

Approval: 8th Senate Meeting

Course Name: Materials for Energy Applications

Course Number: EM504

Credits: 3-1-0-4

Prerequisites: None

Intended for: 3rd and 4th Year UG/PG

Semester: Odd

Course Preamble: This course deals with the various properties of the materials which are directly useful in energy generation, storage, transmission, etc. The course starts with the properties of the materials which are being utilized in generating the electricity by different mechanisms. It also deals with the energy conservation aspect through the utilization of energy efficient structure and building materials. Finally, this course also provides an overview of various materials challenges in achieving the worldwide energy requirement. This course is expected to provide the thorough understanding of the materials and their properties which can be used in various kind of energy applications.

Course Outline: This course is divided in three modules. First module deals with the mechanical properties of the materials which decide the overall life of the various components of the power plants machinery. Second module deals with those electronic and magnetic properties of the materials which are responsible for power generation, storage and transmission. Finally the third module deals with energy conservation through optimal utilization of energy by using energy efficient structure and building materials.

Modules:

Module 1 [15 Lectures]

Creep resistance materials: principles of creep deformation, mathematical modeling and design application of creep resistance materials in power plants. Catalysis; Wear resistance materials: types of wear, mechanism of erosion and cavitation wear, tribo-corrosion, application of wear resistance materials in power plants, Fatigue types, types and protection. Life prediction of turbine materials.

Module 2 [20 Lectures]

Phase diagram, Conductors, transformer materials, Semiconductor physics and devices, Fundamentals and energy applications for Magnetic and Dielectric materials.

Module 3 [7 Lectures]

Energy efficient structure/building materials

Textbooks:

1. Hans Berns , Werner Theisen, Gillian Scheibelein, Ferrous Materials, ISBN-10: 3540718478, 2008 (Springer).
2. A. J. Moulson and J. M. Herbert, Electroceramics: Materials, Properties and Applications, Wiley; 2nd edition, 2003.
3. M.Hall, Materials for Energy Efficiency and Thermal Comfort in Buildings, Elsevier Press, 2010.

Reference books:

1. Oliver Gutfleisch , Matthew A. Willard , Ekkes Brück , Christina H. Chen , S. G. Sankar , and J. Ping Liu, Magnetic Materials and Devices for the 21st Century: Stronger, Lighter, and More Energy Efficient, Adv. Mater.23, 821-842 (2011)
2. L.H.Lewis and F.J. Villacorta, Perspectives on Permanent Magnetic Materials for Energy Conversion and Power Generation, Metallurgical and Mater. Trans. A, 44A, S1-S20 (2013)
3. S.L. Swartz, Topics in Electronic Ceramics, IEEE Trans. Elect. Insulation, 25 [5] 935 (1990)