

Epicyclic Gear Systems – Application, Design & Analysis

INSTRUCTORS:

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COURSE INFORMATION

Course Description

Learn and define the concept of epicyclic gearing including some basic history and the differences among simple planetary gear systems, compound planetary gear systems and star drive gear systems. Cover concepts on the arrangement of the individual components including the carrier, sun, planet, ring and star gears and the rigid requirements for the system to perform properly. Critical factors such as load sharing among the planet or star gears, sequential loading, equal planet/star spacing, relations among the numbers of teeth on each element, calculation of the maximum and optimum number of planet/star gears for a specific system will be covered. Provides an in-depth discussion of the methodology by which noise and vibration may be optimized for such systems and load sharing guidelines for planet load sharing.

Who Should Attend

Engineers, technicians, management and others involved in the selection, application and/or design of epicyclic (planetary) gear systems of all types as well as those who are not currently familiar with this gearing concept but who would like to gain an understanding of epicyclic (planetary) gear systems.

Learning Objectives

- Restate exactly what makes a gear system an epicyclic system
- Calculate the total reduction ratio of an epicyclic system and that of a star system.
- Identify differences and similarities between split power systems and true epicyclic systems.
- Recognize when the use of a star drive system is preferred over a planetary system.
- Explain the importance of equal planet/star gear spacing and how a system be designed with unequal planet spacing.
- Interpret how the numbers of teeth selected for the individual gears in an epicyclic or star drive gear system affect the noise and vibration characteristics of the system.
- Identify are the advantages of selecting odd numbers of teeth for the planet/star gears?
- Evaluate the numbers of teeth on the sun, planet and internal ring gear not arbitrary and what are the relations that must be maintained among these tooth numbers and why
- Explain how the design of the carrier affects the overall performance of these complex systems
- Determine how does input speed affect the design of an epicyclic system and why are the speed concerns different for epicyclic and star drive systems
- Restate how the selection of the “fixed” member in a planetary system affect the ratio and relative rotation directions of the input and output shafts?
- Describe the design and use of load balancing systems including floating sun gears, and floating ring gears.

Required Textbook

Textbook will be provided by MPMA

COURSE OUTLINE

- Introduction
- Just what is an epicyclic gear system including a bit of history
- Range of application for epicyclic gear systems
- A planetary gear system is an epicyclic gear system but not all epicyclic gear systems are planetaries
- Differences between simple and compound epicyclics
- Is a “Star” drive an epicyclic gear system – Why?
- Epicyclic gear system variations
- Epicyclic gear system nomenclature
- Definition of effective/relative speed and reasons for use
- Planet gear spacing considerations and requirements
 - Odd or even tooth numbers – do they matter
- What is a dropped tooth planet and why is it used
- Sequential and simultaneous loading - determination and importance
- Ideal number of planets
- Planet OD clearance concerns – Excel Spreadsheet
- Ravigneaux, Simpson, Power Hinge, Orbitless & Stoeckicht variations
 - Harmonic drive
 - Nutating gear systems
- Assembly and lubrication considerations
- Possibility of assembly check requirements
- Planet bearing loading considerations and limitations
 - Centrifugal force effects
- Planet bearing and rim thickness considerations
- Planet to planet load sharing
- Floating and fixed members – how and why
- Planet carrier design requirements and considerations
- Ultrasafe design considerations for life critical applications
- Epicyclic systems are always split power systems
 - But bit all split power systems are epicyclic
- Planetary design examples

STUDENT FEEDBACK AND GRADING PROCEDURES

Assignments

There will be a short self-graded quiz at the end to show knowledge transfer.

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

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 our Education inbox at education@motionpower.org. Or we can be reached by calling 703-684-0211.

Grievance Procedures

Students who have concerns about the class are encouraged to contact any Education Department staff at education@motionpower.org or by calling 703-684-0211.

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

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:

- <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."