

University of Mumbai

Syllabus
for B.Sc IVth Semester Courses in
Geology
(November 2017 onwards)

Contents:

- Theory Syllabus for Courses:
- USGE 401 - Economic Geology
- USGE 402 - Optical mineralogy and Systematic Mineralogy
COMMON COURSE
- USGE 403 - Field Geology and Hydrogeology

- Practical Course Syllabus for USGE.4.PR

S.Y. B.Sc. Geology
Title: Economic Geology

Course: USGE 401

Learning Objectives: To understand the fundamental processes involved in the formation and distribution of various ore deposits.

Number of lectures: 45

Unit 1

(15 lectures)

Introduction to economic mineral deposits

Introduction, definition of metalliferous and non-metalliferous deposits, ore mineral, gangue, tenor of ore, industrial minerals, overburden and country rock.

Classification of economically important metalliferous and non-metalliferous mineral deposits. Stratabound and stratiform ore deposits.

Structural and stratigraphic controls on mineralization, metallogenic epochs and provinces.

Ore genesis -I

Processes of formation of mineral deposits.

Magmatic concentration (early and late magmatic mineral deposits)

Sublimation and pegmatitic deposits

Unit 2

(15 lectures)

Ore genesis -II

Hydrothermal processes, cavity filling and metasomatism:

Hydrothermal processes: Principle, character of solution, types of openings in rocks, factors affecting deposition from hydrothermal solutions, wall rock alterations.

Cavity filling deposits: processes of formation and characteristic features of: fissure veins and its types (in brief), stock work, saddle veins, ladder veins, pitches and flats, breccia filling deposits, solution cavity fillings.

Contact Metasomatic Deposits: definition, criteria of replacement, resulting mineral deposits.

Sedimentation deposits, Metamorphic deposits

Evaporation deposits: brief account of non-metallic deposits of ocean water, lake water, ground water and hot springs.

Residual deposits: conditions favouring formation of residual deposits.

Mechanical concentration: principles and processes of formation of placer deposits (eluvial, alluvial, beach and aeolian).

Unit 3

(15 lectures)

Ore genesis - III

Oxidation and solution in the zone of oxidation, ore deposits in the zone of oxidation.

Supergene sulphide enrichment: requirements for supergene sulphide deposition, recognition of sulphide enrichment. Gossans and cappings, role of iron gossans, limonite and false gossans.

List of recommended reference books

1. Jensen M.R. and Bateman A.M. (1981), Economic mineral deposits, John Wiley & Sons.
2. Evans A.M. (1993), Ore geology and Industrial minerals, Blackwell Science.
3. Prasad U. (2000), Economic Geology - Economic Mineral Deposits, 2nd ed., CBS, India.

Practicals

Identification (with the help of physical properties), chemical composition, origin and Indian occurrences of Ore minerals and Industrial minerals of following minerals.

Barite

Barytes

Bauxite

Biotite

Calcite

Chalcopyrite

Chromite

Cuprite

Dolomite

Fluorite

Galena

Garnet

Graphite

Gypsum

Hematite

Ilmenite

Kyanite

Limonite

Magnesite

Magnetite

Malachite

Marble

Muscovite

Psilomelane

Pyrite

Pyrolusite

Serpentine

Sphalerite

Stibnite

Talc

Tourmaline

Distribution of mineral deposits

Formation, association and Indian distribution of following ore minerals: Mica, Copper, Manganese, Lead and Zinc, Bauxite, Chromite, Gold

S.Y. B.Sc. Geology

Course: USGE 402

Title: Optical Mineralogy and Systematic Mineralogy

Learning Objectives:

To introduce the basic concept needed to understand the optical mineralogy and to learn the physical and optical properties and characteristics of common rock forming minerals.

Number of lectures: 45

Unit 1

(15 Lectures)

Optical Properties of Minerals:

Nature and behaviour of light: Non-polarised and Polarised light, Refraction and Refractive index, Double refraction, Nicol prism and Filter polaroid, Isotropic and Anisotropic substances, Polarizing Microscope: Its Construction and Working.

Optical characteristics: Relief, Becke's test, Twinkling, Pleochroism, Birefringence, Polarization colours, Newton's scale, Extinction and Extinction angle, Anomalous polarization colours, Uniaxial and Biaxial minerals, Optical indicatrix, Interference figures, Optic sign, Sign of elongation, Use of Quartz wedge, Mica plate and Gypsum plate.

Unit 2

(15 Lectures)

Systematic Mineralogy: part I

Stability relationships, Condition of formation, Crystallography, Physical and optical properties, Composition and structure, Diagnostic Features, Occurrence and Uses of:

Silica Group

Feldspar Group

Feldspathoid Group

Mica Group

Unit 3

(15 Lectures)

Systematic Mineralogy: part II

Stability relationships, Condition of formation, Crystallography, Physical and optical properties, Composition and structure, Diagnostic Features, Occurrence and Uses of:

