CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

ACADEMIC SENATE

GENERAL EDUCATION COMMITTEE

REPORT TO

THE ACADEMIC SENATE

GE-006-189

AMM 3650 - Color Science-Principles and Applications (GE Synthesis B5)

General Education Committee	Date: 02/14/2019
Executive Committee Received and Forwarded	Date: 04/10/2019
Academic Senate	Date: 04/24/2019 First Reading

TITLE OF REFERRAL: AMM 3650: COLOR OF SCIENCE-PRINCIPLES AND APPLICATIONS

BACKGROUND:

This is a new general education course for GE Area B5-Upper Division Synthesis.

RESOURCES CONSULTED:
Office of Academic Programs
Sara Meyer, Alyssa Lang, Melissa Flicker

DISCUSSION:
The GE Committee evaluated the ECO of this course, its objectives, how it meets the relevant GE student learning outcomes, the methods of assessment, and other relevant details and found it to meet the requirements of GE Area B5. The GE Committee also consulted members of the ART Department in the ENV for any impact or duplication and there seems to be none. The course has a 2-unit lecture and a corequisite 1-unit lab format.

RECOMMENDATION:

The GE Committee recommends approval of GE-006-189, AMM 3650: Color Science-Principles and Applications

Curriculog printout provided for reference only. For most recent changes please refer to Curriculog database (https://cpp.curriculog.com/).

AMM - 3650 - Color Science - Principles and Applications

C. Course - New/Modify General Education

General Catalog Information

Department* College of Agriculture | Apparel Merchandising and Management

Proposal Type* (•) New GE Course ( ) Modify GE Course

Modification Summary

Establish or Modify Articulation Agreement* Yes No

Subject Area* AMM

Catalog Number* 3650

Formal Course Title* Color Science - Principles and Applications

Abbreviated Course Title* Color Science - Prncpls & Apps

Unit(s)* (2)

C/S Classification* C-04 (Lecture/Recitation)

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

Contact Hour(s) 2 hours lecture.

Instruction

Mode(s)*	Face-to-Face
Grading Basis*	Graded Only
Repeat for Credit*	May be taken only once
Repeat for Credit Limit	
If course may be repeated for credit, total units applicable to degree and max units per semester.	
When Offered	
Cross Listed Course Subject Area and Catalog Nbr	
Dual Listed Course Subject Area and Catalog Nbr	
Course Category (select all that apply)*	☐ Major Course ☐ Service Course (used in other programs) ☑ GE Course ☐ None of the above
GE 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 principles of physical, chemical, physiological and psychophysical aspects of light, color and colorimetry. Color perception, color specification, and colorant types. Techniques for color measurement, color communication, color matching, coloration, and color quality control. Application of color theory and the CIE color system in industrial coloration.

II. Required Coursework and Background (i.e. Enrollment Requirements)

Prerequisite(s) (leave blank if none)	GE Areas A1, A2, A3, B1, B2, B3 and B4.
Corequisite(s) (leave blank if none)	AMM 3650L.
Pre or Corequisite(s) (leave blank if none)	
Concurrent (leave blank if none)	

III. Course Note(s) (OPTIONAL)

Note(s)	

IV. Expected Outcomes

List the knowledge, skills, or abilities which students should possess upon completing the course.*	By successfully completing the course students will be able to meet the following educational objectives: 1. Explain the color perception process. 2. Apply the principles of color theory and techniques of color application to solve color problems. 3. Identify color specification methods. 4. Select appropriate methods for color measurement, shade matching, and color quality analysis. 5. Employ scientific principles to evaluate various colorants and the coloration process. 6. Formulate solutions to digitally manage color in an industrial supply chain.
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	One of the most salient aspects of our experience of the world around us is that entities we view have color properties. Color is perhaps the most important source of information about our world. It plays a vital role in our lives, influencing our perceptions, moods and actions. Beyond the natural world, color plays a vital role in commerce, including agriculture, food, architecture, interior

GE Area/SLO mapping. *

décor, apparel, defense, and essentially all consumer and industrial goods. Information technology and globalization have significantly impacted color science, creating and requiring new methods for imparting, measuring, evaluating and communicating color.

This course will investigate a key element of science not currently addressed in the curriculum that will be of value to all majors. Color science is essentially an interdisciplinary subject, encompassing physics, chemistry, physiology, math, computer science, and psychology. This course is designed for students from any discipline and focuses on color science in the context of global industry and commerce. Students will apply knowledge gained from the natural sciences and mathematics.

