

ONLINE PHYSICS LECTURE NOTES

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ABSTRACT

Internet is a very powerful medium and is being widely used by the academic community. A large amount of resource on physics education in the form of lecture Notes, online lectures, books, databases and journals are available. We have collected the available data on this topic and tried to present in such a way that it can be helpful for school and college teachers in their teaching and tutorials.

KEYWORDS

Web Physics, Physics Web resources, physics lecture notes, Physics education, Introductory Physics etc.

INTRODUCTION

In order to produce good quality students at primary, secondary or graduate levels, we need dedicated teachers who are fully conversant with the latest developments in the field. There used to be time when books available in the library, were the main source of knowledge. However, the last decade has seen a tremendous change and information available on the web through Internet is one of the important information sources available to the teachers. The difficulty with this medium is to access the right kind of information. In this paper, we have organized the information, which is available on the web, for preparing good lecture notes. An effort has been made to include all the necessary information, which can be a good starting point for the users. We have included the elementary as well as advanced level information on physics education that can be helpful for teachers and students alike. We will begin with the online lectures/lecture notes.

ONLINE LECTURES

An interesting and important website which hosts a lot of information including the lecture notes is Phys Net – Physics Educational Resources (<http://physnet.uni-oldenburg.de/PhysNet/education.html>). This site provides online educational resources for physics. The structure of the site allows one to choose the resource by the type of information required. This includes Lecture Notes, Seminar Talks, Visualization and Demonstration Applets. After the Introductory Material, the resources are listed as far as possible in broad subject areas. The site also contains information for non-physicists as well as for students and teachers of undergraduate and graduate level. There is also a link for other resources and collection. One can find material (lecture notes, seminars etc) about the following subjects:

- Public Understanding
- Introductory Material
- Mathematical Methods
- Classical Mechanics
- Optics
- Electrodynamics
- Solid-State Physics
- Particle and Nuclear Physics

- Quantum Mechanics and Quantum Field Theory
- Thermodynamics and Statistical Physics
- General Relativity and Special Theory of Relativity
- Discussion Groups, Physics FAQs and Physics QUIZs

Besides providing information about the related subjects, the site also provides the visual demonstration.

Example: While teaching the Kinetic Energy in mechanics, a teacher wants to demonstrate the action of different forces on different masses in the presence and absence of friction (with different values of friction). He can use this site or other sites similar to this one to show and explain this experiment. It is a matter of fact that visualization is more effective than reading or listening.

Another important site, which hosts a lot of information on physics, is Physics Web: the Web Site for Physics (<http://physicsweb.org/>). This is a comprehensive site. One can find not only physics subject material but also physics jobs, fellowships and scholarships. Similarly, The Physics Encyclopedia (<http://members.tripod.com/~IgorIvanov/physics/>) hosts exhaustive, comprehensive, carefully selected and structured lists on Internet physics resources.

Another site <http://webbug.physics.uiuc.edu/courses/phys150/spring98/index.html> is a short synopsis of all of Physics. The emphasis is on concepts rather than quantitative descriptions. It is very helpful for those who have minimal mathematical background but curious to understand basic concepts of physics.

<http://www.newi.ac.uk/buckleyc/bed.htm> is a good site for primary education teachers. It deals with basics of electricity, forces, magnetism, sound and introductory chemistry for primary (elementary) school teachers. The site provides supporting lecture material, tutorial work, module information and general "help" documents in connection with the science components of the BA Hons Primary Education course. Brief history of key points is also given at the end of each module. This site can prove useful for a physics teacher to prepare instructional material on electricity, forces, magnetism and sound for elementary level students.

Another very good resource for secondary level physics is The Physics Classroom (<http://www.physicsclassroom.com/>). It is an online physics tutorial written for high school physics teachers/students. This site hosts physics tutorials, multimedia physics studio and physics help. This site is very good for learning basic concepts of physics. Each tutorial includes some lessons and each lesson is explained using text material and figures. Online quizzes are given at the end of each lesson to check understanding. Multimedia physics studio contains animations. These help to visualize and understand major physics concepts. Physics Help link provides many exercises with answers for each topic.

