SYLLABUS — The University of British Columbia — 1999-2000

Science 1 Physics

WEB SITE:	http://musr.physics.ubc.ca/~jess/sci1/
CLASSROOM:	CPSC 460
TIMES:	Variable, average $2\frac{1}{2}$ hr/week
INSTRUCTOR(S):	Jess H. Brewer (JHB) *and* Domingo J. Louis-Martinez (DJLM)
E-MAIL:	JHB: jess@physics.ubc.ca; DJLM: martinez@physics.ubc.ca
OFFICE:	JHB: Henn 320A, 822-6455; DJLM: CPSC 464, 822-5552
LABORATORY:	JHB: TRIUMF, 222-1047
OFFICE HOURS:	Available any time, within reason.
MARKING:	See *"Essentials 101"* handout from Week 1.
TEXTBOOK:	P.A. Tipler, "Physics" (Worth)

REFERENCES:

- *Science 1 HyperTextBook*: http://musr.physics.ubc.ca/~htb/
- Various and assorted Handouts
- Halliday, Resnick & Walker, "Fundamentals of Physics", 4th Ed., extended (Wiley)

ASSIGNMENTS are handed out at a Physics lecture and posted on the *Science 1 Physics* Web site almost every week. Solutions are posted on the Web site a week later. Although the assignments are not all marked for credit, they are an essential part of the learning process. Each student should first attempt each problem independently before consulting colleagues or instructors; but help is always available.

PHYSICS PHUN: Often the week will begin (on Monday at 10:30 AM) with a friendly team competition to see which group of 3 or 4 students can come up with the most inventive, imaginative, rigourous, creative or correct solution to a Physics problem posed at the beginning of the hour. These are often frivolous, sometimes silly, but usually fun; hence the awful pun: *Physics Phun.*

READING: We do not follow the texbook slavishly, though it is a very good one. Reading assignments "jump around" in the text and regularly include supplementary handouts, Web links (particularly the *Science 1 HyperTextBook*, which see) or journal references. You may often wish to explore interesting topics further; we will be glad to suggest sources.

SURFING: We make liberal use of the Internet in *Science 1*, both for "external" reference material and for "internal" logistics and communication. Most printed handouts are also available *via* the World Wide Web as HTML documents. We have several Web sites of our own (see http://musr.physics.ubc.ca/~jess/sci1/) where you can peruse course material such as handouts, assignments, solutions, old exams *etc.* You will be able to send E-mail to other *Science 1* students or faculty — in fact some assignments will require E-mail submission — and disk space will be provided for individual or group Web projects when appropriate.

HYPERTEXTBOOK: In Summer 1999 we constructed an "alpha test" version of the *Science 1 HyperTextBook*, an interactive database of "learning quanta" which we hope will eventually serve as a model for interdisciplinary education using the Web. All *Science 1* students are guaranteed access to the Web and are expected to become co-authors of the *HyperTextBook.* (You'll see how when you try it out.)

NATURAL PHILOSOPHY: You are here to learn Physics, the discipline, not "about Physics." On the other hand, until quite recently Physics was known officially as Natural Philosophy; moreover, modern Physics has drastically altered the ways we perceive the world we live in. It would be tragic to learn how to predict the behaviour of (some parts of) that world without stopping to reflect on the philosophical implications of our new knowledge. A *knowledge* of Physics is valuable for its predictive power — the tools of Physics allow us to build wonderful devices, to manipulate matter profitably and to move wisely through our physical environment. An *understanding* of Physics requires integration of new paradigms and metaphors into one's intellectual repertoire — your mind will be permanently altered by this experience.

THE FIRST-YEAR SYNDROME: Any first year Physics course must necessarily be devoted largely to building up a "Physics vocabulary" of terms and concepts that are generally labelled as "classical" Physics, so that later courses can utilise that vocabulary to describe the unsettling conceptual revisions of the Twentieth Century — some of which render obsolete the very terminology in which we attempt to describe them. This tends to make the first year relatively dull; many physicists, looking back, feel that their first year course was the low point of their Physics education. We do everything in our power to counteract this functional dilemma, but if it occasionally gets a little tedious, please remember this: there can be no magic without some apprenticeship.

SCIENCE 1 PHYSICS: How does *Science 1* Physics differ from other first year Physics courses? One difference is obvious and somewhat trivial, but nonetheless profoundly important: since the teaching staff of *Science 1* attend each other's lectures, we all know what is going on in the other subjects, whereas professors teaching "normal" Physics courses usually have no idea what is happening in their students' Mathematics, Chemistry or Biology courses. It is human nature to notice connections between topics in different fields and to want to discuss them — the *Science 1* environment simply allows this natural tendency to express itself creatively.

