I. CATALOG INFORMATION

A. Discipline: PHYSICS

B. Subject Code and Number: PHYS M20CL

C. Course Title: Wave Motion, Optics, and Modern Physics Laboratory

D. Credit Course units:

Units: 1

Lecture Hours per week: 0

Lab Hours per week : 3

Variable Units : No

E. Student Learning Hours:

Lecture Hours:

Classroom hours: 0 - 0

Laboratory/Activity Hours:

Laboratory/Activity Hours 52.5 - 52.5

Total Combined Hours in a 17.5 week term: 52.5 - 52.5

F. Non-Credit Course hours per week

G. May be taken a total of: [X] 1 [ ] 2 [ ] 3 [ ] 4 time(s) for credit

H. Is the course co-designated (same as) another course: No [X] Yes [ ]
If YES, designate course Subject Code & Number:

I. Course Description:

Examines some of the basic phenomena in wave motion, optics, and modern physics. Uses real-world modern instruments such as digital and analog voltmeters, ammeters, digital storage oscilloscopes, frequency counters, lasers, spectrometers, optical energy and poser meters during the experiments. Teaches the principles of data taking, reduction, synthesis, and analysis, in addition to the writing of scientific reports.

J. Entrance Skills

*Prerequisite: No [ ] Yes [X] Course(s)
PHYS M20B and PHYS M20BL and PHYS M20C or concurrent enrollment and MATH M25C

*Corequisite: No [X] Yes [ ] Course(s)

Limitation on Enrollment: No [X] Yes [ ]

Recommended Preparation: No [X] Yes [ ] Course(s)

Other: No [X] Yes [ ]

K. Other Catalog Information:

II. COURSE OBJECTIVES

Upon successful completion of the course, a student will be able to:

		Methods of evaluation will be consistent with, but not limited by, the following types or examples.
1	analyze real-world experimental data, including appropriate use of units and significant figures.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports
2	relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports
3	assemble and perform experiments in wave motion, optics, and modern physics following instructions in the laboratory manual.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports
4	measure and record the data, including estimated uncertainty, using appropriate units.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports
5	reduce and analyze data, calculate experimental uncertainties, produce and analyze graphs, and summarize the experiment and its results using an appropriate technical writing style.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports
6	critically evaluate the experimental results and procedures using accepted values and other relevant information, and draw conclusions regarding the efficacy of the experimental procedure.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports

7	suggest changes to the experimental procedure which, if implemented, could reduce the experimental uncertainty and/or error.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports
8	suggest practical applications for the values measured, conclusions reached, or methods utilized in the experiment.	Written tests or quizzes before and/or after the experiment Completion of informal or formal laboratory reports

III. COURSE CONTENT

Estimated %	Topic	Learning Outcomes
Lecture (must total 100%)		
Lab (must total 100%)		
7.00%	Melde's Experiment	1, 2, 3, 4, 5, 6, 7, 8
7.00%	The Speed of Sound in Air	1, 2, 3, 4, 5, 6, 7, 8
9.00%	The Speed of Sound in Thin Metal Rods (a formal lab)	1, 2, 3, 4, 5, 6, 7, 8
7.00%	Measuring the Index of Refraction of Glass and Water	1, 2, 3, 4, 5, 6, 7, 8
9.00%	The Speed of Light in Air (a formal lab)	1, 2, 3, 4, 5, 6, 7, 8
7.00%	Spherical Concave Mirrors and Thin Lenses	1, 2, 3, 4, 5, 6, 7, 8
7.00%	Systems of Thin Lenses	1, 2, 3, 4, 5, 6, 7, 8
7.00%	Young's Double Slit	1, 2, 3, 4, 5, 6, 7, 8
7.00%	The Polarization of Light and Optical Stress Analysis	1, 2, 3, 4, 5, 6, 7, 8
7.00%	The Hydrogen Spectrum and Rydberg's Constant	1, 2, 3, 4, 5, 6, 7, 8
9.00%	Electron Diffraction (a formal lab)	1, 2, 3, 4, 5, 6, 7, 8
7.00%	X-ray and the Bragg Angle in NaCl (sodium chloride) Crystals	1, 2, 3, 4, 5, 6, 7, 8
7.00%	Diode Laser Characteristics	1, 2, 3, 4, 5, 6, 7, 8
3.00%	Laser Alignment, Gain,and Longitudinal Modes	1, 3, 4, 5, 6, 7, 8

IV. TYPICAL ASSIGNMENTS

A. Writing assignments

Writing assignments are required. Possible assignments may include, but are not limited to:	
1	respond to questions that require an essay or a brief answer.
2	summarize experimental objectives, method, and results in a concise abstract.
3	write conclusions and analyses in informal laboratory reports using an appropriate technical language style.
4	prepare formal laboratory reports which conform to the style specified in the laboratory manual.

