Spring, 2022

ME 597 – Solid Mechanics II

Lecture 1 – Class Overview

PURDUE UNIVERSITY | Mechanical Engineering

Instructor: Prof. Marcial Gonzalez

Last modified: 1/10/22 3:51:16 PM

General information

Instructor:

- Professor Marcial Gonzalez
- e-mail: marcial-gonzalez@purdue.edu
- Office hours by appointment: ME 3061M

Lectures:

- Tuesday and Thursday: 9 a.m. to 10:15 a.m.
- Room: MSEE B010

Class website:

- purdue.brightspace.com D2L | Brightspace

General information

Classroom guidance – Protect Purdue:

- The **Protect Purdue Plan**, which includes the **Protect Purdue Pledge**, is campus policy and as such **all members of the Purdue community must comply** with the required health and safety guidelines.
- **Required behaviors in this class** include:
  + staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus,
  + wearing a mask in classrooms and campus building, at all times,
  + disinfecting desk/workspace prior to and after use,
  + maintaining proper social distancing with peers and instructors,
  + maintaining robust hygiene prior to, during and after class, and
  + following all safety directions from the instructor.
- Students who are **not engaging in these behaviors** (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to **leave class** and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and could be **dismissed from the university**.

General information

In the event a student is quarantined/isolated:

- If you become **quarantined or isolated** at any point in time during the semester, in addition to support from the **Protect Purdue Health Center**, you will also have access to an **Academic Case Manager** who can provide you academic support during this time.
- Your Academic Case Manager can be reached at acmq@purdue.edu and will provide you with general guidelines/resources around communicating with your instructor, be available for academic support, and offer suggestions for how to be successful when learning remotely.
- If you find yourself **too sick** to progress in the course, **notify your academic case manager** and notify me via email. They will make arrangements based on your particular situation.
  The **Office of the Dean of Students** (odos@purdue.edu) is also available to support you should this situation occur.

General information

Emergency preparedness:

- To report an emergency, **call 911**. To obtain updates regarding an ongoing emergency, **sign up for Purdue Alert text messages**, www.purdue.edu/ea
- There are nearly 300 **Emergency Telephones** outdoors across campus and in parking garages that connect directly to the PUPD. If you feel threatened or need help, push the button and you will be connected immediately.
- If we hear a **fire alarm** during class we will immediately suspend class, evacuate the building, and proceed outdoors. Do not use the elevator.
- If we are notified during class of a **Shelter in Place requirement for a tornado** warning, we will suspend class and shelter as indicated--take a look after class.
- If we are notified during class of a **Shelter in Place requirement for a hazardous materials release, or a civil disturbance**, including a shooting or other use of weapons, we will suspend class and shelter in the classroom, shutting the door and turning off the lights.
- Please **review the Emergency Preparedness website** for additional information.
  www.purdue.edu/ehps/emergency_preparedness/index.html

General information

Homework:

- Biweekly homework sets.
- Posted online every other Friday by 5 p.m. or earlier.
- Due to every other Friday by 5 p.m.
- Submitted online through Gradescope.
- You can discuss homework problems with others, including me, but the work has to be an individual work.
- Late homework won't be accepted.
  In case of illness or conference travel, arrange extensions with me in advance.

Academic integrity:

- Purdue 'Statement of Integrity and Code of Conduct':
  www.purdue.edu/purdue/about/integrity_statement.html
- Please take the time to read it carefully and talk with me if you have any questions.

General information

Exams:

- One in-class midterm exam, March 31st, closed book, closed notes.
- No final exam.

Project:

- Research oriented.
- You will be evaluated based on your weekly progress, a final presentation and a final written report.
- Details will be given during the semester.

Grading:

- Homework (30%), midterm exam (40%), final project (30%)

  Note: 5 HWs, 6 pts. each.

- Grades are not curved.

