What is the Digital Learning Lab?

• Collaborative program between ODL and MIT’s academic departments with a mission to learn, collaborate, and innovate on the use of digital learning on campus and beyond.

• Digital learning experts in the departments
  – Departmental teaching staff that serve as liaisons between ODL and academic departments
  – Collaborate with faculty on MOOC and residential courses
  – Work together to build and develop digital learning projects

• A community of practice sharing innovations, developing tools, supporting best practices
Blended Learning in Mechanical Engineering
[2.01: Elements of Structures]

Simona Socrate
– First run (traditional) Fall 2012

– Online content developed spring/summer 2013

– Blended-learning model since Fall 2013
Each week a new chapter is released. Material for each week include:

- A mandatory Learning Sequence with videos and worked example problems
- A mandatory Problem Set
- An in-class Quizlet
- Optional worked example problems
- Lecture and recitation Notes
• Each week students are assigned a learning sequence: Expert solution strategies are demonstrated in interactive exercises and videos.

• 5% of grade
Each week, students are assigned an interactive problem set with immediate feedback on each answer. Students rely on embedded tools (MATLAB) to diminish algebra burden.
Weekly Quizlets

- 4 days after Pset is due and solutions are posted, students take a Quizlet:
- in class, 15 minutes, pen/paper, identical to one of the previous week Lseq or Pset problems.

Quizlet 4
2.01-Elements of Structures

Quizzet: 

Your name: ____________________

Problem HW6_2 [5 pts]
A composite shaft of length L is constructed from an inner core of radius R and modulus G_1 = 5G_0, and a sleeve of outer radius 2R and modulus G_2 = G_0, bonded together. One end of the shaft (B) is fixed, and the other (A) is free to rotate as shown in the figure. A uniform distributed torque T(x) = t_0 (where t_0 is a constant) with units of N*m) is applied to the shaft in the direction shown in the figure.

ANSWER ALL questions below in symbolic form in terms (as needed) of position (x) and of the known quantities R, t_0, G_0.

1) (1.5 pt) Draw a free-body diagram to obtain an expression for the axial torque resultant T(x), and

\[ \sum N_x = 0 \]

\[ \sum \tau = 0 \]

\[ \tau (x) = - t_0 x \]

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2) (1.5 pt) Obtain an expression for the twist rate \( \frac{d\theta}{dx} \):

\[ \theta (x) = \frac{G_0 I_c + G_0 I_s}{5G_0} + \frac{G_0 \pi R^4}{2} \left( \frac{t_0 R^2}{R^2} - R^2 \right) \]

\[ \frac{d\theta}{dx} = \frac{G_0 I_c + G_0 I_s}{2G_0} - \frac{t_0 R^2}{G_0 R^4} \]

3) (2pt) Obtain a symbolic expression for the maximum magnitude of the shear stress in the shaft \( \tau_{max} \) (limit: where does the maximum magnitude of twist rate occur?). Sketch the profile of shear stress, as a function of radial position, on the section where \( \tau_{max} \) occurs.

\[ \tau (x) = \left| \frac{G_0 t_0 R^2}{4G_0 R^4} \right| \]

\[ \frac{d\theta}{dx} \text{ max.} = \frac{t_0 R^2}{4G_0 R^4} \]

\[ r_{max} = \frac{G_0 t_0 R^2}{4G_0 R^4} \]

\[ \tau_{max} = \frac{G_0 t_0 R^2}{4G_0 R^4} \]

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Recursive learning

each new “task” reactivates mental skemes of previous tasks
Freedom from the classroom “clock”

In class more time is spent on simple demonstrations /exploration with every-day props, with student discussions, interaction.

The online platform allows integration of computational tools (FE methods) where students can actively explore solutions to more complex (“real life”) problems.
### Student’s feedback (2.01)

#### 2.01 Fall 2014 survey: factors that contributed to learning

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### 2.01 Spring 2015 survey: factors that contributed to learning

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Open Response

Quizlet feedback
• **The quizlets were good** - they helped me check in and stay on track with understanding material.
• I like having the quizlets. It makes me **stay on top of my work** and it made the semester much easier.
• The weekly **quizlets ensured I had learned what was taught in the previous week**.
• I would prefer that quizlets are not exact copies of problem set questions

Comments from Fall 2012 and Spring 2013 : Traditional, no MITx
• We **needed more time to work on the things we learned** like recitations or working together. Class and reading wasn't enough for me.
• I relied on the lectures to explain concepts because **the textbook was not easy to read or understand**, and had poor examples.
• I just **didn't have enough opportunity to solidify what I learned** because we had OH once a week and recitation once a week. **not enough problem solving to understand the topics**.
• **The last 30 minutes of lecture often felt rushed.**

Comments from Fall 2013 : total flip on ~ ½ of the course
• I liked having edX videos as a supplement to lectures, **but I don't think videos are a suitable replacement for in-person lessons**. For example, there was an entire video on distributed moments on edX but we didn't really go over it in class (we only did example problems). Rather than including lectures in learning sequences, the material would be more accessible if done in a recitation.
• **learning sequences are ridiculously long. Some even 90 min.. thats a whole other lecture!**
• ..the **edx segment** of the course and I felt it was very beneficial to my learning. Having the material available at all times, with example problems and study guides, **greatly improved my ability to learn the material and study for examinations**.
• ..I also **really liked the edX platform for its instant feedback** on whether or not your answer was correct.
Open Response

Comments from Spring 14, Fall 14, Spring 15: Blended learning

in class demos
- Her in-class physical objects helped to appreciate the real world application of the theory we were learning.
- I love how you incorporate real-life (high-tech) demonstrations in class every time you explain a new concept.
- .. the visualization really helps me understand exactly what a certain variable or equation means!

MITx material
- the lecture videos were very helpful.
- I like learning sequences for practice.
- mitX platform is a little more concise and can be watched at 2x speed so it is much more efficient than attending lectures.
- I thought the integration of MITx in this course is fantastic. I really liked having the Psets online because you can see the solutions right away and learn from your mistakes. While having video lectures online are pretty time consuming (kind of like having another class period) I did actually think they helped me understand the material better.
- The online components of this class were perfect. It really embodies the type of class I would like to take at MIT for all my 4 years. The ability to have online lectures, psets, lecture notes greatly increases my time that I dedicate to work on other things while still maintaining a great standard of learning the material.
Fall 2012: 2.01 traditional format: 45 students: 10% >90; 50% > 80
Student’s Performance (2.01)

Fall 2012: 2.01 traditional format: **45 students**: 10% >90; 50% > 80

Fall 2013: first run of 2.01 on MITx: **75 students**: 50% >90; 87% > 80

cumulative 2.01 grades F13
Fall 2012: 2.01 traditional format: 45 students: 10% >90; 50% > 80

Fall 2013: first run of 2.01 on MITx: 75 students: 50% >90; 87% > 80

Fall 2015: “steady state” on MITx; 69 students: 56% >90; 85% > 80
Cost/Benefit for faculty

Costs:

• Initial effort to translate course content to the MITx platform: ODL provides support but faculty leads on content, holds IP.
• (If desired) initial effort to become familiar with the operational details of the platform. Alternatively, rely on support staff.

Benefits:

• very easy to re-run the course, add/modify content (undergrad TAs in 2.01)
• easy for new faculty to join teaching team and keep curriculum consistent
• freedom from “the classroom clock”. More opportunity to focus on critical course content and rely on online components for prereqs and extensions
• the 21st century equivalent to writing a textbook.. that can continually evolve, can be shared and co-authored, personalized updated and expanded
Questions?