



Syllabus For B.Sc Vth Semester Courses in Geology (June 2019 onwards)

- Contents:
- Theory Syllabus for Courses:
 - SGEO0501 – Precambrian Geology of India
 - SGEO0502 – Igneous Petrology
 - SGEO0503 - Structural Geology
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 - SGEO05AC- Remote Sensing and Image Interpretation
- Practical Course Syllabus for: SGEO05PR and SGEO05ACPR
- Evaluation and Assessment guidelines.

T.Y. B.Sc. Geology
Title: Precambrian Geology of India

Course: SGEO0501

Learning Objectives:

1. To bring about an understanding of the principals of Stratigraphy.
2. Understand the Precambrian Stratigraphy of India.

Number of lectures: 60

Unit 1

Introduction

(15 lectures)

Earth's Crustal Structure and Tectonic framework of India- Cratons.

Tectonic Elements of Continents & Oceans.

Tectonic Divisions of India.

Indian Cratons:

Dharwar Craton,
Bastar Craton,
Aravalli Craton

Unit 2

Cratons and Mobile Belts

(15 lectures)

Singhbhum Craton

Proterozoic Eastern Ghat Mobile Belt

Marginal & Transition Zone

Western Charnockite Zone

Western & Eastern Khondalite Zone.

Satpura Mobile Belt

Central Indian Tectonic Zone- Sausar, Mahakoshal & Betul Supracrustal Belts

Unit 3

Proterozoic History

(15 lectures)

Proterozoic Sedimentary Basins:

Vindhyan Basin,

Delhi Basin

Cuddapah & Kurnool Basins.

Kaladgi Basin.

Unit 4

Precambrians of Extra – Peninsula

(15 lectures)

Precambrian of Himalaya (Lesser & Higher Himalayas)

Precambrian of the Tethyan Basement

Salkhala Group

Vaikrita Group

Jutogh Group

Daling Group

Precambrians of the Lesser Himalaya

Western Sector

Central Sector

Eastern Himalaya

List Of Recommended Reference Books

1. Ramakrishnan, M. and Vaidhyanadhan, R. (2010) Geology of India - Vol. 1, Geological Society of India, Bangalore.
 2. Valdiya, K.S (2010)- The Making of India- Geodynamic evolution, 2nd Edition, Springer, Cham, Heidelberg, New York.
 3. Prasad, C.V.R.K. (2005) Elementary Exercises in Geology; Universities Press (India) Pvt. Ltd, Hyderabad.
 4. Directorate of Geology and Mining, Nagpur. (2000) Geology and Mineral Resources of Maharashtra.
 5. Deshpande, G.G. (1998) Geology of Maharashtra; Geological Society of India, Bangalore.
 6. Kumar, R. (1996) Fundamentals of Historical Geology and Stratigraphy of India, 4th ed., New Age International (P) Limited, Publishers.
 7. Lemon, R.R. (1990) Principles of Stratigraphy; Merrill Publishing Company, Ohio.
 8. Wadia, D.N. (1984) Geology of India, 4th ed., Tata McGraw-Hill Publishing, New York.
 9. Krishnan, M.S. (1982) Geology of India and Burma; 6th Ed. CBS Publishers & Distributors (India).
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Practical:

Stratigraphy and Geology of India

- I) Study of common rocks and economic minerals in Hand specimen from different stratigraphic horizons.
- II) Diagrammatic examples of Lithostratigraphic boundaries and classification.
- III) Study of Geological maps with geological history of the area in chronological order.
- IV) Problems:
 - a) Stratigraphic sequence from geological section.
 - b) Characteristics of a Fold & Fault from a geological map.
 - c) Understanding Precambrian Geological Time Scale.
- V) Numericals on radiometric dating- U-Pb, Rb-Sr, K-Ar
- VI) Numericals on stable isotopes- Oxygen and Carbon.

T.Y. B.Sc. Geology
Title: Igneous Petrology

Course: SGEO0502

Learning objective:

To provide students a systematic approach in understanding the origin of igneous rocks, nomenclature, classification and their association with particular tectonic settings.

