DEPARTMENT OF PHYSICS AND ASTRONOMY
TRENT UNIVERSITY

PHYS-BIOL 1060H: **Physics for the Life Sciences**
2015 WI
Peterborough

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Campus: Peterborough	**Office Location:** SC 318	**Office Hours:** Tuesday 3:30 – 4:30 Thursday 3:30 – 4:30

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Course Description:
This course is required for many Biochemistry students. It is particularly geared towards students who will continue studies in Biochemistry, Biology, Nursing, and any students interested in learning about the physical origins of biological processes and laboratory techniques. Topics covered include physical properties of biomaterials such as elasticity and compressibility; physical limits on sizes and speeds in living systems; fluids: viscosity, surface tension, and how these affect the mobility of organisms; diffusion, thermal motion of molecules, sedimentation, heat flow, and energy; light, photons, and absorption/emission.

Course Pre-requisites: None. 4U Mathematics is recommended.
While there are no formal math pre-requisites for the course, many students will feel underprepared for much of the math that is required to master the subject matter. As such, students will find online a "brush up on you math" document prepared specifically for this course, which is meant as a review of the grade 10 and grade 11 high-school curriculum that is needed for success in this course. Furthermore, students are required to complete the "math practice exercises" posted on BL as their passport for getting help from the instructor during office hours. **Bring your work on the math practice with you when you go to the instructor for help!**

Course Fees:
There is a course fee of $4.00 to cover the cost of photocopied materials. Please bring your money to your first tutorial session.

Required Texts:
There are two required reading sources for this course. Students are expected to read from both sources BEFORE EVERY LECTURE.

- Online class notes, available through Blackboard. These notes will represent the primary source for course materials and class organization.

- Williams *et al.*, "Physics for the Biological Sciences", 5th edition, Nelson, 2011. This required text will be used for broader subject readings and a source for conceptual questions and problem set questions.

Online Blackboard Learn (BL) Course Materials:
For class notes, additional texts, and class resources: https://learn.trentu.ca/

Course Format:

Type	Day	Time	Location
Lecture	Monday	11:00 – 11:50 AM	ECC 201
Lecture	Wednesday	9:00 – 10:50 AM	CC 307
Lab/Tutorial (Section 1)	Tuesday	5:00 – 6:50 PM	SC 305
Lab/Tutorial (Section 2)	Wednesday	5:00 – 6:50 PM	SC 305
Lab/Tutorial (Section 3)	Monday	12:00 – 1:50 PM	ESC B203
Lab/Tutorial (Section 4)	Monday	3:00 – 4:50 PM	ESC B203

Learning Outcomes/Objectives/Goals/Expectations: I have developed the course to address several learning outcomes. By the end of the course a successful student should be able to:

1. Define and calculate Shear Modulus, Young's Modulus, tensile stress, shear stress and compare the stress-strain behaviour of different biomaterials.
2. Describe the relationship between the surface area, volume, and mass of an object that scales according to the "2/3 law" (or "allometrically") and apply this law to analyze physical limitations to the growth of biological systems.
3. Define and apply the concepts of pressure, absolute pressure, gauge pressure, hydrostatic pressure, atmospheric pressure, density, buoyancy, and buoyant forces.
4. Describe the relationship between surface tension and pressure and relate these concepts to a variety of biological applications.
5. Use fluid-flow continuity relations qualitatively and in conjunction with other fluid-flow principles such as Bernoulli's law or Poiseuille's law.
6. Relate Reynold's number to expected transition between laminar and turbulent flow and investigate impact of living at high and low Reynold's numbers.
7. Describe the connections between sedimentation, drag forces, the Barometric Formula, average kinetic energy of particles, and Fick's law, and describe the biological ramifications of diffusion.
8. Describe three mechanisms of heat flow: conduction, radiation, and convection drawing on the concepts of temperature, heat capacity, latent heat, and Newton's Law of Cooling.
9. Use Beer's law (and the notion of an absorption coefficient) to estimate a sample's "absorbance" and "transmittance".
10. Describe the roles of various structures in the eye as they relate to vision.

