MTPE4003 POWDER METALLURGY AND PROCESSING (3-0-0)

Course Objective:
To understand the production, characterization, compaction and sintering of metal powders and to apply powder metallurgy techniques for the manufacture of engineering components.

Module I (8 Hours)
Introduction: history, scope and importance of powder metallurgy; advantages, limitations and applications; comparison with other manufacturing processes. Powder production: mechanical methods – milling, mechanical alloying; physical methods – water, gas and centrifugal atomization; chemical methods – oxide reduction, electrolytic deposition, carbonyl process and hydride-dehydride process.

Module II (6 Hours)
Powder characterization: particle size and size distribution – sieve analysis, sedimentation, laser diffraction; particle shape and surface area; apparent density, tap density, flow rate, compressibility and green strength; chemical characterization of powders. Powder conditioning: blending and mixing, granulation, powder annealing, additives and lubricants.

Module III (6 Hours)
Powder compaction: pressure–density relationship and mechanism of compaction; die compaction – single action and double action pressing; cold isostatic pressing; metal injection moulding; slip casting and tape casting; compaction defects and their remedies.

Module IV (6 Hours)
Sintering: theory, driving force and mechanisms of solid state sintering; stages of sintering and material transport mechanisms; liquid phase sintering and activated sintering; hot pressing, hot isostatic pressing, spark plasma sintering and microwave sintering; sintering atmospheres and furnaces.

Module V (4 Hours)
Applications and testing: PM structural parts, self-lubricating bearings, friction materials, cemented carbides, cermets, dispersion strengthened materials, porous materials and filters, electrical contact materials; testing and quality control of PM components; defects in PM parts.

Course Outcome:
CO1: To understand the scope of powder metallurgy and the different methods of metal powder production.
CO2: To characterize metal powders and select suitable conditioning treatments for processing.
CO3: To apply appropriate compaction techniques for shaping of metal powders.
CO4: To explain the theory and mechanisms of sintering and select suitable sintering practices and secondary operations.
CO5: To recommend powder metallurgy routes for the manufacture of engineering components and evaluate their quality and economics.

Text Books:
1. Angelo P.C. and Subramanian R., Powder Metallurgy: Science, Technology and Applications; Prentice Hall of India Pvt. Ltd.
2. Upadhyaya G.S., Powder Metallurgy Technology; Cambridge International Science Publishing.

Reference Books:
1. German R.M., Powder Metallurgy and Particulate Materials Processing; Metal Powder Industries Federation.
2. Kuhn H.A. and Lawley A., Powder Metallurgy Processing: New Techniques and Analyses; Academic Press.