CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

ACADEMIC SENATE

GENERAL EDUCATION COMMITTEE

REPORT TO

THE ACADEMIC SENATE

GE-117-156

PHY 3020 – Physics for Future Presidents (GE Area B5)

General Education Committee	Date: 07/20/2016
Executive Committee Received and Forwarded	Date: 08/17/2016
Academic Senate	Date: 08/31/2016 First Reading

BACKGROUND:

This is a revisioned course for the semester calendar.

RESOURCES CONSULTED:
Faculty
Department Chairs
Associate Deans
Deans
Office of Academic Programs

DISCUSSION:

The GE Committee reviewed the ECO for this course and found it to satisfy the GE Student Learning Outcomes and other requirements for GE Area B5.

RECOMMENDATION:

The GE Committee recommends approval of GE-117-156, PHY 3020 – Physics for Future Presidents for GE Area B5.

PHY - 3020 - Physics for Future Presidents

C. Course - New General Education* Updated

General Catalog Information

College/Department	**Physics and Astronomy**
Semester Subject Area	**PHY**
Semester Catalog Number	3020
Quarter Subject Area	**PHY**
Quarter Catalog Number	302
Course Title	Physics for Future Presidents
Units*	**(3)**
C/S Classification *	**C-02 (Lecture Discussion)**

To view C/S Classification Long Description click: http://www.cpp.edu/~academic-programs/scheduling/Documents/Curriculum%20Guide/Appendix_C_CS_Classification.pdf

Component*	**Lecture**
Instruction Mode*	**Face-to-Face** **Web-Assisted**
Repeat Basis*	**May be taken only once**
If it may be taken multiple times, limit on number of enrollments	**1**
Cross Listed Course Subject Area and Catalog Nbr (if offered with another department)	
General Education Area / Subarea*	**B5**

To view the General Education SubArea definitions, click http://www.cpp.edu/~academic-programs/scheduling/Documents/Ch.3-GeneralEducationProposals.pdf.

I. Catalog Description

Catalog Description	The physics needed to understand the technological and scientific dimensions of economic and political issues in today's world and beyond. Topics will include energy, climate change, communications technologies and their applications, remote sensing, satellites, and medical technology. Minimal mathematical or scientific background is required.

II. Required Coursework and Background

Corequisite(s)	
Pre or Corequisite (s)	
Concurrent	

III. Expected Outcomes

completing the course.*

1. Explain, in qualitative and basic quantitative terms, the scientific principles (especially but not exclusively physics principles) relevant to economic and political issues such as energy policy, communications technology, climate change, space travel, and medical technologies.
2. Write scientifically informed critiques of and responses to articles on publicly relevant issues in popular science magazines.
3. Compare and contrast different policy proposals in areas relevant to the course topic, and be able to explain which scientific principles and facts are relevant to these issues.

If this is a course for the major, describe how these outcomes relate to the mission, goals and objectives of the major program.

Explain how the course meets the description of the GE SubArea(s). Please select appropriate outcomes according to the GE Area/SLO mapping.

The topics of this course are relevant to a wide range of science and engineering disciplines, while also sitting at the center of social, political, and economic controversies in our time. The emphasis is naturally on topics from the physical sciences, due to the expertise of the department and faculty offering this course, but informed discussion of topics such as environmental issues and implications for humans will draw heavily upon the biological sciences. Additionally, while the students will examine primary sources from the scientific literature, they will also draw heavily upon journalistic sources and articles written for popular audiences, to examine the ways in which these topics are characterized (or mischaracterized) in popular discussion. This course is thus a natural fit for a GE category aimed at synthesizing multiple scientific disciplines and bridging the gap in discourse and understanding between the natural sciences, public policy, and public discourse.

HOW THE COURSE MEETS THE GUIDELINES FOR GE SYNTHESIS COURSES

The major focus of a synthesis course is to integrate and focus fundamental concepts and issues. Each course in this category shall:

- Include readings from original primary/historical sources, as opposed to only secondary sources.

Textbook readings will be supplemented by readings from the work output of professional scientists, including peer-reviewed research article, syntheses and reviews of the open literature by panels of scientists advising governments. Additionally, students will, on a weekly basis, study the public's debates and discussions on the course topics by finding and reading newspaper or magazine articles relevant to the course topics, and contrast these examples from the popular press with professional writings on the same topic.

- Promote original and critical thinking in writing and/or discussion.

  Students will produce weekly writing assignments in which they will critique a recent newspaper or magazine article relevant to the course topic, and compare and contrast the understanding conveyed to the public with the scientific principles and data presented in the course. Additionally, students will have regular discussion assignments. In these assignments they will work as a group to synthesize information from assigned readings and other sources, arrive at a consensus conclusion, and then present their conclusions either in a formal write-up or an in-class oral presentation (alternating between modes of presentation in different weeks).

