<table>
<thead>
<tr>
<th>Academic Program:</th>
<th>LAS: Physics</th>
</tr>
</thead>
</table>
| Date of Assessment: | Spring 2014  
End of First Year of Assessment, as part of the Five Year Plan |
| Lead person: | Fall 2013 – Anindita Ghosh  
Spring 2014 – Glenda Denicolo |
| What did you assess? What specific Program Learning Outcome is associated with the assessment? In what course did the assessment take place? | PLO # 1 assessed:  
Demonstrate knowledge of factual material essential to their discipline in science.  
This is linked to the specific CLO given below:  
**Course and CLO assessed: PHY 130**  
Apply the laws of classical mechanics in areas of linear kinematics and dynamics, force and work/energy concepts, conservation of linear and angular momentum, rotational kinematics and dynamics. |
| Description of assessment activity. Please include the methodology, as well as any specific measurement criteria. What were the expected outcomes? How many students took part in the assessment? | **Description of Assessment Activity:**  
- Embedded questions on two separate tests administered in the latter half of the semester  
- Questions modeled on standardized Physics AP C exams  
- Identical questions posed to all students  
**Description of Assessment Methodology:**  
- Detailed rubric created by the faculty addressing the above CLO is appended below  
- Grade standard set at students achieving 70%  
- Exceeds standard set at greater than 71%  
- Meets standard set at (65-70)%  
- Approaches standard set at (60-64)%  
- Does not meet standard less than 60%  
**Sampling:**  
- One faculty member taught all three PHY 130 sections during Fall 2013 (Anindita Ghosh).  
- Two faculty members taught PHY 130 during Spring 2014 (two sections: Glenda Denicolo; one section: Peter Eckstein, CRN 26062).  
- Assessment performed by the three faculty members.  
- Assessment included all students enrolled in PHY 130 college-wide during both semesters (approx. 100 students in total). |
Summary of findings and interpretation of the findings.

PLO #1: Apply the laws of classical mechanics in areas of linear kinematics and dynamics, force and work/energy concepts, conservation of linear and angular momentum, rotational kinematics and dynamics.

Detailed chart of actual numbers appended below.

**Test 3 (administered mid-October, 2013)**
Total number of students assessed: 61

- Exceeds standard: 41%
- Meets standard: 14.8%
- Approaches standard: 11.5%
- Does not meet standard: 32.8%

**Test 4 (administered mid-October, 2013)**
Total number of students assessed: 59

- Exceeds standard: 54.2%
- Meets standard: 6.8%
- Approaches standard: 10.2%
- Does not meet standard: 28.8%

**Test 3 (administered mid-April, 2014)**
Total number of students assessed: 45

- Exceeds standard: 42%
- Meets standard: 9%
- Approaches standard: 11%
- Does not meet standard: 38%

**Test 4 (administered May, 2014)**
Total number of students assessed: 34

- Exceeds standard: 44%
- Meets standard: 15%
- Approaches standard: 12%
- Does not meet standard: 29%

- The findings indicate that students performed marginally better in the second assessment than the first. This stems primarily from students using a format that was routinely used prior to this assessment.
• The aim was to ensure 67% of student meet or exceed the standards.
• The added percentages of students that meet or exceed the standards (≥ 65% grade) for each semester are: 56%, 61%, 51%, 59%.
• The added percentages of students that approach, meet or exceed the standards (≥ 60% grade) for each semester are: 67%, 71%, 62%, 71%.
• The margin of error in our statistics can be calculated as 
\[
\text{standard error} = \sqrt{\frac{p(1-p)}{n}}, \text{ where } p \text{ is the percentage, } n \text{ is the sample size.}
\]
• For each semester, the added percentage of students that meet or exceed the standards (≥ 65% grade), with the associated statistical error is: 56%±6%, 61%±6%, 51%±7%, 59%±8%.
• Taking into consideration the above-calculated error, we are still a small amount below our initial goal of 67%.

• Statistical information from AP Physics C Mechanics Section II (Essay questions A, B, C) indicates that the percentages of students that achieve a 60% or better grade are:

| AP Physics C Mechanics: Essay questions, national statistics (≥ 60% grade) |
|-----------------------------|-----------------|-----------------|
|                             | Question A      | Question B      | Question C      |
| 1999                        | 54%             | 18.2%           | 25.4%           |
| 2004                        | 57.2%           | 16.8%           | 5.4%            |
| 2009                        | 54.2%           | 3.8%            | 24.8%           |

Source: College Board, Released Exams.

• Taking into consideration that we have written assessment questions with the same balance of topics as the AP C exam, and an equivalent grading rubric, our results at SCCC are in general better than the national average in AP Physics C Mechanics exams.