Course Evaluation:

Type of Assignment	Weighting	Due Date
Quizzes on problem sets	15%	~ Bi-Weekly
Problem set solutions	20%	~ Bi-Weekly
Clicker participation	5%	~ Every Class
Pre-Lecture JIT Quizzes	5%	Before every class
Mid-Term Exam	20%	Wednesday, February 25th, 2015
Final Exam	35%	Exam Period

By the class withdrawal date of March 5, 2015, it is expected that you will know approximately 30% of your final grade. This includes the results of the first mid-term test and several quizzes.

Clicker participation: It is anticipated that clickers will be used in lectures to "poll" the class on their collective understanding and intuition. We will then use the results of such polls to guide subsequent discussion. You are expected to participate in class with clicker voting. You receive full marks for any class in which you voted in at least 50% of the questions. Otherwise you receive zero. Your four lowest marks will be dropped before the final grade is calculated, to allow for weak batteries, equipment malfunction, etc. ONLY use your own clicker. As clicker records are used in this course to compute a portion of course grades, the use of a clicker other than your own is an academic offence. In lecture or tutorial, possession of more than one clicker, or that of another student, may be interpreted as intent to commit an academic offence.

Pre-Lecture JIT Quizzes: Before each lecture, reading from the course notes and/or textbook will be assigned. Students must complete a "Just-In-Time" Quiz on the Blackboard Learning System before coming to lecture. The quiz results will be analyzed and in class instruction modified to address gaps in understanding.

Week-by-Week Schedule:

Time Period or Date	Topic	Book Chapter
Week 1 – 2	Introduction to PHYS 1060; a mechanics primer	7 – 9
Week 2 – 3	Biomaterial engineering; elasticity; scaling I	10
Week 4 – 6	Fluids: Statics and Dynamics. Pressure and Buoyancy, surface tension, viscosity, flow.	11 – 12
Week 7 – 9	Diffusion, Brownian motion, the important of kT, sedimentation and centrifugation, scaling II	12 – 13
Week 10 -11	Heat, heat flow, heat regulation, scaling III, thermodynamics in biological systems	14
Week 11 – 12	Light and photons; the absorption and emission of light by molecules and by bulk materials; the quantum nature of light and implications for vision	3 – 5
Week 12	Exam Review	

Please note that this schedule represents a rough outline of the anticipated schedule for this course. This schedule may change to accommodate the needs of the class.

University Policies

Academic Integrity:
Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from failure on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent University's *Academic Integrity Policy*. You have a responsibility to educate yourself – unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trent's Academic Integrity website to learn more: www.trentu.ca/academicintegrity.

Access to Instruction:
It is Trent University's intent to create an inclusive learning environment. If a student has a disability and/or health consideration and feels that he/she may need accommodations to succeed in this course, the student should contact the Student Accessibility Services Office (SAS), (BH Suite 132, 705-748-1281 or email accessibilityservices@trentu.ca). For Trent University - Oshawa Student Accessibility Services Office contact 905-435-5102 ext. 5024 or email nancyhempel@trentu.ca . Complete text can be found under Access to Instruction in the Academic Calendar.

Academic Integrity Module:

All students are required to complete an online module on academic integrity, which can be found on Blackboard: Academic Integrity at Trent. This module will inform you of the major academic integrity regulations and the consequences for academic dishonesty. It will also provide you with instruction on how to avoid academic dishonesty when completing assignments, tests, group-projects, and papers. At the conclusion of each of the three sections, you will be required to take a multiple choice quiz. You must earn 100% on each quiz, and you may take each quiz as many times as you need to in order to do this.

Your quiz scores will be uploaded to the gradebook on January 16th, 2015; please complete the module quizzes prior to this date. You may be in other courses that require completion of this module. If so, you only need to complete this module successfully once; your marks will be valid for all courses through August 2015 though you will need to provide proof of these marks for each course separately. If you completed this module before September 2014, you are required to complete it again.