



Department of Mining and materials Engineering

MIME 568: Topics in advanced materials

Winter 2021 (3 credits)

INSTRUCTOR

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PREQUISITES

MIME 362 or permission of instructor

COURSE DESCRIPTION

Functional or advanced materials are materials that combine advantageous structural properties with at least one function, such as an environmental response, detection, energy conversion, filtration, and more. These new materials play an increasingly important role in our lives. Their study involves many interdisciplinary topics in physics, chemistry, engineering, and sometimes even in pharmacy and medicine. This multi-university course is offered by the members of the Centre Québécois sur les Matériaux Fonctionnels (CQMF)/Quebec Center for Advanced Materials (QCAM). The course will introduce students to basic concepts in the field of advanced materials. This course is intended for graduate level students interested in the subject.

LEARNING OBJECTIVES

- a) Learn modern concepts on advanced materials, and in particular with modern concepts on polymers, nanoparticles, self-assembly, and materials applications in the field of energy, environment and biomedical.
- b) Critically review literature in the field
- c) Propose creative solutions to engineering problems
- d) Effectively present in front of an audience
- e) Effectively work in a team
- f) Provide constructive feedback
- g) Take feedback into consideration to improve
- h) Effectively write summaries and reports

TEACHING METHODS

This course is given in several universities at the same time. The course has been developed by the academic committee of QCAM: Profs Duong from UQTR, Cerruti from McGill, Howarth from Concordia, and Ayotte from U Sherbrooke. These four professors (referred to as “course organizers” in this document) oversee the course and participate in several of the activities.

In addition to this, each university has an instructor who deals with logistics, and ensures the smooth running of the course according to the expectations and rules of the university. The course has two parts, one dedicated to the acquisition of knowledge through video lectures, the other to the development of a project related to a field of advanced materials science.

A. Lectures

Lectures will be given either in streaming mode or pre-recorded. The live (Zoom) lectures will run on Mondays at 1-2:30pm from Jan 11-March 8, 2021. There will be a total of 12 lectures, six of them in English and six in French. Each student must study the content of six lectures of their choice, in English and/or French. The acquisition of knowledge of these lectures is evaluated by a quiz of 20 minutes / lecture. The six quizzes will be taken in one session online, in open-book format. The quiz questions are given in both languages and the students are free to answer in either English or French. The list of lectures proposed is in appendix A.

B. The project

The project is completed in a team of three students (or exceptionally two or four students). The composition of the teams is determined by the course organizers, with the goal of maximizing diversity between student Universities while making sure that language and time of availability is not a barrier among team members. To help team formation, each student will complete a short survey that will guide the organizers in forming the teams.

The teams will have to choose a current problem related to materials science, falling into the research areas covered by the QCAM (www.cgmf-qcam.ca). Examples of such topics will be covered in the course lectures. The project cannot be directly related to any graduate project of one of the members of the team.

Initial proposal

The team will provide a summary of 3000 characters or less (including spaces) in which the choice of topic will be presented. This summary will briefly present the problem that will be tackled by the team. This must be related to the materials science topics covered by the QCAM, and cannot correspond to the research projects of the members of the group. The summary will identify what problem the team wants to solve, present the state of the art in the field (e.g. existing solutions), and if possible (but not necessarily) what is the proposed solution. The course organizers will provide quick feedback on this summary, and on the adequacy of the chosen problem with the objectives of the course. Minor or major revisions may be requested. In this case, a second summary will have to be provided by the team. The final version of the

summary will be evaluated on the basis of its clarity and relevance to the field of advanced materials.

Note: along with the summary, students will have to submit a contribution chart that outlines how every member contributed to the submission.

