****

**Gear Manufacturing & Inspection:**

**Methods, Practices, Application & Interpretation for the Design Engineer**

**INSTRUCTOR Information**

**Raymond J. Drago, P. E.**

Email: [geardoctor@verzion.net](mailto:geardoctor@verzion.net)

|  |
| --- |
| **COURSE INFORMATION** |

**Course Description**

While function and rating are important factors in a successful gear design, to be truly optimal and successful, the gear designer must also design the gears to be manufactured and inspected. In this course, therefore, we will address key factors in a wide variety of manufacturing and inspection processes to enable the gear designer to better design optimal gears considering both rating and the necessary manufacturing and inspection processes to produce the gears as designed. We will also help the designer to understand how to interpret inspection data so that they can ensure that the gears meet the design. To be clear, this is not a course in how to operate the various machines. Rather it addresses the design provisions that are required to allow the gears to be optimally manufactured and inspected. The learner will develop a broad understanding of the methods used to manufacture and inspect gears, as well as interpret how the resultant information can be applied and interpreted in the design process.

**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**

Design, manufacturing and quality control engineers involved with design, manufacture and inspection of gears and gearbox systems.

**Learning Objectives:**

* Identify methods of manufacturing external and internal spur, single and double helical, and bevel and worm gears
* Describe the methodology and underlying theory for basic manufacture and inspection of each.
* Discuss the “features” associated with each manufacturing method regarding their impact upon and their ability to refine, guide and optimize the design process.
* Take two views of the same results: meeting a “specification” and determining acceptability for a specific application and interpreting the inspection data for purposes other than simply determining accept/reject status.
* Specify the data required to control both the manufacturing and inspection processes on an engineering drawing. This includes both the data to be defined and the presentation of the data on the engineering drawing.
* Discuss the basics of a variety of destructive and nondestructive inspection tests, including their underlying theory, application techniques and, most importantly, interpretation of the resultant data.

**Required Textbooks (Provided by AGMA)**

AGMA’s *Gear Manufacturing & Inspection: Methods, Practices, Application & Interpretation for the Design Engineer,* by Raymond J. Drago., P. E.

|  |
| --- |
| COURSE OUTLINE |

|  |  |
| --- | --- |
| 1. SUMMARY OF GEAR MANUFACTURING PROCESS   a. Generating  b. Forming  c. Non-controlled   1. GENERATING PROCESSES   a. Hobbing  Rack Tooth Form  Gang Hobbing  Special Hops for Internal Gears  Hobbing Spiral Bevel Gears  b. Shaping  Stroke  Continuous  Wafer Cutters  c. Gear Planning  Rack Cutters  CBN Hard Cutting  Backer Bars  d. Face Milling  e. Skiving  f. Generating Grinding  g. Roll Forming  h. Disk Milling  i. Hobbing  j. Shaping – Pinion Shaped Tool  k. Disk Cutter  l. Shaping  m. Continuous Rack Shaping  n. Special Purpose Machines  • Face Milling Spiral Bevel Gears  p. Face Hobbing Spiral Bevel Gears  q. Skiving With Carbide Hob  r. Hard Finishing Bevel Gears  s. Generating Grinding Parallel Axis  Gears  • Conical Wheel  • Saucer Shaped Wheel  • Threaded Wheel  t. Generating Grinding Bevel Gears  u. Bevel Gear Planning  v. Bevel Gear Planning Generator  w. Two Tool Generator – Straight Bevel  Gears | x. Roll Forming  • Parallel Axis Gears  • Worm Gears  y. Roll Finishing A. Gear  Manufacturing  z. Generating Straight Bevel Gears  With Disk Tools  • Cutting  • Grinding  III. FORMING PROCESSES  a. Form Milling  b. Slotting  c. Gashing  d. Form Grinding  • Aluminum Oxide  • CBN  e. Broaching  f. Shearing  g. Forging  • Net Shape  • Near Net Shape  • Powder Processes  • Die Casting  • Injection Molding  • Extrusion  • Stamping  • Flame Cutting  • Electrical Discharge Machining  • Photo Chemical Machining  INSPECTION   1. PURPOSES   a. Accept/Reject  b. Determine Acceptability for  Application   1. TYPES OF INSPECTION 2. GEOMETRIC   a. Chart Identification & Part  Orientation  b. Use and Interpretation of AGMA  quality numbers   1. ELEMENTAL   a. Involute Profile  b. Lead  c. Tooth Spacing  d. Runout  e. Tooth Thickness  f. Surface Finish |

|  |
| --- |
| **STUDENT FEEDBACK AND GRADING PROCEDURES** |

**Assignments**

Assignments and learning activities are given and directed at the discretion of the instructor.

|  |
| --- |
| COURSE MANAGEMENT |

**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.

**Plagiarism, Cheating and other types of Misconduct**Plagiarism[[1]](#footnote-1), cheating and other types of misconduct are unacceptable.

**Students with Disabilities**Students requiring assistance and accommodation should complete the [Special Accommodation Request form](http://www.graduateschool.edu/images/stories/AcademicPrograms/AdmissionsApplicationGuideD3.pdf) and submit it to Stephanie Smialek, Education Manager at [smialek@agma.org](mailto:smialek@agma.org). She can be reached at 773-302-8026.

**Grievance Procedures**Students who have concerns about the class are encouraged to contact Stephanie Smialek, Education Manager, at [smialek@agma.org](mailto:smialek@agma.org) or 773-302-8026.

**Outline Changes**The instructor reserves the right to modify the outline during the course of the class.

|  |
| --- |
| LEARNING AND OTHER RESOURCES |

**Links for writing resources:**

* grammar.ccc.commnet.edu/grammar
* [www.merriam-webster.com](http://www.merriam-webster.com)

**Links for Math resources:**

* [www.sosmath.com](http://www.sosmath.com)
* Khan Academy on www.youtube.com

**Links for time management, study skills and note taking resources:**

* [www.mindtools.com](http://www.mindtools.com)
* [www.testakingtips.com](http://www.testakingtips.com)

**Links for career resources:**

* <https://www.agma.org/newsroom/jobs/>

**Industry News:**

* https://www.agma.org/newsroom/industry-news/

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.” [↑](#footnote-ref-1)