Course or Program Assessment Summary

http://academic.cuesta.edu/sloa/docs/Course_and_Program_Assessment_Summary_F_2011.docx

This form can be used to record SLO assessment plans and results for courses or programs. It is recommended that this document be stored on a group drive, or in MyCuesta.

Division: **Physical Sciences** Program: **Physics** Date: **2/28/2014** v. 3 2012

Courses in program, or course: Physics 205A

Faculty involved with the assessment and analysis: **Patrick M. Len**

Course-to-program outcome mapping document** is completed Yes_x__ No_____

1	Student Learning Outcome Statements □ Program x Course	Physics 205A: 1. Describe and quantify motion (kinematics), and apply Newton's laws to describe how forces affect motion (mechanics). 2. Describe and apply conservation laws of energy, linear momentum, and angular momentum to quantify the initial-to-final evolution of systems of objects. 3. Describe and quantify different types of oscillations and waves, and the physical principles of these phenomena. 4. Describe and apply the laws of thermodynamics to quantify the initial-to-final evolution of microscopic and macroscopic systems of gases, fluids, and solids.
2	Assessment Methods Plan (identify assessment instruments, scoring rubrics, SLO mapping diagrams)	1. Students take conceptual survey on kinematics and Newton's laws (Force Concept Inventory, D. Hestenes, M. Wells, and G. Swackhamer, http://modeling.asu.edu/R&E/FCI.PDF), and a physics student attitudes/beliefs/assumptions survey (Maryland Physics Expectations Survey, E. F. Redish, J. M. Saul, and R. N. Steinberg, http://www.physics.umd.edu/ripe/perg/papers/redish/expects.pdf) in the first and last week of instruction. 2. For the FCI: determine how many students successfully achieved mastery of kinematics and Newton's laws. For the MPEX: determine which modalities (independence, coherence, concepts, reality link, math link, and effort) students have and/or develop positive attitudes towards. 3. Student achievement of course learning outcomes are assessed by administering an Student Assessment of Skills Survey (SASS), a five-point Likert scale questionnaire (Patrick M. Len, in development). □

3	Assessment Administration Plan (date(s), sample size or selection of course sections, scoring procedures, etc.)	Administer FCI and MPEX in the fall semester, both in the first week and the last week of instruction.

4	Assessment Results Summary (summarize Data)	FCI results from fall 2013: http://waiferx.blogspot.com/2013/12/fci-post-test-comparison-cuesta-college.html For fall 2013, Cuesta College students have achieved a normalized gain of $\langle g \rangle = 0.17$, which is slighlty comparable to results ($\langle g \rangle = 0.23 \pm 0.04$), from a historical study of 6,000 students from 62 introductory physics courses (R. R. Hake, http://ajp.aapt.org/resource/1/ajpias/v66/i1/p64_s1?isAuthorized=no), but comparable to previous gains for algebra-based introductory physics at UC-Davis (0.16), and for calculus-based introductory physics at Cuesta College (0.14-0.16) This gain in student learning is comparable to results from previous semesters (fall 2007-fall 2012): http://waiferx.blogspot.com/2012/12/fci-post-test-comparison-cuesta-college.html http://waiferx.blogspot.com/2011/12/fci-post-test-comparison-cuesta-college.html http://waiferx.blogspot.com/2009/12/fci-post-test-comparison-cuesta-college.html http://waiferx.blogspot.com/2009/05/fci-post-test-comparison-cuesta-college.html http://waiferx.blogspot.com/2008/12/fci-post-test-comparison-cuesta-college.html http://waiferx.blogspot.com/2008/05/fci-post-test-comparison-cuesta-college.html http://waiferx.blogspot.com/2007/12/fci-post-test-comparison-cuesta-college.html MPEX results from fall 2013: http://waiferx.blogspot.com/2013/12/education-research-mpex-pre-and-post.html Students have positive (as opposed to negative) post-instruction attitudes towards all six modalities, but develop slightly less positive and more negative pre- to post-instruction attitudes. Caution is advised in interpreting these results, as there are no readily available MPEX statistics released from other institutions. These shifts in student attitudes are comparable to results from previous semesters (fall 2007-fall 2010): http://waiferx.blogspot.com/2010/12/education-research-mpex-pre-and-post.html http://waiferx.blogspot.com/2009/05/education-research-preliminary-mpex.html http://waiferx.blogspot.com/2008/12/education-research-preliminary-mpex.html http://waiferx.blogspot.com/2008/06/education-research-preliminary-mpex.html http://waiferx.blogspot.com/2008/01/education-research-preliminary-mpex.html Prelimimary SASS results from fall 2013 have been compiled, and more analysis will be done later: http://waiferx.blogspot.com/2013/12/education-research-sass-fci-and-student.html