B. Critical thinking assignments

Critical thinking assignments are required. Possible assignments may include, but are not limited to:	
1	solve assigned problems on relativistic length, mass, and time conversions using Lorentz contractions.
2	analyze the experiment and define its goals.
3	comparing and contrasting the various ways an experiment could be conducted.
4	evaluate the significance and relevance of the experimental results.
5	suggest changes in the experimental procedure which could lower the experimental uncertainty of the results.

V. METHODS OF INSTRUCTION

Methods of instruction may include, but are not limited to:

☐ Distance Education – When any portion of class contact hours is replaced by distance education delivery mode (Complete DE Addendum, Section XV)

☐ Lecture/Discussion

☒ Laboratory/Activity

☒ Other (Specify) Demonstrations conducted by the instructor.

☐ Optional Field Trips

☐

☐ Required Field Trips

VI. METHODS OF EVALUATION

Methods of evaluation may include, but are not limited to:

☒ Essay Exam	☒ Classroom Discussion	☒ Skill Demonstration
☒ Problem Solving Exam	☒ Reports/Papers/ Journals	☒ Participation
☒ Objective Exams	☒ Projects	☒ Other (specify)

Students are required to complete a report for each lab exercise. These reports require the mathematical and verbal analyses of the experimental results, and responses to specific questions about the lab.

VII. REPRESENTATIVE TEXTS AND OTHER COURSE MATERIALS

Loyd, David. Physics Laboratory Manual. 4th ed. Cengage Learning, 2014.

Harper, Clinton D. Physics M20C Laboratory Manual. Ver 1.3 ed. Sunshine Publishing, 2010.

Wilson, Jerry, and Cecilia Hernandez-Hall. Physics Laboratory Experiments. 7th ed. Cengage Learning, 2009.

VIII. STUDENT MATERIALS FEES

☒ No ☐ Yes

IX. PARALLEL COURSES

College	*Course Number*	*Course Title*	*Units*
CSU, Northridge	PHYS 227L	Thermodynamics and Modern Physics Laboratory	1
UC, Santa Barbara	PHYS 5L	Physics Lab	1
CSU Long Beach	PHYS 255	Laboratory on Modern Physics	1
CSU Fullerton	PHYS 227L	Fundamental Physics Lab	1
UC Irvine	PHYSICS 52A	Fundamentals of Experimental Physics	2

X. MINIMUM QUALIFICATIONS

Courses Requiring a Masters Degree:
Master's in physics, astronomy, or astrophysics OR Bachelor's in physics or astronomy AND Master's in engineering, mathematics, meteorology, or geophysics OR the equivalent.

XI. ARTICULATION INFORMATION

A. Title V Course Classification:

1. This course is designed to be taken either:

☐ Pass/No Pass only (no letter grade possible); or
☒ Letter grade (P/NP possible at student option)

2. Degree status:
Either ☒ Associate Degree Applicable; or ☐ Non-associate Degree Applicable

B. Moorpark College General Education:

1. Do you recommend this course for inclusion on the Associate Degree General Education list?
   Yes: [X] No: [ ] If YES, what section(s)?

   [ ] A1 - Natural Sciences - Biological Science
   [X] A2 - Natural Sciences - Physical Science
   [ ] B1 - Social and Behavioral Sciences - American History/Institutions
   [ ] B2 - Social and Behavioral Sciences - Other Social Behavioral Science
   [ ] C1 - Humanities - Fine or Performing Arts
   [ ] C2 - Humanities - Other Humanities
   [ ] D1 - Language and Rationality - English Composition
   [ ] D2 - Language and Rationality - Communication and Analytical Thinking
   [ ] E1 - Health/Physical Education
   [ ] E2 - PE or Dance
   [ ] F - Ethnic/Gender Studies

C. California State University(CSU) Articulation:

1. Do you recommend this course for transfer credit to CSU? Yes: [X] No: [ ]

2. If YES do you recommend this course for inclusion on the CSU General Education list?
   Yes: [X] No: [ ] If YES, which area(s)?