Example: If a teacher plan to teach vector and scalar online. He will plan the followings at secondary level

- Concept of a scalar and a vector
- Some examples for each
- How a vector is represented graphically?
- Feedback

He can find each and every thing online in this site and can show online their demonstration by pressing animation. Similarly (<http://www.portal.ca/~peterv/>) is another Physics online resources for high school physics teachers.

The website www.physics.org from the Institute of Physics, provides answers to many questions about physics. In simple words, this site is a one-stop shop for Internet based physics information. One of the exciting features of physics.org is a search interface. When we enter a search term "physics lecture notes" in the search edit box on main home page of this site, the software searched *Lecture Notes for Thermodynamics* This site contains a set of lecture notes for a course on thermodynamics. There is quite a lot of information here, but it is in a very compact form, as you might expect from notes used in the preparation of lectures.

Lecture notes on General Relativity

These lecture notes are a lightly edited Sean M. Carroll version of the ones he handed out while teaching Physics, the graduate course in General Relativity at MIT. Each of the chapters is available here as uncompressed postscript. These notes are free and also available in html at Caltech.

Thermodynamics

A set of lecture notes for undergraduate thermodynamic lectures.

Perhaps the most important site for undergraduate and graduate level teaching is http://mhegazy.topcities.com/online_physics_lecture_notes.htm. The site is developed by an Egyptian Ph.D student. This site hosts free 150 MB physics resources. This site gives us lecture notes on various aspects of physics including:

- Optical Physics and Quantum Electronics
- Physics of Energy and The Environment
- Physics in Every Day Life
- Physical Metallurgy, Physics of Condensed Matter
- Physics of Thin Films
- Principles of Semiconductor Devices
- Principle of Semiconductor Devices
- Quantum Mechanical Models of Solids
- Quantum Mechanics
- Relativity and Cosmology Relativity and Gravitation
- Richard Fitzpatrick's Lecture Notes Physics, Solid State Physics (I and II for Engineers).
- Condensed Matter Physics
- Crystallography
- Dynamics
- Electricity and Magnetism
- Electromagnetism and Optics
- Foundations of Modern Physics
- General Astronomy
- General Physics
- General Relativity
- Introduction to Engineering Materials
- Introduction to Modern Physics
- Introduction to Plasma Physics
- Introduction to Surface Analysis
- Introduction to Synoptic
- Meteorology
- Lasers and their Applications

One can find the stuff of all level physics. It is a full of information site that can be very useful, not only for students but also for teachers and non-physics people. The site also hosts journals on physics besides other physics resources.

Another site developed by Doug Craigen, a former University Professor, is (http://www.dctech.com/physics/lecture_notes.php). DC Physics Directory contains many things which are helpful for online physics teaching e.g. Animations / Simulations, Lecture Notes, Software (download shareware & freeware), Textbooks (online), Tutorials (online). This is a valuable site that provides lecture notes link about the following physics areas:

Advanced Astrophysics: Lecture notes for an astrophysics course

Computational Physics: A third/fourth year course on computational techniques in differential equations, matrix methods, Monte Carlo techniques

Energy and the Environment: Lecture notes on energy issues

Galileo and Einstein: A series of lecture notes with a historical perspective on our understanding of the physical world

General Physics: Lecture notes at undergraduate level

General Physics: A six term introductory sequence for physics majors and minors

How Things Work: A physics course for non-scientists

Lecture Notes in Modern Physics: Cover topic from relativity to particle physics

Modern Physics, Astronomy and Cosmology

Particle Physics

Physics and Psychophysics of Music: Covers relevant physics topics such as frequency, Intensity, Fourier analysis... plus musical definitions and relevant psychological/biological information.

