

Course Outcome:

Able to

1. Apply the physics associated with surface microstructure features for understanding the material behavior.
2. Analyze the mesoscopic phenomena involved in the interfaces in the solids and fluids using advanced measurement techniques.
3. Analyze the physio-chemical nature of the solid and fluid for developing applications that needs to control biofouling and anti-icing on the solid surfaces

Syllabus

Surface Roughness – parameters for defining based on microasperities –Roughness measurements: stylus and optical profilometer techniques. Failure criterion involved surface microasperities. Optical and Electron Microscope – Scanning Electron Microscope (SEM) – Atomic Force Microscope (AFM)

Defects: Vacancies, Dislocations, Grain Boundaries, Size dependent strength

Review of Basic Fluid Mechanics, Solid Mechanics, and Thermodynamics – Contact Angle – Young’s Equation, Cassie-Baxter regime and Wenzel Regime – Contact Angle Hysteresis – Roughness factor and Solid fraction – Lotus and Petal Effects – Measurement Methods for Contact Angle and Contact Angle Hysteresis. Liquid drop interaction with solid and liquid surfaces. – Liquid Drop Impalement Transition

Introduction to slip and no-slip boundary conditions – lubrication approximation.

Surface microstructure fabrication techniques and characterization methods

Introduction to Biofouling and Icing behavior on the solid surfaces – Current status in Biofouling and Ice aggregation control on solid surfaces. Mechanism associated with Biofouling control and Anti-icing behavior with superhydrophobic surfaces

Text / Reference Books

1. Huimin Liu, “Science and Engineering of Droplets: Fundamentals and Applications (Materials and Processing Technology)” William Andrew; 1st edition (31 December 1999).
2. Introduction to Surface Engineering and Functionally Engineered Materials, by Peter Martin, WILEY, 2011.
3. Surface Engineering of Metals: Principles, Equipment, Technologies, by: Tadeusz Burakowski, Tadeusz Wierzchon, CRC Press, 1988.

Evaluation Pattern

<i>Component</i>	<i>Weightage</i>
<i>Periodical Test 1</i>	<i>15</i>
<i>Periodical Test 2</i>	<i>15</i>
<i>Continuous Assessment</i>	<i>20</i>
<i>End Semester Examination</i>	<i>50</i>
<i>Total Marks</i>	<i>100</i>

Skill Development

1. Achieve a capability of surface microasperities characterization using Scanning Electron Microscope, Optical Microscope, Atomic Force Microscope, etc.,
2. Characterize the physio-chemical nature of solid surfaces, i.e., surface energy using static contact angle and contact angle hysteresis.
3. Acquire the capability to prepare a solid surface with a known wettability to solve a world problem like self-cleaning, thermal barrier coating, anti-icing, biofouling, etc.,