ADVANCES IN POLYMERIC MATERIALS

Chemical Engineering 774

INSTRUCTOR:
Dr. M. Thompson JHE A214/H Ext. 23213 mthomps@mcmaster.ca

SCHEDULE: Lectures: Mondays 9am-12 (noon) EST, beginning January 18, 2021

Lectures on MS Teams:
https://teams.microsoft.com/l/channel/19%3a63ef4cf1b9d04f7b8b11df4c87dac623%40thread.tacv2/Lectures?groupId=8ca50e94-f176-4466-9cfb-6ed7a719bf91&tenantId=44376307-b429-42ad-8c25-28cd496f4772

COURSE OBJECTIVES:
To provide a survey of the principles and practices involved with two important fields of polymers, namely polymer blends and polymer composites. To balance out the course, a brief review of polymer physics will be given at the start of the course, and some coverage of reactive modification of polymers will be necessary to complement our discussions on blends and composites.

RESOURCES:

1. L.A. Utracki, "Polymer Blends and Alloys: Thermodynamics and Rheology", Hanser Publishers, NY, 1989
2. M. Xanthos, "Reactive Extrusion", Hanser Publishers, NY, 1990
3. "Polymer Matrix Composites", R. Talreja and J.A.E. Manson, Elsevier Science Ltd., UK, 2001
4. "Physical Properties of Polymers", J. E. Mark et al., eds., American Chemical Society, Washington, 1993

TOPICS:

1. **Overview of Polymer Physics (3 lectures)**
   a. **Glassy, crystalline, and mesomorphic states of order**
   b. **Free Volume Theory**
   c. **Factors affecting glass transition temperature, Tg**
   d. **Factors affecting crystal melting temperature, Tm**
   e. **Random coil and chain entanglement**
   f. **Rubber elasticity**
   g. **Viscoelasticity**
   h. **Deformation mechanics**
2. **Polymer Blends and Alloys (2 lectures)**
   a. **Polymer miscibility**
   b. **Morphology of blends**
   c. **Compatibilization and the interphase**
   d. **Dispersive and distributive mixing**
   e. **Properties of commercial blends**

   f. **Processing Issues**
3. **Reactive Modification of Polymers (2 lectures)**
   a. **Principles of reactive modification in the melt phase**
   b. **Controlled rheology of polymers**
   c. **Bulk polymerization**
   d. **Grafting reactions**
   e. **Polymer functionalization**
   f. **Reactive compatibilization**
   g. **New developments in the field of Reactive Extrusion**
4. **Polymer Composites (2 lectures)**
   a. **Classification of composites**
   b. **Agglomeration**
   c. **Carbon-black filled polymer composites**
   d. **Glass-fibre reinforced polymer composites**
   e. **Nanocomposites**
   f. **Wood and Natural fibre composites**

ASSESSMENT:
Four reports will be handed in over the span of the term, on topics selected by the students and approved by the instructor, each with a value of 25% of the final grade. The reports will deal with each of the four general topic areas, in order that they are given in class.

Failing to complete and hand in all four reports will result in a failing grade for the course. Late penalty is 10% per day, with day 1starting at 12:01am immediately after the deadline.

REPORT
FORMAT: It will be a summary spanning no more than 15-pages with no more than 3 pages of figures or tables.
The report should be submitted in MS Word format, using 12-point Times New Roman font and a sentence spacing of 2 (double spaced). 1" margins on all sides are required. The first page should be a cover page which is not included in the 15-page count. The cover page should include title, author, date, and any other information you wished added. Style is important. References should be cited in the text body using a square bracket, i.e. [], and should be numbered in the order they appeared. All references are to be listed in a separate section under the heading of 'References' at the end of the report (again not included in the 15-page count). **Reference style should comply with the journal 'Polymer Engineering and Science'**.

CONTENT: The reports themselves **must be well linked to the theme** of the modules we just finished in the course. Staying on the topic at hand is critical to receiving a good mark. For example, the report for Reactive Modification - I expect that the focus is on the reaction in a bulk phase of polymers (not solvents), discussing the chemistry pathway, diffusion problems, etc. For polymer blends – I expect everything related back to the morphology of the blend. For reactive modification, discussing the morphology of a blend would therefore be inappropriate and vice versa for a report on blends. You will pick an aspect of the topic – ex., free radical scission, crosslinking by free radical versus moisture, etc. But you must

always be mindful that it must be linked to the theme of the module - so talking about the free radical chemistry of solutions or just the reactions without discussion of how reactive modification is involved, would be completely missing the point of the reports. Since the report is on, say 'reactive modification', then the majority of the report needs to relate to whatever your topic is on and discussion how researchers in the field of reactive modification have used that topic to advance scientific knowledge. *Submitting a report that fails to cover a topic relevant to the appropriate module will result in an immediate loss of 30% before it is even evaluated for content.* **Students are encouraged to discuss their report topics with the instructor before starting to write**.

