Faculty of Engineering

Department of Mechanical Engineering

COURSE OUTLINE

MECH 320 –Mechanics of Solids II

Term – Spring 2017 (201701)

Instructor	**Office Hours**
Dr. Keivan Ahmadi	Days: Tuesday
Phone: (250) 721 8694	Time: 1530-1630
E-mail: kvahmadi@uvic.ca	Location: TBD

List all prerequisites and co-requisites: MECH 220

LECTURE DATE(S)

Section: A /CRN22138	Days: Tue, Wed, Fri:	Time: 1030 - 1120	Location: DSB C103

TUTORIAL SECTIONS

Section: T	Days:	Time:	Location:
01	Tue	1430-1520	ELL 168

LAB SECTIONS

Section: B (Multiple)	Days:	Time:	Location:
Insert additional rows if required	Lab schedule will be uploaded on Coursespaces during the first two weeks of the term		
Lab B1:	Mon	1000 - 1120	ELW 135
Lab B2:	Mon	1300 - 1420	ELW 135
Lab B3:	Mon	1600 - 1720	ELW 135
Lab B4	Thu	1000 - 1120	ELW 135
Lab B5	Thu	1600 - 1720	ELW 135
Lab B6	Fri	1530 - 1650	ELW 135
Lab B7	Mon	1730 – 1850	ELW 135
Lab B8	Thu	1730 - 1850	ELW 135

Lab times and locations are also available from the timetable through Sign in to UVic, My Page**.**

TA Name	**E-mail**	**Office Hours**
Hamed Assadi	hamedassadi@uvic.ca	EOW 121 / Fri 1500-1600
Zhengyuan (Isaac) Ma	isaacma@uvic.ca	TBA
Xiang Sheng	xsheng@uvic.ca	EOW 148 / Thu 1000-1100
Keifeng Xu	kaifengxu@uvic.ca	TBA

Required Text	**Optional Text**
Title:	Advanced Mechanics of Materials and Applied Elasticity/ Fifth Edition

Learning Outcomes next page

Author:	Ansel C. Ugural, Saul K. Fenster
Publisher/Year:	Prentice Hall, 2003.
Reference Materials: Electronic lecture notes and lab manuals will be posted on Coursespaces, but students are encouraged to take notes during lectures.	

COURSE OBJECTIVES: Verbose description of the material being covered in the course. How does the course build/relate to other courses in the program.

This course introduces the general form of stress and strain tensors and their properties in 3D solids. Also presented in this course are the fundamentals of the theory of elasticity and their applications in studying the stress, strain and deflection distributions in practical 2D problems. The topics of this course will prepare the students to conduct stress and strain analysis in engineering problems, and then use the results of their analysis to determine the failure threshold of mechanical structures.

LEARNING OUTCOMES: At the end of this course, students will be able to:

1- Describe a state of stress and strain using matrix or tensor notations.
2- Manipulate a given state of stress or strain in order to resolve the normal and shear components along specific planes in 3D
  - Calculate 3D principal stresses, strains and their corresponding directions for a given stress or strain tensor
  - Calculate the normal and shear stresses on a 3D oblique plane for given set of principle stresses
3- Describe the Generalized hook's law for Stress-Strain relations in 3D
  - Formulate and apply the generalized hook's law for homogeneous isotropic materials in 2D problems
4- Describe the strain-displacement and stress-strain relations and the equilibrium and compatibility equations in the theory of elasticity; and apply them to determine the stress and deflection distributions in 2D problems
  - Identify and formulate the boundary conditions in 2D problems
  - Use Airy's stress functions to determine the stress distribution in 2D problems
  - Compose the equilibrium, compatibility and stress-strain equations in the polar coordinate system
  - Solve the equations of equilibrium and compatibility in the polar coordinate system to determine the distribution of the stress in the regions close to concentrated external loads
  - Determine the stresses and deflections in Euler-Bernoulli beams under pure bending
  - Apply the inverse solution method to determine the stress distribution in bending of beams with Asymmetrical cross section
  - Apply the method of transformed sections to approximate the composite cross-section of a beam with an equivalent unified cross-section
  - Apply the Prandtl stress functions to determine the stress and deflections of prismatic beams under pure torsion
  - Determine the stress distribution in Axisymmetrically loaded structures such as thick-walled cylinders and rotating annular solid disks
  - Select the appropriate stress concentration factor from lookup tables in 2D problems
5- Apply various brittle and ductile failure criteria to determine the failure threshold in 2D and 3D problems
  - Describe the mechanism of fracture and crack propagation in brittle materials
  - Determine the appropriate stress intensity factor from lookup tables and apply it to assess the fracture threshold in 2D problems

