



METALLURGICAL AND MATERIALS ENGG.

CREEP DEFORMATION OF MATERIALS

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TYPE OF COURSE : New | Elective | PG/PhD course **EXAM DATE** : 4 weeks (28 Jan'19 - 22 Feb'19)
INTENDED AUDIENCE : ME/MS/PhD **COURSE DURATION** : 31 Mar 2019

PRE-REQUISITES : Basics of mechanical metallurgy- to have an understanding of the concepts of stress, strain, dislocations, grain size effects, second phase distribution effects etc

INDUSTRIES APPLICABLE TO : Nuclear industry-BARC/IGCAR Aerospace industry-DRDO/ISRO/Boeing
Automobile industry – General Motors/TATA Motors etc

COURSE OUTLINE :

This course aims to provide the audience an introduction to time dependent plastic deformation of materials (creep) especially at high homologous temperatures. The goal is for the audience to learn the rate controlling mechanisms of creep and their utility in predicting the remaining useful life of a structure. Other Parametric approaches such as Larson-Miller parameter, Theta-projection concept, Kachanov-Rabotnov model will also be introduced. The course will conclude by highlighting the importance of accounting for creep in development of technologically important materials such as titanium alloys, zirconium alloys and advanced materials such as nanocrystalline materials.

ABOUT INSTRUCTOR :

Prof. Srikant Gollapudi is currently on the faculty of the School of Minerals, Metallurgical and Materials Engineering at IIT Bhubaneswar. He is a Metallurgist by training and obtained his PhD in Materials Science and Engineering from NC State University with his doctoral thesis on Creep mechanisms in titanium alloy tubing. The instructor conducted his post doctoral research at Massachusetts Institute of Technology and has worked in different organizations such as General Motors, Defence Metallurgical Research Laboratory and Saint Gobain Research India. The industrial experience has helped the instructor gain a better appreciation of the real life applications of academic knowledge.

COURSE PLAN :

- Week 01** : Basics of plastic deformation; role of dislocations, vacancies; microstructural effects on plastic deformation; effect of stress, temperature; Introduction to creep curve and equations describing creep; effect of stress and temperature on creep curve; Introduction to mechanisms of creep.
- Week 02** : Mechanisms of creep: Newtonian viscous creep mechanisms (stress exponent 1) such as Coble creep/N-H creep/Harper-Dorn/Spingarn-Nix; Grain boundary sliding and superplasticity (stress exponent 2); Viscous creep or Alloy creep (stress exponent 3) Power law creep based on Weertman model, Jogged screw model and its modification etc (stress exponent 4-7).
- Week 03** : Power law breakdown at high stresses;Rate controlling mechanisms (mechanisms in series and parallel); Creep constitutive equation (Bird-Mukherjee-Dorn equation); Deformation mechanism maps (Ashby maps; Mohamed-Langdon maps); Parametric approach to creep (Larson-Miller parameter, Sherby-Dorn parameter, Monkman-Grant parameter, θ -projection concept, Kachanov-Rabotnov model); Creep testing techniques: Conventional vs Impression creep testing techniques.
- Week 04** : Creep fracture; Creep of technological important materials such as titanium alloys/ zirconium alloys/ magnesium alloys, Creep of advanced materials such as nano crystalline materials.