Relativity and Cosmology

Relativity and Gravitation

Silicon, Circuits, and the Digital Revolution Lecture notes from a course on the physics in your computer

Tensors and Relativity: An introductory course on General Relativity

These links provide us lecture notes on different branches of physics at an introductory to advanced level physics. The site also hosts java applets, animations / simulations on many areas of physics. The site is therefore equally helpful for secondary level as well as university teacher.

ONLINE BOOKS

Importance of books can never be undermined by any other source. An interesting web The Online Books Page (<http://digital.library.upenn.edu/books/>) hosts books on various topics. These are listed below:

- *Ozone Depletion, Greenhouse Gases, and Climate Change* by National Research Council (HTML at ulib.org)
- *The Global Greenhouse Regime: Who Pays?* Edited by Peter Hayes and Kirk Smith (HTML at UNU Press)
- *Greenhouse Warming: Negotiating a Global Regime* by Richard Elliot Benedick, Abram Chayes, Daniel A. Lashof, Jessica Tuchman Mathews, William A. Nitze, and Elliot L. Richardson (frame and cookie-dependent page images at Electric Press)
- *Snow Avalanche Hazards and Mitigation in the United States* by National Research Council Commission on Engineering and Technical Systems (page images at NAP)
- *The Earth's Electrical Environment* by National Research Council Geophysics Study Committee (page images at NAP)
- *Four-Dimensional Model Assimilation of Data: A Strategy for the Earth System Sciences* by Environment, and Resources National Research Council Commission on Geosciences (page images at NAP).
- *Gravitational Physics: Exploring the Structure of Space and Time* by National Research Council Board on Physics and Astronomy (page images and partial HTML at NAP)
- *The Story of Electricity* by John Munro (Gutenberg text; unofficial until 31 Dec 2003)
- *Some Problems of Geodynamics* by A. E. H. Love (frame- and JavaScript-dependent page images at Cornell)
- *Airborne Geophysics and Precise Positioning: Scientific Issues and Future Directions* by National Research Council Committee on Geodesy (page images at NAP)
- *A Plan for a Research Program on Aerosol Radiative Forcing and Climate Change* by National Research Council Board of Atmospheric Sciences and Climate (page images at NAP)
- *Atomic, Molecular, and Optical Science: An Investment in the Future* by National Research Council Board on Physics and Astronomy (page images and partial HTML at NAP)
- *The X Rays: Their Production and Application* by Frederick Strange Koller (frame- and JavaScript-dependent page images)
- *A Course of Six Lectures on the Various Forces of Matter, and Their Relation to Each Other* by Michael Faraday (HTML at Fordham)
- *Condensed-Matter Physics* by National Research Council Physics Survey Committee (page images at NAP)
- *Condensed-Matter and Materials Physics: Basic Research for Tomorrow's Technology* by National Research Council Board on Physics and Astronomy (page images and partial HTML at NAP)
- *Fields* (electronic edition, 2002) by Warren Siegel (PDF and Postscript with commentary at sunysb.edu)

- *Gauge Fields in Condensed Matter* (1989) by Hagen Kleinert
- volume 1: page images and PDF in Germany
- volume 2: page images and PDF in Germany
- *Nuclear Physics* by National Research Council Physics Survey Committee (page images at NAP)
- *Nuclear Physics: The Core of Matter, The Fuel of Stars* by National Research Council Board on Physics and Astronomy (page images and partial HTML at NAP)
- *Cold Fusion Research: A Report of the Energy Research Advisory Board to the United States Department of Energy* (1989) by United States Energy Research Advisory Board
- *Film Badge Dosimetry in Atmospheric Nuclear Tests* by National Research Council Energy Engineering Board (page images at NAP)
- *Plasma Science: From Fundamental Research to Technological Applications* by National Research Council Board on Physics and Astronomy (page images at NAP)
- *Plasmas and Fluids* by National Research Council Physics Survey Committee (page images at NAP)
- *From Certainty to Uncertainty: The Story of Science and Ideas in the Twentieth Century* by F. David Peat (page images at NAP)
- *The Grand Unified Theory of Classical Quantum Mechanics* (electronic edition, 2002) by Randell L. Mills (PDF files with commentary at blacklightpower.com)
- *Elementary-Particle Physics: Revealing the Secrets of Energy and Matter* by National Research Council Board on Physics and Astronomy (page images and partial HTML at NAP)
- *Superspace, or One Thousand and One Lessons in Supersymmetry* (corrected from the 1983 edition) by S. James Gates, Marcus T. Grisaru, Martin Rocek, and Warren Siegel (PDF at arxiv.org).
- *Relativity: The Special and the General Theory* by Albert Einstein, trans. by Robert W. Lawson
- HTML at Bartleby <http://www.bartleby.com/173/>
- Gutenberg text; unofficial until 31 Jan 2004
- *Introduction to String Field Theory* (1988) by Warren Siegel (PDF and Postscript at arxiv.org)
- *The Data Analysis Briefbook* by Rudolf K. Bock and Werner Krischer (illustrated HTML at CERN)