<table>
<thead>
<tr>
<th>Actions required to improve teaching and learning in light of the findings? Who will be responsible?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The small but definite improvement in the grades from 3rd to 4th tests indicates that if the assessment methodology is to be held constant, then:</td>
</tr>
<tr>
<td>• Greater emphasis should be laid on AP C style questions on all tests as well as in classes</td>
</tr>
<tr>
<td>• Availability of AP exams for students for additional practice</td>
</tr>
<tr>
<td>• All faculty teaching the courses should collaborate for uniformity of assessment tools</td>
</tr>
</tbody>
</table>
Description and timeline for follow-up activities. When and what will be done to see if the actions taken have been effective? (“Closing the loop.”)

- The format and assessment tools should remain unchanged for a possible re-assessment of PLO # 1 in future years.

- National average percentage of students (< 57%) that meet or exceeds a grade of 65% indicates that our current goal of 67% of students meeting this same standard might be too high.

- We recommend adjusting the goal to 60% of students to meet or exceed standards.

- Statistically, we have achieved a goal of 60% of students meeting or exceeding the standards.

- In the future, we recommend increasing exposure of PHY130 students to problems that require symbolic manipulation (same style as assessment questions) as opposed to numeric-only problems.
# FALL 2013 RESULTS

## RESULTS OF TEST 3
**ADMINISTERED MID OCTOBER, 2013**

<table>
<thead>
<tr>
<th>Test</th>
<th>CRN 90119</th>
<th>CRN 90982</th>
<th>CRN 93863</th>
<th>TOTAL NUMBER OF STUDENTS</th>
<th>PERCENTAGE OF STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19</td>
<td>21</td>
<td>21</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td><strong>EXCEEDS STANDARD</strong></td>
<td>6</td>
<td>8</td>
<td>11</td>
<td>25</td>
<td>41%</td>
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<tr>
<td><strong>MEETS STANDARD</strong></td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>9</td>
<td>14.8%</td>
</tr>
<tr>
<td><strong>APPROACHES STANDARD</strong></td>
<td>9</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>11.5%</td>
</tr>
<tr>
<td><strong>DOES NOT MEET STANDARD</strong></td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>20</td>
<td>32.8%</td>
</tr>
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</table>

## RESULTS OF TEST 4
**ADMINISTERED MID NOVEMBER, 2013**

<table>
<thead>
<tr>
<th>Test 4 (ADMINISTERED MID-NOVEMBER)</th>
<th>CRN 90119</th>
<th>CRN 90982</th>
<th>CRN 93863</th>
<th>TOTAL NUMBER OF STUDENTS</th>
<th>PERCENTAGE OF STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL NUMBER OF STUDENTS</strong></td>
<td>19</td>
<td>20</td>
<td>20</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td><strong>EXCEEDS STANDARD</strong></td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>32</td>
<td>54.2%</td>
</tr>
<tr>
<td><strong>MEETS STANDARD</strong></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6.8%</td>
</tr>
<tr>
<td><strong>APPROACHES STANDARD</strong></td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>10.2%</td>
</tr>
<tr>
<td><strong>DOES NOT MEET STANDARD</strong></td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>17</td>
<td>28.8%</td>
</tr>
</tbody>
</table>
## SPRING 2014 RESULTS

### RESULTS OF TEST 3
ADMINISTERED MID APRIL, 2014

<table>
<thead>
<tr>
<th></th>
<th>CRN 20075</th>
<th>CRN 20921</th>
<th>CRN 26062</th>
<th>TOTAL NUMBER OF STUDENTS</th>
<th>PERCENTAGE OF STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL NUMBER OF STUDENTS</td>
<td>18</td>
<td>20</td>
<td>7</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>EXCEEDS STANDARD</td>
<td>8</td>
<td>9</td>
<td>2</td>
<td>19</td>
<td>42%</td>
</tr>
<tr>
<td>MEETS STANDARD</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>9%</td>
</tr>
<tr>
<td>APPROACHES STANDARD</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>11%</td>
</tr>
<tr>
<td>DOES NOT MEET STANDARD</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>17</td>
<td>38%</td>
</tr>
</tbody>
</table>

### RESULTS OF TEST 4
ADMINISTERED MAY, 2014

<table>
<thead>
<tr>
<th></th>
<th>CRN 20075</th>
<th>CRN 20921</th>
<th>CRN 26062</th>
<th>TOTAL NUMBER OF STUDENTS</th>
<th>PERCENTAGE OF STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL NUMBER OF STUDENTS</td>
<td>14</td>
<td>20</td>
<td>*</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>EXCEEDS STANDARD</td>
<td>7</td>
<td>8</td>
<td>*</td>
<td>15</td>
<td>44%</td>
</tr>
<tr>
<td>MEETS STANDARD</td>
<td>4</td>
<td>1</td>
<td>*</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>APPROACHES STANDARD</td>
<td>1</td>
<td>3</td>
<td>*</td>
<td>4</td>
<td>12%</td>
</tr>
<tr>
<td>DOES NOT MEET STANDARD</td>
<td>2</td>
<td>8</td>
<td>*</td>
<td>10</td>
<td>29%</td>
</tr>
</tbody>
</table>

