# ENGR M12L: ENGINEERING MATERIALS LAB

**Originator**
srelle

**College**
Moorpark College

**Discipline (CB01A)**
ENGR - Engineering

**Course Number (CB01B)**
M12L

**Course Title (CB02)**
Engineering Materials Lab

**Banner/Short Title**
Engineering Materials Lab

**Credit Type**
Credit

**Start Term**
Spring 2020

**Catalog Course Description**
Provides opportunities to directly observe and study the interrelationships between engineering materials' structure and properties. Teaches the operation of engineering materials testing equipment, data gathering and analysis, and technical writing mechanics through formal laboratory reports.

**Taxonomy of Programs (TOP) Code (CB03)**
0924.00 - *Engineering Technology, General (requires Trigonometry)

**Course Credit Status (CB04)**
D (Credit - Degree Applicable)

**Course Transfer Status (CB05) (select one only)**
A (Transferable to both UC and CSU)

**Course Basic Skills Status (CB08)**
N - The Course is Not a Basic Skills Course

**SAM Priority Code (CB09)**
C - Clearly Occupational

**Course Cooperative Work Experience Education Status (CB10)**
N - Is Not Part of a Cooperative Work Experience Education Program

**Course Classification Status (CB11)**
Y - Credit Course

**Educational Assistance Class Instruction (Approved Special Class) (CB13)**
N - The Course is Not an Approved Special Class

**Course Prior to Transfer Level (CB21)**
Y - Not Applicable

**Course Noncredit Category (CB22)**
Y - Credit Course

**Funding Agency Category (CB23)**
Y - Not Applicable (Funding Not Used)

**Course Program Status (CB24)**
1 - Program Applicable

**General Education Status (CB25)**
Y - Not Applicable

**Support Course Status (CB26)**
N - Course is not a support course

**Field trips**
Will not be required

**Grading method**
Letter Graded

**Alternate grading methods**
Student Option- Letter/Pass
Pass/No Pass Grading

**Does this course require an instructional materials fee?**
No

**Repeatable for Credit**
No

**Is this course part of a family?**
No

## Units and Hours

**Carnegie Unit Override**
No

## In-Class

**Lecture**

**Activity**

**Laboratory**
**Minimum Contact/In-Class Laboratory Hours**
52.5
**Maximum Contact/In-Class Laboratory Hours**
52.5

## Total in-Class

**Total in-Class**
**Total Minimum Contact/In-Class Hours**
52.5
**Total Maximum Contact/In-Class Hours**
52.5

## Outside-of-Class

**Internship/Cooperative Work Experience**

**Paid**

**Unpaid**

## Total Outside-of-Class

**Total Outside-of-Class**

## Total Student Learning

**Total Student Learning**

**Total Minimum Student Learning Hours**

52.5

**Total Maximum Student Learning Hours**

52.5

**Minimum Units (CB07)**

1

**Maximum Units (CB06)**

1

**Prerequisites**

ENGR M12 or concurrent enrollment

## Entrance Skills

**Prerequisite Course Objectives**

ENGR M12-explain the interrelationships between processing, structure, properties, and performance for various engineering materials such as metals, polymers, ceramics, composites, and semiconductors.
ENGR M12-discuss the nature of chemical bonds and their effects on microscopic structure and macroscopic properties of crystalline and non-crystalline materials.
ENGR M12-discuss and calculate mechanical, chemical, electrical, thermal, and magnetic properties for various engineering materials.
ENGR M12-discuss imperfections in solids and examine their role in determining material properties.
ENGR M12-distinguish between steady-state and non-steady state diffusion; explain what factors influence diffusion and solve for diffusion rates.
ENGR M12-identify, explain, and calculate various design parameters related to material failure.
ENGR M12-propose an appropriate material for a particular application based on design and performance criteria, material properties, economics, and societal and environmental impacts.

