.mscsoftware.com and www.ansys.com

Module B

Printed notes will be handed out whenever needed.

Textbooks

In addition to the printed handouts, the following textbooks will be used as reference materials.

Mallick, P.K. (1993), Fiber-reinforced Composites, 2nd Edition, Marcel Dekker, New York.

Hyer, M.W. (2009), Stress Analysis of Fiber-reinforced Composite Materials, DESTech Publications, Lancaster, Pennsylvania.

You are advised to purchase a copy of the text by Hyer if possible.

Additional materials provided in Moodle

The Moodle website includes:

- Previous examination papers in NAVL4410 from 2009 onwards;
- Answers to the numerical questions in NAVL4410 from 2009 onwards.

Recommended Internet Sites

Useful websites will be advised in the class.

9. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

A change in this course this year is the retention of finite-element methods for NAVL students, following the discontinuation of MMAN3540 Computational Engineering.

10. Academic honesty and plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism: student.unsw.edu.au/plagiarism The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work

or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here: www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

11. Administrative matters and links

All students are expected to read and be familiar with School guidelines and polices, available on the intranet. In particular, students should be familiar with the following:

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support Services

Appendix A: Engineers Australia (EA) Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership