**Crystallography and Mineralogy**

1.1. Course Number: GE 212

1.2. Contact Hours: 3-1-2 Credits: 13

1.3. Semester Offered: 2nd Year-Odd

1.4. Prerequisite: Basic knowledge of Geology, Physics, and Chemistry

1.5. Syllabus Committee Members: Dr. Alok Kumar Singh & Dr. Hemant Kumar Singh

**2. Objective:** Understanding the basic knowledge of crystals, crystal systems and minerals.

3. **Course Content:** Unit-wise distribution of content and number of lectures

| Unit | Topics | Sub-topics | Lectures |
|---|---|---|---|
| 1 | Basic concept of Crystal form and Symmetry | Crystal Elements, symmetry, law of crystallography, classification of crystal systems, Miller indices and crystal forms. | 6 |
| 2 | Six Crystal Systems and stereographic projection | Symmetry character and form of normal classes of the following systems, Cubic, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic. Stereographic projection of symmetry elements and form. | 7 |
| 3 | Twinning and Twin Laws | common types of twins and their examples in minerals.<br><br>Space Lattice and Symmetry of internal structures – 14 Bravais Lattice. Introduction to space group, Historical development of X-ray Crystallography, Bragg's Law and its derivation, X-rays in mineral science. | 7 |
| 4 | Structural classification of silicates | A detailed study of the vital silicate mineral groups: Nesosilicates, Sorosilicate, Ring Silicates, Inosilicates, Phyllosilicates, Tectosilicates, atomic classification structure, polymorphs/structural states, chemistry including the substitution of elements/solid solution and experimental work on pressure temperature stability of the minerals, modes of occurrence and alterations. | 10 |
| 5 | Mineral optics | Principles of optical mineralogy: polarized light; optical mineralogy; behavior of isotropic and anisotropic minerals in polarized light: Birefringence, refractive index, double refraction, sign of elongation, Pleochroism, extinction angle, 2V, dispersion in minerals and pleochroic scheme, Uniaxial and Biaxial minerals, Concept of optical Indicatrix-Uniaxial Indicatrix and Biaxial Indicatrix. Use of Indicatrix, relation | 10 |

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|---|---|---|---|
| | | between crystallographic axes and the Indicatrix axes, Interference figures, Determination of 2V from Interference figures. | |
| | | **Total** | **40** |

List of Experiments:

- Hand specimen identification of various rock forming minerals.
- Mineral Preparation for Microscopic study for determination of optical properties of common rock-forming minerals.
- Study of interference figures of uniaxial and biaxial crystals, determination of optic signs.
- Goniometer and its use in measuring the interfacial angle of crystals and calculation of the axial ratio.
- Representation of symmetry elements of crystals belonging to 32 classes of symmetry and study of their stereograms.

**4. Readings:**

**4.1. Textbook:**

- Cornelis Klein and Barbara Dutrow, The manual of Mineral Science, Wiley Publication 2007.
- Dana, E.S. and Ford, W.E.: A textbook of Mineralogy. Wiley Eastern Limited.
- Deer, W. A., Howie, R. A. and Zussman, J., An introduction to the rock forming
- Minerals, ELBS publication,1962-1963.
- Nesse, W.D., Introduction to Optical mineralogy, 2008

**4.2. Reference Books:**

- P. F. Kerr, Optical Mineralogy, McGraw Hill Book Company
- P. K. Verma, Optical mineralogy, CRC press 200
- Putnis, Andrew. 1992: Introduction to Mineral Sciences. Cambridge Univ. Press
- Spear, F. S. (1993): Mineralogical phase equilibria and Pressure- Temperature-Time paths
- Berry, L.G., Mason, B. and Dietrich, R.V., 1983. Mineralogy CBS Publishers.

**5. Outcome of the course:**

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

- know about basic of crystals, crystal systems and minerals and their characteristics.

- Understand basic aspects of a crystal including the axes and system in which it usually crystallizes. It also includes the relationship of behavior of light and the crystals.
- Assess Optical mineralogy in detail from Mineral Preparation to Optical characteristics identification