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## Requisite Justification

**Requisite Type**

Prerequisite

**Requisite**

ENGR M12 Lecture Course

**Requisite Description**

Course in a sequence

**Level of Scrutiny/Justification**

Closely related lecture/laboratory course

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**Requisite Type**

Concurrent

**Requisite**

ENGR M12 Lecture Course

**Requisite Description**

Course in a sequence

**Level of Scrutiny/Justification**

Closely related lecture/laboratory course

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**Student Learning Outcomes (CSLOs)**

| | Upon satisfactory completion of the course, students will be able to: |
|---|---|
| 1 | measure material properties using standard materials testing equipment and techniques. |
| 2 | gather and analyze experimental data, and discuss experimental findings as they relate to material processing, structure, and property. |

**Course Objectives**

| | Upon satisfactory completion of the course, students will be able to: |
|---|---|
| 1 | operate, safely and correctly, typical material properties testing equipment, such as tensile tester, hardness tester, impact tester, x-ray diffractometer, etc. |
| 2 | make material properties measurements, such as mechanical, electrical, deteriorative, thermal, optical, etc. |
| 3 | collect and analyze data, construct and interpret graphs, and evaluate and discuss experimental findings as they relate to material processing, structure, and property. |
| 4 | evaluate the results of various material processing techniques, such as heat treating, cold working, and powder pressing, on material properties. |
| 5 | report experimental findings in informal or formal laboratory reports using an appropriate technical writing style. |

## Course Content

**Lecture/Course Content**

Does not apply.

**Laboratory or Activity Content**

Laboratory activities cover a range of topics, activities, and experiments that draw from the following content:

- **6.25% - Lab safety, proper testing techniques, data collection, error analysis**
- **6.25% - Atomic structure and bonding**
- **6.25% - Crystal structures and crystallography using x-ray diffraction**
- **6.25% - Imperfections in crystals, including polycrystalline, semi-crystalline, and amorphous solids**
- **6.25% - Diffusion**
  - Metals and metal alloys
- **6.25% - Strengthening and toughening in metals**
  - Metal forming and fabrication
- **12.5% - Mechanical properties and testing of metals, polymers, ceramics**
  - Elastic and plastic deformation
  - Stress-strain analysis
- **12.5% - Mechanical failure: fracture, fatigue, creep**
  - Metals, polymers, ceramics
- **6.25% - Phase diagrams**
  - Phase transformations
- **12.5% - Iron-Carbon system**
  - Heat treatment of steels
- **6.25% - Thermal, electrical and magnetic properties**
  - Conductors and insulators
- **6.25% - Chemical properties**
  - Corrosion
- **6.25% - Semiconductors**

Laboratory experiments will use testing and measuring devices such as tensile tester, hardness tester, toughness tester, x-ray diffractometer, oven, etc. Evaluation of material properties and behavior will be based upon various standard materials testing techniques including but not limited to: Hardness, tension, compression, impact, fatigue, creep. Various processing treatments of metals and metal alloys such as strain hardening, cold working, heat treating, recrystallization, Jominy, precipitation hardening, etc. will be discussed and utilized.

## Methods of Evaluation

**Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):**

Problem solving exercises
Skills demonstrations
Written expression

**Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):**

Classroom Discussion
Group projects
Individual projects
Laboratory activities
Laboratory reports
Projects
Participation
Reports/Papers/Journals
Skills demonstrations

## Instructional Methodology

**Specify the methods of instruction that may be employed in this course**

Computer-aided presentations
Class activities
Class discussions
Demonstrations
Group discussions
Guest speakers
Instructor-guided interpretation and analysis
Instructor-guided use of technology
Internet research
Laboratory activities
Small group activities

**Describe specific examples of the methods the instructor will use:**

For each lab activity the instructor will:

- explain the applicable theory and background information
- explain the use of technology and instrumentation as appropriate
- demonstrate the data collection and analysis techniques as appropriate

## Representative Course Assignments

**Writing Assignments**

- Summarize the experimental objectives, methods, and results in a concise abstract. An example would be: Prepare an abstract for the crystallography experiment where x-ray diffraction was used to study crystal structures of metals and to identify unknown metals.
- Respond to instructor-posed questions in informal laboratory reports. An example would be: Explain how metal strengthening techniques are related to crystalline defects known as dislocations.
- Prepare formal laboratory reports which conform to the technical writing style specified by the instructor or in the laboratory manual. An example would be: Using American Society of Mechanical Engineers (ASME) writing guidelines, prepare a formal laboratory report on the mechanical properties and testing of metals and polymers.

**Critical Thinking Assignments**

- Compare and contrast the various experimental methods which can be used to achieve the objectives of an experiment. An example would be: Identify and explain two heat treating techniques that could be used to enhance the strength of a 1018 steel, and discuss the benefits and drawbacks of each technique.
- Analyze the collected data, evaluate the experimental results, and determine whether or not the objectives of the experiment were achieved. An example would be: Using microscopic images of grains and grain boundaries, in addition to tensile testing results, discuss whether or not the heat treatment techniques used for changing the mechanical properties of 1018 and 1050 steels were successful.