   A1 [ ] A2 [ ] A3 [ ] B1 [ ] B2 [ ] B3 [X] B4 [ ]

   C1 [ ] C2 [ ] D1 [ ] D2 [ ] D3 [ ] D4 [ ] D5 [ ]

   D6 [ ] D7 [ ] D8 [ ] D9 [ ] D10 [ ] E [ ]

D. University of California (UC) Articulation:

1. Do you recommend this course for transfer to the UC? Yes: [X] No: [ ]

2. If YES do you recommend this course for the Intersegmental General Education Transfer Curriculum (IGETC)? Yes: [X] No: [ ]

   IGETC Area 1: English Communication

   [ ] English Composition
   [ ] Critical Thinking-English Composition
   [ ] Oral Communication

   IGETC Area 2: Mathematical Concepts and Quantitative Reasoning

   [ ] Mathematical Concepts

   IGETC Area 3: Arts and Humanities

   [ ] Arts

- [ ] Humanities

IGETC Area 4: Social and Behavioral Sciences

- [ ] Anthropology and Archaeology
- [ ] Economics
- [ ] Ethnic Studies
- [ ] Gender Studies
- [ ] Geography
- [ ] History
- [ ] Interdisciplinary, Social & Behavioral Sciences
- [ ] Political Science, Government & Legal Institutions
- [ ] Psychology
- [ ] Sociology & Criminology

IGETC Area 5: Physical and Biological Sciences (mark all that apply)

- [ ] Physical Science Lab or Physical Science Lab only (none-sequence)
- [ ] Physical Science Lecture only (non-sequence)
- [ ] Biological Science
- [ ] Physical Science Courses
- [ ] Physical Science Lab or Biological Science Lab Only (non-sequence)
- [ ] Biological Science Courses
- [ ] Biological Science Lab course
- [ ] First Science course in a Special sequence
- [ ] Second Science course in a Special Sequence
- [X] Laboratory Activity
- [ ] Physical Sciences

IGETC Area 6: Language other than English

- [ ] Languages other than English (UC Requirement Only)
- [ ] U.S. History, Constitution, and American Ideals (CSU Requirement ONLY)
- [ ] U.S. History, Constitution, and American Ideals (CSU Requirement ONLY)

XII. REVIEW OF LIBRARY RESOURCES

A. What planned assignment(s) will require library resources and use?

The following assignments require library resources: None

B. Are the currently held library resources sufficient to support the course assignment?

YES: [X] NO: [ ]

If NO, please list additional library resources needed to support this course.

XIII. PREREQUISITE AND/OR COREQUISITE JUSTIFICATION

Requisite Justification for PHYS M20B

[X] A. Sequential course within a discipline.

1. analyze simple static charge distributions and calculate the resulting electric field and electric potential.

2. analyze simple current distributions and calculate the resulting magnetic field.

3. predict the trajectory of charged particles in uniform electric and magnetic fields.

4. analyze DC and AC circuits in terms of current, potential difference, and power dissipation for each element.

5. recognize, recall, and apply the equations that describe physical phenomena involving thermodynamics and electromagnetism.

6. demonstrate ability to analyze and solve physics problems of greater than average difficulty using calculus.

7. demonstrate ability to analyze and synthesize physics problems of greater than average complexity and evaluate and judge the results of the solutions to these problems.

[ ] B. Standard Prerequisite or Corequisite required by universities.

[ ] C. Corequisite is linked to companion lecture course.

[ ] D. Prerequisite or Corequisite is authorized by legal statute or regulation.
Code Section: _____

[ ] E. Prerequisite or Corequisite is necessary to protect the students' health and safety.

[ ] F. Computation or communication skill is needed.

[ ] G. Performance courses: Audition, portfolio, tryouts, etc. needed.

and

Requisite Justification for PHYS M20BL

[X] A. Sequential course within a discipline.

1. assemble and perform experiments in thermodynamics and electromagnetism following instructions in the laboratory manual.

2. measure and record the data, including estimated uncertainty, using appropriate units and significant figures.

3. reduce and analyze real-world experimental data, calculate uncertainties, produce and analyze graphs, and summarize the experiment and its results using an appropriate technical writing style.

4. critically evaluate the experimental results and procedures using accepted values and other relevant information, and draw conclusions regarding the efficacy of the experimental procedure related to the lecture portion of the class.

5. suggest changes to the experimental procedure which, if implemented, could reduce the experimental uncertainty and/or error.

6. suggest practical applications for the values measured, conclusions reached, or methods utilized in the experiment.

☐ B. Standard Prerequisite or Corequisite required by universities.

☐ C. Corequisite is linked to companion lecture course.

☐ D. Prerequisite or Corequisite is authorized by legal statute or regulation.
Code Section: _____

☐ E. Prerequisite or Corequisite is necessary to protect the students' health and safety.

