# Indian Association for the Cultivation of Science

## SPS and SMCS

## Integrated Bachelors-Masters Program in Science

## PHS 2201: Classical Mechanics & Special Relativity


**Instructor:**
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# 1 Main points to remember

- **Course Webpage**: I have created a webpage, where all the details regarding this course will be posted. You are encouraged to check the webpage in regular intervals. You can access it by clicking here. Or, copy paste the following url to your browser: *https://sumantachakraborty.weebly.com/cm-and-sr.html*. You are also encouraged to check the "announcements" section located here.
- **Assignments and Evaluation**: I will hand over **three** assignments over the duration of the course. These you have to work out of your own and you **do not** have to submit them to me. However if you are stuck at some problem, you can discuss them with the teaching assistant in the tutorial. The evaluation for this part of the course will be based on: (a) Mid-Semester Examination (**25** Marks); (b) **Two** Quizzes and (c) End-Semester Examination (**10** Marks). All the examination will be closed book, closed note. Please contact the academic office for any other issue regarding the course.
- **Communications**: The main mode of communication outside class will be through emails. Thus I would request all of you to check emails at least once everyday. The assignments as well as other instructions will be handed over through emails only. The classes will be on **Monday** and **Wednesday** from **09:00** am to **10:30** am and the tutorial will be on **Thursday** from **1:00** pm to **2:00** pm.

# 2 Syllabus

- Rigid body, D'Alembert's principle, Virtual displacement.
- Lagrange's equation and application, Variational Principle and Hamilton's equations.
- Elasticity, Stress and Strain tensor.
- Fluid dynamics, Euler equation, Equation of continuity, Bernoulli's equation.

# 3 Books and Articles

Below you will find the books and/or articles relevant for this course. I have mentioned the level of difficulty of each of these books by following the convention: **B**: Basic book, **I**: Intermediate book and **A**: Advanced book. Hopefully you will enjoy reading them. If you come across any other interesting book appropriate for this course, let me know.

- *Mechanics: Berkley Physics Course: Volume 1* — C. Kittel, W.D. Knight, M.A. Ruderman, C.A. Helmholtz and B.J. Moyer — McGraw-Hill International Publishers. (**B**)
- *An Introduction to Mechanics* — D. Kleppner and R. Kolenkow — McGraw-Hill Publishers. (**B**)
- *Introduction to Classical Mechanics* — R. Takwale and P. Puranik — McGraw-Hill Publishers. (**I**)
- *Classical Mechanics* — A. Raychaudhuri — Oxford University Press. (**I**)
- *A Treatise on General Properties of Matter* — H. Chatterjee and R. Sengupta, New Central Book Agency. (**I**)
- *Classical Mechanics and general properties of matter* — S.N. Maiti and D.P. Raychaudhuri — New Age International Publishers. (**I**)

- *Classical Mechanics* — H. Goldstein, C.P. Poole and J.L. Safko — Pearson International Publishers. (**A**)
- *Classical Mechanics* — N.C. Rana and P.C. Joag — McGraw-Hill Publishers. (**A**)
- *Classical Dynamics: A Modern Perspective* — E.C.G. Sudarshan and N. Mukunda — Hindustan Book Agency. (**A**)
- *Classical Mechanics: Course in Theoretical Physics: Volume 01* — L.D. Landau and E.M. Lifschitz — Elsevier. (**A**)
- *Fluid Mechanics: Course in Theoretical Physics: Volume 06* — L.D. Landau and E.M. Lifschitz — Elsevier. (**A**)
- *Theory of Elasticity: Course in Theoretical Physics: Volume 07* — L.D. Landau and E.M. Lifschitz — Elsevier. (**A**)

# 4 Time Scale

The course will start from **6th January** and will continue till **21st February**. In total this course will continue for **seven** weeks and possibly we will have around **14** classes. Below a tentative course structure has been presented, I will try to stick to this schedule as much as possible.

- **Class-01 (06.01.2020)** — Principle of least action, Generalized coordinates, Example of various constraints, Introduction to Lagrangian formulation.
- **Assignment-01 (06.01.2020)** — The first assignment will be handed over.
- **Class-02 (08.01.2020)** — Ambiguities in Lagrangian formulation, Principle for determining the Lagrangian, Lagrangian for free particle.
- **Tutorial-01 (09.01.2020)** — First assignment will be discussed.
- **Class-03 (13.01.2020)** — Lagrangian for a system of interacting particles, Examples.
- **Class-04 (15.01.2020)** — Lagrangian for constrained systems, Virtual displacement and D'Alembert's principle.
- **Quizz-01 (16.01.2020)** — First class test will be conducted.
- **Class-05 (20.01.2020)** — Conservation from Lagrangian, Notion of energy, linear momentum and angular momentum.
- **Class-06 (22.01.2020)** — Solving central force in the Lagrangian framework.
- **Assignment-02 (22.01.2020)** — The second assignment will be handed over.
- **Tutorial-02 (23.01.2020)** — First assignment as well as answers of first Quizz will be discussed.
- **Tutorial-03 (24.01.2020)** — Second assignment will be discussed.
- **Class-07 (27.01.2020)** — Introduction to Hamiltonian and Hamilton's equations.
- **Class-08 (03.02.2020)** — Example of solving Hamilton's equations.

- **Class-09 (05.02.2020)** — Rigid body dynamics.
- **Quizz-02 (06.02.2020)** — Second class test will be conducted.
- **Class-10 (07.02.2020)** — Introduction to elasticity and stress tensor.
- **Class-11 (10.02.2020)** — Solving problems in elasticity, Introduction to Fluid dynamics.
- **Class-12 (12.02.2020)** — Derivation of Euler equation and equation of continuity.
- **Assignment-03 (12.02.2020)** — Third assignment will be handed over.
- **Tutorial-03 (13.02.2019)**— Second assignment and answers of second Quizz will be discussed.
- **Class-13 (14.02.2020)** — Derivation of Bernoulli's equation and relevant problems.
- **Tutorial-04 (17.02.2020)**— Third assignment will be discussed.