

**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 231 – Engineering Measurement Analysis

**UNIT VALUE:** 3

**MINIMUM NUMBER OF SEMESTER HOURS:** 80

**BASIC SKILLS REQUIREMENTS:** Appropriate language and computational skills

**ENTRANCE REQUIREMENTS**

**PREREQUISITE:** Math 140

**COREQUISITE:** None

**RECOMMENDED PREPARATION:** None

**SCOPE OF COURSE:**

Analysis and treatment of engineering data. Probability, statistics, error theory, correlation and regression analysis, dimensional analysis, data processing, and preparation of technical reports. Laboratory experiments in hydraulic flow, surveying, heat transfer, and static and dynamic test systems.

**SPECIFIC COURSE OBJECTIVES:**

The successful student will be able to:

1. Apply statistical methods utilized in engineering application.
2. Plan, coordinate, complete, and describe experimental laboratory work.
3. Prepare and write technical reports.
4. Think critically in successful reasoning from observation to generalization in experimental work.

**CONTENT IN TERMS OF SPECIFIC BODY OF KNOWLEDGE:**

**LECTURE:**

- I. Measurements:
  - A. Standards
  - B. Accuracy
  - C. Precision
  - D. Error
  - E. Types of error
- II. Data reduction and presentation

- III. Data distributions
  - A. Binomial
  - B. Gaussian or normal
  - C. Poisson
- IV. Significance of abnormal distributions
- V. Distribution characteristics
  - A. Central tendency
  - B. Dispersion
- VI. Rejection of outlying data
  - A. Experimental blunder
  - B. Statistical criteria
- VII. Data analysis by graphical and statistical methods
- VIII. Error theory
  - A. Propagation of error
  - B. Mathematical models
  - C. Mechanical analogs
  - D. Empirical systems
- IX. Probability, permutations and combinations
- X. Dimensional analysis - reduction of variables
- XI. Statistical inference
  - A. z- and t- tests
  - B. Chi-squared test
  - C. F ratio
- XII. Nonparametric tests
- XIII. Regression analysis and correlations
- XIV. Experiment planning and design
- XV. Systems and controls
- XVI. Report writing

**LABORATORY:**

1. Accuracy, precision and types of systematic error. A Bourdon pressures gauge is calibrated against a dead-weight tester. Types of error are identified from the data and mechanical corrections are suggested.
2. Statistical description of data: central tendency, dispersion; histogram and frequency polygon; plot of ogive on probability coordinates to determine normality of distribution. A Rockwell hardness tester is used.
3. Probability: random distribution and frequency polygons. Dice are thrown; coins are tossed.
4. Standardization and calibration. "Unknown" thermocouples are standardized against phase-change temperatures, using a potentiometer.
5. Plane surveying: determination of an inaccessible distance. An irregular tetrahedron is surveyed. Solution of the problem requires a review of trigonometry and of simultaneous equations.
6. Dimensional analysis: principal harmonic frequency of a wire as a function of controlled variables.
7. Dimensional analysis: heat transfer as a function of controlled variables (Reynolds number, Prandtl number and the Dittus-Boelter equation).
8. Flow measurement of incompressible fluids. Part I: coefficient of a sharp-edged orifice. Part II: coefficient of a triangular wier.
9. Topographical surveying: determination of elevations.  
Inference tests for significance of difference: four systems for measuring rotational speed.
10. Transient-state analysis. A continuous-flow stirred tank using heat content as a reaction analogy.

Since experiments listed as 5, 6, 7, 8, and 9 often cannot be completed in a single laboratory period, not all of the experiments listed would be performed in any particular semester.

**REQUIRED READING:**

Johnson, Richard. Miller & Freund's Probability and Statistics for Engineers. 6<sup>th</sup> Ed. Englewood Cliffs: Prentice Hall, 2000.

**SUGGESTED READING:**

Spiegel. Statistics. Schaum's College Outline Series, 1986.

Schenck. Theories of Engineering Experimentation. New York: McGraw Hill, 1995.

**REQUIRED WRITING:**

Each student is required to prepare and submit a report on each laboratory experiment. Grading of reports is based upon:

1. Effectiveness (organization, lucidity, completeness, conciseness).
2. Correctness and clear, logical presentation of data, calculations and diagrams, tables, graphs or illustrations where appropriate.
3. Interpretation and explanation of 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.**

Each student is expected to spend at least two hours in study preparation outside the class for each lecture hour. Complete written laboratory reports. Considerable outside time will be necessary for the preparation of these reports until the student becomes skilled in report writing.

**INSTRUCTIONAL METHODOLOGY:****Check all that apply:**

- lecture  
 laboratory  
 lecture-laboratory combination  
 directed study

**DISTANCE LEARNING:**

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

Yes  No

**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: Three one-hour examination (300 points)  
Final examination (200 points)

LABORATORY: Laboratory report scores and performance (150 points)

Laboratory counts one-third of the course grade; lecture counts two-thirds, except that if laboratory grade = F, the course grade = F.

**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 and Takashi Nakajima

**SIGNATURES ON FILE**