Additional guidelines for Synthesis Courses:

- Include readings from original primary/historical sources, as opposed to only secondary sources.
    - Students will review the history of color science and use industry and professional resources (Munsell Color Laboratory, CIE, AATCC etc) to understand colorimetry as an applied science.
- Promote original and critical thinking in writing and/or discussion.
    - Student will evaluate problems in color science and coloration and present their findings.
- Focus attention on understanding the interrelationships among the disciplines and their applications.
    - Color science embraces chemistry, physics and math. Students will need to synthesise their knowledge from these disciplines and apply it to solve color problems.
- Examine ideas and issues covered in this area in deeper and/or broader more integrative ways.
    - Through assignments and classroom activities students will understand how color science explains important perceptual phenomena, underpins all creative design activities, and how its application resolves critical commercial problems in a globally-integrated world.
- Encourage synthetic-creative thinking in order to identify problems, understand broader implications and construct original ideas.
    - The weekly assignments will challenge students to

apply their developing knowledge of color science to solve problems.

- Identify and evaluate assumptions and limitations of ideas and models.
    - This element will be incorporated in assignments, class discussions, and exam questions.
- Develop written and oral communication skills appropriate for an upper division course.
    - Each week students will be required to make written and oral presentations. Profesisonal standards are expected and will be supported by appropriate rubrics.
- 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
- The relationship between science, technology, and civilization.
    - The understanding of color provided in this course embraces its role in our world, the application of science and technology to measure, evaluate, apply and communicate it.
- The effect science and technology have on culture and human values.
    - The importance role of color science in society and in commerce will be a theme of the course
- The application and generalization of basic scientific or quantitative knowledge from the foundational courses to real world or practical problems.
    - The applications of color science is virtually unbounded. Examples will be provided and built into the course assignments.

Describe how these outcomes relate to the associated GE Learning Outcomes listed

1a. Write effectively for various audiences.

Students will respond in written form to questions provided by the instructor through short answer quiz questions, written assignments, and exam essays

below.*

questions. For example, students will be able to write a test report professionally.

1b. Speak effectively for various audiences.

Students will engage in classroom discussions and give a combination of short and longer classroom presentations on topics related to color perception, color representation, and color communication.

1c. Find, evaluate, use and share information effectively and ethically.

Through assignments and class activities, students will work individually and in groups to find, evaluate, apply, and share information to solve problems related to color science.

1d, Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.

Weekly assignments and in-class discussions will require students to develop and support arguments based on color theory and scientific method.

1e. Apply and communicate quantitative arguments using equations and graphical representations of data.

Color science involves a large volume of data and extensive use of calculations. Students will use scientific instruments to measure phenomena, and then utlize appropriate equations and make graphical representations of data to explain information.

2a. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

Through assignments and in class activities, students will demonstrate how color can be identified, explained, and presented in a scientific way. Both quantitative and qualitative methods will be used and performed in multiple assignment and activities.

2d. Integrate concepts, examples, and theories from more than one discipline to identify problems, construct original ideas, and draw conclusions.

Topics covered in lectures, assignments, and class discussions will embrace multiple disciplines, such as chemistry, physics, psychology, physiology, engineering, mathematics, social sciences, among others. The synthesis, integration and application of knowledge through quizzes, exams and assignments is a critical element of this class.

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

V. 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*

1. Roy S. Berns, Principles of Color Technology. New York: Wiley, 2000.
2. Rolf G. Kuehni, Color Vision and Technology, AATCC Publication, 2013.
3. American Association of Textile Chemists and Colorists (AATCC) Technical Manual.
4. American Society for Testing and Materials (ASTM) Book of Textile Standards
5. The New Munsell Student Color Set 3rd Edition, New York: Fairchild Publications, 2014.

Other Readings and Other Resources:

Academic Journals:

Color Research and Application:https://onlinelibrary.wiley.com/journal/15206378

Coloration Technology: https://onlinelibrary.wiley.com/journal/14784408

AATCC Journal of Research: https://www.aatcc.org/pub/aatcc-journal/

Professional Organizations:

CIE (International Commission on Illumination): http://www.cie.co.at/

ISCC (Inter-Society Color Council – the principal professional society in the field of color in the United States) https://www.iscc.org/

AIC (International Color Association) https://www.aic-color.org/

The Color Association of United States: http://www.colorassociation.com/

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

VI. Minimum Student Materials

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 Materials*	Textbook

VII. 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*	Smart Classroom

VIII. 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*

Topics
Color in Our World Definition of color, and its role in the natural world. The role of color in society and its applications in industry and commerce. The evolution of color science. Objectivity and subjectivity in color science.