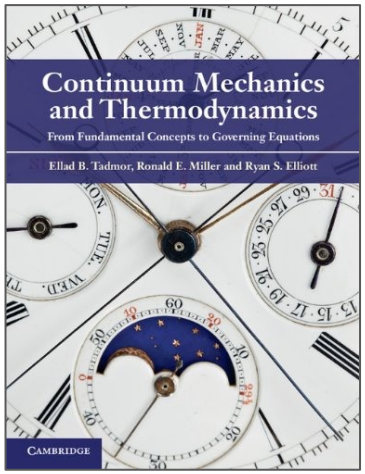
  97-100% A+; 93-97% A; 90-93% A-; 87-90% B+; 83-87% B; 80-83% B-;
  77-80% C+; 73-77% C; 70-73% C-; 67-70% D+; 63-67% D; 60-63% D-; <60% F

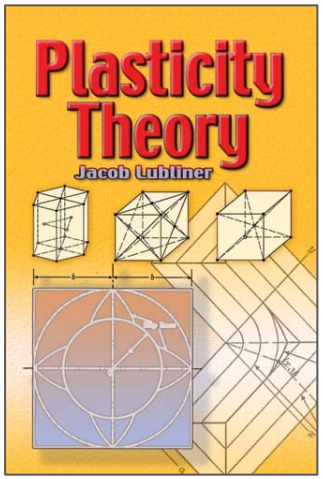
ME 597 – Course outline - Syllabus

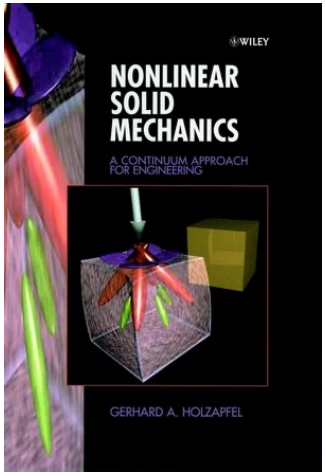
- Tensor algebra and tensor analysis
- Kinematics of deformations
- Mechanical conservation and balance laws
- Thermodynamics
- Constitutive relations
- Hyperelastic solids
- Viscoelastic solids
- Plasticity
- Structural elements (beams, plates, shells)
- Solid-solid interactions (contact mechanics) and fluid-solid interactions

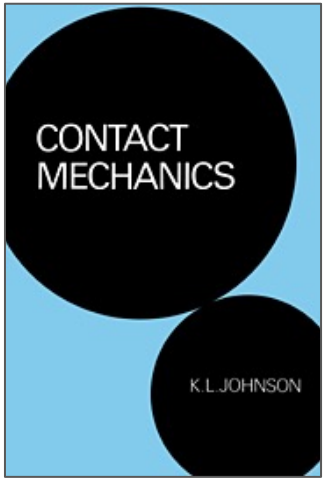
Suggested reading

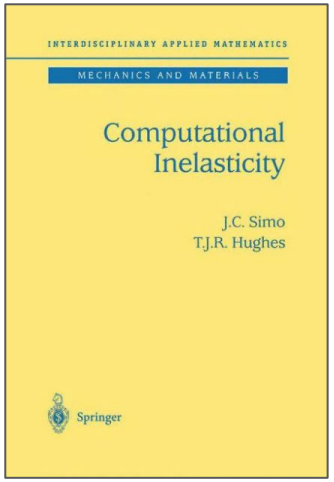
Let me know if you want to leaf through a book before buying it







