University of Puerto Rico. Mayagüez Campus
College of Engineering.
Industrial Engineering Department

Course Syllabus

General Information
Course Number: InIn 5565
Course Title: Measurement and Prediction of Product Reliability
Credit-Hours: Three

Course Description: Introduction to reliability theory; system analysis; constant failure rate models; time dependent failure rate models; state dependent systems; availability; maintainability; complete and censored data analysis (parameter estimation and distribution fitting); prediction of reliability.

Prerequisites: InIn 4020- Applied Industrial Statistics or authorization of the Director of the Department.

Textbook and References

Journals
IEEE Transactions on Reliability (IEEE, New York)
Journal of Quality Technology (ASQ, Milwaukee, WI)
Technometrics (ASQ, ASA)

Purpose
This course is primarily designed for majors in Industrial Engineering at either the graduate or undergraduate level; however, it is appropriate for anyone who is interested in the field of reliability. The purpose is to provide students the theoretical and applied background needed to predict, or measure, the reliability of a system. This purpose is achieved by studying life models such as the Weibull, the log-normal, and the exponential distributions. Emphasis is given to the analysis of failure data at either accelerated or normal life conditions. This course is an elective course for graduate and undergraduate students.

Course Goals
☐ Use mathematical/numerical methods to estimate life distribution parameters for censored data.
☐ Design and analyze life test experiments for censoring and accelerated conditions.
☐ Apply failure distributions to reliability computation, use stress-strength models.
☐ Apply reliability physics to acceleration of failures & predict system/component life w/o stress.
☐ Model failure mechanisms of electronic & mechanical systems & devices.
☐ Analyze complex systems reliability and characteristic functions in transient and steady state.
☐ Allocate reliability to components to achieve a reliability design goal.
Course Syllabus

Apply reliability growth models to achieve a design goal.

Requirements
All students are expected to come to class on time, and prepared; do all assigned readings and related homework; actively participate in class discussions; and satisfy all assessment criteria to receive credit for the course.

Department and Campus Policies
Class attendance: Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student. (Bulletin of Information Undergraduate Studies)

Absence from examinations: Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero of "F" in the examination missed. (Bulletin of Information Undergraduate Studies)

Final examinations: Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays. (See Bulletin of Information Undergraduate Studies).

Partial withdrawals: A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar. (See Bulletin of Information Undergraduate Studies).

Complete withdrawals: A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes. (See Bulletin of Information Undergraduate Studies).

Disabilities: Disabilities: According to the Americans with Disability Act (ADA), all reasonable accommodations will be coordinated with the Dean of Students according to the particular needs of the student. For more information, please contact Student Services with Disabilities at the Student Dean's Office at (Q-019), 787-265-3862 ó 787-832-4040 x-3250 ó 3258. After being recognized as a person with disabilities by both the professor and the institution, the student will receive reasonable accommodations in the course and his/her evaluations.

Ethics: Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Overview and reliability concepts. Definitions, statistical vs. deterministic approach. Statistical reliability.</td>
<td>Ch.1</td>
</tr>
<tr>
<td>3-4</td>
<td>Failure distributions: Reliability function, hazard rate, mean time to failure and the bathtub curve.</td>
<td>Ch.2</td>
</tr>
<tr>
<td>5-7</td>
<td>Constant failure rate model and time-dependent failure-rate models</td>
<td>Ch. 3 &amp; 4</td>
</tr>
<tr>
<td>8-9</td>
<td>Systems reliability</td>
<td>Ch. 5</td>
</tr>
<tr>
<td>10-12</td>
<td>State-dependent system</td>
<td>Ch. 6</td>
</tr>
<tr>
<td>13-15</td>
<td>Physical reliability models</td>
<td>Ch. 7</td>
</tr>
<tr>
<td>16-18</td>
<td>Introduction to design for reliability: Reliability allocation &amp; Fault tree analysis</td>
<td>Ch. 8</td>
</tr>
<tr>
<td>19</td>
<td>Data collection and empirical methods</td>
<td>Ch. 12</td>
</tr>
<tr>
<td>20</td>
<td>Identifying distributions: Probability plotting and curve fitting</td>
<td>Sec. 15.1 - 15.2</td>
</tr>
<tr>
<td>21-23</td>
<td>Parameter estimation: Maximum likelihood. Censored data.</td>
<td>Sec 15.3 - 15.5</td>
</tr>
<tr>
<td>24</td>
<td>Goodness of fit tests</td>
<td>Ch. 16</td>
</tr>
<tr>
<td>25</td>
<td>Reliability life testing: Binomial acceptance testing &amp; Sequential tests</td>
<td>Ch.13</td>
</tr>
<tr>
<td>26-28</td>
<td>Accelerated life testing</td>
<td>Ch. 13 and class notes</td>
</tr>
</tbody>
</table>

Each lecture is about 80 minutes long.

Revised by Dr. Noel Artiles-León on February 20, 2007

File: ININ 5565_2006.wpd