Light and Vision: Key factors about light and illuminants. The importance of light for life. The technical difference between a light sources and illuminant.
Color Stimuli: Lights and Objects: Introduction to the normal causes of our experience of vision and color: light stimuli.
Colorants and Materials: Colorants as modifiers of reflected light and resulting in perceived colors. Absorption and emission of photons, the units of light.
Measuring Color stimuli: Transmittance and reflectance measurement. Operation, calibration and sample presentation for spectrophotometric measurement.
Color and Color vision: The operation of the human eye and discussion on physiological aspects of color perception. Placing our color experiences in logical order and sorting basic sets of color attributes. Explain the term such as color space, color solid, color judgements. Difference between threshold and supra-threshold. The reliability of Color judgements.
The Colorimetric System: The CIE colorimetric system – its components, significance and drawbacks for color control in manufacturing. Historyical development of the color colorimetric system is described. From CIE 1931 to CIE 1964, and to CIE 1976.
Color Order System: A history of color order and a discussion of the relationship of geometric distances between color points in a color solid to perceptual distances. The Munsell and NCS color systems.
Adding of Lights and Colorants: The problems of color mixing. Additive and subtraction color mixing law and their applications.
Color Reproduction: Color and general appearance. Exploration of visual and computer based color matching.
Strength of Colorants: Color power, color strength, and colorant standardization. How strength difference and color difference are interrelated.
Color Constancy and Metamerism: The relationship and differences between these two color phenomena.
Color Quality Control: Kinds of color difference judgements. Intra- and inter- observer variability in color judgements. An objective method for determining average perceived color difference. CIELAB, CMC, and CIE2000 Color difference formulae are introduced to objective assessment of the color differences of shades.
Computer Color Matching: Fundamentals of computer color matching, significance, applications, and best practice.

Color management across the supply chain:
Color management in commercial supply chains. Examples of specifier color quality manuals.

Synthesis of important issues addressed throughout the course.

IX. 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*

Lecturing, assigned readings, discussion, group interactions, in class activities, and assignments.

X. Evaluation of Outcomes

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

There is a focus on experiential learning in which class lectures are complemented by assignments, quizzes, exams, and presentations.

Weekly Assignments 70%

Quizzes, Midterm and Final Exams 25%

Reflective Writing 5%

Describe the required meaningful writing assignments tobe included. *

Students will be given weekly assignments where, through reference to professional, scientific and industry resources they will succinctly evaluate key concepts and issues in color science and coloration to develop their analysis.

In the mid term and final exams, students will integrate knowledge they have covered within the course to identify solutions in given situations.

For example, in one of the essay questions on the exam, will ask students about color communication, a topic they have read articles about (from e.g. one peer-reviewed, one professional, and one consumer resource). They are required to summarize several methods to communicate colors which are historically and presently used. Then students will critically compare the differences based on the convenience, accuracy and efficiency of each method. Students finally draw a conclusion as to which method is recommended and why.

For the reflective writing assignment at the end of the semester, students will develop a short essay that describes the most significant concept learned in this course and why this is important to their professional development.

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.*

	Explain the color perception process.	Apply the principles of color theory and techniques of color application to solve color problems.	Identify color specification methods.	Select appropriate methods for color measurement, shade matching, and color quality analysis.	Employ scientific principles to evaluate various colorants and the coloration process.	Formulate solutions to digitally manage color in an industrial supply chain.
1a – Write effectively				X		
1b - Speak effectively to various audiences	X	X				X
1c - Find, evaluate, use, and share information effectively and ethically		X	X			
1d - Construct arguments based on sound evidence and reasoning to support an opinion or conclusion				X	X	
1e Apply and communicate quantitative arguments using equations and graphical representations of data.		X		X	X	
2a - Apply scientific methods and		X		X	X	

models to draw quantitative and qualitative conclusions about the physical and natural world.						
2d - Integrate concepts, examples, and theories from more than one discipline to identify problems, construct original ideas, and draw conclusions				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.*

OUTCOMES	**1. Weekly Assignments**	**2. Quizzes**	**3. Exams**	
I. Acquire foundational skills and capacities.				
a. Write and speak effectively to various audiences.	X		X	
b. Locate, evaluate, and responsibly use and share data employing information and communication technologies.	X	X		
c. Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.	X			
d. Apply and communicate quantitative arguments using tables, graphs, and equations.	X		X	
II. Develop an understanding of various branches of knowledge and their interrel				
a. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.	X		X	

d. Integrate concepts, theories, and examples from more than one field of study to identify problems, construct original ideas, and draw conclusions.	X		X	

XI. Course/Department/College Specific Requirements (OPTIONAL)

Department/ College Required ECO Information (Optional)

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AY Proposal Submitted 2018-2019

AY Proposal Implemented

PS Academic Group 10-CAG

PS Academic Organization 460-AMM

Course Type Apparel Merchandising and Management

Impact Report (for modified courses only) ☐ Attached

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Senate Referral Number GE-006-189

Senate Report Number