* Pending data, not currently available.
In a ballistic pendulum experiment, the spring loaded gun has a spring constant $k$ and is compressed by the amount $x$ horizontally. When released from rest, a bullet of mass $m$ leaves the gun with a velocity $v$. The bullet collides with a stationary pendulum of length $L$ and mass $M$ and the combination swings up to make an angle $\theta$ with the vertical at its highest point. Derive expressions for the following.

(a) The velocity of the bullet in terms of $k$, $x$, $m$.
(b) The velocity of the bullet-pendulum combination immediately after collision in terms of $m$, $M$, $x$, $k$.
(c) The maximum height of the bullet-pendulum combination in terms of $m$, $M$, $x$, $k$, $g$.
(d) By factor does the height change if the velocity $v$ of the bullet is doubled? Explain.

**Rubric:**

100 points total

(a) For any statement of conversation of energy
For a correct application of conservation of energy, with a clear indication of energy of spring and kinetic energy of bullet
$\frac{1}{2}mv^2 = \frac{1}{2}kx^2$
$v = x\sqrt{\frac{k}{m}}$
10 points
15 points

(b) For any statement of conservation of momentum
For correct expressions for the momentum before and after the collision, using the answer to part (a)
$P_{\text{initial}} = mv$
$P_{\text{final}} = (m+M)V$
For setting $P_{\text{initial}} = P_{\text{final}}$ and deriving $V = \frac{mv}{m+M} = \frac{xv(km)}{(m+M)}$
5 points
5 points
10 points

(c) For the correct expressions of energies in initial and final instants
$E_{\text{initial}} = \frac{1}{2} (m+M)V^2$
$E_{\text{final}} = (m+M)gh$
For the correct expression for final height using conservation of energy
$h = \frac{mkx^2}{2g(m+M)^2}$
10 points
10 points
10 points

(d) For correctly linking initial $v$ with maximum height $h$
From part (b): $V = \frac{mv}{m+M}$
From part (c): $V^2 = 2gh$
For numerical answer $h$ changes by a factor of 4
5 points
5 points
5 points
In a ballistic pendulum experiment, the spring loaded gun has a spring constant $k$ and is compressed by the amount $x$ horizontally. When released from rest, the bullet of mass $m$ leaves the gun with a velocity $v$. The bullet collides with a stationary pendulum of length $L$ and mass $M$ and the combination swings up to make an angle $\theta$ with the vertical at its highest point. Derive expressions for the following.

(a) The velocity of the bullet in terms of $k$, $x$, $m$.
(b) The velocity of the bullet-pendulum combination immediately after collision in terms of $m$, $M$, $x$, $k$.
(c) The maximum height of the bullet-pendulum combination in terms of $m$, $M$, $x$, $k$, $g$.
(d) By factor does the height change if the compression of the spring is doubled? Explain.

Rubric:

100 points total

(a) For any statement of conversation of energy
   For a correct application of conservation of energy, with a clear indication of energy of spring and kinetic energy of bullet
   $\frac{1}{2} mv^2 = \frac{1}{2} kx^2$
   $v = x \sqrt{\frac{k}{m}}$
   10 points
   15 points

(b) For any statement of conservation of momentum
   For correct expressions for the momentum before and after the collision, using the answer to part (a)
   $P_{\text{initial}} = mv$
   $P_{\text{final}} = (m+M)V$
   For setting $P_{\text{initial}} = P_{\text{final}}$ and deriving $V = (mv)/(m+M) = (xV(km))/(m+M)$
   5 points
   5 points
   5 points
   10 points

(c) For the correct expressions of energies in initial and final instants
   $E_{\text{initial}} = \frac{1}{2} (m+M)V^2$
   $E_{\text{final}} = (m+M)g h$
   For the correct expression for final height using conservation of energy
   $h = \frac{mkx^2}{2g(m+M)^2}$
   10 points
   10 points

(d) For correctly linking $x$ with maximum height $h$
   From part (a): $kx^2 = mv^2$
   From part (b): $V = mv/(m+M)$
   From part (c): $V^2 = 2g h$
   For numerical answer $h$ changes by a factor of 4
   5 points

Spring 2014
A solid disk of mass $M$ and radius $R$ is used as a frictionless pulley. A small block of mass $m$ is attached to a string, the other end of which is attached to the pulley and wrapped around it several times. The block of mass $m$ is released and falls a distance $D$ to the floor. Derive expressions for each of the following questions in terms of $M$, $m$, $R$, $D$ and $g$.