Mid-term 5-minute presentation: speed-dating lecture

Once the abstract is accepted, the team will prepare a five minute oral presentation. This presentation will highlight the following points:

- i. What is the theme of the field of functional materials
- ii. What is the problem identified in this theme
- iii. What are the existing solutions for this problem
- iv. What is the new solution proposed by the team

This presentation will be given to other students on a day of an 'online speed-dating' lecture. During this lecture, students will present their presentation to other teams, meeting up virtually in couples that quickly rotate. Each period of speed-dating lasts about 20 minutes: at first, one team present to another team (5 min); after this, the other team will present their project (5 min). A final period of 10 minutes is allocated for questions and comments. During the course of a 90 min lecture, each team will have presented approximately 4 times to other 4 teams.

While listening to presentations from other teams, students are encouraged to take notes, since after the speed-dating lecture each student will have to provide feedback to the other teams that they have listened to (see peer feedback section, below).

A few days later, all peer review comments, rendered anonymous, will be compiled and sent to each team. A revised version of the five minute presentation will have to be uploaded on the website, and will be evaluated.

Note: along with the revised presentation, students will have to submit a contribution chart that outlines how every member contributed to the submitted presentation.

The evaluation criteria of the 5-min presentation are:

- a. Clarity of the presentation (clarity of the presentation of the problem, existing solutions, and the proposed solution) 25%
- b. Domain knowledge (possibility to introduce and explain new concepts, reference to recent works) 25%
- c. Creativity and originality (demonstration of how the proposed solution addresses the problem, how the proposed solution differs from what already exists) 25%

d. Communication and teamwork (quality of the oral presentation, quality of PowerPoint support, distribution of tasks in the team) 25%

Final presentation

At the end of the course, the team will present their project in more detail via

- A document of 10 pages maximum
- An oral presentation during a presentation day

The document and the presentation should address the following points

- What are the contributions of each team member
- What is the problem? Why is the problem chosen important? How is it relevant to the field of functional materials science?
- What are the existing solutions or what are the existing works that at least partially address the identified problem?
- What is the proposed solution? What assumptions are they based on? What are the advantages and disadvantages? How is this solution original and different from existing solutions?
- What is the methodology for implementing the solution you propose? Can you identify difficulties? What is the level of risk?

Oral presentation by Zoom

The oral presentation should last exactly 10 minutes followed by 5 minutes of questions. All members of the group must speak during the presentation. It will be evaluated according to the following points:

- Clarity of the presentation of the problem (20%)
- Clarity of the presentation of the solution (20%)
- Critical discussion of the solution (advantages, disadvantages, risks) (20%)
- Use and understanding of contemporary concepts in functional and advanced materials sciences (20%)
- Answers to questions (10%)
- Visual and oral quality of presentation (10%)

Note: along with the presentation, students will have to submit a contribution chart that outlines how every member contributed to the submitted presentation.

Final report

The final report must be 10 pages maximum, written with a 1.5 line spacing, Times New Roman font 12 points (or equivalent), margins 1.5 cm plus. A maximum of 60 references must be used (references do not count in 10 pages). Format the references according to the ACS style (<https://libguides.williams.edu/citing/acs>). The document will be evaluated according to the following criteria:

- Clarity of the presentation of the problem (20%)
- Clarity of the presentation of the solution (20%)
- Critical discussion of the solution (advantages, disadvantages, risks) (20%)
- Use and understanding of contemporary concepts in functional and advanced materials sciences (20%)
- Organization and didactic character (10%)
- Good use of literature and quality of illustrations (10%)

Note: along with the report, students will have to submit a contribution chart that outlines how every member contributed to the submitted document.

Peer feedback form

This form consists of 4 questions:

- What is the presentation about?
- What are the highlights of the presentation?
- What are the weak points of the presentation?
- Do you have any other comments or suggestions for your peers?

The comments made will be forwarded to the teams anonymously (see above), but each student will receive a grade relative to their comments, based on their scientific quality and usefulness.

