

MS3013 – Environmental effects on Materials

Course Code	MS3013				
Course Title	Environmental effects on Materials				
Pre-requisites	NIL				
Pre-requisite for	MS4014	Nanomaterials: fundamentals and applications			
No of AUs	3				
Contact Hours	LECTURES	26 hrs	TUTORIALS	13 hrs	

Course Aims

The main objectives of this course is to help you to:

1. learn how the environmental affects the properties and performance of engineered metallic, ceramic and polymeric materials.
2. understand the prevention of the negative environmental effects on metallic, ceramic and polymeric materials.

This would be useful for those of you who are interested corrosion engineering of materials applied in material industry.

Intended Learning Outcomes (LO)

On completion of this course, you should be able to:

1. Identify how the environment affects the degradation or corrosion of metallic, ceramic and polymeric materials
2. Determine the prevention or stabilization methods for metallic, ceramic and polymeric materials degradation due to environmental effects
3. Determine how metallic, ceramic and polymeric materials can be used and their reliability in different conditions

Course Content

1. Electrochemical corrosion mechanism of metallic materials: Corrosion cells; The electrochemical series; Polarization; Evan's diagrams (Tafel plot); Mixed potential theory; Pourbaix diagrams and Passivation.
2. Forms of corrosion of metallic materials: Uniform corrosion; Localized corrosion including pitting, crevice corrosion, selective dissolution, intergranular corrosion, environment-sensitive cracking, flow-assisted corrosion, microbiologically influenced corrosion (MIC).
3. Principles of corrosion protection of metallic materials: Materials selection; Design against corrosion; Corrosion inhibitors; Protective coatings; Cathodic protection and anodic protection.
4. Failure of ceramic materials in gaseous and liquid environments
5. High temperature oxidation, oxidation in complex environment and oxidation remedy of non-oxide ceramics
6. Physicochemical changes and characterization of weathered polymeric materials
7. Photo-oxidation of polymers: Principles and mechanism; Photo-chemistries and oxidation; Photo stabilization of polymers with the use of additives (e.g. pigments, UV absorbers, antioxidants, etc)
8. Biodegradation of polymers: Micro-organism mediated enzymatic degradation; materials factors influencing biodegradation rate; Protection against biodegradation; Approaches to examine biodegradation.

Reading and References

Prescribed Texts:

1. Electrochemistry by Carl Hamann, et. al., 2ed ed. Wiley-VCH press, 2007.
2. Corrosion for Science and Engineering by K. R. Trethewey and J. Chamberlain, 2nd ed., Longman, 1995
3. Fundamentals of Polymer Degradation and Stabilisation, edited by Norman S. Allen and Michelle Edge, Elsevier Science Publishers, England, 1992.

Recommended references:

1. Principles and Prevention of Corrosion by Denny Jones, 2nd ed., Prentice-Hall
2. Corrosion Engineering by Mars G. Fontana, 3rd ed.
3. NACE Corrosion Engineer's Reference Book by R. Baboian, 3rd ed, NACE Press
4. Weathering of Polymers, by Anthony Davis and David Sims, Elsevier Applied Science Publishers Ltd, England, 1983
1. Handbook of Polymer Degradation, edited by S. Halim Hamid, Mohamad B. Amin and Ali G Maadhah, Marcel Dekker, Inc. , 1992
2. Compositional and Failure Analysis of Polymer, by John Scheirs, John Wiley & Sons, 2000.

Course Policies and Student Responsibilities

(1) CA

Absentees must be supported by a medical certificate or other valid official documents.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.