(a) Calculate the linear acceleration of the system.

(b) Write an expression for the speed of the block just before it reaches the floor.

(c) Derive an expression for the angular momentum of the disk after the block has landed.

**Rubric:**

**100 points total**

(a)

For the correct application of Newton’s second law for each body

$T - mg = -ma$

$TR = \frac{1}{2} MR^2 \alpha$

For a correct combination of the two equations above, clearly indicating the connection between $\alpha$ and $a$

$\alpha = a/R$

$T = mg - ma$

$(mg - ma)R = \frac{1}{2} MR^2 a/R$

$a = mg/(m + M)$

(b)

For the correct expression relating the final velocity, $v$, to the fallen distance $D$

$v = a \ t \quad$ and $\quad D = \frac{1}{2} a \ t^2$

or

$v = (2 \ a \ D)^{1/2}$

For correctly solving for $t$ or just substituting the answer to part (a) into the equation for $v$, yielding an expression in terms of the required given quantities

$v = [2 \ D \ m \ g / (m+M)]^{1/2}$

(c)

For the correct expression relating the final velocity, $v$, to angular momentum for the disk

$L = I \ \omega = (\frac{1}{2} MR^2) \ \omega$

For correctly relating the linear speed of the block with the angular speed of the disk

$\omega = v/R$

For correctly substituting in the expression for $\omega$ in the equation for angular momentum, yielding an expression in terms of the required given quantities

$L = (\frac{1}{2} MR^2) [2 \ D \ m \ g / (m+M)]^{1/2} / R$
A solid disk of mass $M$ and radius $R$ is used as a frictionless pulley. A small block of mass $m$ is attached to a string, the other end of which is attached to the pulley and wrapped around it several times. The block of mass $m$ is released and lands on the floor after a time $t$. Derive expressions for each of the following questions in terms of $M$, $m$, $R$, $t$ and $g$.

(a) Calculate the linear acceleration of the system.
(b) Write an expression for the speed of the block just before it reaches the floor.
(c) Once the block has landed, calculate the force necessary to stop the disk from spinning.

Rubric:

100 points total

(a)
For the correct application of Newton’s second law for each body
- $T - mg = -ma$
- $TR = \frac{1}{2} MR^2 \alpha$

For a correct combination of the two equations above, clearly indicating the connection between $\alpha$ and $a$
- $\alpha = \frac{a}{R}$
- $T = mg - ma$
- $(mg - ma)R = \frac{1}{2} MR^2 a/R$
- $a = mg / (m + M)$

(b)
For the correct expression relating the final velocity, $v$, to the time of fall $t$
- $v = a \times t$

For correctly solving for $t$ or just substituting the answer to part (a) into the equation for $v$, yielding an expression in terms of the required given quantities
- $v = m \frac{g}{t}/(m + M)$

(c)
For correctly relating the linear speed of the block with the angular speed of the disk
- $\omega = v / R$

For identifying the relation between angular speed and angular acceleration
- $\alpha = \omega / t$

For correctly applying the rotational version of Newton 2nd law to the disk
- $\tau = F \times R = I \times \alpha$

For isolating $F$, and substituting in the expression for $\omega$ and $\alpha$ in the equation
- $F = I \alpha / R = \frac{1}{2} MR^2 \times (v / R t) / R$

For using the answer to part (b), yielding an expression in terms of the required given quantities
- $F = \frac{1}{2} (MR^2) \times (v / R t) / R = \frac{1}{2} M / t [m g / (m + M)] = \frac{1}{2} M m g / (m + M)$
Assessment questions were written in order to follow the same balance of topics as in the AP Physics C Mechanics, Section II: Essay questions. This is our current tally of how our assessment questions cover the topics in mechanics:

<table>
<thead>
<tr>
<th>KINEMATICS</th>
<th>NEWTON'S LAWS; WORK; ENERGY; POWER</th>
<th>MOMENTUM; ROTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.1 (questions 1+2)</td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
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</tr>
<tr>
<td>Sum:</td>
<td>20 points out of 200 (10%)</td>
<td>100 points out of 200 (50%)</td>
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<tr>
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<td>20</td>
<td>5</td>
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<tr>
<td>Sum:</td>
<td>40 points out of 200 (20%)</td>
<td>80 points out of 200 (40%)</td>
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</tbody>
</table>

Please send any material associated with the assessment (Excel spreadsheet/ rubric/ reports, etc.) with this report to J. Pedersen, College Dean of Instruction: pedersj@sunysuffolk.edu and to your campus Associate Dean of Academic Affairs. Thank you.

Spring 2014