Smelling the Roses in ME211

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Abstract

ME211 "Introduction to Solid Mechanics" is a core / required class in Mechanical Engineering. The class is fast-paced, with a fundamental new concept being introduced every other lecture or so, and no time for reflection and absorption.

In this experiment, ME211 was taught over F-15 and W-16 as two linked two-credit classes. The format, content and exams were identical to the regular section, but at half the pace.

The approach was assessed by a direct comparison of exam results with a control section of the regular version of ME211 taught in W-16. While the performance in the first two mid-terms mirrored the GPA distribution for both classes, the performance of the experimental section was significantly superior to that of the regular section.

Methods

The student population for the experimental section was self-selected. 25 students enrolled in the first semester, but one student changed majors after F-15 and did not enroll in the second section. The demographics of the students in the experimental section were strikingly different from the usual enrollment in a Mechanical Engineering class, with 37.5% females, and 29.2% being males of apparently non-European descent.

The homeworks were similar for both sections, although not identical because of the timing. The first two mid-terms were identical for both sections, although neither section knew this. Solutions were not published before the regular class had taken the exams, but some numbers were changed to ensure integrity. Both sections took an identical final on the same day (April 20, 2016), and these exams were marked together as a unified group.

The regular section of ME211 consists of three faculty-taught lectures plus one GSI-led discussion section per week. The experimental section consisted of three faculty-taught lectures plus one GSI-led discussion section every two weeks.

Each semester of the experimental section required students to enroll in a 2-credit class ME499-098. At the end of F-15, one mid-term and half the homeworks had been completed, and a "Y" grade was assigned. At the end of W-16, the "Y" grade was replaced by a letter grade based on the overall performance during the two semesters.

Results

ME 211 INTRODUCTION TO SOLID MECHANICS

COURSE OUTLINE – Winter 2016

Hibbeler 3rd edition

Class	Date	Topic	Reading	Homework
1	W 1/6	Introduction	Chapter 1	
2	F 1/8	Forces	Chapter 2; suppl. A	None
3	M 1/11	Vector products and moments	§3.1–§3.6; suppl. B	
4	W 1/13	Equilibrium (2D)	§4.1–§4.4; suppl. C	
5	F 1/15	Equilibrium (3D)	§4.5, §4.6; suppl. D	HW 1
	M 1/18	**MLK Day**		
6	W 1/20	Friction	§4.7–§4.8, suppl E	
7	F 1/22	Two-force member structures	§5.1–§5.4	HW 2
8	M 1/25	More general structures	§5.5; suppl. F	
9	W 1/27	Centroids and distributed loading	§6.1, §6.3; suppl. G	
10	F 1/29	Internal loading	§7.1, §7.2	HW 3
11	M 2/1	Shear force and bending moment diagrams	§11.1,§11.2; suppl. H	
12	W 2/3	Shear force and bending moment examples		
13	F 2/5	Concept of stress	§7.3–§7.7	HW4
14	M 2/8	Concept of strain	§7.8,§7.9; suppl. I	
15	W 2/10	Material behavior	Chapter 8; suppl. J	
16	F 2/12	Review of Lectures 1–12		HW 5
17	**M 2/15**	**Mid-term #1 — Lectures 1–12**		
18	W 2/17	Axial loading (determinate problems)	§9.1–§9.3; suppl. K	
19	F 2/19	Indeterminate problems and thermal strain	§9.4–§9.6; suppl. L	HW 6
20	M 2/22	Torsion of cylinders	§10.1–§10.4; suppl. M	
21	W 2/24	Torsion examples, including indeterminate problems)	§10.5	
	F 2/26	TBD		HW 7
	M 2/29	**Spring Break**		
	W 3/2	**Spring Break**		
	F 3/4	**Spring Break**		
22	M 3/7	Bending stresses	§11.3; §11.4	
23	W 3/9	Centroidal second moments	§6.2; §6.4–§6.6; suppl. N	
24	F 3/11	Bending stresses (examples)		HW 8
25	M 3/14	Eccentric loading	§13.2; suppl O	
26	W 3/16	Pressure vessels	§13.1	
27	F 3/18	Review of Lectures 13–24		HW 9
28	**M 3/21**	**Mid-term #2 — Lectures 13-24**		
29	W 3/23	Combined loading		
30	F 3/25	Examples of combined loading		HW 10
31	M 3/28	Stress transformation equations	§14.1–§14.3	
32	W 3/30	Mohr's circle and 3-D max. shear stress	§14.4, 14.5	
33	F 4/1	Max. shear stress in combined loading	suppl P	HW 11
34	M 4/4	Strain transformation, strain gage rosettes	§14.6–§14.9	
35	W 4/6	Multiaxial stress	§14.1; suppl. Q	
36	F 4/8	Relation between elastic constants		HW 12
37	M 4/11	Bending deflections (continuous loading)	§16.1, §16.2; suppl. R	
38	W 4/13	Discontinuity functions	§16.3; suppl. S	
39	F 4/15	Bending deflections (examples)		
40	M 4/18	Review of whole course		HW 13