6- Distinguish between static and dynamic loads
7- Construct a Finite Element Model for 2D truss structures by computing the stiffness matrix of the element, transferring it to the global coordinate system, assembling the global stiffness matrix and using it to compute the nodal deflections under external loads.

Weight & Date(s) of Assessments:	**Weight**	**Date**
Project	%5	Due the day of final exam
Quiz	(4 quizzes x 4%) %16	See the course calendar
Labs	(3 experiments x 3%) %9	TBA
Mid-term	% 20	Feb 21st 2017 at 1430-1630
Final Exam	%50	Date: TBA

HOMEWORK

Every Friday a set of homework problems will be posted on Coursespaces. Homework problems will not be graded, and their submission is not required; however the in-depth completion of the problems is strongly recommended, because the quiz questions will be similar to the homework problems. The solutions will be posted one week after uploading the question.

See the course schedule for dates

LABORATORIES (Description & Method of Delivery)

Each lab section is divided into student groups. These groups will be maintained throughout the term. One lab report must be submitted per group, per lab section. Lab reports will be due exactly two week after the completion of the scheduled lab section and will be submitted electronically to Coursespace.

- You must prepare in advance of the laboratory to be able to complete the lab on time.
- Lab Schedule and Lab Manual are posted on Coursespaces

Lab #	**Modules**	**Start**	**Due (5 pm)**
1	Photoelasticity	TBA	TBA
2	Combined Bending Torsion	TBA	TBA
3	Impact test	TBA	TBA

PROJECTS: (Description & Method of Delivery) (remove sample text)

The course includes one project in which the students will use COMSOL Multiphysics software to study the stress, strain and displacement distributions in two selected problems. The projects will be conducted individually. Four problems will be offered in this project and each student will select two problems to solve. An online instruction will be provided to guide the students through modeling and analysis in COMSOL. The software is available in the undergraduate computer lab located at ELW B228. The project reports must be submitted to Coursespace before the final exam (TBA).

NOTE:

- Failure to complete all laboratory requirements will result in a grade of N being awarded for the course.
- Failure to pass the final exam will result in a failing grade for the course.
- Self-contained (with no wireless communication capability) calculators are allowed in all exams. Students should note, however, that the grading of the test problems in this class will be based heavily on the methodology applied in calculating the final solution. A significant proportion of assignment and test marks are awarded based on a clear and logical description of the entire solution process. Using such grading criteria, specification of the correct numerical solution constitutes a small portion of the allotted marks.

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

There will be no supplemental examination for this course.

Faculty of Engineering

Department of Mechanical Engineering

COURSE OUTLINE

GENERAL INFORMATION

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

Attendance

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time….

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course." UVic Calendar, (2017) http://web.uvic.ca/calendar2017-01/undergrad/info/regulations/attendance.html#

Faculty of Engineering, University of Victoria
Standards for Professional Behaviour

"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty,
to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals…."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities.
http://www.uvic.ca/engineering/assets/docs/professional-behaviour.pdf

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity
http://web.uvic.ca/calendar2017-01/undergrad/info/regulations/academic-integrity.html#

Equality

This course aims to provide equal opportunities and access for all students to enjoy the benefits and privileges of the class and its curriculum and to meet the syllabus requirements. Reasonable and appropriate accommodation will be made available to students with documented disabilities (physical, mental, learning) in order to give them the opportunity to successfully meet the essential requirements of the course. The accommodation will not alter academic standards or learning outcomes, although the student may be allowed to demonstrate knowledge and skills in a different way. It is not necessary for you to reveal your disability and/or confidential medical information to the course instructor. If you believe that you may require accommodation, the course instructor can provide you with information about confidential resources on campus that can assist you in arranging for appropriate accommodation. Alternatively, you may want to contact the Resource Centre for Students with a Disability located in the Campus Services Building.
The University of Victoria is committed to promoting, providing, and protecting a positive, and supportive and safe learning and working environment for all its members.