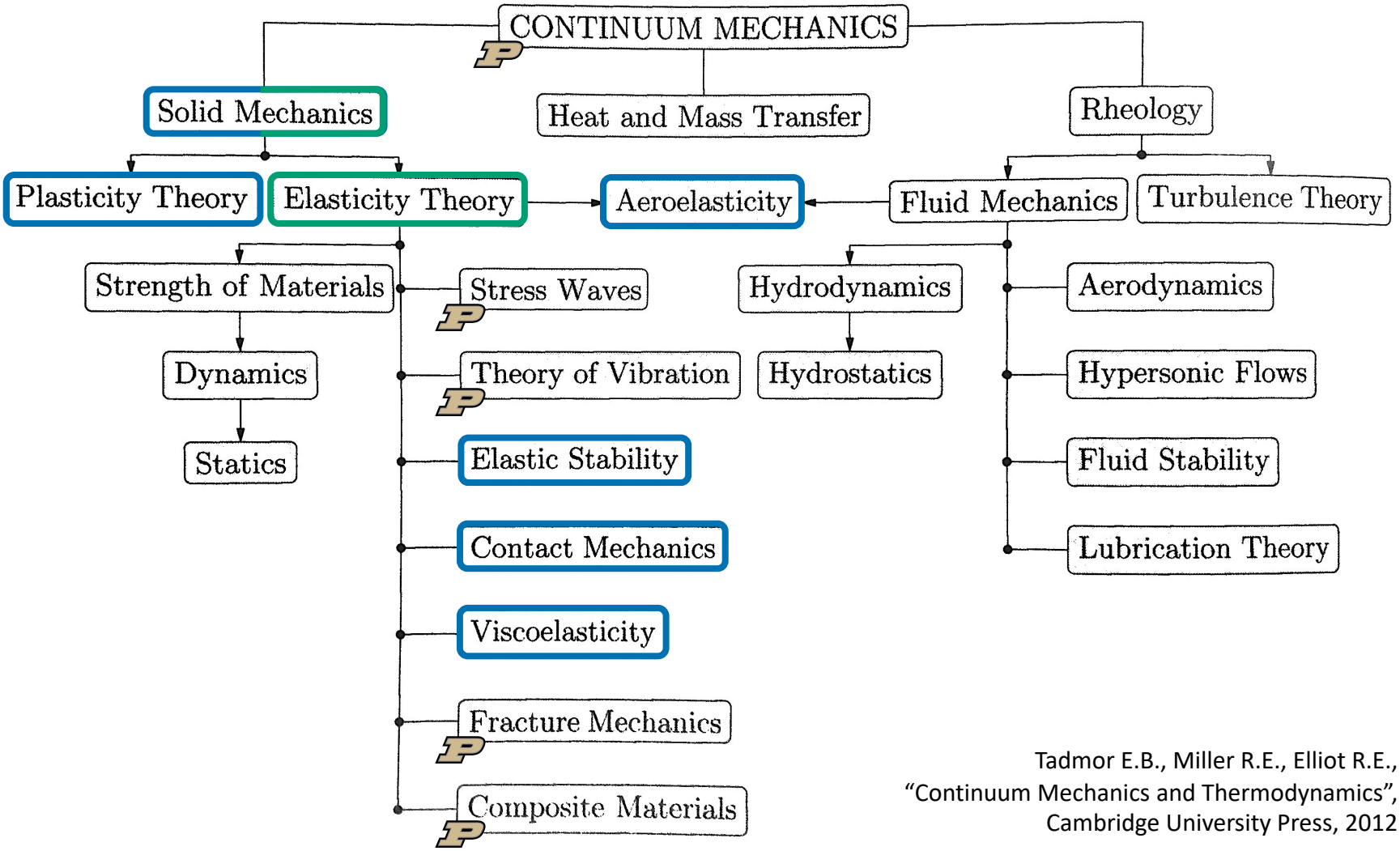




- Tadmor E.B., Miller R.E., Elliot R.S., "*Continuum Mechanics and Thermodynamics*", Cambridge University Press, 2012.
- Holzapfel G.A., "*Nonlinear Solid Mechanics*", Wiley, 2000.
- Lubliner J., "*Plasticity Theory*", Dover Reprint, 1990. (link)
- Johnson K.L., "*Contact Mechanics*", Cambridge University Press, 2012. (link)
- Simo J.C. and Hughes T.J.R., "*Computational Inelasticity*", Springer, 1998. (link)

