

CML522 Chemical Dynamics and Surface Chemistry

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Unless you try to do something beyond what you have already mastered, you will never grow. –Ralph Waldo Emerson

Good students are not those who display the trappings of studiousness (perfect attendance, rapt attention, meticulous work). Good students are those who learn. Whatever their preconceptions, barriers, or deficits - whatever their story - they take new information and new experiences and, to the best of their ability, make them tools for transforming themselves and their world. –M. Cohan

Contacts

My office is # MS 733-IIG2 and e-mail address is nkurur@chemistry.iitd.ac.in. I find e-mail to be a convenient way to transact business, and it is only a matter of time before you do too, because I am rarely in my office. Note however that I will only reply to course related mails when sent from your official institute email account with the subject line CML522.

Attendance

I believe that attending classes is an integral part of the learning process. In addition, it is also well documented that there is a strong correlation between attendance and performance in courses. If your attendance falls below 75%, you will awarded one grade less than what you earned. I also insist that you are present in the class IN TIME.

Calendar

	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Upto M1	04/01	07/01	11/01	18/01	21/01	25/01	28/01	01/02	04/02	08/02
Betn. M1 & M2	15/02	18/02	22/02	25/02	07/03	10/03	14/03	17/03		
Betn. M2 & Maj.	31/03	04/04	07/04	11/04	14/04	18/04	21/04	25/04	28/04	02/05

Syllabus

The course contents in the *Courses of Study* reads **Kinetics of simple and complex reactions, Transport properties, Theories of reaction rates and dynamics of gas and liquid phase reactions, Experimental techniques to study fast reactions, Photochemical reactions, Surface phenomena and physical methods for studying surfaces, Heterogeneous and homogeneous catalysis.**

This syllabus is for official purposes and extremely vague. I am particularly keen to discuss in addition to classical chemical kinetics, which you should know already, material that should be new to you - molecular reaction dynamics, femtochemistry, electron transfer, unimolecular reactions, kinetic isotope effect, and reactions on surfaces. From a practical standpoint, these latter topics will probably not help you to answer the questions in a competitive examination like CSIR/GATE/GRE, but they certainly will expose you to chemical kinetics and dynamics as is practiced now.

Books related

There are any number of physical chemistry textbooks (referred to here by the author names) that you could use profitably for the initial part of this course. The book by Atkins is popular both locally and world-wide. There are others that are, arguably, just as good but not as popular. These include those by McQuarrie and Simon (a personal favourite); Alberty, Silbey, and Bawendi (numerous copies in the library); Engel and Reid; Laidler and Meiser; Ball; Berry, Rice, and Ross (another personal favorite); and two favorites of yesteryears Castellani; and Moore. Last, but far from the least, is the local favorite, K L Kapoor, which if I do not mention in these parts of the world I risk losing my life!

For the latter portions we will delve into specialized books on kinetics and dynamics of which also there is no dearth. There are the classics due to Laidler (numerous copies are available in the library), first published in 1958 and still going strong, and Frost and Pearson, now in a new avatar due to Moore and Pearson. I am particularly fond of two more recent books: one by Houston and another due to Steinfeld, Francisco, and Hase. A far from complete list of books that you might find useful includes Wright; Gardiner; Wilkinson; Espenson; Hammes; Pilling and Seakins; Brouard; Smith; Levine and Bernstein, and . . .

We will also discuss some landmark research papers in some of the relevant fields with the intention to expose you to the primary scientific literature and how to read and understand scientific papers.

Teaching philosophy

I hear and I forget. I see and I remember. I do and I understand. –Confucius

I believe in active learning. Ask questions in the class - feel free to interrupt me! If you don't understand something I have said, it is likely that there are others who don't and they will be grateful to you for having asked the question. I realize there are a number of reasons to not ask questions but I am hoping that we can all get over such apprehensions because it is extremely important to clear up misunderstandings before they multiply.

Working problems is an essential ingredient to learning a subject. Do the problems in the book that you are reading as you come to them. They are there to enhance your understanding and learning of the particular topic they accompany. For additional practice, get another text or other source of problems if you can.

Finally, you must take responsibility for your own learning. An active, responsible learner seeks not to limit what she should know, but embraces and conceptually consumes as much material as possible. Knowledge is power; arm yourself with it! Whether or not you win the game depends upon your skill, your level of effort, and your dedication to the course.

Assessment

In addition to the minors ($2 \times 17.5\%$) and major (35%) exams, there will be regular homeworks and surprise quizzes which will contribute 20% to the overall grade. The homeworks are handed out on Thursday and due in before class the following Thursday. The homework contributes to your grades in more ways than one (like attendance, there is a strong correlation between those who do the homeworks and those who do well on exams, which, in turn, reflects on the final grade), so it is in your best interest to do all the homeworks assigned. The homework will not be corrected or graded for accuracy of the solutions but will be checked for completeness and effort, and will be given a grade. Collaboration with classmates to discuss problem solving strategies is encouraged, although it is advisable to first struggle through it by yourself. In case a reminder is required, let me point out here that **OUTRIGHT COPYING CONSTITUTES ACADEMIC DISHONESTY**. The remaining 10% will be based on a group presentation on a research paper related to the subject.

The difference between the amoeba and Einstein is that, although both make use of the methods of trial and error for elimination, the amoeba dislikes erring while Einstein is intrigued by it. He consciously searches for his errors in the hope of learning by his discovery and elimination. –Karl Popper, an educational philosopher