EVALUATION

1. Means of evaluation

- Six Quizzes
- Team values and expectations at the end of team workshop #1
- Initial proposal summary, 2000 characters
- Mid-term presentation, 5-min

- e) Bullet point summary of team workshop #2 discussion
- f) Peer feedback
- g) Final report, 10 pages
- h) Final oral presentation

3. Weights

- a) Quizzes: $6 * 4\% = 24\%$ (individual grade)
- b) Team values and expectations: 2% (adjusted team grade)
- c) Summary of 10 lines: 5% (adjusted team grade)
- d) Midterm presentation: 16% (adjusted team grade)
- e) Bullet point summary of workshop #2 discussion: 2% (adjusted team grade)
- f) Peer feedback: 5% (individual grade)
- g) 10 pages project proposal: 23% (adjusted team grade)
- h) Oral presentation: 23% (adjusted team grade)

Important note: since this class is heavily team based, we will work with you on how you can become an effective team. See details in Appendix B. Also, each component that is marked as “adjusted team grade” will be adjusted according to the team member reviewing system described in appendix C and the peer contribution submitted along each team submission. This means that each individual will have a grade that may be different from that of other team members, and that will depend on their own contributions to the team project.

4. Important Dates (Winter 2021)

Date	Mandatory online activities (1-2:30 pm)	Individual Assignments (due at noon of the day)	Team Assignments (due at noon of the day unless otherwise specified)
1/11	First class	Get to know you form.	
1/25	First teamwork workshop		Team values and expectation form (due at 1 pm of 1/26)
2/8			Initial proposal
2/15		Team member review #1	Revision of initial proposal
3/15	Quiz (NOTE: this lecture will last until 3:15 pm)		
3/22		Team member review #2 (due at noon of 3/22) + Peer feedback on midway proposals (due at 1 pm of 3/23)	Midway proposal presentations

3/29	Second teamwork workshop	Hitchhikers and couch potatoes essay	Bullet point summary of workshop discussion (due at 1 pm of 3/20)
3/31			Revision of midway proposal
4/19		Team member review #3	
DATE TO BE CONFIRMED DURING FINAL EXAM PERIOD	Final presentation discussion		Final report + oral presentation

SPECIFIC DISPOSITIONS

Communications

The course will be offered on a secure platform. All communications (submission of exams, survey, etc.) will be via this website. Each student enrolled in their reference university will receive an identifier via email that will enable them to access it.

Absences and notification

Absence from the lectures mentioned in the table below as mandatory need to be justified either by a medical justification written by a health professional or by prior agreement with the professors in charge. Should an internet connection problem arise, we ask you that you notify XXX as soon as possible.

Delays

- 1) A penalty of 10% per hour of delay is applied to the delivery of all the team assignments mentioned above and on the individual assignment "Peer feedback on midway proposal".
- 2) A penalty of 0.05 will be applied to the individual weighing factor per each 24 hour cycle of delay in submission of the Team member reviews 1, 2 and 3.

Right to submit in English or in French

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

Academic integrity

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of

Student Conduct and Disciplinary Procedures (see www.mcgill.ca/integrity for more information).

Part of academic integrity is following instructions relative to online quizzes: in quiz 1, you are allowed to look at your course notes, but you cannot communicate with anyone during the time of the quiz.

L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site www.mcgill.ca/integrity).

Appendix A: list of lecture topics, professors teaching them, and language

Date	Lecturer	University	Language	Title
11 janvier	Theo van de Ven	McGill	English-1	Cellulose-based Advanced Materials
18 janvier	Steen B. Schougaard	UQAM	French-1	Les piles aux lithium-ion/Lithium-ion batteries
25 janvier	Marta Cerruti	McGill	English-2	Bioactive scaffolds for bone tissue engineering
1 février	Noémie-Manuelle Dorval Courchesne	McGill	English-3	Engineered Living Materials
8 février	François Brouillette	UQTR	French-2	Papiers spécialisés – Propriétés recherchées, modification des fibres et techniques de mesure
15 février	Suzanne Giasson	UdeM	French-3	Les polymères aux interfaces
22 février	Emanuele Orgiu	INRS	English-4	Organic field-effect transistors
8 mars	Marc-André Fortin	ULaval	French-4	Introduction à l'imagerie biomédicale
Pre-recorded	Ashlee Howarth	Concordia	English-5	Metal-Organic Framework (MOF)
Pre-recorded	Nadi Brady	UdeS	English-6	TEM
Pre-recorded	Antonella Badia	UdeM	French-5	TBD
Pre-recorded	TBD	TBD	French-6	TBD

APPENDIX B : How to become an effective team

When you start your work with your classmates, you may not realize yet that you are a team, and not merely a group of individuals. Groups of individuals may tend to work independently and simply pool work together with no discussion and may spend a lot of time in conflict over work-related or personal issues.