**Reading Assignments**

- Read the relevant sections of the Materials Science and Engineering Laboratory Manual used in the course or the laboratory handout prepared by the instructor to prepare for the weekly experimental work.

- Research using the Library's print or on-line resources to find additional information on how manipulation of material properties via various processing techniques is used in our technology. An example would be: Research how the electrical properties of intrinsic semiconductors can be enhanced by a process known as doping and answer the questions in the laboratory handout.

**Skills Demonstrations**

- Demonstrate how the tensile tester is used to study the mechanical properties of metals, polymers, ceramics, and composites.
- Demonstrate how to calibrate the hardness tester and how to use it to test the hardness of metals and their alloys which can range from relatively soft to relatively hard.
- Demonstrate how to operate the x-ray diffractometer and how to use the analysis software to study crystal structures and to identify unknown metals.

## Outside Assignments

## Articulation

**C-ID Descriptor Number**
ENGR 140L

**Status**
Approved

**Additional C-ID Descriptor(s)**

| C-ID Descriptor(s) | Status |
|---|---|
| ENGR 140B (with ENGR M12L) | Approved |

**Equivalent Courses at 4 year institutions**

| University | Course ID | Course Title | Units |
|---|---|---|---|
| Cal Poly, SLO | MATE 215 | Materials Lab | 1 |
| UC, Davis | ENGIN 45 | Properties of Materials | 1 |
| San Diego State Univeristy | ME 241 | Materials Lab | 1 |
| CSU, Northridge | MSE 227L | Materials Science and Engineering Laboratory | 1 |
| CSU Fresno | ME 32 | Engineering Materials Lab | 1 |

**Comparable Courses within the VCCCD**
ENGR V18L - Engineering Materials Lab

**Equivalent Courses at other CCCs**

| College | Course ID | Course Title | Units |
|---|---|---|---|
| Reedley College | ENGR 4L | Engineering Materials Lab | 1 |

## District General Education

## A. Natural Sciences

## B. Social and Behavioral Sciences

## C. Humanities

## D. Language and Rationality

## E. Health and Physical Education/Kinesiology

## F. Ethnic Studies/Gender Studies

**Course is CSU transferable**
Yes

**CSU Baccalaureate List effective term:**
Fall 2015

## CSU GE-Breadth

## Area A: English Language Communication and Critical Thinking

## Area B: Scientific Inquiry and Quantitative Reasoning

## Area C: Arts and Humanities

## Area D: Social Sciences

## Area E: Lifelong Learning and Self-Development

## CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

## UC TCA

**UC TCA**
Approved

## IGETC

## Area 1: English Communication

## Area 2A: Mathematical Concepts & Quantitative Reasoning

## Area 3: Arts and Humanities

## Area 4: Social and Behavioral Sciences

## Area 5: Physical and Biological Sciences

## Area 6: Languages Other than English (LOTE)

## Textbooks and Lab Manuals

**Resource Type**
Manual

**Description**
Ashraf, S.M., Ahmad, S., and Riaz, U. (2011). *A laboratory manual of metals and alloys: Volume II* (2nd rev. ed.). I K International Publishing.

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**Resource Type**
Manual

**Description**
Hatt, W. K. (2017). *Laboratory manual of testing materials,* (Kindle ed.). HardPress Publishing.

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**Resource Type**
Other Instructional Materials

**Description**
Current editions of laboratory manuals that are typically developed on-site.

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## Library Resources

**Assignments requiring library resources**
Final laboratory design project or questions in the laboratory handout that may require information beyond what is directly discussed or presented in the course.

**Sufficient Library Resources exist**
Yes

**Example of Assignments Requiring Library Resources**
Research using the Internet to find reference hardness values either in Rockwell scale or Brinell scale for lead-tin alloys and compare them to your experimental values by calculating percent errors.

**Primary Minimum Qualification**
ENGINEERING

## Review and Approval Dates

**Department Chair**
09/22/2019

**Dean**
09/26/2019

**Technical Review**
10/03/2019

**Curriculum Committee**
10/15/2019

**DTRW-I**
MM/DD/YYYY

**Curriculum Committee**
MM/DD/YYYY

**Board**
MM/DD/YYYY

**CCCCO**
10/18/2019

**Control Number**
CCC000564896

**DOE/accreditation approval date**
MM/DD/YYYY