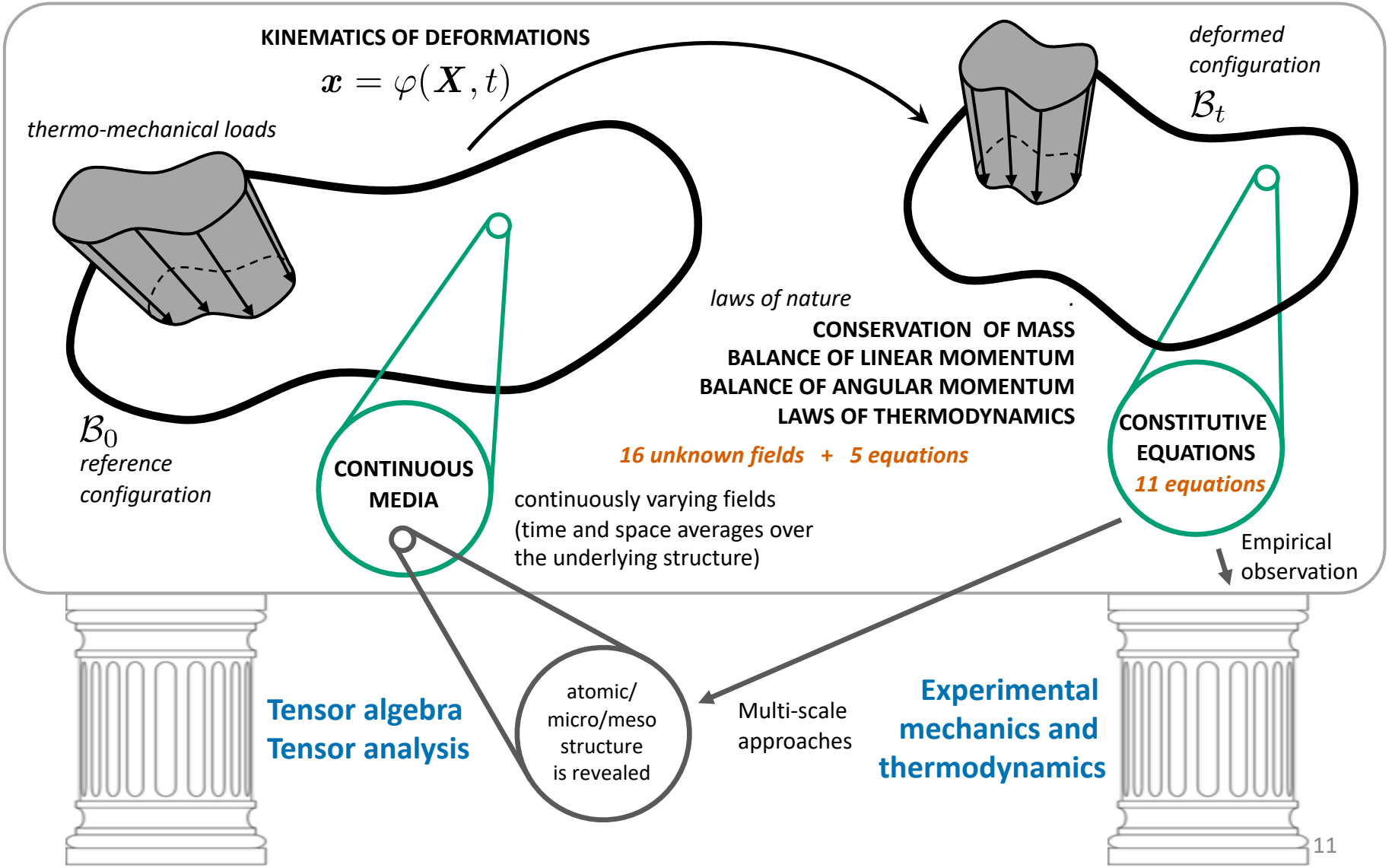
→ *These books are available at the Engineering Library*

CM as a ‘grand unifying theory’ of engineering science



Tadmor E.B., Miller R.E., Elliot R.E.,
“Continuum Mechanics and Thermodynamics”,
Cambridge University Press, 2012

CM as a ‘contextual framework’ for current research



Content and structure of the lectures

Before class:

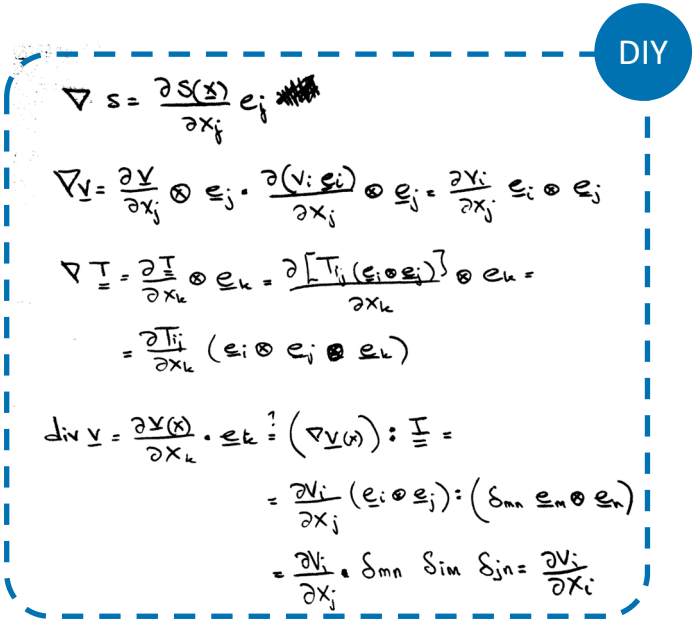
- Lecture slides will be posted online on *Brightspace.*

