Please check one:  ☑ New course  ☐ Revised course

PART I: CATALOG DESCRIPTION
1. Course prefix and number: BIO 5385
2. Title: Experimental Design
3. Long title: Experimental Design for the Laboratory and Field
4. Class hours per week, lab hours per week, and credit: 2-2-3
5. Term(s) to be offered:  ☑ Fall  ☐ Spring  ☐ Summer  ☐ On demand
6. Initial term of offering:  ☑ Fall  ☐ Spring  ☐ Summer  ☐ Year 2007
7. Course description: This course will explore the design, implementation and analysis of scientific experiments in biology from a statistical perspective for field and laboratory based studies. The course will focus on the use of modern statistical approaches that include mixed-model, permutational and multi-model procedures within the context of readily available statistical software packages.

8. Registration restrictions:
   a. Identify any equivalent courses:
   b. Prerequisite(s): BIO 4750 or MAT 2250G; Not concurrently
   c. Who can waive the prerequisite(s)?
      ☐ No one  ☐ Chair  ☑ Instructor  ☐ Advisor  ☐ Other (Please specify)
   d. Co-requisites:
   e. Repeat status:  ☑ Course may not be repeated.
   f. Degree, college, major(s), level, or class to which registration in the course is restricted, if any:
   g. Degree, college, major(s), level, or class to be excluded from the course, if any:

9. Special course attributes
10. Grading methods:  ☑ Standard letter  ☐ C/NC  ☐ Audit  ☐ ABC/NC
11. Instructional delivery method: lecture lab combined

PART TWO: ASSURANCE OF STUDENT LEARNING
1. List the student learning objectives of this course:
   i. Identify how to take a problem or hypothesis and translate it into a usable statistical design (Effective critical thinking and problem solving)
   ii. Utilize modern statistical techniques including mixed-models, permutational statistics and Bayesian inference that can provide a more powerful analytic framework compared to traditional parametric statistics (Depth of content knowledge)
iii. Develop a proficiency in the use of the SAS statistical package for standard and non-standard analyses (Depth of content knowledge)

iv. Apply skills in integrating statistics into their research and scholarly activities (Advanced scholarship through research or creative activity)

v. Integrate the techniques learned into a research project suitable for their progress in their research program (Effective oral and written communication)

2. Identify the assignments/activities the instructor will use to determine how well students attained the learning objectives:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Term Exams (2) (30%)</th>
<th>Laboratory Exercises and Discussion (30%)</th>
<th>Class Participation (10%)</th>
<th>Project (15%)</th>
<th>Final Exam (15%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify how to take a problem or hypothesis and translate it into a usable statistical design</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Utilize modern statistical techniques including mixed-models, permutational statistics and Bayesian inference that can provide a more powerful analytic framework compared to traditional parametric statistics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Develop a proficiency in the use of the SAS statistical package for standard and non-standard analyses</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td>Apply skills in integrating statistics into their research and scholarly activities</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrate the techniques learned into a research project suitable for the students progress in their research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

3. Explain how the instructor will determine students’ grades for the course:
   Assessment will be based upon two term exams (30%), Laboratory Exercises and Discussions (30%), Class Participation (10%), Project (15%) and a Final Exam (15%)

4. For technology-delivered and other nontraditional-delivered courses/sections, address the following:
   Not Technology Delivered
5. For courses numbered 4750-4999, specify additional or more stringent requirements for students enrolling for graduate credit. **Not Applicable**

6. If applicable, indicate whether this course is writing-active, writing-intensive, or writing-centered, and describe how the course satisfies the criteria for the type of writing course identified. (See Appendix *.)

   **Writing Active – Students will have one major project plus they will have laboratory write-ups and scientific paper methodology reviews to complete.**

**PART III: OUTLINE OF THE COURSE**

b. Units of time: 2 fifty-minute lectures and 1 two-hour laboratory/discussion for 15 weeks.

   **Week 1**
   • Sampling Design or Designer Samples
   • Karl Popper and Stuart Hurlburt (Pseudoreplication in Fact and Fiction)
   • Describing Things or How a Computer Can Make Lying Easy

   **Week 2**
   • Lab Exercise – Leaves of Grass (or Oak)
   • What Does Improbably Likely Mean
   • What DIF Does it Make?

   **Week 3**
   • The Same Old Textbook Story
   • Risky Behavior and ANOVA
   • Statistics for a Non-Black-and-White World

   **Week 4**
   • Making the World Fit
   • Statistics in the Real World
   • Partially Correct or Partially Wrong?

   **Week 5**
   • Where is the Forest? I Only see Trees!
   • Getting on the Right (Indirect) Path
   • Discussion – Sampling, Statistics and Science

   **Week 6**
   • 2-Way and X-Way Factorial ANOVA

   **Week 7**
   • Nested ANOVA Designs
   • Split-Plots

   **Week 8**
   • Mixed Model ANOVA
   • Introduction to Bayesian Thinking

   **Week 9**
   • ANCOVA
   • Standard ANCOVA, Permutational ANCOVA

   **Week 10**
   • MANOVA

   **Week 11**
   • Repeated Measures – 3 Methods
   • Split Plot, Profile Analysis, Covariance Modelling
Week 12
• PCA and Factor Analysis
• Uses in data reduction and EDA

Week 13
• Generalized Linear Models
• Relaxing the assumption of Normality

Week 14
• Path Analysis

Week 15
• Multimodel Inference
• Why Popper was Wrong, Maybe.

PART IV: PURPOSE AND NEED

1. Explain the department’s rationale for developing and proposing the course.

Science, and especially the biological sciences, generates data which is complex, rarely meets the assumptions of standard parametric analyses and is consequently hard to interpret. Much of the problems associated with biological data can be reduced or eliminated by employing statistical design criteria during the research design phase. This course will instill a statistical perspective that students can use to help in developing their own research protocols and provide the tools necessary for constructive consultation with statisticians.

2. Justify the level of the course and any course prerequisites, co-requisites, or registration restrictions.

This course is intended for graduate students with the need for a quantitative background. A general introductory statistics course is necessary so that basic statistical terms and techniques have been introduced and the focus can be upon the use of advanced statistical designs for research.

3. If the course is similar to an existing course or courses, justify its development and offering.

   a. This course slightly overlaps BIO 5381 in some of its content but the focus is primarily one of employing the concept of statistical design in research while 5381 is a broader survey of statistical techniques used in biology. PSY 5710 and 5711 cover experimental design for psychological research and is thus complimentary to this course which focuses on experimental design for life sciences research.

   b. No deletions are planned. Although modern biology is inherently a field based upon experimental evidence, we currently have no courses which teach experimental design.

4. Impact on Program(s):
   This will be an approved elective in the M.S. in Biological Sciences program.

PART V: IMPLEMENTATION

1. Faculty member(s) to whom the course may be assigned:
This course will be taught by Dr. James M. Novak or any other qualified member of The Department of Biological Sciences.

2. Additional costs to students:
   $20 course fee (pending approval by the President’s Council).

3. Text and supplementary materials to be used (Include publication dates):
PART VI: COMMUNITY COLLEGE TRANSFER
   Not applicable

PART VII: APPROVALS

Date approved by the Biological Sciences Department: 4/28/06

Date approved by the College of Sciences Curriculum Committee: 11/3/06

Date approved by CGS: 12/5/06