COMPREHENSIVE INSTRUCTIONAL PROGRAM REVIEW

Physics and Astronomy
Moreno Valley College

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Round Three 2012-2016

RCCD | RIVERSIDE COMMUNITY COLLEGE DISTRICT

Office of Educational Services

Comprehensive Instructional Program Review Document

A. Mission and Relationship to the College(s)

The mission of the Physics Program of the Moreno Valley College is to provide high quality physics instruction to a diverse student body. The program builds on student-centered learning and innovative methods of transfer of knowledge. The program is in alignment with the Moreno Valley College Missions that responds to the educational needs of the region. It prepares students for four-year baccalaureate college transfers in science and engineering and other professional programs where physics is required. The program keeps in touch with the latest advancements in science and technology and introduces innovative pedagogical tools that prepare the students for a successful career.

B. History

The physics program has seen considerable changes over the last four years. The currently offered classes include Introductory General Physics PHY-10, Introductory Lab PHY-11, and Calculus-based PHY-4A, PHY-4B and PHY-4C. The total FTE in the program is 1.4. The total enrollment in the program has doubled since 2008 (87 students in Fall 2008, 167 in Fall 2012).

Since 2009 Fall, we have started to offer PHY-4C, a calculus-based Thermodynamics and Waves course. This required introducing a new lab with new equipment. Based on the increased demand, we also started to offer one extra section of PHY-4A since Spring 2011 and one extra section of PHY-4B since Spring 2013. Our calculus-based physics students have above 90% transfer rate to four-year institutions where they pursue STEM-related majors. We have also maintained a fill rate of above 100% and a success rate of above 70%.

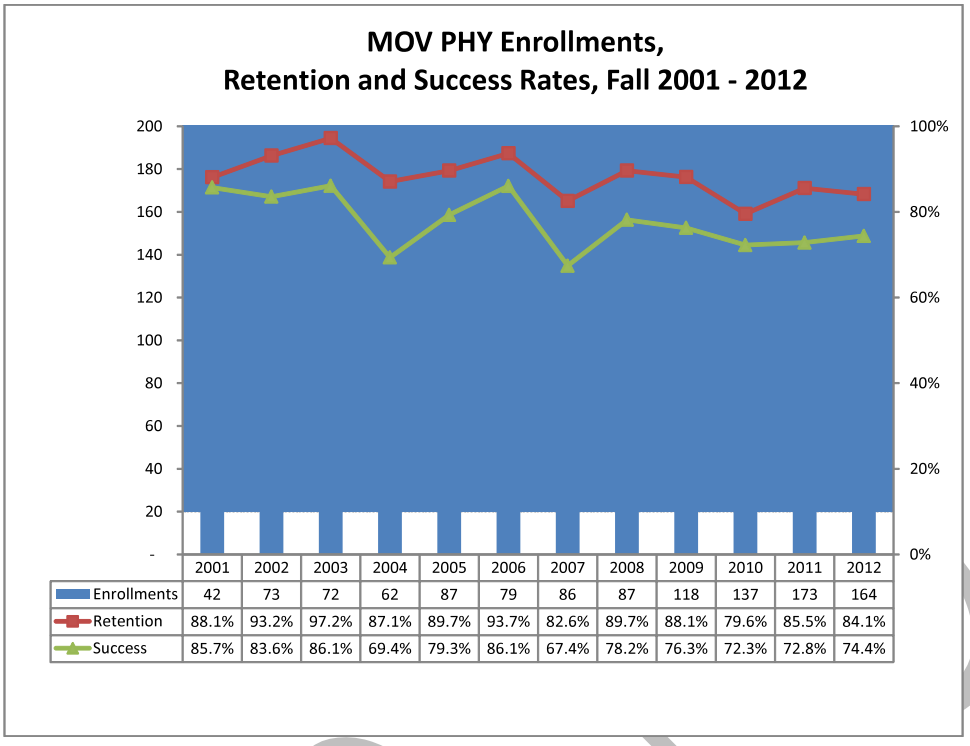
The program currently actively pursues STEM-related activities with students.

Our assessment studies recommended formation of groups and assign weaker students to strong groups for independent study. Currently, group discussions are encouraged in the classroom and the lab.

C. Data Analysis and Environmental Scan

Enrollment Analysis

The following graph shows the enrollment history of Physics from since 2001. In 2001, only PHY-10 and PHY-11 were offered as general course requirements for professional programs such as Nursing or Physician Assistant. Since 2005, we are offering the calculus-based physics (4 Series) for science and engineering majors that are transferrable to four-year colleges. Since 2008, our enrollments have almost doubled. Part of this increase could be ascribed to the economic condition, but we believe this was mostly because offering college-level physics fulfilled a long-standing need of the community. Since 2011, we are offering two sections of PHY-4A (Mechanics) and since 2013, two sections of PHY-4B (Electricity and Magnetism).

