

## **CH-423 Materials Science and Marine Chemistry**

**Credit Hours:** 3-0

**Pre-requisite:** NIL

### **Course Objectives:**

The objectives of this course are:

1. To introduce basic structures and properties of advanced materials.
2. To learn about nanomaterials and understand how physical properties change at the nanoscale.
3. To understand the chemical structure and properties of amorphous materials.
4. To introduce marine chemistry, oceanography, and geochemistry

### **Course Outcomes:**

After completion of this course, the students will be able to:

1. Acquire knowledge of crystal structure and physical properties of crystalline materials
2. Know chemical bonding and properties of amorphous materials.
3. Learn about nanomaterials and their applications.
4. Gain knowledge of optical, magnetic, and energy materials.

### **Course Contents:**

- (i) Materials Science: Introduction to inorganic materials; Electronic Materials: Band theory, metals, insulators, semiconductors, band gaps, doping, and devices; Crystalline materials: crystal structures, unit cells, 7 crystal systems, 14 Bravais lattices, Miller indices; Amorphous materials: Inorganic glasses, silicates, other oxides, metallics; Solid solutions: Phase stability: unary and binary phase diagrams; Nanomaterials: General introduction about structure, synthesis and properties of nanomaterials; Functional materials: Optical/optoelectronic materials, magnetic materials, phase change materials, thermoelectric, light-emitting diodes, smart and responsive materials for buildings, thermochromic; Energy materials: Photovoltaics, batteries, electrocatalysts/photo-catalysts, carbon capture, and sequestration.
- (ii) Marine Chemistry: Introduction to Oceanography; Marine Chemistry and Geochemistry; Physical and Chemical Properties of Sea Water, Organic Matter and Energy Fluxes, Carbon Dioxide Intake and Transformation, Major Minor and

Trace Inorganic and Organic Constituents in Sea Water and Sediments and their Impacts on Biota; Renewable Energy Sources, Industrial and Environmental Aspects of Arabian Sea. Geochemistry and geochemical distribution of elements in coastal areas of Pakistan.

**Recommended Books:**

- 1) B. Fahlman, Materials Chemistry, Springer (2011).
- 2) Harry R. Allcock, Introduction to Materials Chemistry, Wiley; 1<sup>st</sup> edition (2008).
- 3) Smart, L. & Moore, E., Solid-State Chemistry - An Introduction, 4<sup>th</sup> edition (2012)
- 4) Rajendra Kumar Goyal, Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques, and Applications, CRC Press; 1<sup>st</sup> edition (2017).
- 5) Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann, M., Advanced Inorganic Chemistry, 6th ed., Wiley-Interscience, (1999).
- 6) Mendham, J., Denney, R. C., Barnes, J. D. and Thomas, M. J. K., Vogel's Quantitative Chemical Analysis, 6th ed., Prentice Hall, (2000).
7. Hester RE, Harrison RM Chemistry in the Marine Environment (2000) Royal Society of Chemistry
8. Miller FJ Chemical Oceanography 3<sup>rd</sup> Ed (2005) CRC Press
9. Sammartano S, Gianguzza A and Pelizzetti E Chemistry of Marine Water and Sediments 1<sup>st</sup> Ed (2002) Springer.