During class:

- Bring a printout of the slides with you.
- Lecture notes are not self-explanatory.
- We will work out some problems and derivations together …

  DIY "Do It Yourself"

  …. 'we will work out the solutions and derivations together'



- Most importantly: **Actively participate in class!**

Goal and structure of the homework sets

Goal:

- Facilitate a deeper understanding of the course material.
- Give you feedback on your learning and help prepare you for the exam.
- Give *me* feedback on your learning and help *me* better prepare you for the exam.
  Another good reason for enforcing individual work on homework assignments.

Structure:

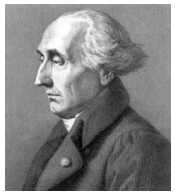
- A mix of theoretical (proof-based problems) and practical problems (algebra-based problems).
- Provide reasoning and justification for each step in your solution (regardless the type of problem).
  You will be graded on the quality of these steps.
- Advice: start working on the homework set as soon as it is posted!

Tentative schedule

Tuesday (9 to 10:15 a.m., MSEE B010)	Thursday (9 to 10:15 a.m., MSEE B010)	HW (Friday, 5 p.m., Gradescope)
01/11 - (01) Class overview	01/13 - (02) Introduction to vectors and tensors	-
01/18 - (03) Kinematics of deformations	01/20 - (04) Kinematics of deformations	HW1 posted
01/25 - (05) Conservation and balance laws	01/27 - (06) Thermodynamics and constitutive relations	-
02/01 - (07) Constitutive relations | Coleman-Noll proc.	02/03 - (08) Hyperelastic solids	HW1 due - HW2 posted
02/08 - (09) Hyperelastic solids	02/10 - (10) Viscoelastic solids	-
02/15 - (11) Viscoelastic solids	02/17 - (12) Viscoelastic solids | Internal variables	HW2 due - HW3 posted
02/22 - (13) Plasticity	02/24 - (14) Plasticity | J2 or von Mises	-
03/01 - (15) Plasticity | Mohr-Coulomb, Drucker-Prager	03/03 - (16) Solid-solid interactions | Contact mechanics	HW3 due - HW4 posted
03/08 - (17) Solid-solid interactions | Contact mechanics	03/10 - (18) Solid-solid interactions | Contact mechanics	-
SPRING VACATION	SPRING VACATION	HW4 due
03/22 - (19) Structural elements | Beams, plates, shells	03/24 - (20) Midterm Prep	
03/29 - (21) Guidelines for special project	03/31 - EXAM Time/Room (TBD)	-
04/05 - Project progress report #1a (presentation)	04/07 - Project progress report #1b (presentation)	Project progress report via WebEx
04/12 - (22) Structural elements | Beams, plates, shells	04/14 - Project progress report #1c (presentation)	HW5 posted
04/19 - (23) Fluid-solid interactions	04/21 - Project progress report #2a (presentation)	Project progress report via WebEx
04/26 - Project progress report #2b (presentation)	04/28 - Project progress report #2c (presentation)	HW5 due
Week of 05/02 - Time (TBD): Final project report and video submission		

General information

Know your ~~history~~ genealogy



J. Bernoulli

L. Euler

J.L. Lagrange

S.D. Poisson

G.P.L. Dirichlet

R.O.S. Lipschitz

C.F. Klein

A.O. Foppl

L. Prandtl

J.L.R. d'Alembert

P.-S. Laplace

S.P. Timoshenko

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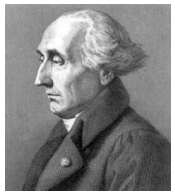

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You

General information

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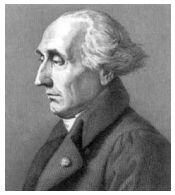

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P.-S. Laplace

S.P. Timoshenko

E.P. Popov

M. Ortiz

Marcial Gonzalez

You

Class overview

Any questions?