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College of Engineering, Pune 5.
(An autonomous Institute of Government of Maharashtra, Pune 411005)

2PM-5PM

End Semester Examination

26 NOV 2014

B. Tech. (Metallurgical Engineering) /M. Tech. - Physical/Process Metallurgy)

Powder Metallurgy

Time 3 hours]

[Max. Marks 60

Instructions to candidates:

- 1) Neat diagrams must be drawn wherever necessary.
- 2) Use of non-programmable electronic pocket calculator is allowed.

Q.1

[15]

- (a) Recommend one different method each for the production of spherical, porous, dendritic and angular powder with appropriate justification.
- (b) Compare the properties and characteristics of iron powder produced by atomization, reduction and electrolytic processes.

Q.2 Solve any two:

[15]

- (a) Write in brief the principle of operation and the uses of following equipments in powder characterization.
 - i. BET equipment.
 - ii. Sedigraph or Sedimentometer
- (b) Find the settling velocity for aluminium spherical particles (density = 2.7 g/cm^3) with average radius of $12.5 \mu\text{m}$ settling in water (density = 1.0 g/cm^3 , viscosity = 10^{-2} g/cm/s). Also check the validity of the Stoke's law for the system under consideration.
- (c) Discuss the different types of alloying techniques applied to powder systems.

Q.2 Solve any two:

[15]

- (a) Compare conventional P/M method and powder injection moulding in terms of the following aspects:
 - (a) Recommended powder particle shape and size
 - (b) Recommended powder mix
 - (c) Sintering cycles used
 - (d) Limitations

P.T.O.

Q.2

- (b) Explain the effect of particle morphology on compaction and sintering.
- (c) Explain the method(s) you would suggest to remove porosity in sintered compacts?

Q.3 Describe the main parameters of powder types, property requirements, sintering variables and other important factors in the processing of following powder metallurgical parts (*any two*): **[15]**

- i. Cemented carbides
- ii. Electrical contact materials
- iii. Composite friction materials

Q.4 Solve any two: **[15]**

- (a) Discuss the various modes by which mass transport occurs during sintering of a single component green compact. Can all these modes cause densification?
- (b) Discuss the different types of secondary/finishing operations performed on powder metallurgical parts.
- (c) Illustrate the problems associated with the heat treatments of PM components and their remedies.

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