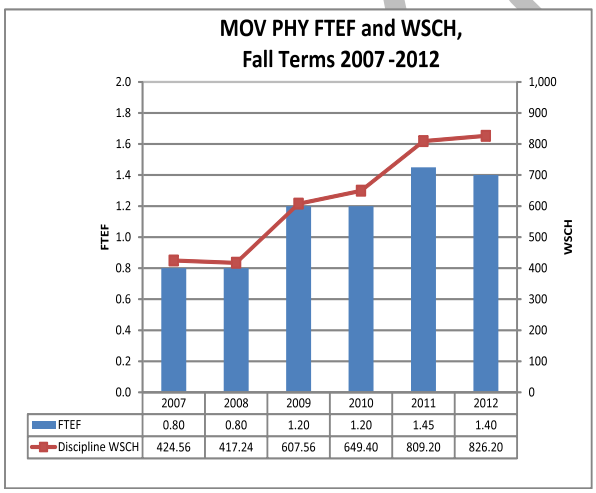


	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Enrollments	42	73	72	62	87	79	86	87	118	137	173	164
Retention	88.1%	93.2%	97.2%	87.1%	89.7%	93.7%	82.6%	89.7%	88.1%	79.6%	85.5%	84.1%
Success	85.7%	83.6%	86.1%	69.4%	79.3%	86.1%	67.4%	78.2%	76.3%	72.3%	72.8%	74.4%

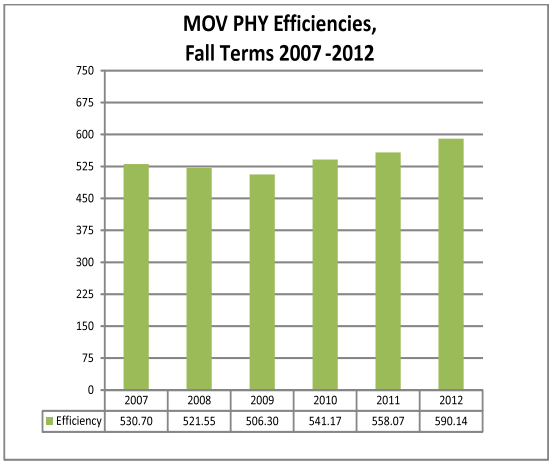
Success Analysis: Since 2008, the success rate in Physics has consistently been above 72% even as our enrollments have increased from 87 students to 164. The success rate is comparable to the average success rate of the RCCD (~67-68%) and to the state physics success rate of 70%.

Retention Analysis: Since 2008, our retention rate has been above 84%, although it reached a high of 94% in 2006. The recent rates ranging from 84% to 89.7% are comparable to the average 85-86% retention rate of the RCCD.

Efficiency Analysis: As can be seen in the following graphs the efficiency of the program since 2010 has ranged from 541 to 590, far above the ideal number of 525 with 1.4 Full-time equivalent faculty.



	2007	2008	2009	2010	2011	2012
FTEF	0.80	0.80	1.20	1.20	1.45	1.40
Discipline WSCH	424.56	417.24	607.56	649.40	809.20	826.20



	2007	2008	2009	2010	2011	2012
Efficiency	530.70	521.55	506.30	541.17	558.07	590.14

D. Programs and Curriculum

Name of Course / Program	Date CORs Last Updated	Comments - CORs
Astronomy 1A	November, 2013	Approved by District Curriculum Committee Chair 11/01/2013
PHY 10 Conceptual Physics	Currently in the approval process	Approved at MVC College Curriculum Committee on 12/02/2013
PHY11 Introductory Physics Laboratory	Currently in the approval process	Approved by the Riverside Department on 12/03/2013/awaiting MVC Department approval
PHY 4A Mechanics	Currently awaiting the addition of a lab manual to complete the approval process	Approved by RCC and Norco/not approved at MVC Curriculum on 4/23/13 because COR does not include a lab manual. Conditional approval for C-ID because of lack of a lab manual.
PHY4B Electricity & Magnetism	Currently awaiting the addition of a lab manual to complete the approval process	Approved by RCC and Norco/not approved at MVC Curriculum on 4/23/13 because COR does not include a lab manual.
PHY4C Thermodynamics & Waves	COR includes a lab manual. Awaiting Board of Trustees approval and implementation by the District	Approved by District Curriculum Committee Chair 11/12/2013

Student Learning Outcomes Assessment

Physics 4A:
In principle, all SLOs mentioned in the COR are assessed through four tests, one final exam, nine labs, multiple computer programming sessions related to physics-related data analysis, curve fitting and data presentation.