Amphibole Group

Pyroxene Group

Olivine Group

Garnet Group

Zeolite Group

Clay minerals

List Of Recommended Reference Books

1. Read H.H. (Rev. ed. C.D. Gribble) (1988), Rutley's Elements of Mineralogy" (27TH Edition), CBS Publications.
2. Cornelius K. and Hurlbut Jr. S. (1994), Manual of Mineralogy, Twenty first Edition and Minerals and Rocks Exercises in Crystallography, J. Wiley & Sons.
3. Dana J.D. and Ford W.E. (rev. ed.) (2010), Dana's Manual of Mineralogy, J. Wiley & Sons.
4. Rogers A.F. and Kerr P.F. (1942), Optical Mineralogy (2nd Edition), McGraw- Hill Co. Inc., New York.
5. Berry L.G., Mason B.H. and Dietrich R.V. (1983), Mineralogy, concepts, descriptions, determinations, W.F. Freeman and Co.
6. Deer W.A., Howie A.H. and Zussman J. (1992), An introduction to rock forming minerals, Longman Scientific and Technical.
7. Shelly David (1985), Optical Mineralogy (2nd Edition), Elsevier.
8. Nesse W.D. and Schulze D.J. (2004), Introduction to Optical Mineralogy" (Third Edition) and An Atlas of Minerals in Thin Section, Oxford University Press.
9. Perkins Dexter (2011), Mineralogy (International Edition), Pearson Education.
10. Wenk H.R. and Bulakh A. (2004), Minerals: their constitution and origin, Cambridge University Press.

Practicals:

Mineralogy:

Study of Physical and Optical characters, mode of formation and occurrence in Rock types of the following :

Igneous rock forming minerals: Quartz, Orthoclase, Microcline, Albite, Labradorite, Leucite, Nepheline, Sodalite, Muscovite, Biotite, Hornblende, Augite, Aegirine, Hypersthene, Olivine, Tourmaline and Apatite.

Metamorphic rock forming minerals: Garnet, Staurolite, Chlorite, Talc, Serpentine, Actinolite, Tremolite, Anthophyllite, Epidote, Andalusite, Kyanite, Sillimanite, Calcite, Dolomite, Asbestos, Chrysolite, Magnesite.

Study of Physical properties, mode of occurrence and conditions of origin of the following Secondary minerals: Quartz (Rock crystal), Amethyst, Calcite (Rhombohedral, Scalenohedral & Nail-head spar), Stilbite, Scolecite, Mesolite, Chabazite, Laumontite, Apophyllite (Prismatic & Pyramidal), Gyrolite and Okenite.

S.Y. B.Sc. Geology
Title: Field Geology and Hydrogeology

Course: USGE 403

Learning Objectives:

Understanding of construction & working of field equipment, Outcrops observations, measurements, recordings & interpretations and Hydro geological concepts, exploration, exploitation & recharge of groundwater.

Number of lectures: 45

Unit 1

(15 Lectures)

Nature of Geologic Surveying:

Uses of geologic surveying, Diversity of Surveys, Scope of geological field-work. Study of Outcrops, Importance of Contacts and Discrimination between different types of contacts. Discrimination of Strike and Dip.

Topographical Maps (SOI) - Map Index and Map Scale, Map folding, map reading. Study of Geological Maps and understanding Map Symbols.

Field Observations: Schedule for Field Observations. General Suggestions for Field work: Beginning a field problem. Collecting and trimming samples. Taking photographs.

Data recording and mapping in various terrains

Lava flow mapping- Mapping in igneous terrains

Field observations of sedimentary rocks

Data recording for structurally complicated terrains- foliations and lineations

Methods of Geologic Mapping:

Method of reconnaissance mapping – Contact mapping on topographical map, Tape and Compass, Detailed geological mapping using Plane Table survey.

Mapping of horizontal contacts using Altimeter: Its construction and use.

Unit 2

(15 lectures)

Ground Water:

Definition, Utilisation, Hydrogeologic Cycle, Subsurface movement of water, Zones of Groundwater. Definition of Watertable. Types of Aquifers. Presentation of Water Level data on Maps and Graphs. Natural and Artificial Discharge of Groundwater. Springs.

Occurrence of Groundwater:

Origin of groundwater. Rock properties affecting groundwater. Vertical distribution of groundwater. Geological formations as aquifers.

Groundwater Movement:

Darcy's Law, Coefficient of permeability. Groundwater flow rate. Laboratory and field measurements of permeability. Tracing groundwater movements. Groundwater flow-lines and flow-nets.

Unit 3

(15 lectures)

Surface Investigations for Groundwater:

Conventional methods – surface indicators of ground water, biological indicators , Test-drilling.

Geophysical log in ground water exploration:

Resistivity logging, Potential logging, Temperature logging.

Geophysical exploration for ground water:

Resistivity method and Seismic method.

Ground water recharge:

Artificial Recharge of Groundwater: Concept. Methods. Water Spreading, rain water harvesting.

Waste water reused. Recharge mounds. Induced recharge.

List of recommended reference books

1. Coe, A.L (Ed) (2010) Geological field techniques, Wiley-Blackwell
2. Compton R.R. (1985), Geology in the Field., John Wiley and Sons.
3. Gokhale N.W. (2009), A Guide to Field Geology, CBS Publ. India
4. Berkman D.A. (1987), Field Geologists' Manual., Monograph Series 9., The Australasian Institute of Mining and Metallurgy, Victoria, Australia.
5. Mathur S.M. (2001), Guide to Field Geology., PHI Learning., India.
6. Todd D.K. (1980), Groundwater Hydrology, 2nd ed. John Wiley.
7. Bouwer H. (1978), Groundwater Hydrology., McGraw-Hill
8. Chorley R.J. (ed) (1969), Introduction to Geographical Hydrology., Methuen.

Practicals:

Calculation of true and apparent dip

Calculating rake and plunge of lineation

Plotting geological map and outcrop completion

Flow Nets.

Problems on permeability, porosity and rate of flow.

Water table contour map and its application