- Focus attention on understanding the interrelationships among the disciplines and their applications.

  This class is entirely focused on applying scientific principles from multiple disciplines to issues of societal importance and interest.

- Examine ideas and issues covered in this area in deeper and/or broader more integrative ways.

  Students will go beyond the interpretation of specific facts or observations in isolation, and will study problems that require the application of ideas from multiple areas of science. For instance, in comparing fossil fuels with nuclear power, students will need to apply the scientific principles underlying each technology, take into account the biological effects of the by-products of each technology, and also take into account economic implications of the costs and risks of each technology.

- Encourage synthetic-creative thinking in order to identify problems, understand broader implications and construct original ideas.

  See response to the previous item.

- Identify and evaluate assumptions and limitations of ideas and models.

  Most of the discussion in this course will be on issues that have no single, simple answer. In comparing, say, different possible environmental policies, students will have to confront uncertainty in

estimates for future population growth, energy consumption, and the foreseeable advances in the efficiency of different technologies. Students will, in their writings and presentations, have to identify the shortcomings in the forecasts that they are using to reach a conclusion about the relative merits of two technologies or policies.

- Develop written and oral communication skills appropriate for an upper division course (completion of courses in Area A: Subareas A1, A2, & A3 is required.)

  Students will engage in weekly writing assignments and frequent presentations that are graded both on the quality of the writing/speaking, the extent to which they critically engage with the assertions made in the article that they are critiquing, and the quality/accuracy of the information which they cite for their argument.

- Provide student work for assessment of the student's understanding of the required educational objectives in this subarea or in this course.

  See Section IX of this ECO

- The relationship between science, technology, and civilization

  This course is focused entirely on applying scientific principles to the analysis of technological problems at the heart of many current public policy debates.

- The effect science and technology have on culture and human values.

  See previous item.

- The application and generalization of basic scientific or quantitative knowledge from the foundational courses to real world or practical problems

  Analyzing the benefits and challenges of different technologies will draw heavily upon knowledge of the physical sciences from the students' B1 courses, and quantitative skills developed in B4. Assessing the strengths and limitations of different studies and measurements that inform the studies cited in class will draw on the facility with measurement and data analysis developed in the B3 course. Analyzing the effects of technology on the environment and human well-being will draw heavily upon knowledge of the life sciences from B2.

Describe how these outcomes relate to the associated GE Learning

Ia) Write effectively for various audiences.

Students will produce weekly short essays that respond to and critique newspaper and magazine articles relevant to the course topics. These

Outcomes listed below.*

essays will be graded for writing competence, the quality and sophistication of the reasoning employed, and the degree to which the student effectively draws upon scientific information to support their critique.

Ib) Speak effectively for various audiences.

Students will give small-group presentations on questions posed by the instructor.

Ic) Find, evaluate, use and share information effectively and ethically.

Students will have weekly assignments in which they critique newspaper and magazine articles relevant to the course topics, and draw upon information from the textbook and professional science writings to defend their critique.

Id) Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.

The most common form of graded work in this course will be writing assignments and presentations in which students cite scientific evidence to support critiques of articles or answers to questions posed by the instructor.

Ie) Apply and communicate quantitative arguments using equations and graphical representations of data.

In their written critiques and oral presentations, students will have to draw upon both qualitative principles and quantitative data. For instance, it will not be enough for a student to say that a particular policy is unrealistic because the available resources are insufficient. Instead, students will be expected to note (from assigned readings) the rate at which consumption of the resource is growing, and use simple quantitative scaling relationships and equations (e.g. exponential growth) to extrapolate from present to future resource requirements. Likewise, it will not be enough for students to argue that a particular solar energy technology is insufficient to address a particular need. Instead, students would be expected to note the size of a pilot project and then extrapolate to determine the land area that would have to be covered to generate enough energy.

IIa) Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

See answer to previous question (GE SLO Id).

IId) Integrate concepts, examples, and theories from more than one discipline to identify problems, construct original ideas, and draw conclusions.

Analyzing the benefits and challenges of different technologies will require students to draw upon knowledge of both the physical sciences

(for analyzing the technology) and the life sciences (for analyzing impacts on ecosystems and human life).

General Education Outcomes*

Ia. Write effectively for various audiences

Ib. Speak effectively to various audiences.

Ic. Find, evaluate, use, and share information effectively and ethically.

Id. Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.

Ie. Apply and communicate quantitative arguments using equations and graphical representations of data.

IIa. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

IId. Integrate concepts, examples, and theories from more than one discipline to identify problems, construct original ideas, and draw conclusions.