Team members instead always work together (in person or apart, but aware of who is doing what). They take different roles and responsibilities, help each other, resolve conflicts amicably, and keep personal issues from interfering with team functioning.

When you look for a job, teamwork skills, along with communication skills, are at the top of the list of your to-be employer. In this class we will help you develop this crucial skill.

1. Team formation

Teams will be formed based on three criteria:

- 1) Maximize mix between chemical and materials engineering students
- 2) Maximize mix between graduate and undergraduate students
- 3) Put together people who are in similar time zones so they can work together effectively.

In addition to this, you will be able to 'veto' up to 2 people in the class that you do NOT want to be teamed up with.

2. Team identity and expectation setting: teamwork workshop #1

Once teams are formed, each team will work together and meet their team members during Team workshop #1. At the end of this workshop you will have defined your team name, and you will submit a team agreement form that provides an initial description of your team's identity and expectations (**worth 2%**, full marks given to all teams that submit a form with meaningful content within deadline).

3. Dealing with problems in teams, setting expectations and solving challenges: teamwork workshop #2

Our second team workshop will be dedicated to dealing with challenges related to teamwork. Before this workshop you will read an essay about teamwork ("**Hitchhikers and couch potatoes**") and write a one paragraph essay on how the "Hitchhikers and couch potatoes" essay applies to their past teamwork experiences. This essay is ungraded but will be the starting point of your in-class discussion, so it is important that you submit this on time.

At the end of this workshop you will submit a guided bullet point summary of your discussion (**worth 2%**, full marks given to all teams that submit a form with meaningful content within deadline), which will be used by the TA and instructors to help you navigate teamwork for the rest of the semester by running “**team clinic**” activities outside class time with teams that have particular problems related to teamwork.

4. Extra measures

In addition to all this, **team members have the right to not put the name of a person in the team that did not contribute to an assignment if all of the team members agree that the team member did not contribute to the assignment.** The omitted team member will get a zero on that portion of the grade. Should there be a conflict, the instructor will call for a meeting.

The last resource measure for **utterly underperforming team members is that the team can exclude them from the remaining part of the teamwork during the semester.** For this to happen, a meeting with the instructor needs to be called. Similarly, if one person in a team feels like they are the only performing team member and wish to abandon a team and move to another team, they can do so as a last resource, upon meeting with the instructor and all team members.

APPENDIX C. Peer evaluation

1. Overview

Peer evaluations form an integral part of MIME 568, both in terms of team process and course evaluation. Your evaluations will be anonymous and will allow you to give both quantitative and qualitative feedback to your teammates, with two goals:

- 1) Help your team grow throughout the class
- 2) Allow individual's contribution to team work to be properly evaluated

The evaluations consider five criteria:

1. **Assignment contributions:** to what degree did the teammate assume responsibility for their work and participate equitably in the assignment?
2. **Quality of work:** to what degree did the quality of the teammate's work meet overall team expectations?
3. **Communication:** to what degree did the teammate communicate effectively and constructively with other team members, in and out of class?
4. **Equity:** to what degree did the teammate contribute to creating a positive and inclusive team environment?
5. **Professionalism:** to what degree did the teammate act with professional behavior and communication etiquette?

