**CÂMARA CURRICULAR DO CoPGr**

**FORMULÁRIO PARA APRESENTAÇÃO DE DISCIPLINAS**

DISCIPLINE ID: PEM5110

DISCIPLINE NAME: Physical Metallurgy

PROGRAM/AREA: Programa de Pós-Graduação em Engenharia de Materiais – Metallic Materials, Ceramic and Polymer.

NUMBER OF THE AREA: 97134

INITIAL VALIDITY (Year/ Semester): 06/2006

CREDIT: 12

THEORETICAL CLASSES: 04 PRACTICAL CLASSES, SEMINARS AND OTHERS: 0

SELF STUDY HOURS: 08

DURATION IN WEEKS: 15

TOTAL OF HOURS: 180

RESPONSIBLE FACULTIES

1. Miguel Justino Ribeiro Barboza.

1

X Docente Usp, N.º 5840622

Docente externo. Data de obtenção do título: Instituição:

2.

Docente Usp, N.º

Docente externo. Data de obtenção do título: Instituição:

3.

Docente Usp, N.º

Docente externo. Data de obtenção do título: Instituição

**OBJECTIVES:**

The Physical Metallurgy course aims to provide students with the knowledge of key aspects of the structure and its relations with the elastoplastic behavior of metals and alloys. Thus, it covers topics involving crystal imperfections, heat treatment, metal forming and mechanical behavior of metals and alloys under conditions of static and dynamic loading.

The course structure of Physical Metallurgy is directly related to the daily needs of the industrial sector. In this context, a thorough understanding of the main issues raised, will enable the professional future, the training required for selection and microstructural optimization of materials submitted to different forming processes and heat treatments.

**CONTENTS:**

1. Defects in Crystals: Dislocations and slip 1.1 Observation of Dislocations 1.2 Forces on Dislocations 1.3 Stress field and energy fields 1.4 Intersection and interaction of dislocations 1.5 Conservative and non-conservative movements of dislocations 1.6 Origin and multiplication of dislocations 2.0 Homogeneous and heterogeneous nucleation 2.1 Interfaces 3. Thermomechanical processing of metals 3.2 Work hardening 3.3 Annealing, recovery and recrystallization 3.4 Dislocations substructures 4. Bainitic and martensitic transformations 4.1 Systems: Iron-Carbon and Iron-Nickel 4.2 Interfaces: austenite – martensite 4.3 Nucleation and growth of platelets 4.4 Athermic and isothermal transformations 4.5 Residual stress field 4.6 Stress relief 4.7 Bainitic transformation 4.8 Formation mechanisms 4.9 Bainite: morphological characteristics and properties 5. Precipitation hardening 5.1 Aging and overaging 5.2 Guinier-Preston zones 5.3 Dislocation interaction with particles 5.4 Importance of the morphology and distribution of hard particles 5.5 Precipitation hardening: steel, non-ferrous alloys and superalloys 6. Mechanical properties and fracture modes 6.1 Mechanical behavior of metals: static and cyclic loads 6.2 Aspects and importance of dislocation structures and grain sizes 6.3 Temperature: influence on the mechanical behavior 6.4 Fracture mechanisms in pure metals and alloys 6.5 Influence of temperature on fracture modes 6.6 Mechanical properties and fracture: effect of thermomechanical treatments 6.7 Basic facts to consider for Material Selection in engineering.

**BIBLIOGRAPHY:**

1. Shackelford, J. F, Introduction to Materials for Engineers, Prentice Hall, 1996. 2. Callister Jr, W. D., Materials Science and Engineering: An Introduction, John Wiley & Sons, 2000. 3. Avner, S. H., Introduction to Physical Metallurgy, McGraw-Hill, 1974. 4. Hull, D. Introduction to Dislocation, Pergamon Press, 1965. 5. Friedel, J., Dislocations, Pergamon Press, 1964. 6. Dislocations and Properties of Real Materials, Proceedings of Conference December 1984, The Institute of Metals London, 1985. 7. Reed-Hill, R. E., Princípios de Metalurgia Física, Guanabara Dois, 1982. 8. Honeycombe, R. W. K., Aços – Microestrutura e Propriedades, Fundação Calouste Gulbenkian, 1982. 9. Martin, J. W., Preciptation Hardening, Pergamon Press, 1968. 10. Dieter, G. E., Metalurgia Mecânica, Guanabara Koogan S. A., 1982. 11. Meyers, M. A., Chawla K. K., Princípios de Metalurgia Mecânica, Edgard Blücher Ltda, 1982. 12. Tegart, W. J., Elements of Mechanical Metallurgy, Macmillan Series in Materials Science, 1966. 13. Brooks, C. R., Choudhury, A., Metallurgical Failure Analysis, McGraw-Hill, 1993. 14. Chiaverini, V., Aços e Ferros Fundidos, ABM, 1988. 15. Martin, J. W., Doherty, R. D., Stability of Microstructure in Metallic Systems, Cambridge University Press, 1976. 16. Barrett, C., Massalski, T. B., Structure of Metals, Pergamon Press, 1980.