First handout on **ESO209A**, **Dynamics**.
First lecture: July 30, 2018. Lectures: 5-6 pm, Mon Wed, L16. Tutorials: 5-6 pm, Tue, TB103, 104, …, 109.

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Best way to contact me: my gmail address, with **ESO209A** in the subject line (easiest for me to search). If you send email in any other way, I may miss your email, forget to respond, absent-mindedly delete it, or fail to find it again.

Welcome to dynamics, a contender for "greatest subject in the world". What we will mostly be doing is **Newton-Euler** mechanics. Do not be fooled by the ordinariness of the humble messenger, your instructor, Chatterjee.

Here is some material on Newton from Wikipedia, for your interest:

Sir Isaac Newton *PRS FRS (25 December 1642 – 20 March 1726/27[1]) was an English mathematician, astronomer, theologian, author and physicist (described in his own day as a "natural philosopher") who* ***is widely recognised as one of the most influential scientists of all time****, and a key figure in the scientific revolution. His book Philosophiæ Naturalis Principia Mathematica ("Mathematical Principles of Natural Philosophy"), first published in 1687, laid the foundations of classical mechanics. Newton also made pathbreaking contributions to optics, and he shares credit with Gottfried Wilhelm Leibniz for developing the infinitesimal calculus.*

Newton's Principia formulated the laws of motion and universal gravitation that dominated scientists' view of the physical universe for the next three centuries. *By deriving Kepler's laws of planetary motion from his mathematical description of gravity, and using the same principles to account for the trajectories of comets, the tides, the precession of the equinoxes, and other phenomena, Newton removed the last doubts about the validity of the heliocentric model of the Solar System and demonstrated that the motion of objects on Earth and of celestial bodies could be accounted for by the same principles. Newton's theoretical prediction that the Earth is shaped as an oblate spheroid was later vindicated by the geodetic measurements of Maupertuis, La Condamine, and others, thus convincing most Continental European scientists of the superiority of Newtonian mechanics over the earlier system of Descartes.*

Newton also built the first practical reflecting telescope and developed a sophisticated theory of colour based on the observation that a prism decomposes white light into the colours of the visible spectrum. Newton's work on light was collected in his highly influential book Opticks, first published in 1704. He also formulated an empirical law of cooling, made the first theoretical calculation of the speed of sound, and introduced the notion of a Newtonian fluid. In addition to his work on calculus, as a mathematician Newton contributed to the study of power series, generalised the binomial theorem to non-integer exponents, developed a method for approximating the roots of a function, and classified most of the cubic plane curves.

And here is some on Euler, also from Wikipedia:

Leonhard Euler (15 April 1707 – 18 September 1783) was a Swiss mathematician, physicist, astronomer, logician and engineer, who made important and influential discoveries in many branches of mathematics, such as infinitesimal calculus and graph theory, while also making pioneering contributions to several branches such as topology and analytic number theory. He also introduced much of the modern mathematical terminology and notation, particularly for mathematical analysis, such as the notion of a mathematical function. He is also known for his work in mechanics, fluid dynamics, optics, astronomy, and music theory.

Euler *was* ***one of the most eminent mathematicians of the 18th century*** *and is held to be* ***one of the greatest in history.*** *He is also widely considered to be* ***the most prolific mathematician of all time.*** *His collected works fill 60 to 80 quarto volumes, more than anybody in the field. (Etc.)*

A statement attributed to Pierre-Simon Laplace expresses Euler's influence on mathematics: "Read Euler, read Euler, he is the master of us all."

I encourage you to wonder if these **two** great names are attached to the subject without good reason.

The material covered is going to start from free body diagrams (which are distinct from *body free* diagrams), cover frames of reference, particles and rigid bodies, rotations, angular velocities and accelerations, rotating frames, derivatives of vectors in rotating frames, variable mass systems, vibrations, numerical solutions in Matlab, gyroscopes, and some other material. A pdf file outlining what I covered in a previous semester will be sent to you separately, to give you a sense of it. However, in the end, only what is covered in *your* class will be in the syllabus.

After every class, I will usually stay for some minutes to talk with students on any course related topics, to clear doubts, and so on. If you need more time from me, let me know then and we will arrange something.

We will loosely follow the dynamics book by Meriam and Kraige (the 7th edition seems available in the campus shopping centre and online in some places) and also my own lecture notes: http://home.iitk.ac.in/~anindya/bk123.pdf

My aim is to make it easy for you to learn, and to make it slightly unpleasant for you if you do not learn. My loyalty is to students who come to lecture on time and try to pay attention. So if you cause distractions, I may ask you to leave.

It is my belief that our lectures have value that is not measurable in exams. So attendance will be taken on many (but not all) days. Attendance, whenever taken, will carry marks. Claims of attendance on other days will not fetch marks.

It is my belief that surprise quizzes help in studying. So all quizzes in the course will be surprise quizzes, and there will be between 2 and 20 of them. There will be no compensation for missed quizzes: for family matters, for academic or other visits outside, for illness … nothing. IITK rules do allow this. At the end of the semester, in consultation with the class, one or more of your worst quiz scores will be dropped using some algorithm we will work out in class.

It is my belief that IITK students should be evaluated for both the numerical correctness of their answers as well as the quality of their presentation. However, both these things need not be simultaneously tested for. Accordingly, the quizzes will be multiple choice, with numerical answers; and midsem and endsem exams will be graded with due attention to quality of presentation. Quality of figures, handwriting, clarity of presentation, boxes drawn around important parts of the answer, … these will matter.

It is my belief that all cheating in class, or in quizzes/exams, is theft. The cheater steals from the honest student whose job he takes away, from the employer whose salary he claims without competence, from the teacher whose joy he erodes, from the institute whose reputation he weakens. Help giver and help taker are both guilty. Punishment will exceed the crime. I will give you a hearing if possible, e.g., by involving another faculty member in considering whether cheating has occurred. If we decide it has, we will document it. Punishment will include, usually, at least a zero on the entire piece of work (e.g., cheating on one question on the endsem would mean zero on the entire endsem), plus possibly an added penalty (e.g., something between 1-100 marks off your total on the rest). While a good student may expect 27/30 on the midsem, a weak student may expect 3/30, so if both get zero then the good student is punished more. If you are a good student and a weak friend seeks your help, maybe he is no friend.

It is my belief that I should set a few traps here and there to catch potential cheaters. Maybe I will, to aid honesty.

The total marks of 100 in the semester are to be divided as follows:

Attendance: 10 (counting only days on which attendance is taken), Quizzes: 15, Midsem: 30, Endsem: 35, Marks given by tutor based on his criteria: 10. *Appearing for the endsem is mandatory. No endsem equals F grade.*

While I will generally hesitate to interfere with the tutor's policy regarding the 10 marks, if you disagree strongly with his policy then please let me know and I *may* have a discussion with the relevant tutor.

In case there is a change in the marks scheme, I will let you know in class and by email.

My policy is that if I have sent an email to the ESO209A mailing list, then I have duly informed you. Make sure you are receiving your email. If email to you bounces, I will not be responsible for informing you by other means.

A minor point: tired of students whose joy in shortcuts distracts them from the discipline we wish to develop, I have procured a rubber stamp (see below). If I get a chance to put this on your script, expect to lose extra marks.

Finally, my aim is that a sincere student who comes to class, pays attention, and practices problems should at least pass the course. Someone regular, with clear understanding, correct answers *and* good presentation should get an A.

Good luck. See you in class.