Number of lectures: 60

Unit-1

(15 lectures)

The Interior of the Earth:

Evidence of the Earth's Composition and Mineralogy: Seismic data, The Geothermal Gradient, Meteorites, Xenoliths.

Mantle Petrology; Low Velocity Zone, Pressure and Temperature variations with Depth and high pressure experimentation.

Classification and Description of Igneous Rocks:

The IUGS Classification System, Other aspects of classification; Chemical Classification;

Textures of Igneous rocks,

Crystallinity, Granularity, Shape of Crystals and Mutual Relations.

Equigranular, Inequigranular, Directive and Intergrowth Textures.

Terms related to some specific Textures and Microstructures : Perlitic Cracks, Spherulites, Orbicular Structure, Rapakivi Structure, Zoned Crystals, Xenocrysts, Quench Texture, Crystal Pseudomorph, and Cumulus Crystals.

Characters of the Common Igneous Rocks: Plutonic and Volcanic types; Examples of Common Igneous Rock Types and their Indian Occurrences.

Unit 2

(15 lectures)

The Phase Rule and crystallization and melting relations in one, two and three component Systems:

Melting Behavior of Natural Magmas, Phase Equilibrium and The Phase Rule, One Component Systems, Two Component (Binary Systems) and Its Petrogenetic Significance. Binary Systems with Complete Solid Solution, Binary Eutectic Systems, Binary Peritectic Systems, the Alkali Feldspar System,

Ternary Systems:- Ternary Eutectic Systems, Ternary Systems with Solid Solution Reaction Series, The Effect of Pressure and Fluid on Melting Behavior. The effects of Pressure on the Melting and Crystallization of Magma; Time and Crystallization; Rock Types and Mode of Occurrence.

Unit 3

(15 lectures)

The Evolution of Magmas:

Differentiation: Fractional Crystallization; Other Differentiation Mechanisms.

Magmatic Mixing and Assimilation.

Melting of the Mantle, Partial Melting, Magma Generation and Differentiation.

Generation of Basaltic magma from a Chemically Uniform Mantle.

Unit 4

(15 lectures)

Brief study of Plate tectonic settings and associated igneous rocks.

Subduction –Related Activity: Island Arc Volcanism, Rocks and Magma Series, The Ophiolite Suite; Calcalkaline and Tholeiite Groups; Petrogenesis of Island Arc Magmas, Plutonic Rocks – Batholiths related to subduction zones. Gabbroic Layered Intrusions; Anorthosites; Alkali Basalts and Nephelinites; Carbonatites, Kimberlites and related Rocks.

List Of Recommended Reference Books

1. Bose M.K. (1997), Igneous Petrology. The World Press Pvt. Ltd. 568 p.
2. Bowen N.L. (1928), The evolution of Igneous Rocks. Princeton Univ. Press. N.J 332 p.
3. Hall A. (1987), Igneous Petrology. Longman. 573p.
4. Hatch F.H., Wells A.K and Wells M.K. (1984), Petrology of the igneous rocks. CBS Publishers, 551 p.
5. Philpotts A.R. (1994), Principles of igneous and metamorphic Petrology, Prentice Hall of India. 498p.
6. Turner F.J & Verhoogen J. (1951), Igneous and Metamorphic Rocks, McGraw Hill.
7. Williams H, Turner F.J & Gilbert C.M. (1955), Petrography. San Francisco: W.H. Freeman and company. 406p
8. Winter J. D. (2001), an Introduction to Igneous and Metamorphic Petrology, Prentice Hall, 697p.
9. Ehlers, E.G. and H. Blatt (1982), Petrology, Igneous, Sedimentary and Metamorphic, W.H Freeman, San Francisco.
10. Philpotts A. R. (2009), Petrography of Igneous and Metamorphic Rocks, Cambridge University Press, 686p.

Practical Course:

Megascopic identification and Petrography of Igneous Rocks

Igneous Textures.