Example of a specific SLO: Apply Newton's Law to Analyze the Dynamics of Objects.

This SLO is related to direct physical experience that students undergo everyday and it allows the students to crtically examine a very familiar situation. It also initiates the critical thinking process as students need to demonstrate higher-order thinking skills on issues related to their personal experiences.

Assessment tools: Exam, Test, Quiz and Homework.

The scoring criteria included:

i) Competency in making a free-body force diagram,
ii) Understanding of Newton's 2nd Law to write a dynamic equation, and
iii) Analyzing the motion using kinematic equations,
iv) Relating the problem to the student's experience

The question, with variation. was repeated three times over every semester.

Assessment carried out in Spring of 2011, Fall 2011, Spring 2012, Fall 2012, Spring 2013

Result: During the final, 80% or above students exhibited total competence in this particular SLO.

Outcome of this continuing assessment study: We now encourage formation of small groups and assign weaker students to strong groups for independent study. We also carry on special sessions and labs on vector analysis to facilitate the understanding of force diagrams better.

The project has been discussed with my colleagues in Riverside City College.

The course is currently assessed with an extra SLO: Apply the concepts of energy and momentum conservation to solve mechanical situations.

Physics 4B:
In principle, all SLOs mentioned in the COR are assessed through four tests, one final exam, nine labs, multiple computer programming sessions, curve fitting and data presentation.

Example of a specific SLO: Analyzing capacitive circuits to determine their charge, voltage, energy and electrical fields.

This SLO is related to electrical circuits that are present in our everyday devices, including computers, telephones, etc. Students are asked to find the the current and voltage characteristics of an RC circuit.

Assessment tools used are Written Exam, Test, Lab, Homework.
Scoring criteria included:

i) Set up a differential equation using Kirchoff's Law and solve it
ii) Draw graphs of volatge and current in the circuit as functions of time
iii) Analyze the concept of energy storage in a capacitor.

Assessment carried out in Spring of 2011, Spring 2012, and Spring 2013.

In each semesters, during the final, 75% or more students exhibited total competence in this particular SLO. The SLO is also tested with a lab project.

We plan to apply the SLO across other familiar situations, encouraging critical thinking skills involving practical circuits that use capacitors. One of the outcomes of this assessment is to encourage formation of groups and assign weaker students to strong groups for independent study. This problem and the project has been discussed with my colleagues in Riverside City College. Another SLO that we plan to assess is Faraday's Law to calculate induced and motional EMF's and apply them to various situations. We are also working on a motor/robotics project that might be implemented next year as a regular class project. This project will provide much needed industrial experience for our students.

Physics 4C:
All SLOs mentioned in the COR are assessed through four tests, one final exam, nine labs, multiple computer programming sessions, curve fitting and data presentation.

Example of a specific SLO Assessed : Explain the concepts of thermodynamics, such as temperature, heat and internal energy and their relationship to each other and apply these concepts to solve problems.

This SLO is related to the underlying mechanisms that sustain our biology, environment and modern civilization. The SLO addresses the first and second law of thermodynamics. These are fundamental laws of nature and it is imperative that students are familiar with this.

A myriad topics are addressed under this SLO, especially heat and work cycles of different kinds of engines such as Otto, Diesel, Carnot and Stirling.

We used the following assessment tools: Exam, Test, Lab and Homwork.

Scoring criteria was based on:

i) Draw PV diagram of the above cycles
ii) identify isotherms, adiabats, isochors and isobars
iii) Find the heat input and output for every state change
iv) Find the total work done in one cycle
v) Find the efficiency of one cycle.

The question, with variation. was repeated three times over one semester since Fall 2011. During the finals, 80% or more students exhibited total competence in this particular SLO. Future goals would include the introduction of a Otto-cycle lab (we already offer a Carnot engine lab). We plan to apply the SLO across other familiar situations, encouraging critical thinking skills involving familiar

automobile engines. One of the outcomes of this assessment: need to organize groups and assign weaker students to strong groups for independent study. This course will be assessed with a different SLO: Apply the definitions oscillatory and wave motion to construct solutions to problems.

Physics 10:
SLO assesed: The principle of conservation of energy. This SLO is related to the very essence of all the processes that happen in the universe.

We used the following assessment tools Exam, Test, Quiz and Homework. The students are also encouraged to write essays on the topic.