The report is expected to provide an in-depth coverage of current literature related to the selected topic. The level of detail will be similar to journal review article rather than the broader, less detailed coverage given by many textbooks. Try not to talk about the findings of one paper and then another and then another. Instead, try to synthesize common findings among multiple articles about an important parameter, theory or finding. Higher marks will be given for the latter since it shows advanced understanding of the topic.

MARKING: Marking will be based on level of comprehension, clarity of discussion, and suitable grammar. Each report must be submitted at the designated date and time it is due, or an alternative date must have been worked out with the instructor prior to the original due date, to avoid a failing grade on the report.

REPORT SUBMISSION: Reports will be submitted to AVENUE to Learn. It is the student's responsibility to ensure they have access to AVENUE as early as possible in the course, and notify the instructor before the end of January if they are experiencing issues in accessing it.

DUE DATES (before mid-night):

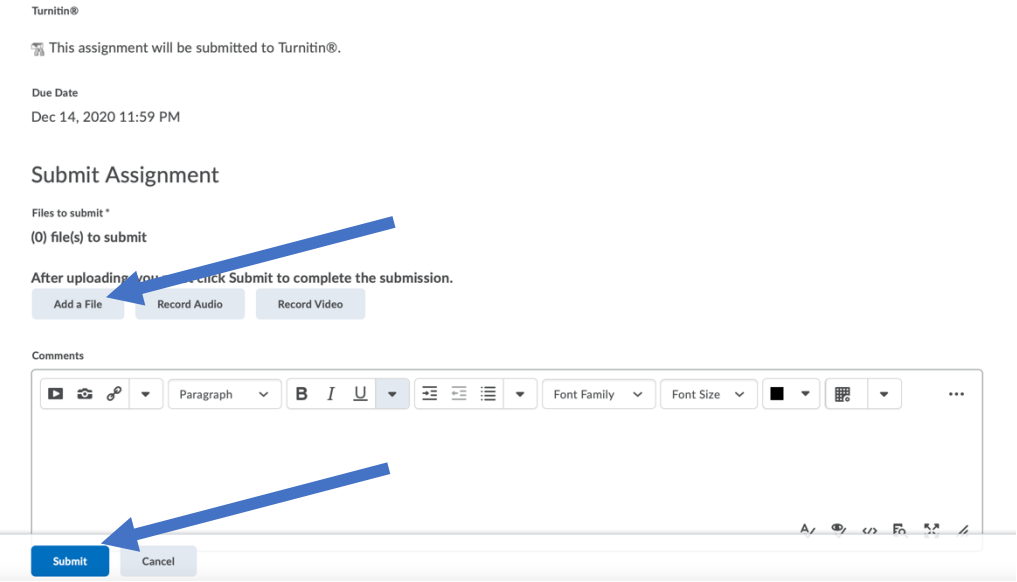
1st report – Polymer Properties	February 15, 2021
2nd report – Polymer Blends	March 8, 2021
3rd report – Reactive extrusion	April 5, 2021
4th report – Polymer Composites	April 26, 2021

This course uses the built-in TURNITIN function within AVENUE at the time of submitting your report. The website scans your submitted documents to the Assignments folder for plagiarism and provides an originality report indicating the percent of the report's content which can be found in other persons' works.

It is the policy of the university that a student may decline to submit their report to turnitin.com (https://www.mcmaster.ca/academicintegrity/turnitin/guidelines.html). However, this right does not allow the student to avoid checking their work for plagiarism. Turnitin.com is provided freely to McMaster's students to make the check but otherwise a student should personally pay for an outside firm to certify that their report is free of content matching other persons' work. The due date does not change because the student has elected to use an outside firm to check their work.

How to Submit your Report:

- Go to the "Assessments" drop down menu. "Assignments" should be the first in the list that drops down.
- On the Assignments page, there will be four assignments in a table. Click on the name of the assignment corresponding to the report (see the due dates table above for which report corresponds with which module).
- Note the message that the assignment will be submitted to Turnitin
- Click on the "Add a File" button and follow the instructions to upload the file.
- Click on the blue "Submit" button at the bottom of the 'Submit Assignment' page in order to send the report to the instructor and Turnitin.



POLICY REMINDERS

CONDUCT EXPECTATIONS

As a McMaster graduate student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.