# PALOMAR COLLEGE
# COURSE OUTLINE OF RECORD FOR
# DEGREE CREDIT COURSE

_X_ Transfer course _X_ A.A. degree applicable course
(check all that apply)

**COURSE NUMBER AND TITLE:** ENGR 245 Properties of Materials

**UNIT VALUE:** 3

**MINIMUM NUMBER OF SEMESTER HOURS:** 80

**BASIC SKILLS REQUIREMENTS:** Appropriate language and computation skills.

**ENTRANCE REQUIREMENTS**

**PREREQUISITE:** CHEM 110 and CHEM 110L

**COREQUISITE:** None

**RECOMMENDED PREPARATION:** None

**SCOPE OF COURSE:**
Physical properties of engineering materials. Atomic, molecular, and crystal-lattice characteristics. Relations between these and mechanical, thermal, electrical, corrosion, and radiation properties. Metallic, ceramic, polymer, and agglomerate materials. Selection, treatment, and use of materials.

**SPECIFIC COURSE OBJECTIVES:**
The successful student will be able to:

1. Apply the principles underlying the physical behavior of materials - particularly those used in engineering.
2. Apply information about the behavior and treatment of some of the most common and most frequently used material systems.
3. Prepare and write technical reports.
4. Use critical thinking to analyze and solve problems in class assignments, laboratory work, individual preparation of laboratory reports, quizzes, and examinations.

**CONTENT IN TERMS OF SPECIFIC BODY OF KNOWLEDGE:**
I. LECTURE

1. Types of Engineering Materials
   a. Metals
   b. Ceramics
   c. Polymers
   d. Composites
2. Applications
   a. Tools
   b. Structures
   c. Containers

   d. Films
   e. Electrical and Magnetic Devices
3. Material Behavior
   a. Stress
   b. Strain
   c. Expansion
   d. Conduction
   e. Electromagnetism
   f. Corrosion
   g. Failure of Design Behavior
4. Submicroscopic Factors
   a. Bonding
   b. Coordination
   c. Crystal Lattices
   d. Lattice Defects
   e. Solid-State Charge Transport
5. Macroscopic Factors
   a. Thermal and Mechanical Treatment
   b. Agglomeration
6. Metal Alloy Systems
   a. Ferrous Alloys
   b. Non-ferrous Alloys
7. Ceramics
   a. Natural
   b. Modified
8. Polymers
   a. Natural
   b. Synthetic
9. Wood, Concretes, Laminates, and Agglomerates
10. Measurements
   a. Precision
   b. Error
   c. Variability
   d. Testing and Testing Methods

II. LABORATORY

1. Plastic and elastic deformation. Stress-Strain diagrams; the effect of discontinuities; stress concentration, strain relaxation; Poisson's ratio. A rubber model is used.

2. Crystal Lattice Models. Unit cells, Miller indices, Burgers vectors; volume, area and linear densities, packing fraction. Construction of hard-ball models.

3. Hardness and tensile testing. Rockwell and Brinell tests for a variety of ferrous and non-ferrous models. Tensile tests: stress and strain; Young's modulus.

4. Transformation of iron allotropes. Lattice shift due to phase transformation. Size and density changes. Thermal expansion.

5. Recrystallization of cold-worked brass. Recrystallization with gradients of cold work and of temperature. Micrographic preparation and examination; comparison and correlation with hardness variations.

6. Hardening, tempering and annealing of steels. Low- and high-carbon steels: comparisons of ductility, malleability, hardness and brittleness.

7. Phase Diagrams. Cooling curves and micrographic examination of lead-antimony alloys.

8. Brittle Transformation of steels. Temperature and toughness of different steels. Use of Charpy and Izod tests.

9. Hardenability of Steels. Use of a metallurgical furnace for a Jominy-type test. Hardenability of several steels.

10. Precipitation hardening of aluminum. Solution treatment and precipitation hardening in different aluminum alloys. Overaging and atmospheric stress corrosion.

11. Corrosion processes. Review of processes and mechanisms. Demonstration examples, slides to illustrate various corrosion mechanism.

