Master of Science – Nano Science & Nano Technology

(M.Sc.) (Nano Science & Nano Technology) Semester –II

Course Code	PS02CNST53	Title of the Course	Nanostructures and Metallic Materials
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	1. To strengthen the knowledge on metallic materials 2. To get idea on application part of advanced metallurgy in materials science

Course Content		
Unit	Description	Weightage* (%)
1.	Metals and extractive metallurgy, Deformation, Strain Hardening, Annealing, Cold and Hot working, Residual stresses, Dislocation multiplication, Deformation & bonding process, Superplastic forming, Solidification and grain size strengthening, Microstructure and its relation to the properties. Homogeneous and heterogeneous nucleation, Growth, types of growth, Solidification time, Casting, Solidification defects, Control of casting structure, Solidification and metal joining	25%
2.	Phase and the Unary phase Diagram, Solubility and solutions, Hume-Rothery's rules of solidsolubility, Solid solution strengthening, Isomorphous phase diagram, Strength and phase diagram, Solidification of solid solution alloys, Equilibrium and non equilibrium solidification, Segregation, Castability	25%
3.	Principles of dispersion strengthening, Intermetallic compounds, Three phase reactions, Eutectic phase diagram, Eutectic system, Peritectic reactions, Monotectic reaction, Ternary phase diagram, Nucleation and growth in solid state reactions, Alloys strengthening by exceeding solubility limit. Age hardening or precipitation hardening. Nucleation & growth in solid state reaction, Eutectoid reaction, Control of eutectoid reactions, Age hardening, G.P. Zones, controlling the transformation, Heat treatments	25%
4.	Fe-Fe_3C phase diagram, pearlite, bainite, martensite, cementite, Heat treatments processes, Jominy test, Surface treatments, Classification of steels and their applications. Aluminium alloys, Magnesium alloys, Copper alloys, Nickel, Cobalt, Zinc alloys, Titanium alloys, Refractory metals	25%

Teaching-Learning Methodology	Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Apply knowledge on microstructure and processing concepts of metals specifically.
2.	This can be very helpful to express ideas for relevant industrial sectors.
3.	Students will have many job opportunities and career growth as leading metal/alloys manufacturing firms are in India.

Suggested References:	
Sr. No.	References
1.	Askeland, D.R., Fulay P. R. & Wright W. J. (2010). *The Science and Engineering of Materials.* Cengage Learning, Stamford, CT, USA.
2.	Kodgire, V. D. (2011). *Materials Science & Metallurgy*. Everest *Publishing* House.
3.	Raghavan, V. (2015). *Physical metallurgy: principles and practice*. PHI Learning Pvt. Ltd..
4.	Chanda, M. (1981). *Science of Engineering Materials: Volume 2 Materials*. Macmillan International Higher Education.
5.	Callister, W. D., & Rethwisch, D. G. (2018). *Materials science and engineering: an introduction* (Vol. 9). New York: Wiley.

On-line resources to be used if available as reference material
On-line Resources
https://nptel.ac.in/courses/113/104/113104068/
https://web.iit.edu/sites/web/files/departments/academic-affairs/academic-resource-center/pdfs/Strengthening_Mechanisms_Workshop.pdf

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