5	Discussion of Assessment Procedure and Results, and Effectiveness of Previous Improvement Plans	(Refer to #4 above.) There have been steady results from student learning gains and attitudes as tracked by the FCI and MPEX from semester-to-semester. Notably higher gains have been noted for the FCI and MPEX for very small classes, probably due to more instructor attention, and/or statistical effects of small sampling sizes.
6	Recommended Changes & Plans for Implementation of Improvements	Determine common, prevalent MPEX traits that students develop less positive and more negative pre- to post- results, and address these. Also track differences in FCI gains and try to correlate with instructors and instructional modes.
7	Description or evidence of dialog among course or program-level faculty about assessment plan and results	Findings from the FCI and MPEX have already been posted online on an education research blog for discussion and feedback: http://waiferx.blogspot.com/search/label/FCI http://waiferx.blogspot.com/search/label/MPEX

**Course and program level outcomes are required by ACCJC to be aligned. Each program needs to complete a program map to show the alignment. See examples of completed CPAS and program mapping documents are available at http://academic.cuesta.edu/sloa

Course or Program Assessment Summary

http://academic.cuesta.edu/sloa/docs/Course_and_Program_Assessment_Summary_F_2011.docx

This form can be used to record SLO assessment plans and results for courses or programs. It is recommended that this document be stored on a group drive, or in MyCuesta.

Division: **Physical Sciences** Program: **Physics** Date: **2/28/2014** v. 3 2012

Courses in program, or course: Physics 205B

Faculty involved with the assessment and analysis: **Patrick M. Len**

Course-to-program outcome mapping document** is completed Yes_x__ No_____

1	Student Learning Outcome Statements □ Program x Course	Physics 205B: 1. Using a ray model of light, describe and quantify polarization, reflection, refraction, and images produced by lenses. 2. Using a wave model of light, describe and quantify interference produced by thin films, double-slits, diffraction gratings, and single slits. 3. Describe and quantify the static behavior of electric forces, fields, and potentials. 4. Describe and quantify the steady-state or time-dependent behavior of electric circuits, magnetic forces and magnetic fields. 5. Describe and quantify selected modern physics topics such as relativity and nuclear physics.
2	Assessment Methods Plan (identify assessment instruments, scoring rubrics, SLO mapping diagrams)	1. Students take conceptual survey on electric circuits (Electric Circuit Concept Evaluation, D. Sokoloff, http://physics.dickinson.edu/~wp_web/wp_resources/wp_assessment.html#ECCE), and a physics student attitudes/beliefs/assumptions survey (E. F. Redish, J. M. Saul, and R. N. Steinberg, http://www.physics.umd.edu/ripe/perg/papers/redish/expects.pdf) in the first and last week of instruction. 2. For the ECCE: determine how many students successfully achieved mastery of electric circuit concepts. For the MPEX: determine which modalities (independence, coherence, concepts, reality link, math link, and effort) students have and/or develop positive attitudes towards. □

