Course Type	Course Code	Name of Course	L	T	P	Credit
DC4	**NGLC212**	Fundamentals of Crystallography, Mineralogy, and Geochemistry	3	1	0	4

Course Objective

Students will develop a 3D visualization of crystal structures, learn mineral identification through logical reasoning (not memorization), understand geochemical reasoning, and apply concepts to real geological problems.

Learning Outcomes

Upon successful completion of this course, students will be able to:

- Explain crystal structures, symmetry, and apply Miller indices for crystallographic analysis.
- Classify and identify common minerals based on physical, chemical, and structural properties.
- Apply basic principles of mineral chemistry to interpret mineral formation.
- Interpret elemental distribution and geochemical processes.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Earth Materials and Basics: Earth as a geochemical system; Minerals, rocks, ores – definitions & distinctions; Element abundance in Earth	3L+1T	Explain the Earth as a geochemical system and distinguish between minerals, rocks, and ores with reference to elemental abundance.
2	Fundamentals of Crystallography: Crystal systems (7 systems); Bravais lattices; Symmetry elements & operations; Miller indices (planes & directions); Unit cell geometry & interplanar spacing	12L + 4T	Apply crystallographic principles to analyze crystal systems, symmetry, and determine Miller indices and unit cell parameters.
3	Crystal Chemistry: Atomic bonding & coordination; Ionic radii, substitution; Pauling's rules & structure–property relations	6L+2T	Interpret mineral structures and stability using atomic bonding, ionic substitution, and Pauling's rules.
4	Physical Mineralogy: Physical properties overview; Diagnostic properties (hardness, cleavage, etc.); Mineral identification logic	6L + 2T	Identify minerals based on physical and diagnostic properties using systematic reasoning.
5	Optical Mineralogy: Nature of light & optics basics; Optical properties (RI, birefringence); Interference colours & extinction	6L + 2T	Explain the optical properties of minerals and interpret interference colors and extinction behavior.
6	Systematic Mineralogy: Silicate structures & classification; Rock-forming minerals (silicates); non-silicates (carbonates, oxides, sulfides)	5L + 1T	Classify minerals into silicate and non-silicate groups based on structure and composition.
7	Geochemistry: Element distribution in Earth; Goldschmidt classification; Geochemical cycles; Magmatic differentiation	4L + 2T	Interpret elemental distribution and geochemical processes using concepts such as Goldschmidt classification.
Total		42L + 14 T = 56	

Textbooks:

1. Klein, C., Dutrow, B., 2007. Manual of Mineral Science. John Wiley & Sons Inc, USA, 23rd Edition, 704 p.
2. Nesse., W.D., 2012. Introduction to Optical Mineralogy. Oxford University Press, 4th Edition, 361 p.
3. Rollinson, H. and Pease, V., 2021. Using Geochemical Data: To understand Geological Processes. Cambridge University Press, 2nd Edition, 358 p.

Reference Books:

1. Blackburn, W.H., Dennen., W.H. Principles of Mineralogy. Brown (William C.) Co., USA, 1st Edition, 432 p.
2. He, B.B., 2018. Two-Dimensional X-Ray Diffraction. John Wiley & Sons, USA, 2nd Edition, 496 p.

3. Perkins, D., 1998. Mineralogy. Prentice Hall, USA, 1st Edition, 480 p.
4. Ehlers, E.G., 1987. Optical Mineralogy (Vol 1): Theory and Technique. Blackwell Science Inc, USA, 1st Edition, 172 p.
5. Ehlers, E.G., 1987. Optical Mineralogy (Vol. 2): Mineral Descriptions. Blackwell Science Inc, USA, 1st Edition, 286 p.
6. Hammond, C., 2015. The Basics of Crystallography and Diffraction. Oxford University Press Inc., New York, 4th Edition, 544 p.