ONLINE DATABASES

Databases are widely used by the physics community for obtaining useful information, which can be helpful in the lecture preparation. Some of the sites are:

NIST Scientific and Technical Databases Physics (www.nist.gov/srd/physics.htm)

This site provides easy access to many (currently over 80) of the NIST scientific and technical databases. These databases cover a broad range of substances and properties from many different scientific disciplines. The Gateway includes links to free online NIST data systems as well as to information on NIST databases available for purchase.

Selected Physics Online Databases (<http://www.iskp.uni-bonn.de/institut/physicsDB.html>) This site contains The Internet Pilot to Physics (TIPTOP), Physics Conferences SPIRES: HEP database at SLAC (articles, conference proceedings etc.), DURHAM data base (HEP reaction data), Review of Particle Properties by the Particle Data Group, HEP Preprint Database (request forms), X-Ray emission lines and/or cross sections: at Illinois Institute of Technology or Uppsala University, Conversion of (non-)SI units, Rutherfords Lexikon der Elemente.

Engineering Physics Online databases (<http://www.umanitoba.ca/libraries/units/engineering/db-engphysics.html>)

This site contains information from INSPEC (IOPP-Axiom), METADEX, Atomic Spectral Broadening Bibliographic Database, High Energy Physics Database NASA Technical Report Database, Metaphys: The Physics Document Search Engine, Spin Physics Database, General Databases, Conference

Databases ,Dissertation Abstracts, General Science Index, NTIS Technical Reports Database, Pub Science, Tables of Contents Services, Virtual Technical Reports Center

University of Portland Library - Chemistry & Physics - Online

<http://lewis.up.edu/library/subjectguides/chemphys.html>

This database provides citations, abstracts, and some full text from over 4,000 academic, general science, social sciences, humanities, and education journals. Citations to articles, conference proceedings, and product reviews in engineering, mathematics, physics, and computer technology. Citations for papers presented at every congress, conference, symposium, workshop, exposition, and meeting received at the British Library are also available.

CONCLUSION

How can these sites be useful in preparing lectures?

These sites are very useful for teachers in preparing their lectures. Especially for those who are new teachers or they want to start a new course. These sites or similar to these can help them in getting material, most popular and valuable books about the subject. He or she can look at the lecture notes prepared by experienced teachers and get guidelines and ideas about the nature of the course, level and how to organize the lecture. With the help of these sites or similar to these, he or she can get a good material and can manage for lecture in a very short period. When a new teacher will go through the lecture notes of experienced teachers, he/she will gain confidence which is as important as content for class room management.

Besides all the above-mentioned information, some related information is available in various articles published in different journals/conference proceedings [Bolton, J., and Ross, S., (1997), Clinch, J., and Kevin Richards, (2002), Fazal-e-Aleem, (1997), Featon, D., and Folk, B., (1997), Jauhiainen, J., et al, (2002), Lenaerts, J., and Wieme, W., Ogar, J., (1997), Ronen, M.A., (1995), Sokoloff, D.R, and Thornton, R.K., (1997), Stewart, M.F., and Gregory, J.R., (1997)].

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