3	Assessment Administration Plan (date(s), sample size or selection of course sections, scoring procedures, etc.)	Administer ECCE and MPEX in the spring semester, both in the first week and the last week of instruction.
4	Assessment Results Summary (summarize Data)	ECCE results from spring 2012: http://waiferx.blogspot.com/2012/05/education-research-ecce-statistics.html For spring 2012, Cuesta College students have achieved normalized gains of $\langle g \rangle = 0.19$, which is much larger than for previous semesters (0.01 to 0.06). Caution is advised in interpreting these results, as there are no readily available ECCE statistics released from other institutions, and *extremely small number of students from some semesters (as few as 8-27 students),* such that statistical analysis based on such a small number of students would be suspect. ECCE results from previous semesters (fall 2011-spring 2011): http://waiferx.blogspot.com/2010/12/education-research-ecce-statistics.html http://waiferx.blogspot.com/2011/07/education-research-ecce-statistics.html MPEX results from spring 2012: http://waiferx.blogspot.com/2012/05/education-research-mpex-pre-and-post_16.html Students have post-instruction positive (as opposed to negative) attitudes towards all six modalities, but develop slightly less positive and more negative pre- to post-instruction attitudes. Caution is advised in interpreting these results, as there are no readily available MPEX statistics released from other institutions. These shifts in student attitudes are comparable to results from previous semesters (fall 2010-spring 2011): http://waiferx.blogspot.com/2011/07/education-research-mpex-pre-and-post.html http://waiferx.blogspot.com/2010/12/education-research-mpex-pre-and-post.html http://waiferx.blogspot.com/2010/06/education-research-mpex-pre-and-post.html

5	Discussion of Assessment Procedure and Results, and Effectiveness of Previous Improvement Plans	(Refer to #4 above.) There have been steady results from student learning gains and attitudes as tracked by the ECCE and MPEX from semester-to-semester. Notably higher gains have been noted for the ECCE and MPEX for very small classes, probably due to more instructor attention, and/or statistical effects of small sampling sizes.
6	Recommended Changes & Plans for Implementation of Improvements	Determine common, prevalent MPEX traits that students develop less positive and more negative pre- to post- results, and address these. Also track differences in ECCE gains and try to correlate with instructors and instructional modes.
7	Description or evidence of dialog among course or program-level faculty about assessment plan and results	Findings from the ECCE and MPEX have already been posted online on an education research blog for discussion and feedback: http://waiferx.blogspot.com/search/label/ECCE http://waiferx.blogspot.com/search/label/MPEX

**Course and program level outcomes are required by ACCJC to be aligned. Each program needs to complete a program map to show the alignment. See examples of completed CPAS and program mapping documents are available at http://academic.cuesta.edu/sloa

Course and Program Assessment Summary PHYS 208A

Division: Physical Sciences ***Program:*** Physics ***Course(s):*** PHYS 208A ***Date:*** 2/28/2014

Program Core/Required Courses:

Program Faculty: J.Eickemeyer *P.Len*

1	**Student Learning**	1. Solve kinematics problems by: a) identifying important given information

	Outcome Statements **□ Course**	b) choosing appropriate equations c) formulating a solution 2. Utilize Newton's Laws of Motion to solve problems that include: a) constructing free body diagrams b) determining appropriate assumptions c) choosing appropriate coordinate systems d) evaluating given information in order to arrive at a solution 3. Demonstrate an understanding of the concept of conservation of energy and: a) analyze various problems to determine if using the concept of energy is the most appropriate way b) of solving the problems c) set-up appropriate equations d) calculate kinetic energy, potential energy, and work 4. Apply the concepts of impulse and momentum by: a) identifying conditions where its use is appropriate b) diagramming systems in order to use conservation of momentum or impulse momentum equations c) to solve problems 5. Examine systems involving fluids and: a) calculate buoyant forces on submerged objects b) apply continuity equations and Bernoulli's equation to solve for unknown quantities 6. Understand the laws of thermodynamics and heat transfer and: a) formulate a solution utilizing appropriate equations b) assess the efficiency of thermodynamic process used today
2	**Assessment Methods Plan (attach any assessment instruments, scoring rubrics, SLO mapping diagrams)**	1. Administer SLO self survey during last two weeks of class (SLOs 1-6) 2. Using simple rubric and selected questions from quizzes and exams, determine the percentage of students who successfully demonstrate SLO's 1 – 6
3	**Assessment Administration Plan (date(s), sample size and selection of course sections, scoring procedures, etc.)**	Administer each element during fall semester (largest number of students enrolled).
4	**Assessment Results Summary (attach any Data/Statistical Reports)**	Students demonstrated a sound knowledge of kinematics and Newton's Laws of Motion (SLO's 1,2) with results ranging from 82% to 90% favorable. Energy and momentum principles (SLO's 3,4) were a little lower, with an 57.1% favorable average response. Fluids (SLO 5) came in at 60% favorable, and Thermodynamics (SLO 6) was very favorable at 100%.
5	**Discussion of Assessment**	Students perceived a stronger understanding of topics early in the course (corresponding to SLOA's 1 – 3) compared to the later topics. This generally correlates to student performance in the same areas. We have