OUTLINE FOR FALL 1999:

Week	Date	Reading	TOPIC(s)
1.	6 Sept.	Handouts	"*Introductions*" — meet the *Science 1* staff
		Ch. 1	"*Representations*" — notation; units & dimensions
2.	13 Sept.	*Phun 1*	"*Eye-Ball Estimates*"
		Ch. 2	"*Simple Motions*" — calculus & kinematics
		Handouts	"*Exponentials*" — bank interest, viscous drag, radioactivity
3.	20 Sept.	*Phun 2*	"*Perturbation Paradigm*"
		Ch. 4	*Review* — basic Newtonian Mechanics
		Ch. 6	*Review* — work, kinetic & potential energy
4.	27 Sept.	Handouts	"*Count the ways*" — defining entropy in Stat. Mech.
		Ch. 15	"*What's hot?*" — defining temperature
5.	4 Oct.	Handouts	"*Boltzmann*" — occupation probabilities
6.	11 Oct.		*First Math/Phys Midterm*
		Ch. 3	"*Vectors*" — motion in 2D & 3D
			components, addition, scalar product;
			applications to kinematics, geometry, ...
7.	18 Oct.	*Phun 3*	"*Weird Vectors*"
		Ch. 5	"*Dynamics with direction*" — Newton's Laws done right
		Ch. 7	Systems of particles, momentum conservation
8.	25 Oct.	Ch. 3	"*Speaking Anglish*" — uniform circular motion
		Ch. 6	"*A new twist on Newton*" — torque, angular momentum
9.	1 Nov.	*Phun 4*	???
		Ch. 8,9	"*A Moment of Inertia*" — rigid bodies
		Ch. 8,9	"*Let it Roll*" — rolling motion
10.	8 Nov.	Handout	*Radiation Hazards*
		Ch. 40	*Radiation Biology* (with Tony)
11.	15 Nov.	*Phun 5*	*Do-it-yourself Midterm questions*
		Ch. 8,9	*Falling Ladder* — understanding & problem-solving
			Second Math/Phys Midterm
		Demos	"*Good Vibrations*"
12.	22 Nov.	Ch. 12	"*Oscillations 11*" (springs, pendulums, ...)
		Handout	"*Oscillations 12*" ($\mathcal{S}$imple $\mathcal{H}$armonic $\mathcal{M}$otion)
		Handout	"*Oscillations 101*" ($\mathcal{SHM}$, ODE and $e^{i\omega t}$)
13.	29 Nov.	Ch. 12	"*Oscillations 200*" ($\mathcal{D}$amped $\mathcal{H}$armonic $\mathcal{M}$otion, resonance)
			Concept Maps
			Exam Questions
	17 Dec.		*Physics Christmas Examination*

TENTATIVE OUTLINE FOR SPRING 2000:

Week	Date	Reading	TOPIC(s)
1.	4 Jan.	Handout	Waves: $\mathcal{SHM}$ in space and time
			simple derivation of *wave equation*
		ψ1 Fun 1	"*Hot Rubber Band*"
2.	10 Jan.	Ch. 13	water waves, vibrating strings
		Ch. 14	sound waves, beats
			Doppler effect
3.	17 Jan.	*ψ1 Fun 2*	T.B.A.
		Handout	"*Quantum Mechanics in a 1-D Nutshell*"
			"*From the Bohr atom to the Planck length*"
4.	24 Jan.	Ch. 10,18,19	*Action at a Distance* — why invent a "*field*"?
		Handouts	*Symmetric Conservation* — Gauss' law for $\vec{\boldsymbol{g}}$ & $\vec{\boldsymbol{E}}$
			More fun with Gauss' Law
5.	31 Jan.	*ψ1 Fun 3*	T.B.A.
		Ch. 20	*Potential vs. Capacity*
		Ch. 21	"*C & thee*" — capacitance explored
6.	7 Feb.	Ch. 22	"*R & I*" — resistance *vs.* current
		Ch. 23	Kirchhoff's rules
		Ch.	"*RC*" — time constant in DC circuits
	14 Feb. ♡		*Spring Reading Break*
7.	21 Feb.	Ch. 24	"*I cross B*" — the Lorentz force and why we invent $\vec{\boldsymbol{B}}$
		Ch. 25	"*Do $\vec{\boldsymbol{B}}$, do $\vec{\boldsymbol{B}}$, do!*" — moving charges make $\vec{B}$ (Biot & Savart)
		Handout	"*Link the loop with symmetry*" — using Ampère's law
8.	28 Feb.		TRIUMF tour
		ψ1 Fun 4	T.B.A.
			Third (Spring) Physics Midterm
			(*Bamfield* 3-5 March)
9.	6 March	Ch. 26	"*Don't change that flux!*" — inductance, Faraday & Lenz
		ψ1 Fun 5	T.B.A.
			"*Inductive logic*" — defining, calculating and using L
10.	13 March	Ch. 28	LCR circuits & Alternating Current
		ψ1 Fun 6	T.B.A.
11.	20 March	Ch. 29	Maxwell's equations
		Handout	"*Let there be light!*" — $\mathcal{EM}$ waves
12.	27 March	Ch. 33	"*Rainbow, rainbow!*" — thin film interference
		Handouts	"*Phasors on stun*" — 2 to N slit interference
13.	3 April	*ψ1 Fun 7*	T.B.A.
		Handouts	Diffraction
	mid April		*Physics Final Examination*