Equigranular:

- a. Coarse –grained, Holocrystalline, Panidomorphic.
- b. Coarse –grained, Holocrystalline, Hypidiomorphic
- c. Medium –grained, Holocrystalline, Hypidiomorphic
- d. Fine –grained, Holocrystalline, Panidomorphic. (Orthophyric)
- e. Fine –grained, Holo/ Hemicrystalline, Hypidiomorphic
- f. Fine-grained, Holocrystalline, Allotriomorphic (Aplitic)
- g. Fine- grained, Hemicrystalline, Aphanitic, (Felsitic)
- h. Fine –grained, Holohyaline, Aphanitic

Inequigranular:

- a. Coarse/Medium/Fine, Holo/Hemicrystalline, Porphyritic
- b. Coarse/Medium/Fine, Holo/Hemicrystalline, Glomeroporphyritic
- c. Coarse/Medium, Holo/Hemicrystalline, Ophitic/ Subophitic
- d. Medium/ Fine, Holo/Hemicrystalline, Poikilitic
- e. Medium/Fine, Holocrystalline, Intergranular
- f. Medium/Fine, Hemicrystalline, Intersertal
- g. Medium/Fine, Intergranular-cum-ophitic (Ophimottling)

Directive:

- a. Fine, Hemicrystalline/Holohyaline, Banded (Fluidal)
- b. Fine, Hemicrystalline, Trachytic

Intergrowth:

- a. Graphic/Micrographic
- b. Perthitic

c. Granophyric

Igneous Mega-Structures

1. Vesicular/ Amygdaloidal Lava
2. Blockery/ Clinkery Lava
3. Ropy Lava Surface
4. Columnar Joint Block
5. Flow Banding
6. Glomeroporphyritic Clusters
7. Intrusive Contacts and Xenoliths

Igneous Micro-Structures

1. Reaction: (a. Corona , b. Myrmekite)
2. Xenolithic
3. Spherulitic/ Variolitic
4. Perlitic Fracture

Study of the Texture, Mineral composition, Mode of occurrence, and Association of the following Rock Types.

1. Granite
2. Rhyolite
3. Pegmatite
4. Aplite
5. Quartz porphyry
6. Pitchstone
7. Obsidian
8. Syenite (Hornblende / Biotite)
9. Trachyte
10. Feldspar porphyry
11. Nepheline Syenite
12. Diorite
13. Gabbro
14. Norite
15. Dolerite
16. Basalt (Vesicular/ Non- Vesicular/ Porphyritic, Amygdaloidal)
17. Picrite
18. Peridotite
19. Dunite
20. Anorthosite
21. Carbonatite

T.Y.B.Sc Geology

Course: SGEO0503

Title: Structural Geology

Learning Objectives:

To understand the concept of stress and strain and how rock behaves under different stress regimes. A detailed study of various geological structures i.e. Joints, Folds and Faults

Recommended: Personal laptop Computer with Stereo Plotting software

Number of lectures: 60

Unit 1

(15 lectures)

Introduction, Types of Structures, Stress, Strain, Measurements of Stress and Strain, Mechanical Behaviour of Rocks

Introduction and Review

Structures and Structural Geology

Fundamental Concepts

Stress

Definitions

Stress on a Plane

Stress at a Point

Mohr Construction

Mohr's Hypothesis

Stress Ellipsoid

Strain

Definitions

Kinds of Strain

Strain Ellipsoid

Mohr Circles for Strain

Simple and Pure Shear

Measurement of Strain in Rocks

Kinds of Strain

Strain Markers

Flinn Diagram

Mechanical Behavior of Rock Materials

Elastic (Hooken) Behavior

Permanent Deformation – Ductility

Controlling Factors

Unit 2

(15 lectures)

Study of Structures I: Joints and Faults

Joints and Shear Fractures

Griffith and Coulomb theory of fractures

Joints and Fracture Mechanics

Classification of joints

Fault Classification and Terminology

Anatomy of Faults

Criteria for Faulting

Fault Mechanics

Anderson's Fault Types

Brittle versus Ductile Faults

Thrust Faults

Nature of Thrust Faults
Detachment within a Sedimentary Sequence
Small – Scale Features of Thrust Sheets
Strike – Slip Faults
Properties and Geometry
Environments of Strike – Slip Faulting
Fault Geometry and Other Fault Types
Termination of Strike – Slip Faults
Transforms
Normal Faults
Properties and Geometry