	Procedure and Results, and Effectiveness of Previous Improvement Plans	seen a significant improvement energy and thermodynamics (SLO's 3,6), compared to the previous year, This improvement may be due to a more intensive discussion of area under the curve, and the greater emphasis on problem solving that has been put into place in the expanded homework assignments, and in the problem solving sections in lab.
6	**Recommended Changes & Plans for Implementation of Improvements**	More emphasis needs to be placed on the topic of impulse and momentum (SLO 4), with an expanded set of in class activities that target the common physics misconceptions that the students have been shown to have from previous studies.

Course and Program Assessment Summary PHYS 208A

Division: Physical Sciences ***Program:*** Physics ***Course(s):*** PHYS 208A ***Date:*** 2/28/14

Program Core/Required Courses:

Program Faculty: J.Eickemeyer *P.Len*

1	**Student Learning Outcome Statements** **□ Course**	7. Solve kinematics problems by: a) identifying important given information b) choosing appropriate equations c) formulating a solution 8. Utilize Newton's Laws of Motion to solve problems that include: a) constructing free body diagrams b) determining appropriate assumptions c) choosing appropriate coordinate systems d) evaluating given information in order to arrive at a solution 9. Demonstrate an understanding of the concept of conservation of energy and: a) analyze various problems to determine if using the concept of energy is the most appropriate way

		b) of solving the problems c) set-up appropriate equations d) calculate kinetic energy, potential energy, and work 10. Apply the concepts of impulse and momentum by: a) identifying conditions where its use is appropriate b) diagramming systems in order to use conservation of momentum or impulse momentum equations c) to solve problems 11. Examine systems involving fluids and: a) calculate buoyant forces on submerged objects b) apply continuity equations and Bernoulli's equation to solve for unknown quantities 12. Understand the laws of thermodynamics and heat transfer and: a) formulate a solution utilizing appropriate equations b) assess the efficiency of thermodynamic process used today
2	**Assessment Methods Plan (attach any assessment instruments, scoring rubrics, SLO mapping diagrams)**	1. Administer SLO self survey during last two weeks of class (SLOs 1-6) 2. Using simple rubric and selected questions from quizzes and exams, determine the percentage of students who successfully demonstrate SLO's 1 – 6
3	**Assessment Administration Plan (date(s), sample size and selection of course sections, scoring procedures, etc.)**	Administer each element during fall semester (largest number of students enrolled).
4	**Assessment Results Summary (attach any Data/Statistical Reports)**	Students demonstrated a sound knowledge of kinematics and Newton's Laws of Motion (SLO's 1,2) with results ranging from 82% to 90% favorable. Energy and momentum principles (SLO's 3,4) were a little lower, with an 57.1% favorable average response. Fluids (SLO 5) came in at 60% favorable, and Thermodynamics (SLO 6) was very favorable at 100%.
5	**Discussion of Assessment Procedure and Results, and Effectiveness of Previous Improvement Plans**	Students perceived a stronger understanding of topics early in the course (corresponding to SLOA's 1 – 3) compared to the later topics. This generally correlates to student performance in the same areas. We have seen a significant improvement energy and thermodynamics (SLO's 3,6), compared to the previous year, This improvement may be due to a more intensive discussion of area under the curve, and the greater emphasis on problem solving that has been put into place in the expanded homework assignments, and in the problem solving sections in lab.
6	**Recommended Changes & Plans for Implementation of**	More emphasis needs to be placed on the topic of impulse and momentum (SLO 4), with an expanded set of in class activities that target the common physics misconceptions that the students have been shown to have from previous studies.