Scoring criteria were based on: i) How well the concept of energy is understood and its relation to work, ii) Identification of different forms of energy, iii) Solving simple problems involving energy, work and velocity. During the finals, 80% or more students exhibited total competence in this particular SLO. **Results: We plan to employ more hands-on projects that demonstrates the concept of energy conservation.**

Physics 11:
SLO assessed: Analyze data to compare and contrast the experimental results to the accepted results such as to justify the scientific prinicples involved.

We use the Heat Engine Lab to asssess this particular SLO where heat energy is transfered into mechanical work through a heat engine. The amount of work done is experimentally observed and theoretically calculated. Conclusions on scientific principles are drawn based on comparing the theoretical and experimental results.

During finals, over 90% of the students are able to derive the correct conclusion based on this experiment.

Astronomy 1A:
SLO assessed: Outline the basic historical observations and explanations leading to the current theories of planetary motion.

Scoring criteria were based on: i) The students understanding of the circular geometric representations of the universe of the Greek models and its shortcomings, ii) the historical antecedents (Kepler, Galileo) to the Copernicus heliocentric model.

During finals, over 80% of the students are able to derive the correct conclusion based on this experiment.

Course Rotation and Assessment Cycle

COURSE OFFERED								Frequency of data collection and analysis	In the last 4 years, how many times has the course been assessed?	Next assessment report due date[1]	Who will prepare the assessment report?
Course	Fall 2012	Winter 2013	Spring 2013	Sum 2013	Fall 2013	Winter 2014	Spring 2014				
PHY 10	X		X		X		X	Annually	2	2014	Bhattacharya
PHY 11	X		X		X		X	Annually	2	2014	Bhattacharya
PHY 4A	X		X		X		X	Annually	2	2014	Bhattacharya
PHY 4B			X				X	When offered	2	2014	Bhattacharya
PHY 4C	X				X			When offered	1	2014	Bhattacharya
AST 1A	X		X		X		X	Annually	1	2014	Bhattacharya

Collaboration with Other Units including Instructional, Student Services or Administrative Units (Internal). **This section is now optional.**

The physics program collaborates successfully with the MVC STEM program. It advises MVC students for UCR Wind Turbine Project competition. It is also involved in a Weather Balloon Project where a weather balloon is launched to reach altitudes of 100,000 feet. MVC students successfully launched a balloon in July, 2013 and obtained high altitude stratospheric picture of the earth. These projects help prepare our students for potential science and engineering careers.

G. Outreach Activities (External). **This section is now optional.**

Discuss any activities or projects you have undertaken with other educational institutions, the community, or business/industry. Do you plan to begin any new outreach activities? If so, please describe.

The physics program also collaborates with UCR astronomer Professor Bahram Mobasher in analyzing Hubble astronomical image data. A number of students were trained to use software that images and analyzes deep astronomical fields obtained by the Hubble telescope.

H. Long Term Major Resource Planning

1. **Laboratory Space**

(a) The physics program does not have a dedicated laboratory. Currently, it borrows space from chemistry, biology and microbiology labs.

(b) Five physics lab sections are offered currently with an average of 25 to 30 students per section. National Science Teacher's Association recommends a laboratory size of 24 students with a minimum floor space of 60 square feet. Total floor space recommended 1,440 square feet. We expect to offer six physics lab sections, each section lasting 3 hours and 10 minutes.

(c) The laboratory space can be used for some or all the physics lecture classes. Furthermore, the lab can be used by chemistry, biology, geography or any other disciplines.

2. The program also needs significant equipment purchase to run PHY4B and PHY4C labs. We only list here three important items. Total cost of these three items $43,200.

(a) 24 PCs for physics laboratory. Each unit costs $1000. Total cost $24,000.
(b) 8 units of adiabatic gas law apparatus. Each unit cost $850. Total cost $4400.
(c) 8 units of e/m apparatus. Each unit cost $1850. Total cost $14,800

I. Summary

1. Year one:
   - Restructure PHY-4B and PHY-4C labs. However, this is contingent on getting the requested computer support.
   - Identify new STEM-related projects to be implemented by students.
   - Develop a plan to increase the number of women students in the calculus-based physics classes.
2. Year two:
   - Identify university physics and astronomy research groups for pedagogical/research and collaboration.
   - Develop a plan to facilitate smooth transfer of the students to university.

3. Year three:
   - Restructure PHY10 and Astronomy offerings. These courses would need new demonstration items.
   - Identify new SLOs for them.

4. Year four:
   - Offer Physics 4D.
   - Work with Math Lab to offer the experimental section of PHY-4D.