☐ F. Computation or communication skill is needed.

☐ G. Performance courses: Audition, portfolio, tryouts, etc. needed.

and

Requisite Justification for PHYS M20C or concurrent enrollment

☒ A. Sequential course within a discipline.

1. analyze basic physical situations involving reflection and refraction and use this analysis to predict the path of a light ray.

2. analyze situations involving interference and diffraction of light waves and apply these to situations including double slits, diffraction gratings, and wide slits.

3. apply concepts from special relativity to analyze physical situations, including time dilation, length contraction, and the Lorentz transformation; solve basic problems involving relativistic momentum

and energy.

4. apply basic concepts of quantum mechanics to analyze basic physical setups, including a particle in a box and simple atomic models.

5. recognize and apply the equations that describe physical phenomena involving wave motion, optics, and modern physics.

6. demonstrate ability to analyze and solve physics problems of greater than average difficulty.

7. demonstrate ability to analyze, synthesize physics problems of reasonable complexity and evaluate and judge the results of the solutions to these problems.

☐ B. Standard Prerequisite or Corequisite required by universities.

☐ C. Corequisite is linked to companion lecture course.

☐ D. Prerequisite or Corequisite is authorized by legal statute or regulation.
Code Section: _____

☐ E. Prerequisite or Corequisite is necessary to protect the students' health and safety.

☐ F. Computation or communication skill is needed.

☐ G. Performance courses: Audition, portfolio, tryouts, etc. needed.

and

Requisite Justification for MATH M25C

☐ A. Sequential course within a discipline.

☒ B. Standard Prerequisite or Corequisite required by universities.

CSU Northridge, UC Los Angeles, UC Santa Barbara

☐ C. Corequisite is linked to companion lecture course.

☐ D. Prerequisite or Corequisite is authorized by legal statute or regulation.
Code Section: _____

☐

- [ ] E. Prerequisite or Corequisite is necessary to protect the students' health and safety.

- [ ] F. Computation or communication skill is needed.

- [ ] G. Performance courses: Audition, portfolio, tryouts, etc. needed.

XIV. WORKPLACE PREPARATION

PHYS M20CL: Not Applicable

XV. DISTANCE LEARNING COURSE OUTLINE ADDENDUM

PHYS M20CL: Not Applicable

XVI. GENERAL EDUCATION COURSE OUTLINE ADDENDUM

General Education Division of Learning [check all applicable boxes]:

- [X] Natural Sciences
  - [ ] Biological Science
  - [X] Physical Science
- [ ] Social and Behavioral Sciences
  - [ ] American History/Institutions
  - [ ] Other Social Science
- [ ] Humanities
  - [ ] Fine or Performing Arts
  - [ ] Other Humanities
- [ ] Language and Rationality
  - [ ] English Composition
  - [ ] Communication and Analytical Thinking
- [ ] Health/Physical Education
- [ ] Ethnic/Women's Studies

Check either Option 1 or Option 2

- [X] **OPTION #1:** Moorpark College has already received approval from the CSU and/or UC systems for this course to fulfill a GE requirement. Note: This option applies only to technical revisions and updated courses.
- [ ] **OPTION #2:** Moorpark College has not received approval from the CSU and/or UC systems for this course to fulfill a GE requirement. This option applies to all new and substantively revised courses.

XVII. STUDENT MATERIALS FEE ADDENDUM

PHYS M20CL: Not Applicable

XVIII. REPEATABILITY JUSTIFICATION TITLE 5, SECTION 55041

PHYS M20CL: Not Applicable

XIX. CURRICULUM APPROVAL

Course Information:

Discipline: PHYSICS

Discipline Code and Number: PHYS M20CL

Course Revision Category: Outline Update

Course Proposed By:

Originating Faculty Ronald Wallingford 03/27/2013

Faculty Peer: Scarlet Relle 10/22/2013

Curriculum Rep: Robert Keil 04/01/2013

Department Chair: Ronald Wallingford 10/18/2013

Division Dean: Julius Sokenu 10/28/2013

Approved By:

Curriculum Chair: Jerry Mansfield 12/14/2013

Executive Vice President: Lori Bennett 12/18/2013

Articulation Officer: Letrisha Mai 11/19/2013

Librarian: Mary LaBarge 11/19/2013

Implementation Term and Year: Fall 2014

Approval Dates:

Approved by Moorpark College Curriculum Committee: 12/03/2013

Approved by Board of Trustees (if applicable): _____

Approved by State (if applicable): _____