	Improvements	

Course and Program Assessment Summary PHYS 208C

Division: Physical Sciences ***Program:*** Physics ***Course(s):*** PHYS 208C ***Date:*** 2/28/14

Program Core/Required Courses:

Program Faculty: J.Eickemeyer

1	**Student Learning Outcome Statements** **□ Course**	1. Be able to calculate time dialation, length contraction and mass increases using special relativity effects. 2. Understand the concept of energy and its relationship to special relativity 3. Describe how general relativity results relate to gravitational effects near exotic objects. 4. Understand how the experimental data verify that waves have particle-like properties. 5. Understand how the experimental data verify that particles have wave-;like properties. 6. Relate the principles of quantum theory to atomic structure. 7. Be able to summarize the solutions to the Schroedinger Equation for the hydrogen atom. 8. Outline the solutions to the Schroedinger Equation as they relate to many electron atoms. 9. Use the uncertainty principle to calculate the range of the strong nuclear force. 10. Be able to calculate the energy released in nuclear reactions. 11. Outline the properties of sub-atomic particles.
2	**Assessment Methods Plan (attach any assessment instruments, scoring rubrics, SLO mapping diagrams)**	1. Administer SLO self survey during last two weeks of class (SLOs 1-11) 2. Using simple rubric and selected questions from quizzes and exams, determine the percentage of students who successfully demonstrate SLO's 1 – 11
3	**Assessment Administration Plan (date(s), sample size and**	Administer each element during fall semester and spring semesters.

	selection of course sections, scoring procedures, etc.)	
4	**Assessment Results Summary (attach any Data/Statistical Reports)**	Survey results for the spring 2012 semester indicate a solid knowledge of special and general relativity, with favorable responses ranging form 71-100%(SLO's 1-3). The survey of correctly solved problems in the particle wave duality sections (SLO'4-5) were somewhat lower, with an average of about 50%. Students demonstrated a sound knowledge of the relationship of quantum theory to atomic structure, range of the strong nuclear force, energy released during nuclear reactions, and the properties of sub-atomic particles, (SLO's 6,9,10,11) with results ranging from 72-100%. Student self survey results consistently indicate that the student's knowledge of the Schroedinger Equation applications is higher than the actual test results for SLO' 7,8.
5	**Discussion of Assessment Procedure and Results, and Effectiveness of Previous Improvement Plans**	Results were the lowest in areas that require the application of second order differential equations as they relate to to the Schroedinger Equation, and particle-wave duality. More time will taken to explain the mathematics related to these concepts. Some improvement is noted in learning objective 7, with a 20% improvement over last year. Results in high in most other areas (SLO's 1-3,6,9-11) were fairly positive, with results ranging from . 72-100%.
6	**Recommended Changes & Plans for Implementation of Improvements**	.The students have great difficulty with the abstract conceptual nature of relativity and quantum physics. This component of the course is being illustrated with more illustrative examples in lecture, and with more homework problems.

Program Assessment Summary

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Division: Physical Sciences *Program:* Physics *Date:* March 5, 2012 *v. 2 2012*

Courses in program: ____PHYS 208A, PHYS 208B, PHYS 208C_____

Faculty involved with the assessment and analysis: ___Jim Eickemeyer, Bret Clark_____

Course to program outcome mapping document** is completed Yes__X__ No_____

1	Student Learning Outcome Statements	1. Apply statics and dynamics principles in order to solve problems involving: a) motion of masses b) electric forces

	□ Program	c) gravitational forces d) magnetic forces 2. Utilize the concept of conservation of energy in problems involving: a) motion of masses b) electric fields and potentials c) magnetic fields d) gravitational fields 3. Apply conservation of momentum and the relationship between impulse and momentum in order to solve problems involving: a) general collisions b) forces applied over time c) perfectly elastic and inelastic collisions 4. Analyze systems where quantum effects and relativity are appropriate 5. Safely perform laboratory experiments based on qualitative and quantitative analyses utilizing various apparati and measuring devices.
2	Assessment Methods Plan (identify assessment instruments, scoring rubrics, SLO mapping diagrams)	Administer a SLO self-survey during the last two weeks of class (SLOs 1 – 5) Using a simple rubric and selected questions from quizzes and exams, determine the percentage of students who successfully the SLO's for each class.
3	Assessment Administration Plan (date(s), sample size or selection of course sections, scoring procedures, etc.)	Administer during the fall and/or spring semesters to all physics students
4	Assessment Results Summary (summarize Data)	Student responses demonstrate a sound understanding of many of the basic physics principles related to SLO's 1-4. Some improvements are needed in applications that require the student to apply advanced mathematical (usually calculus related) principles to the SLO's in Physics 208A, Physics 208B and Physics 208C.
5	Discussion of Assessment Procedure and Results, and Effectiveness of Previous Improvement Plans	Improved success and retention for students in physics has reached a four hear high.
6	Recommended Changes & Plans for Implementation of Improvements	. Increased emphasis is being placed on problem solving during lab periods, and on expanded computer based homework assignments. We have been studying many common student misconceptions about physics relationships, and have used enhanced in class activities to help the student clarify the appropriate relationships. In fall 2012, student learning outcomes in Phys 205A were directly assessed using the Force Concept Inventory (FCI), and were found to be comparable to or better