Resource Centre for Students with Disabilities
http://www.uvic.ca/services/rcsd/

Accommodation of Religious Observance (AC1210)
http://web.uvic.ca/calendar2017-01/general/policies.html

Discrimination and Harassment Policy (GV0205)
http://web.uvic.ca/calendar2017-01/general/policies.html

Learning Outcomes next page

Course Schedule

Lecture	Topics	Date/Week
1	Introduction, Concept of Stress and Strain	Wed, January 4
2	Stress Tensor, Force Resultants	Fri, January 6
3	Review: 2D Stress Transformation, Principal Stress, 2D D.E.'s of Equilibrium,	Tue, January 10
4	3D Stress Transformation	Wed, January 11
5	3D Principal Stress and Directions	Fri, January 13
6	Stress on 3D Oblique Plane, Octahedral Stress, Boundary Conditions	Tue, January 17
7	Stress-Strain Relations, Derivation of 2D and 3D Strain (normal and shear), Eqns of Compatibility	Wed, January 18
8	2D and 3D Strain Transformation and principal strains	Fri, January 20
9	Review Hooke's Law and Poisson Effect, Derivation of Generalized Hooke's Law	Tue, January 24
10	St. Venant's Principle, Introduction to the Theory of Elasticity	Wed, January 25
11	Theory of Elasticity, 2D Elasticity, Airy's Stress Function, Inverse Method by Polynomials, Example Problems	Fri, January 27
12	Continue Example Problems	Tue, January 31
13	Polar Coordinate representation of Stress and Strain	Wed, February 1
14	Stresses due to Concentrated Loads	Fri, February 3
15	Stress Concentrations, Theory of Elast. to Derive Stress around Hole in Plate, Stress Concentration Factors	Tue, February 7
16	Failure Criteria: Basic Concepts, Failure Modes for Brittle and Ductile Mat.	Wed, February 8
17	Max Shear Stress Theory, Von Mises, Max Principle Stress Theory, Mohr's Theory	Fri, February 10
18	Introduction to Fracture Mechanics **(Midterm exam will be given during the tutorial hour)**	Tue, February 21
19	Impact and Dynamic Loads	Wed, February 22
20	Beam Theory, Bernoulli-Euler Bending Theory, Theory of Elasticity applied to Beams	Fri, February 24
21	Bending of Beams with Asymmetrical Cross-Section	Tue, February 28
22	Composite Beams	Wed, March 1
23	Torsion of Prismatic Beams, Solution with Theory of Elasticity	Fri, March 3
24	Prandtl's Membrane Analogy	Tue, March 7
25	Axisymmetrically Loaded Members, Theory of Elasticity for Derivation of Thick Walled Cylinders	Wed, March 8
26	Thick Walled Cylinders with Internal/External Pressure, Interference Fit of Composite Cylinders	Fri, March 10

Learning Outcomes next page

27	Rotating Solid and Annular Disks	Tue, March 14
28	Introduction to the Finite Element Method, Definitions, Outline of Procedure	Wed, March 15
29	Modelling 1-D Spring Elements	Fri, March 17
30	FEM: Assembling Total Stiffness Matrix, Applying Boundary Conditions	Tue, March 21
31	FEM: 2D Truss Structures with 1-D Bar Elements	Wed, March 22
32	Local Element and Global Stiffness Matrix, Transformations	Fri, March 24
33	FEM: Example of Plane Truss with Bar Elements	Tue, March 28
34	Course Review	Wed, March 29
35	Course Review	Fri, March 31