I. Course Description: Fundamental concepts of modern physics are covered, including topics in the special theory of relativity, wave-particle duality, quantization of energy, Schrödinger equation, potential wells, and atomic physics. Experimental basis for modern physics is discussed. Problems at the end of each chapter are excellent preparations for examinations. Sample problems will be worked out during the class. Laboratory exercises are an integral part of the course.

II. Course Purpose:
1. To present the emergence of the "new physics" in the twentieth century by following the thought processes that led to the developments of modern physics theories;
2. To present the experimental basis for modern physics;
3. To familiarize the students with modern theories pertaining to the microscopic universe;
4. To familiarize the students with physical properties of entities at speeds that approach the speed of light in vacuum;
5. To contribute to the students essential knowledge base and critical thinking skills necessary for the solution of practical problems;
6. To provide an appreciation of the nature of physics, its methods and its goals.

III. Course Outline
1. Relativity (Ch. 1 & 2)
   Homework 1. (Chapter 1) 9, 13, 15, 19, 21, 23, 25, 33, 46, 50.
   Homework 2 (Chapter 2) 5, 9, 11, 17, 21, 29, 31, 42, 43, 47.

2. Quantization of Charge, Light, and Energy (Ch. 3)
   Homework 3. (Chapter 3) 1, 5, 12, 16, 24, 26, 29, 30, 33, 35, 39, 42, 43, 44, 49.

Test 1. (TBD)

3. The Nuclear Atom (Ch. 4)
   Atomic spectra. Rutherford’s nuclear model. Bohr atom. X-Ray Spectra. Franck-
Hertz experiment.
Homework 4. (Chapter 4) 4, 6, 9, 13, 17, 25, 29, 34, 36, 49.

4. The Wavelike Properties of Particles (Ch. 5)
Homework 5. (Chapter 5) 1, 3, 5, 9, 10, 13, 15, 17, 19, 21, 25, 27, 29, 34, 38.

5. The Schrodinger Equation (Ch. 6)
Schrödinger wave equation in one dimension. Infinite square well. Finite square well. Quantum oscillator. Expectation values and operators. Simple harmonic oscillator. Reflection and transmission of waves.
Homework 6. (Chapter 6) 1, 3, 5, 9, 12, 13, 16, 19, 22, 26, 30, 34, 45, 47, 51.

Test 2. (TBD)

6. Atomic Physics (Ch. 7)
Homework 7. (Chapter 7) 1, 2, 3, 5, 9, 13, 17, 26, 34, 35, 36, 37, 39.

Final Exam (TBD)

IV. Laboratory
For the laboratory grade students must prepare one formal report, have at all times in lab a lab notebook in which they must write all calculations, observations and procedures performed during the experiments. Students are expected to be in the lab on time, points will be deducted for tardiness. The formal lab reports formats may be downloaded from CANVAS.

Lab. 1. Electronics Survey
Lab. 2. Speed of light.
Lab. 3. Physlets. Special relativity and Relativistic Mechanics
Lab. 4. Michelson Interferometer.
Lab. 5. Stefan-Boltzmann Law:
Lab. 6 Photoelectric effect.
Lab. 7. Bragg scattering and microwave two slit diffraction.
Lab. 8. Electron particle-wave duality.
Lab. 10. Hydrogen and quantum dots spectra.
Lab. 11. Quantum Mechanics Simulations: Bound States. Unbound states and Tunneling

V. Assessment of Student Performance
1. tests (35 points)
2. final exam (30 points)
3. homework problems (13 points)

Homework problems are due one week after the corresponding chapter has been completed in the lectures unless otherwise noted. Late homework will not be accepted. Homework should be presented in an ordered and neat presentation; points will be deducted for lack of these.

4. labs, pre-labs, lab notebook, and formal lab report (22 points)

<table>
<thead>
<tr>
<th>Final Score</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>92.5 - 100</td>
<td>A</td>
</tr>
<tr>
<td>89.5 – 92.4</td>
<td>A-</td>
</tr>
<tr>
<td>86.5 – 89.4</td>
<td>B+</td>
</tr>
<tr>
<td>82.5 – 86.4</td>
<td>B</td>
</tr>
<tr>
<td>79.5 – 82.4</td>
<td>B-</td>
</tr>
<tr>
<td>76.5 – 79.4</td>
<td>C+</td>
</tr>
<tr>
<td>72.5 – 76.4</td>
<td>C</td>
</tr>
<tr>
<td>69.5 – 72.4</td>
<td>C-</td>
</tr>
<tr>
<td>66.5 – 69.4</td>
<td>D+</td>
</tr>
<tr>
<td>59.5 – 66.4</td>
<td>D</td>
</tr>
<tr>
<td>0 – 59.4</td>
<td>F</td>
</tr>
</tbody>
</table>

**Fourth Hour:**
In this class, the deep learning outcomes associated with TCNJ's 4th hour are accomplished through laboratory experiments.

**VI. Bibliography**

VII. SELECTED TCNJ POLICIES

Final Examinations
The final exam is not scheduled until the middle of the semester. Therefore do not plan on any travel until after the last day of the exam period. TCNJ’s final examination policy is available on the web:

http://academicaffairs.pages.tcnj.edu/college-governance/policies/final-examevaluationreading-days-policy/

Attendance
Every student is expected to participate in each of his/her courses through regular attendance at all class sessions. It is further expected that every student will be present, on time, and prepared to participate when scheduled class sessions begin. While attendance itself is not used as a criterion for academic evaluations, grading in this course is based on participation in quizzes to be given at the beginning of several classes. No make-ups or extensions will be given unless a student has a genuine emergency. If a student misses an exam or assignment deadline they must contact the instructor within 36 hours to explain the situation; otherwise the student will earn a zero for that exam or assignment.

Students who must miss classes due to participation in a field trip, athletic event, or other official college function or for a religious holiday should arrange with their instructors for such class absences well in advance. In every instance, however, the student has the responsibility to initiate arrangements for make-up work.

TCNJ’s full attendance policy is available at:

http://policies.tcnj.edu/policies/digest.php?docId=9134

Academic Integrity Policy
Academic dishonesty is any attempt by the student to gain academic advantage through dishonest means, to submit, as his or her own, work which has not been done by him/her or to give improper aid to another student in the completion of an assignment. Such dishonesty would include, but is not limited to: submitting as his/her own a project, paper, problem set, report, test, or speech copied from, partially copied, or paraphrased from the work of another (whether the source is printed, under copyright, or in manuscript form). Credit must be given for words quoted or paraphrased. The rules apply to any academic dishonesty, whether the work is graded or ungraded, group or individual, written or oral.

TCNJ’s academic integrity policy is available at:

http://policies.tcnj.edu/policies/viewPolicy.php?docId=7642

Americans with Disabilities Act (ADA) Policy
Any student who has a documented disability and is in need of academic accommodations should notify the professor of this course and contact the Office of Differing Abilities Services (609-771-2571). Accommodations are individualized and in accordance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1992. TCNJ’s Americans with Disabilities Act (ADA) policy is available at:

http://affirm.pages.tcnj.edu/key-documents