		than four-year colleges and universities. Notable about this Phsics 20A class was the requirement that students read and answer questions on the textbook and presentation slides before coming to lecture (in a flipped classroom), and the continuing use(since fall 2011) of flashcards to engage in 'think-pair-share" (peer instruction). Results are posted at http://waiferx.blogspot.com,/2012/12/fci-post-test-comparison-cuesta-college.html
7	Description or evidence of dialog among course or program-level faculty about assessment plan and results	Discussions between Pat Len, and Jim Eickemeyer have provided a variety of different ideas and approaches to improving the learning proficiency in the Physics Department at Cuesta College.

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Program Assessment Mapping and Calendar last updated: February 28, 2014

Title of Program: PHYSICS

Program Level SLOs

1. Apply statics and dynamics principles in order to solve problems involving:
   a) motion of masses
   b) electric forces
   c) gravitational forces
   d) magnetic forces
2. Utilize the concept of conservation of energy in problems involving:
   a) motion of masses
   b) electric fields and potentials
   c) magnetic fields
   d) gravitational fields
3. Apply conservation of momentum and the relationship between impulse and momentum in order to solve
   problems involving:
   a) general collisions
   b) forces applied over time
   c) perfectly elastic and inelastic collisions
4. Analyze systems where quantum effects and relativity are appropriate
5. Safely perform laboratory experiments based on qualitative and quantitative analyses utilizing various
   apparati and measuring devices.
6. Students develop positive, enduring attitudes towards physics, and science and education in general.

Course Level SLOs

Phys 205A

1. Describe and quantify motion and relationships with forces. (e.g: given initial conditions and forces acting on object, draw free-body diagram, apply Newton's laws, constrain different degrees of freedom, and apply kinematic equation of constant acceleration to determine kinematics of object at a later time.)
2. Describe and apply conservation laws of energy, linear momentum, and angular momentum. (e.g: given initial state of system (position, velocity, et.), determine how conservation laws apply, and determine final state of system)
3. Describe and quantify behavior of oscillations/waves/stresses in different materials. (e.g: describe how materials will behave due to either harmonic or constant applied forces)
4. Describe and apply thermodynamic laws to gases, fluids, and solids. (e.g: given initial state of system (pressure, speed, temperature, work/heat exchanges), determine how conservation laws apply, and determine final state of system)

Phys 205B

1. Describe and quantify geometric and physical behavior of light. (e.g: model image formation by lenses, or interference/diffraction by slits)
2. Describe and quantify behavior of electric forces, fields, potential energy, and potentials.

3. Describe and apply conservation laws of current and potentials to circuits. (e.g: given circuit with ideal/non-ideal emfs, resistors, capacitors, switches, determine currents and potential differences)
4. Describe and quantify behavior of magnetic forces, fields, fluxes, and induction. (e.g: given configuration of current-carrying wires/loops, determine resulting forces, induced emfs, or induce currents on other objects, or in time-varying circuits)
5. Describe and quantify phenomena in modern (post 19th century) physics such as relativity, atomic physics, nuclear physics, etc. (e.g: describe why certain systems demand non-classical models, and be able to quantify behaviors of these systems)

