# Ceramic and Colloidal Processing

## Course Organisation

Andrea Testino


hip prosthesis

# Ceramic and Colloidal Processing MSE-326

**3rd year- semester 5 – the whole of MSE-326 will be given in ENGLISH**

## Room: MXG 110

**Course and exercises**

- Ceramic and Colloidal Processing (A. Testino) - 3 credits
- Tuesdays 9h15-12h00 – 2hrs course – 1hr exercises/discussion
- Lectures *ex cathedra* (in presence)
- Lectures and exercises in pdf format to be found on MOODLE for each week. They will be posted (updated) the Monday before course (at the latest).
- Exercise solutions will be posted on Tuesday/Wednesday.

**TP: virtual**

- Virtual and/or in class description of the practical work during the course
- See details on the overall program

# Supporting Material

- Course mainly based on French book
- **Les Céramiques,** J. Barton, P. Bowen, C. Carry & J.M. Haussonne, Les Traité des Matériaux, Volume 16, PPUR, 2005 (5 books available EPFL library)
- But with accompanying books in English that cover all sections

**English Books:**

1. **Ceramic Processing and Sintering** - M. N. Rahaman Taylor & Francis, London, 2003 (available as e-book EPFL library)
2. **Fundamentals of Ceramic Powder Processing and Synthesis**, T.A. Ring – Academic Press, 1996 (available as e-book EPFL library)
3. **Principles of Ceramic Processing**, JSReed , Wiley, 1995 (available as e-book EPFL library)
4. **The Colloidal Domain** – DF Evans & H. Wennerström, Wiley, 1999. (5 books available EPFL library)

# News of the year!

1. Each slide belongs to a category: **1** **2** **3**

**1** Fundamental concept: must be clearly understood.

**2** Insights that are fundamental to understand and clarify previous level.

**3** Additional information which may contain details, equations, tables, examples which help to understand and compare.

Typically, the overall number of slides are equally distributed in the three categories.

# News of the year!

2. Teaching method: ex-cathedra but

   A. Slides available in large advance: You will have time to read them and address questions during the third hour if something is still not clear. It is not flip-class method, a kind of hybrid;
   B. You will have videos recorded during previous years, the course is very much similar but not exactly the same. Attending the class is highly recommended.

3. Final evaluation

   A. Your active participation during classes will be highly encouraged. An example will be given during the first class;
   B. Your understanding of concepts among the diverse categories will define your final overall grade. If concepts under category 1 are not clear, the exam has high probability to fail.

# Exam

- Oral in January exam session
- 15 min
- No preparation, No notes etc.
- More information - October 31st …the mid-term test – where questions will be asked to the whole class and not individual students – the mid-term test will inform students of the typical method and typical questions asked
- The mid-term test will not be graded.
- Active participation during classes
- Final grade for MSE-326 (3 credits).

| Date/ Time | Title |
|---|---|
| ***19 Sept 9.15-12.00 week 1*** | 1.Introduction - ceramics et colloids- applications and examples<br>**Exercises 1 (1h)** |
| ***26 Sept 9.15-12.00 week 2*** | 2. Powder Characterization physical, chemical and morphology<br>**Exercises 2 (1h)** |
| ***3 Oct 9.15-12.00 week 3*** | 3. Raw materials and powder synthesis – solid-solid, solid -gas<br>**Exercises 3 (1h)** |
| ***10 Oct 9.15-12.00 week 4*** | 4. Powder synthesis, precipitation<br>**Exercises 4 - Virtual TP – tbd** |
| ***17 Oct 9.15-12.00 week 5*** | 5. Powder synthesis -gas phase et thermodynamics of solutions.<br>**Exercises 5 (1h)** |
| ***24 Oct 9.15-12.00 week 6*** | 6. Powder Treatment (1) Milling and classification.<br>**Exercises 6 - Virtual TP - tbd** |
| ***31 Oct 9.15-12.00 week 7*** | 7. Powder Treatment (2)- Dispersion and wetting, van der Waals forces<br>**Exercises 7 -** Complete exercises 1-7 and revision /discussion questions on course or lab classes<br>**NEXT WEEK exam method – mid-term test**… |

| Date/ Time | Title |
|---|---|
| ***7 nov*** ***9.15-12.00*** ***week 8*** | 8.: Interaction between charged surfaces -electrostatic repulsion - Colloidal stability : le DLVO model – aggregation kinetics – **Exercises 8 & EXAM…METHOD MID-TERM TEST** |
| ***14 nov*** ***9.15-12.00*** ***week 9*** | 9. Polymers in solution: solubility, conformation, adsorption at interfaces, Steric stabilization. Surfactants and micelles - colloids **Exercises 9 Hamaker program** |
| ***21 nov*** ***9.15-12.00*** ***week 10*** | 10. Powder Treatment (3) Rheology, mixing and granulation **Exercises 10 (1h)** |
| ***28 nov*** ***9.15-12.00*** ***week 11*** | 11. Ceramic forming methods dry pressing, tape casting, slip casting, drying and binder removal (burnout) **Exercises 11 (1h)** |
| ***5 dec*** ***9.15-12.00*** ***week 12*** | 12. Sintering: origin and phenomenology, kinetics and stages of sintering **Exercises 12(1h)** |
| ***12 dec*** ***9.15-12.00*** ***week 13*** | 13 Control of microstructures. Liquid phase sintering. Sintering technology. **Exercises 13** |
| ***19 dec*** ***9.15-12.00*** ***week 14*** | 14. Thin films and coatings **Exercises 14. Exam Method – Course Summary** |