INSTRUCTORS:
Rob Budny
Email: rob@rbbengineering.com
Andrew Milburn
Email: andy@milburnengineering.com

COURSE INFORMATION

Course Description
Explore gear failure analysis in this hands-on seminar where students not only see slides of failed gears but can hold and examine those same field samples close up. Use of a microscope to examine field samples.

It is recommended that you spend a minimum of 1 hour reading and reviewing the material each day.

Course Rationale/Students Course Designed to Serve
Suitable for gear engineers, users, researchers, maintenance technicians, lubricant experts, and managers.

Expected Student Learning (Course Level) Outcomes
- Identify the primary and secondary failure modes
- Use the proper nomenclature to describe the morphology of gear failure
- Understand common tools and methods used in gear failure analysis
- Diagnose the root causes of failure
- Prescribe remedies to prevent repeat failures
- Use the GEARTECH textbook and other provided resources for ongoing study of gear failure analysis
- Tailor failure analysis techniques for their specific requirements

Required Textbook (Provided by AGMA)
Gear Failure Analysis Seminar, Robert Errichello

Reference Materials (articles, websites.)
- Standard for Design and Specifications of Gearboxes for Wind Turbines (ANSI/AGMA/AWEA 6006-A03)
- Point-Surface-Origin, PSO, Macropitting Caused by Geometric Stress Concentration (AGMA Technical Paper, 10FTM11)
- Morphology of Micropitting (AGMA Technical Paper, 11FTM17)
- Appearance of Gear Teeth – Terminology of Wear and Failure (ANSI/AGMA 1010-F14)
- Textbook includes the Gear Failure Atlas
COURSE OUTLINE

I. Fracture
   a. Brittle Fracture
   b. Ductile Fracture
   c. Mixed Mode Fracture

II. Plastic Deformation
   a. Cold Flow
   b. Hot Flow

III. Bending Fatigue
   a. Low-Cycle Fatigue
   b. High-Cycle Fatigue
   c. Subsurface Initiated Fatigue

IV. Hertzian Fatigue
   a. Macropitting
   b. Micropitting
   c. Subcase Fatigue

V. Wear
   a. Adhesion
   b. Abrasion
   c. Polishing
   d. Corrosion
   e. Fretting
   f. Scaling
   g. White Layer Flaking
   h. Electric discharge
   i. Cavitation
   j. Erosion

VI. Scuffing

VII. Cracking
   a. Hardening Cracks
   b. Grinding Damage
   c. Rim & Web Cracks
   d. Case/Core Separation

STUDENT FEEDBACK AND GRADING PROCEDURES
Assignments
Group work, case studies, and a quiz are administered during this course. Immediate feedback is given and the material is reviewed by the instructor.

COURSE MANAGEMENT

NOTE: Release of liability forms must be completed prior to field trips. Weather Delays and Cancelations
We will communicate any cancellations, delays or other concerns for safety prior to class via email, voicemail, and/or text message. Please be sure that we have all pertinent contact information as you travel to your class location.

Attendance for Domestic and International Students
Please be mindful that these are short, accelerated courses. Attendance is extremely important. If you are going to be absent from any class day, please contact the course coordinator. Casandra Blassingame, Vice President of Education Services, blassingame@agma.org or Rosemarie Bundoc, Education Manager, bundoc@agma.org.

Plagiarism, Cheating and other types of Misconduct
Plagiarism¹, cheating and other types of misconduct are unacceptable.

Students with Disabilities
Students requiring assistance and accommodation should complete the Special Accommodation Request form and submit it to Rosemarie Bundoc at bundoc@agma.org. She can be reached at 703-838-0069.

Grievance Procedures
Students who have concerns about the class are encouraged to contact Casandra Blassingame, Vice President of Education Services at blassingame@agma.org or 703-838-0055.

LEARNING AND OTHER RESOURCES

Links for writing resources:
- grammar.ccc.commnet.edu/grammar
- www.merriam-webster.com

Links for Math resources:
- www.sosmath.com
- Khan Academy on www.youtube.com

Links for time management, study skills and note taking resources:
- www.mindtools.com
- www.testtakingtips.com

Links for career resources:

¹ Plagiarism is defined as “the use or close imitation of the language and thoughts of another author and the representation of them as one’s own original work.”
• [https://www.agma.org/newsroom/jobs/](https://www.agma.org/newsroom/jobs/)

**Industry News:**
• [https://www.agma.org/newsroom/industry-news/](https://www.agma.org/newsroom/industry-news/)