Phys 208A

1. Solve kinematics problems by:
a) identifying important given information
b) choosing appropriate equations
c) formulating a solution
2. Utilize Newton's Laws of Motion to solve problems that include:
a) constructing free body diagrams
b) determining appropriate assumptions
c) choosing appropriate coordinate systems
d) evaluating given information in order to arrive at a solution
3. Demonstrate an understanding of the concept of conservation of energy and:
a) analyze various problems to determine if using the concept of energy is the most appropriate way of solving the problems
b) set-up appropriate equations
c) calculate kinetic energy, potential energy, and work
4. Apply the concepts of impulse and momentum by:
a) identifying conditions where its use is appropriate
b) diagramming systems in order to use conservation of momentum or impulse momentum equations to solve problems
5. Examine systems involving fluids and:
a) calculate buoyant forces on submerged objects
b) apply continuity equations and Bernoulli's equation to solve for unknown quantities
6. Understand the laws of thermodynamics and heat transfer and:
a) formulate a solution utilizing appropriate equations
b) assess the efficiency of thermodynamic process used today

Phys 208B

1. Describe the mechanics of wave motion for transverse and longitudinal waves.
2. Be able to apply the principles of wave motion to sound, sound intensity, shock waves, and the Doppler effect.
3. Describe and quantify the physical and geometric properties of geometrical optical systems and light wave phenomena.
4. Analyze and compute Electric forces, fields, potentials, and electrical energy using calculus for continuous charge distributions.
5. Determine the voltage drops, currents, and charges of resistors and capacitors in CD circuits.
6. Describe and apply the appropriate relationships to magnetic forces, fields and magnetic energy using calculus relationships.

7. Quantify the relationships between capacitors, resistors, and inductors in an AC circuit using calculus relationships.

Phys 208C

1. Be able to calculate time dialation, length contraction and mass increases using special relativity results.
2. Understand the concept of energy and it relationship to special relativity.
3. Describe how general relativity results relate to gravitational effects near exotic objects.
4. Understand how the experimental data verify that waves have particle-like properties.
5. Understand how the experimental data verify that particles have wave-like properties.
6. Relate the principles of quantum theory to atomic structure.
7. Be able to summarize the solutions to the Schroedinger Equation for the hydrogen atom.
8. Outline the solutions to the Schroedinger Equation as they relate to many electron atoms.
9. Use the uncertainty principle to calculate the range of the strong nuclear force.
10. Be able to calculate the energy released in nuclear reactions.
11. Outline the properties of dub-atomic particles.
12. Be able to solve problems involving the half-life of a substance.
13. Summarize the strengths and ranges of the known forces of nature.

Relationship between assessed Course Level SLOs and Program Level SLOs.

Course	Course name	Program Student Learning Outcomes					
		1	2	3	4	5	6
PHYS 205A		B	B	B		B	B
PHYS 205B			B	B	B	B	B
PHYS 208A		B	B	B		B	B
PHYS 208B			B	B		B	B
PHYS 208C					B		

Key: A (SLOs exist for course) B (SLOs are assessed in course) C (Course assessment report completed)

Course Assessment Calendar

CYCLE STAGE	Fall 2013	Sp 2014	Fall 2014	Sp 2015	Fall 2015	Sp 2016
SLO Assessment	Phys 208A Phys 208B Phys 205A	Phys 208C Phys 205B	Phys 205A	Phys 205B	Phys 208A Phys 208B Phys 205A	Phys 208C Phys 205B

Analyze Results & Plan Improvements		Phys 208A Phys 208B Phys 205A	Phys 208C Phys 205B	Phys 205A	Phys 205B	Phys 208A Phys 208B Phys 205A
Plan Implementation			Phys 208A Phys 208B Phys 205A	Phys 208C Phys 20B	Phys 205A	Phys 205B
Post-Implementation SLO Assessment				Phys 208A Phys 208B	Phys 208C Phys 205B	Phys 205A

Program Assessment Calendar

CYCLE STAGE	Fall 2013	Sp 2014	Fall 2014	Sp 2015	Fall 2015	Sp 2016
SLO Assessment			PSLO 1, 2	PSLO 3, 4	PSLO 5, 6	
Analyze Results & Plan Improvements			PSLO 1, 2	PSLO 3, 4	PSLO 5, 6	
Plan Implementation			PSLO 1, 2	PSLO 3, 4	PSLO 5, 6	
Post-Implementation SLO Assessment				PSLO 1, 2	PSLO 3, 4	PSLO 5, 6