N. B. There are also Discussion sections scheduled for every Wednesday. The final exam is on April 20.

ME 499-098 INTRODUCTION TO SOLID MECHANICS (PART 1)

COURSE OUTLINE – Fall 2015

Hibbeler, 3rd edition

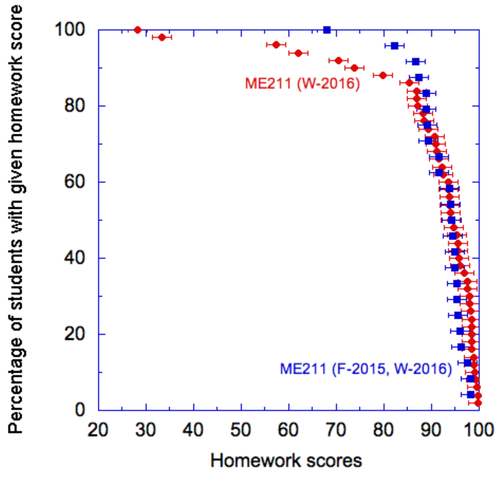
Class	Date	Topic	Reading	Homework
1	W 9/9	Introduction	Chapter 1	
2	M 9/14	Forces	Chapter 2; suppl. A	
3	W 9/16	Vector products and moments	§3.1–§3.6; suppl. B	
	M 9/21	*Discussion*		
4	W 9/23	Equilibrium (2D)	§4.1–§4.4; suppl. C	HW1 (F-9/25)
5	M 9/28	Equilibrium (3D)	§4.5, §4.6; suppl. D	
6	W 9/30	Friction	§4.7–§4.8, suppl E	
	M 10/5	*Discussion*		
7	W 10/7	Two-force member structures	§5.1–§5.4	HW2 (F-10/9)
8	M 10/12	More general structures	§5.5; suppl. F	
9	W 10/14	Centroids and distributed loading	§6.1; §6.3; suppl. G	
	M 10/19	**Fall Break**		
	W 10/21	*Discussion*		HW3 (F-10/23)
10	M 10/26	Internal loading	§7.1, §7.2	
11	W 10/28	Shear force and bending moment diagrams	§11.1,§11.2; suppl. H	
	M 11/2	*Discussion*		
12	W 11/4	Shear force and bending moment examples		HW4 (F-11/6)
13	M 11/9	Review of Lectures 1–12		
14	**W 11/11**	**Mid-term #1 — Lectures 1–12**		
15	M 11/16	Concept of stress	§7.3–§7.7	
16	W 11/18	Concept of strain	§7.8,§7.9; suppl. I	
17	M 11/23	Material behavior	Chapter 8; suppl. J	
	W 11/25	*Discussion*		
18	M 11/30	Axial loading (determinate problems)	§9.1–§9.3; suppl. K	
19	W 12/2	Indeterminate problems and thermal strain	§9.4–§9.6; suppl. L	HW5 (F-12/4)
	M 12/7	*Discussion*		
20	W 12/9	Torsion of cylinders	§10.1–§10.4; suppl. M	
21	M 12/14	Torsion examples, including indeterminate problems	§10.5	HW 6 (F-12/18)