To view the mapping, click https://www.cpp.edu/~academic-programs/Documents/GE%20SLO%20Mapping.pdf

IV. Instructional Materials

Provide bibliography that includes texts that may be used as the primary source for instruction, and other appropriate reference materials to be used in instruction. The reference list should be current, arranged alphabetically by author and the materials should be listed in accepted bibliographic form.

Instructional Materials*

Textbooks may vary with instructor and over time, but will be similar to Richard Muller's *Physics for Future Presidents*, 1st edition, Cengage Learning (2009)

Primary sources for science and policy information will be drawn from the following, as well as similar resources:

Gordon E. Moore, 'Cramming More Components onto Integrated Circuits,' *Electronics*, pp. 114–117, April 19, 1965.

IPCC [Intergovernmental Panel on Climate Change], 2013: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A.

Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

IPCC, 2014: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate*

Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

IPCC, 2014: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 688 pp.

Hans A. Bethe, *The Road From Los Alamos: Collected Essays of Hans A. Bethe* (American Institute of Physics, 1991 edition)

Garrett Hardin, 'Tragedy of the Commons', *Science*, v. 162, p. 1243-1248 (1968)

Primary Sources for comparing public discourse with scientific information:

Students will be responsible for finding and critiquing current newspaper articles on scientific topics relevant to public policy.

Lectures, lecture notes, and current papers on the diverse topics will also be made available on BlackBoard by the instructor.

Faculty are encouraged to make all materials accessible. Indicate with an asterisk those items that have had accessibility (ATI/Section 508) reviewed. For more information, http://www.cpp.edu/~accessibility

V. Minimum Student Material

List any materials, supplies, equipment, etc., which students must provide, such as notebooks, computers, internet access, special clothing or uniforms, safety equipment, lockers, sports equipment, etc. Note that materials that require the assessment of a fee may not be included unless the fee has been approved according to University procedures.

Minimum Student Material*

Access to a computer with word processing software
Internet access
E-mail
Calculator
Notebook

VI. Minimum College Facilities

List the university facilities/equipment that will be required in order to offer this class, such as gymnastic equipment, special classroom, technological equipment, laboratories, etc.

Minimum College Facilities*

External Support

LIbrary Services
Demonstration Equipment Stockroom
Information Technology (IT) Services
Classroom Management System (e.g. BB)
Copier

Physical Space & Major Equipment

Lecture room with seating for up to 40 students

Smart classroom (computer/projector)
Periodic table
Overhead screen
White board/dry erase markers
Adjustable lighting

VII. Course Outline

Describe specifically what will be included in the course content. This should not be a repetition of the course description but an expansion that provides information on specific material to be included in the class, e.g. lecture topics, skills to be taught, etc. This should not be a week-by-week guide unless all instructors are expected to follow that schedule.

Course Outline*

Course topics will be organized into roughly 10 units of 1-2 weeks each.

Unit	Topics (Short)	Topics (Detailed)
1	Energy, Power, and Explosions	Energy content of various materials. Gasoline, an d forms of energy. Energy vs. power? Alternative en
2	Atoms and Heat	What is an atom? Periodic table. How much energ Temperature. Global warming? Heat engines, refri conditioning systems.
3	Gravity, Force, Satellites	'Weightless' astronaut? Satellites. Escape velocity. efficiency. Force and acceleration. Rockets. Flying Floating on water. Air pressure. Hurricanes. Conv e heaters.
4	Radioactivity and Nuclear Power	The nucleus and its explosion. Radiation and deat hypothesis. Tooth and chest x- ray doses. Alpha, Half-life rule. Radioisotope dating. Fission. Fusion. doubling rule. Nuclear weapons basics. Critical m bombs. Fallout. Nuclear reactors. Plutonium prod waste. Chernobyl.
5	Electricity and Magnetism	Charge, current, voltage, resistance. Conductors, superconductors. Static electricity. Electric power. electromagnets. Electric and magnetic fields. Elec Magnetic levitation.
6	Waves	Mysterious uses of waves: UFOs, Sofar rescuing o Transverse and longitudinal waves. Water surface Earthquakes. P, S, L waves. Waves cancel, reinfor Doppler shift.
7	Light	Light communication. Color and color perception. Mirrors. Index of refraction. Mirages. Dispersion R and telescopes. Diffraction. Holograms. Polarizati
8	Invisible Light	Infrared. Thermal radiation and temperature. Milit night'. UV and 'black lights'. Sunburn. Germicidal Greenhouse effect and CO_2. Electromagnetic spec imaging.

