Instructor: Dr. Fardad Azarmi, Dolve Hall – Office 111D
Phone: 231- 9784, Email: fardad.azarmi@ndsu.edu

Office hours: Tuesday 2:30-3:30 PM by appointment
Lecture: Tuesdays-Thursdays, 3:30-4:45 PM- Dolve 215

Pre-requisites: Graduate standing

Bulletin Description:

Topics include; tribology, concept of surface, failure of surface, surface protection mechanisms, surface preparation for deposition, hard coatings, microstructural characterization, materials science, analytical techniques for surface characterization, evaluation of mechanical performance of deposited layer, case studies.

Course Description and Outcomes:

This course provides a practical and comprehensive overview of the role that surfaces play in materials behavior. It introduces the concept of surface engineering and how surface engineering may be used to optimize a components performance. A brief introduction of techniques to protect engineering surfaces will be discussed here. This course is mainly designed to provide engineers and researchers with an understanding of the principles of the characterization techniques and their application on coating, thin films, and surface analysis. On successful completion of this course the students will be able to:

- Understand the concepts of surface engineering and how it can improve in-service performance of standard materials.
- A brief introduction to surface damages such as corrosion, erosion and wear.
- Understand the effect of surface condition (morphology, temperature, roughness, etc.) on its performance.
- How surface engineering can change surface metallurgy and surface chemistry.
- Demonstrate critical awareness of proper surface preparation and its role in achieving the maximum level of protection available through protective deposition systems.
- Understand the concepts of hard coatings.
- A brief introduction to thermal spraying techniques.
- Identify the factors that accelerate coating deterioration and the techniques used to avoid common defects.
- Understand the principal methods of the microstructural characterization.
- Introduction to advanced techniques for surface analysis.
- Students will be be able to develop the skills and apply the knowledge learn in this class for research studies related to surface science.

Course Website:

- A blackboard site will be maintained for the course and will include all announcements, assignments, lecture notes, and solutions to problem sets and tests. The posted version of any of these documents will be the official version, superseding any previous versions. You will be able to check your grades on the site.

Textbook:

There is no specific text book for this course. Students are expected to use lecture notes and library resources. The following textbooks are suggested for students who like to get some extra knowledge in this field (Not required for this course):

- *Surface Engineering*, Editor: J.R. Davis, ASM International, 2001.
- *The Science and Engineering of Thermal Spray Coatings*, 2nd Edition, by Lech Pawlowski, Wiley, 2008.
- *Materials Science and Engineering, 7th Edition, by William D. Callister, Jr., John Wiley & Sons, Inc., 2007.*
- *Surface Engineering, Vol. 15, ASM Handbook.*

Course Policies:

Grading Policy

Homework	20%
In-class Quizzes	20%
Final Exam	10%
Report (Case Study1)	20%
Seminar (Case Study2)	30%

Contract Grades:	A 90% or greater
	B 80% to less than 90%
	C 70% to less than 80%
	D 60% to less than 70%
	F less than 60%

- The instructor holds the right to amend course policies and grade distribution during the semester if needed.
- In class quizzes and Final examination will be a combination of True/False, Complete the Sentence, Multiple Choice, Short Essay, and Work-Out Problems.
- Case studies will consist of an experimental or numerical study conducted by students related to the application of surface engineering, coating process, surface analysis, or review of one of the important related sub-areas. Students need to submit a draft which is suitable for publication in a journal paper or in a conference proceeding.
- The grade for both case studies will be based on the quality of the work, novelty, and its structure.
- High quality case studies can be submitted for publication upon approval of your academic advisor.
- Report (Case study 1) must be prepared using Microsoft word with maximum of 5 pages including figures and Tables.
- Seminar (Case study 2) will consist of an experimental or numerical study conducted by students related to the application of surface engineering, coating process, surface analysis, or review of one of the important related sub-areas.
- Power point or Prezi can be used for seminar presentation.
- Instructor holds the right to amend course policies and grade distribution during the semester if needed.

Lecture Policy

- Each class will generally consist of instruction using PowerPoint along with white/black board written notes. Lecture time will also be used for active learning exercises such as group problems, reading quizzes, research breaks. Open discussion and questions from the class are encouraged and expected. Problem sets will be assigned for each of the major topic sections.
- The attendance will not be recorded and will never count towards the final grade but students are strongly encouraged to attend all class sessions in order to be able to cope with the pace of the course.
- No cell phones or beepers during lecture, or examinations.
- Some lectures will be used for class discussion.

Tentative Class Schedule*

Week	Lecture Topics	In-Class Activities
1	**-Introduction to Surface Engineering**	
2	**-Principles of Corrosion**	
3	**-Principles of Friction- Erosion- Adhesive Wear**	***Introduction of Case Study 1***
4	**-Lubrication- Wear Test Methods**	***Discussion on Case Study 1***
5	**-Surface Engineering to Change Surface Metallurgy- Surface Hardening**	***Discussion on Case Study - Optional-***
6	**-Surface Engineering to Change Surface Chemistry- Chemical Conversion Coatings**	***Finalizing Case Study 1***
7	**-Introduction to Surface Protection Techniques- Coatings**	***How to prepare a research Article***
8	**-Integrating Deposition Systems into the Design Process.**	***Due Date: Case Study 1 (Report-Maximum 5 pages)***
9-11	**-Degradation, Defects, and Failures of Coatings-**	***Practice on Journal Publication***
12	**-General Topic on Microstructural Characterization of Materials: Optical Microscopy, SEM, TEM, X-ray Diffraction, and EDX.**	***Introduction to Case Study2***
13	**-Surface Analysis- Classification of Methods. Available Techniques for Surface Analysis such as AES, XPS, Auger, and SIMS.**	***Tour of Materials Lab Visit ME 331 Lab***
14	**-Powder Metallurgy**	
15	**-Final Exam**	
16	**-Case Study 2- Presentation**	***8-10 Slides***

*The instructor holds the right to adjust the schedule during the semester if needed

Learning Resources Available:
NDSU Main Library, Dolve Hall 136 Library, www.matweb.com, www.efunda.com, ASM Handbook Online – http://products.asminternational.org/hbk/index.jsp

Americans with Disabilities Act for Students with Special Needs
Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Center for Accessibility and Disability Resources (www.ndsu.edu/disabilityservices) as soon as possible.

Veterans and Student Soldiers: Veterans and student soldiers with special circumstances or who are activated are encouraged to notify the instructor in advance (Policy 331.1 Course Syllabus).

Attendance Statement:
According to NDSU Policy 333 (www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected. Veterans and student service members with special circumstances or who are activated need to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

Academic Honesty Statement:
The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

Technology Issues and Concerns:
- Please contact NDSU Help Desk at ndsu.helpdesk@ndsu.edu, Call: 701-231-8685 (option 1)
- You will need your student ID card if having account issues. CEA Tech Support is available to answer questions or difficulties arising from the operating system or hardware only. Please do not refer questions concerning how to use Creo™ or your homework assignment.

Academic Responsibility:
All work in this course must be completed in a manner consistent with NDSU University Senate Policy, Section 335: Code of Academic Responsibility and Conduct. http://www.ndsu.nodak.edu/policy/335.htm

ABET Students Outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.