

7 <sup>th</sup> Semester	RMM7D003	Advanced Phase Transformations	L-T-P 3-0-0	3 Credits
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**Module-I: (10 hours)**

Introduction, Recapitulation of the principles of thermodynamics applicable to phase transformation. Schemes of classification of phase transformation. Thermodynamic models for the calculation of phase diagrams. Solidification, solidification structures. Quantitative theory of nucleation: homogeneous and heterogeneous nucleation; kinetics of nucleation.

**Module-II: (10 hours)**

Diffusion and interface-controlled growth. Overall transformation kinetics including empirical transformation kinetics during isothermal and non-isothermal treatment. Massive Transformation: thermodynamics and kinetics, morphology.

**Module-III: (10 hours)**

Precipitation, spinodal decomposition, precipitate coarsening. Order-disorder transformation. Cellular phase transformation. Displacive transformations: general characteristics (including crystallography and morphology)

**Module-IV: (10 hours)**

Stress-induced martensite, Thermoelastic martensite, shape memory effect. Some examples of applications of phase transformation in steels, Ti-alloys and other non-ferrous alloys. Classification of martensite transformations, thermodynamics and kinetics martensite transformation, bainite transformation in steels.

**Books:**

- [1] J W Christian: The theory of transformations in metals and alloys.
- [2] Phase transformations in metals and alloys by D.A.Porter, K.E.Easterling and Sharif, CRC press
- [3] Phase transformation in materials by Romesh C Sharma, CBS publishers & Distributors
- [4] Solid State Phase Transformations by Raghavan, PHI
- [5] Physical Metallurgy Principles, Robert E. Reed-Hill, East West Press

**Digital Learning Resources:**

Course Name: Phase transformation in Materials  
 Course Link: <https://nptel.ac.in/courses/112/104/112104220/>  
 Course Instructor: Prof. Krishanu Biswas

Course Name: Phase Diagrams in Materials Science and Engineering  
 Course Link: <https://nptel.ac.in/courses/113/104/113104068/>  
 Course Instructor: Prof. Krishanu Biswas