9	Quantum Physics	Laser, and its applications. Solar cells and digital c DVDs. Semiconductor electronics. Light-emitting Diodes to turn AC into DC. Transistor. Computer Quantization of waves. Uncertainty principle. Tunn microscopes (STMs). Quantum computers.
10	The Universe	How can the Universe expand? Hubble's Law. The star? Planets around other stars.The Milky Way. back in time. Dark energy. The Big Bang. Gravity gravity. Black holes. Before the Big Bang. A The

VIII. Instructional Methods

Describe the type(s) of method(s) that are required or recommended for the instruction of this course (lectures, demonstrations, etc.). Include any method that is essential to the course, such as the use of particular tools or software.

Instructional Methods*

- Reading from the textbook to prepare for the classes, enforced by reading quizzes online and at the beginning of each class
- Lectures that explain subtle points, and exemplify relevant physical phenomena with physics demonstrations designed to illustrate basic physical principles, e.g., the use of a discharge tube to demonstrate the formation of emission line spectra by excited atoms, and the uniqueness of each element's spectrum
- Extensive use of computer simulations, especially those provided by University of Colorado Physics Education Technology Project (http://phet.colorado.edu) to show processes that cannot be demonstrated(e.g,. how atoms constantly before based on their temperature), or to illustrate basic principles (e.g., planets orbiting stars)
- Reading popular science articles (from New York Times Science section, Scientific American, New Scientist, Popular Science Magazine, etc.) and writing short critical reviews
- Online and In-class Group Discussion Assignments followed by communication of group consensus (Typical topic: Automobiles typically carry 100 lb of gasoline. That has the energy content of 1500 lb of TNT. Is gasoline really as dangerous as this makes it sound?)

IX. Evaluation of Outcomes

Describe the methods to be used to evaluate students' learning, i.e. written exams, term papers, projects, participation, quizzes, attendance, etc.*

Students' learning of course content is evaluated via the following work:

1. Weekly reading quizzes, based on assigned readings from the textbook and primary sources, to reinforce the importance of preparation.
2. Weekly short essays in which students will find newspaper or magazine articles relevant to the week's topic and critique the article's analysis of the topic.
3. Weekly group discussion assignments, in which small groups of students will work together to arrive at a consensus on questions relevant to the week's reading and present either a written or oral summary of the group's answer.
4. Midterm and final exams that will combine short-answer questions on basic information with essay questions that will require explanations that draw on both basic facts and quantitative arguments.
5. Presentations where individual students will pick a topic approved by the instructor and present to their classmates. They will be asked to look at the newspaper articles, statements of politicians, etc. critically, and present their shortcomings based on our understanding of physics principles.

Describe the meaningful writing assignments to be included.*

Meaningful Writing Assignment: Students will produce weekly short essays (approximately one page) in which they critique newspaper or magazine articles relevant to the week's topic. The essays will be graded for the competence of the writing, the quality and depth of the student's reasoning, and the extent to which the student makes good use of information sources to defend the critique. Students will receive written feedback on their essays, and standards will rise during the quarter as they are expected to improve in response to feedback.

Discuss how these methods may be

used to address the course and program outcomes, as appropriate. Include or attach a matrix to align the evaluation methods to the outcomes.*

Course SLOs	Quizzes	Essays	Discussions	Exams	Presentations
1: The student will be able to explain, in qualitative and basic quantitative terms, the scientific principles (especially but not exclusively physics principles) relevant to economic and political issues such as energy policy, communications technology, climate change, space travel, and medical technologies.	x		x	x	x
2: The student will be able to write scientifically informed critiques of and responses to articles on publicly relevant issues in popular science magazines.		x		x	x
3: The student will be able to compare and contrast different policy proposals in areas relevant to the course topic, and be able to explain which scientific principles and facts are relevant to these issues.		x	x	x	x

If this is a general education course, discuss how these methods may be used to address the associated GE Learning Outcomes listed below. Include or attach a matrix to align the evaluation methods to the outcomes.*

GE SLOs	Quizzes	Essays	Discussions	Exams	Presentation
Ia. Write effectively for various audiences.		X		x	X
Ib. Speak effectively to various audiences.					X
Ic. Find, evaluate, use, and share information effectively and ethically.		X	x		X
Id. Construct arguments based on sound evidence and reasoning to support an opinion or		x	x	x	X

Ie. Apply and communicate quantitative arguments using equations and graphical representations of data.		x	x	x	X
IIa. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.	X	X	x	X	X
IId. Integrate concepts, examples, and theories from more than one discipline to identify problems, construct original ideas, and draw conclusions.	X	X	x	X	X

X. This OPTIONAL Section is for describing Course/Department/College specific requirements.

Department/ College Required ECO Information (Optional)