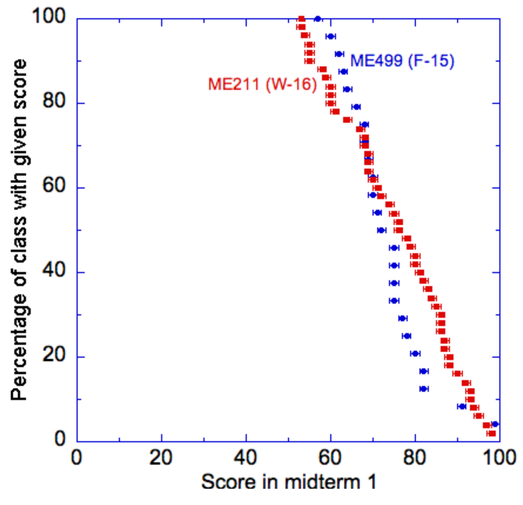
ME 490-098 INTRODUCTION TO SOLID MECHANICS (PART 2)

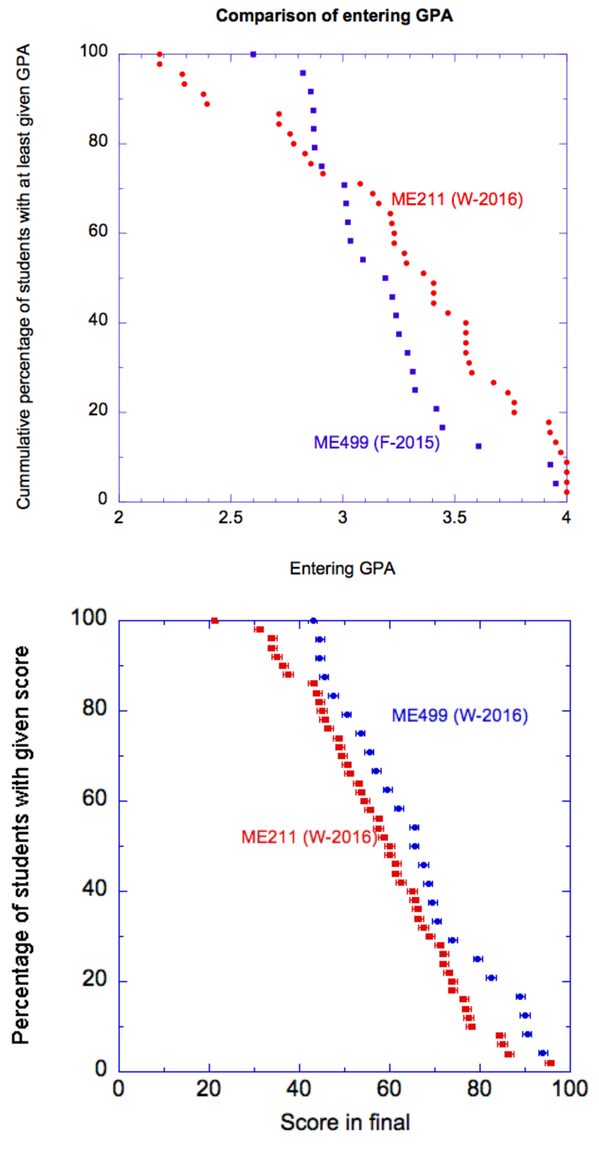
COURSE OUTLINE – Winter 2016

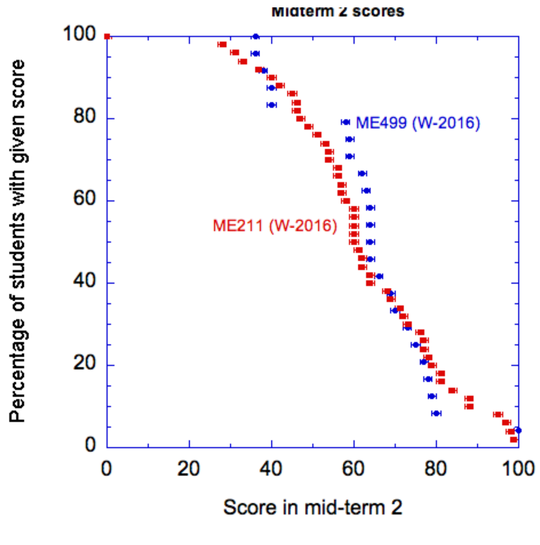
Hibbeler, 3rd edition

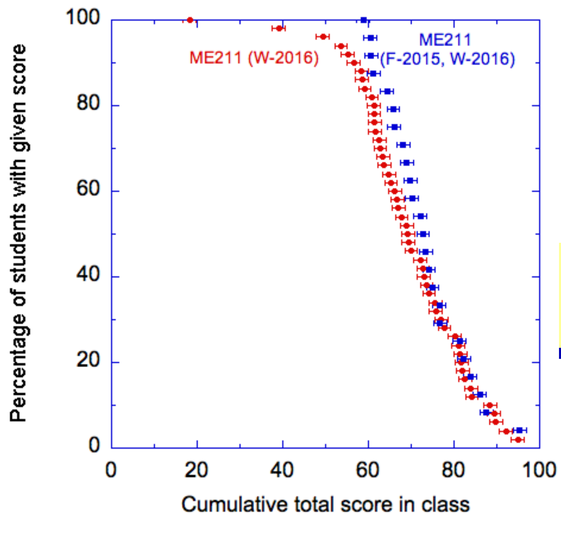
Class	Date	Topic	Reading	Homework
	W 1/6	*Review of torsion*		
	M 1/11	*Discussion (torsion)*		
22	W 1/11	Bending stresses	§11.3, §11.4	
	M 1/18	**MLK Day**		
23	W 1/20	Centroidal second moments	§6.2, §6.4–§6.6; suppl. N	HW-7 (F-1/22)
24	M 1/25	Bending stresses (examples)		
	W 1/27	*Discussion*		
25	M 2/1	Eccentric loading	§13.2; suppl O	
26	W 2/3	Review of Lectures 13–24		HW 8 (F-2/5)
27	**M 2/8**	**Mid-term #2 — Lectures 13–24**		
28	W 2/10	Pressure vessels	§13.1	
29	M 2/15	Combined loading		
30	W 2/17	Examples of combined loading		
	M 2/22	*Discussion*		
31	W 2/24	Stress transformation equations	§14.1–§14.3	HW 9 (F-2/26)
	M 2/29	**Spring Break**		
	W 3/2	**Spring Break**		
32	M 3/7	Mohr's circle and 3-D max. shear stress	§14.4, 14.5	
33	W 3/9	Max. shear stress in combined loading	suppl P	
	M 3/14	*Discussion*		
34	W 3/16	Strain transformation, strain gage rosettes	§14.6–§14.9	HW 10 (F 3/18)
35	M 3/21	Multiaxial stress	§14.1; suppl. Q	
36	W 3/23	Relation between elastic constants		
	M 3/28	*Discussion*		
37	W 3/30	Bending deflections (continuous loading)	§16.1, §16.2; suppl. R	HW 11 (F-4/1)
38	M 4/4	Discontinuity functions	§16.3; suppl. S	
39	W 4/6	Bending deflections (examples)		
	M 4/11	*Discussion*		
	W 4/13	Review of F-15 content		HW 12 (F-4/15)
40	M 4/18	Review of whole course		
	4/20	**Final - Lectures 1-40**		











Acknowledgements

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