Each criterion is evaluated on a 5-point scale based on the following general guidelines:

0. Unacceptable: Took away from team's ability to perform in the criterion

1. Emerging: Showed some effort, but created an impediment for the team to grow in the criterion
2. Marginally acceptable: Provided minimum contribution expected in the criterion; may have created an annoyance for the team the criterion
3. Accomplished: Performed individually at a high level in the criterion
4. Exemplary: Performed individually at a high level **and** helped other teammates to also perform at a high level in the criterion

2. When will you be requested to fill out a peer evaluation form?

Throughout the class, you will fill out 3 peer evaluations, i.e. every time your team has gone through a crucial team assignment:

- a. After the initial project proposal submission
- b. After the mid-way project proposal discussion
- c. At the end of the class

3. Filling out peer evaluation forms

When an evaluation is available to you, the TA will send you a link to an Office Form that you will be able to fill online. **You will have to fill out one peer evaluation form for each of your teammates;** in these forms, you will provide written feedback for each person and evaluate them on the five criteria above. In each evaluation, you will indicate to what degree each teammate performed in each criterion. A sample of the evaluation rubric is shown at the end of this document (again, the actual evaluation is done online using Office forms). Each peer evaluation event will be open for one week. Late evaluations will be accepted up to one week late, but submitting a late evaluation will reduce your evaluation score received by 2% per day late.

4. Determining team score contributions

Your evaluation of each teammate will generate a raw score out of 20 (five criteria each with a maximum score of four). After the evaluation due date, each person will receive anonymous, randomly-ordered comments and ratings from their teammates. Scores given by each person will be normalized to an average of 100.

Ex. 1: if the raw total evaluation scores you gave to your 5 teammates were 18, 18.5, 19, 19.5, and 20 (average of 19) these would be normalized, respectively, to 95, 97, 100, 103, and 105 (average of 100).

Ex. 2: if you gave every teammate a perfect score in every criterion, each teammate would receive a raw total evaluation score of 20 from you, the average would be 20, and each teammate would receive 100 for the evaluation (everyone is average).

Ex. 3: if you gave every teammate a score of 1 in every criteria, each teammate would receive a raw total evaluation score of 6 from you (1 pt per 6 criteria), the average would be 6, and each teammate would still receive 100 for the evaluation (everyone is average).

With this system, differences in evaluation standard between individuals are removed. Similarly, individuals do not penalize themselves by giving their teammates high evaluations, nor do they benefit by giving their teammates low evaluations.

The final peer evaluation score for each individual will be the average of all peer evaluations they receive from their teammates. Some individuals may have scores above 100 and some below, but the average evaluation score each person gives will be 100, and therefore the average final evaluation score for the whole team will be 100. These evaluations will be used as a multiplication factor to evaluate individual team grades.

For example: if the normalized scores in Example 1 were representative for the five team members shown, then ALL the items marked as adjusted team grade would be multiplied by 0.95, 0.97, 1, 1.03 and 1.05. So if for example the team grade for the final project presentation was 80%, those five students would receive team grade components of 76% (i.e. $80\% * 0.95$), 78%, 80%, 82%, and 84%, respectively. The same would be true for all other evaluation items marked as adjusted team grades.

The individual contribution to each item that is stated as “adjusted team grade” in the table showing evaluation items in the syllabus will be determined using the multiplication factor calculated as discussed above, adjusted (+/- 0.1) by the professors based on the contributions described on the contribution charts submitted along with each team assignment.

You will see your raw “multiplication factor” as it evolves throughout the course on mycourses.

5. Final remarks

We encourage you to use the peer evaluation forms as only one tool for giving/receiving feedback in your team, in addition to in-class workshops, team clinics with the TA, and out-of-class teamwork time you will schedule. These forms often help bring issues forward before they might otherwise be discussed, and their anonymous nature makes it easier and more comfortable for some people to raise issues related to team dynamics. However, these evaluations alone are likely not sufficient for resolving complicated team issues, and some people find the anonymous nature awkward. Be prepared for this. Try to make sure that the feedback you give in your peer evaluation forms (and face-to-face) is constructive and balanced – let your teammates know what they are doing well in addition to where they might be able to improve.