12. Aggregate materials. Sieve analyses; bulking of sand; unit weights of different mixes.

13. Concrete: mixing and wet properties. Batch proportions, varying cement content and water/cement ratio. Slump cone and Kelly ball tests; unit weights and placement characteristics. Casting.

14. Concrete Testing. Variation in strength with cement content and with water/cement ratio. Cost and reliability factors.

Experiment 5 works much better if two periods are allowed. Experiment 11 is essentially a demonstration with presentation of material beyond that available in the text.

**REQUIRED READING:**

William D. Callister, Jr. Materials Science and Engineering. 5th edition. New York: Wiley & Sons, Inc., 2000.

**SUGGESTED READING:**

Weast, J.F., et al. Handbook of Chemistry and Physics. Ohio: Chemical Rubber Co., 1989.

**REQUIRED WRITING:**

Each student is required to prepare and submit a report on seven to nine laboratory experiments. Sufficient time must be spent to permit the preparation of a thorough and careful report. Grading of reports is based upon:

1. Effectiveness (organization, lucidity , completeness, conciseness).
2. Correctness and clear, logical presentation of date, calculations and diagrams, tables, graphs or illustrations where appropriate.
3. Interpretation and explanation of experiments, data and conclusions.
4. Each report will be from 1500 to 3500 words long.
5. Laboratory reports not summarized by individual reports will be graded by written quizzes.

**OUTSIDE ASSIGNMENTS:**
**Students are expected to spend a minimum of three hours per unit per week in class and on outside assignments, prorated for short-term classes.**

Complete written laboratory reports. Considerable outside time will be necessary for the preparation of these reports, until the student becomes skilled in report writing. Read assigned portions of the text. Review and correlate class notes to assigned portions of the test.

**INSTRUCTIONAL METHODOLOGY:**

**Check all that apply:**
_X_ lecture
_X_ laboratory
_____ lecture-laboratory combination
____ directed study

**This course may be offered as a distance learning course and meets Title 5 regulations 55370, 55372, 55374, 55376, 55378, and 55380.**
Yes _____ No_X_.

**If yes, check all that apply.**

____ Television Course (Video one-way, e.g. ITV, video cassette, etc.)
____ Online Course (Text one-way, e.g. newspaper, correspondence, electronic file, etc.)
____ Two-Way Video Conferencing (Two-way interactive video and audio)
____ One-Way Video Conferencing (One-way interactive video and two-way interactive audio)
____ Computer Assisted Instruction (A specialized form of mediated instruction relying primarily on student access to information and prepared lessons or teaching materials through a computer terminal, but not under immediate supervision of a qualified instructor.)

**GRADING POLICY AND STANDARDS** (include methods of determining whether the stated objectives have been met by students):
Lecture Grade will be based upon a total accumulation of points acquired in open-book, problem-based examinations:

| | |
|---|---|
| 3 one-hour exams | 300 points |
| 1 two-hour final exam | 200 points |
| | 500 points possible |

Laboratory Grade will be based upon reports scores, performance in laboratory, and quiz scores. Example:

| | |
|---|---|
| 7 reports | 140 points |
| 2 projects chief | 20 points |
| 5 quizzes | 50 points |
| | 210 points possible |

(Late reports lose 10% per calendar day.)
Two-thirds of the course grade will be determined from the lecture grade, one-third from the laboratory grade. However, a passing grade in the course is contingent upon a passing laboratory grade.

**IS COURSE REPEATABLE FOR REASON(S) OTHER THAN DEFICIENT GRADE?**
Yes ___ No _X_ Number of times course may be taken for credit: _1_.

If yes, identify specific provision of Title 5 Division 2 section(s), 55761-55763 and 58161 which qualifies course as repeatable:

**CONTACT PERSON:** William Bedford

**SIGNATURES:**

SIGNATURES ON FILE

*I certify that this course meets all the minimum requirements for A.A. degree applicable courses.

Course outlines of record should be reviewed regularly and revised as necessary.

NOTE: Some revisions to course outlines of record require Curriculum Committee approval, others may not. Please consult your dean or the Instruction Office if you need assistance.