MSE-469 Powder Metallurgy

Credit Hours: 2-0

Pre-requisites: Nil

Course Description

This course provides a deep understanding of the principles, processes, materials, and applications involved in the production and utilization of powdered materials. Powder metallurgy (PM) is a manufacturing process that enables the production of complex-shaped components with required properties. This makes PM an important technology in various industries including aerospace, automotive, electronics, biomedical, and other industrial applications.

Course Contents

- Introduction to powder metallurgy, Applications of powder metallurgy. Advantages and design limitations of powder metallurgy.
- Powder particles sampling, dispersion & de-agglomeration; Sieve and microscopic analysis; sedimentation; laser light; particle size distributions; data presentation.
- Characterization of powders: microstructure; particle shape; pycnometer; surface area test; internal structure and chemistry.
- Production of powders: mechanical methods; electrolytic methods; Atomization techniques; chemical methods.
- Powders modification and handling; mixing and blending; different lubricants and binders; Powders molding, shaping and compaction (cold and hot compacting methods physical characteristics of powder compacts, compaction defects).
- Sintering theory and practices, solid state and liquid phase sintering, modern sintering techniques, sintering atmospheres, thermodynamics of sintering.
- Inspection and quality control for P/M parts, the economics of P/M production, new development in powder metallurgy processes

Weekly Plan

Week	Topics
1	Introduction to powder metallurgy
2	Applications of powder metallurgy. Advantages and design limitations of powder metallurgy.
3	

4	Powder particles sampling, dispersion & de-agglomeration
5	Sieve and microscopic analysis; sedimentation; laser light; particle size distributions; data presentation
6	
7	Characterization of powders: microstructure; particle shape; pycnometer; surface area test; internal structure and chemistry
8	
9	**Mid-Semester Exams**
10	Production of powders: mechanical methods; electrolytic methods; Atomization techniques; chemical methods
11	Powders modification and handling; mixing and blending; different lubricants and binders; Powders molding, shaping and compaction (cold and hot compacting methods physical characteristics of powder compacts, compaction defects).
12	
13	Sintering theory and practices, solid state and liquid phase sintering, modern sintering techniques, sintering atmospheres, thermodynamics of sintering
14	
15	Inspection and quality control for P/M parts, the economics of P/M production, new development in powder metallurgy processes
16	
17-18	**End Semester Exams**

Course Outcomes

At the end of the course, students will be able to:

- Understand the applications, advantages, limitations and design considerations of PM products.
- Explain various metallic powder production techniques.
- Compare different testing methods used to determine quality of metallic powders.
- Evaluate and design different approaches for the sustainability of the process.

Suggested Books

- Powder Metallurgy: Science, Technology, and Materials by A. Upadhyaya, G. S. Upadhyaya. 1st ed. Universities Press, (2011)
- Powder metallurgy: science, technology and applications by P. C. Angelo, B. Ravisankar, R. Subramanian. 2nd ed. PHI Pvt. Ltd. (2022)
- Fundamentals of Powder Metallurgy by L. F. Pease, W. G. West. Metal Powder Industries Federation, (2002)