Unit 3

(15 lectures)

Study of Structures II: Folds-I

Fold Geometry and Classifications
Descriptive Anatomy of Simple Folds
Map – Scale Parallel Folds and Similar Folds
Recognition of Folds
Fold Classifications
Based on interlimb angle
Ramsay standard classification
Noncylindrical and Sheath Folds
Fundamentals of Parallel Folds and Similar Folds
Complex Folds
Identification of overturned folds
Occurrence and Recognition
Fold Interference Patterns
Recognition of Multiple Fold Phases

Unit 4.

(15 lectures)

Study of Structures II: Folds-II

Fold Mechanics
Fold Mechanisms and Accompanying Phenomena
Deformation Mechanisms and Strain
Theory of progressive evolution of fold shapes in single competent layers.
Layer parallel shortening
Dependence of fold shape on viscosity contrast in a single layer buckles
High competence contrast, Low Competence contrast
Zone of contact strain and its interrelationship with buckle folds
Change of fold shape with packing distance of competent layers
Fold styles in multilayers

List Of Recommended Reference Books

1. Fossen, H. (2010), Structural Geology, Cambridge University Press
2. Hobbs D.W., Means W.D. And Williams P.F. (1976), An Outline of Structural Geology, John Wiley.
3. Benninson, G and Moseley, K. (2003), An introduction to geological structures and maps, 7th edition, Arnold Publications
4. Lisle, R (2003) Geological structures and maps: a practical guide, Butterworth-

Heinemann Ltd.

5. Billings M.P. (1972), Structural Geology, 3rd ed., Prentice- Hall, Inc., Englewood cliffs, New Jersey.
6. Ragan D.M. (1968), Structural Geology- An Introduction to Geometrical Techniques, 2nd ed., John Wiley and Sons.
7. Ramsay J.G. and Huber M.I. (2002), The Techniques of modern structural geology, 2nd ed., Vol. 2, Elsevier Science Ltd.

Practical Course:

- Profiles and cross sections of geological maps with showing various structural features: folds, faults, dykes, two series of dipping beds. (8 maps at least)
- Patterns of dipping strata;
- Stress and strain analysis- applications
- **Equal-area net part I**
 - a. Plotting a line that lies in a plane
 - b. Determining the angle between two lines
 - c. True strike and Dip from apparent dips
 - d. Attitude of intersection of two planes
- **Equal-area net part II**
 - a. Determining the angle between two planes
 - b. Determining the orthographic projection of a line on a plane
 - c. Determining the angle between a line and a plane
 - d. Bisecting the angle between two lines
 - e. Bisecting the angle between two planes
- **Counting and contouring of the structural data**

T.Y. B.Sc. Geology
Title: Metamorphic Petrology.

Course: SGEO0504

Learning Objectives:

As a branch of petrology, metamorphic petrology deals with the change in rock structure, composition and texture based on the varying pressure and temperature conditions. This course aims at preparing the learner for appreciating the processes that lead to such changes. The learner will be able to identify in hand specimen as well as through petrographic examination, the various rocks.

Number of lectures: 60

Unit 1:

(15 lectures)

Introduction to Metamorphic Petrology

Definition of metamorphism.

Agents of metamorphism

Types of Metamorphism

Introduction to metamorphic fluids

Metasomatism and examples of metasomatism

Classification of Metamorphic rocks

Textures and structures of metamorphic rocks

Unit 2:

(15 lectures)

Thermodynamics and metamorphism

Phase rule and phase diagrams

Calculations on entropy, enthalpy, Gibbs free energy

Introduction to chemographic projections

Types of metamorphic reactions

Concept of metamorphic facies

Unit 3:

(15 lectures)

Metamorphism- types and products-I

Metamorphism of basic rocks and their facies

UHP and UHT metamorphism of basic rocks

Introduction to P-T-t paths

Metamorphism of pelitic rocks- Barrovian zones

Partial melting and migmatites

Unit 4:

(15

lectures)

Metamorphism- types and products-II

Metamorphism of carbonate rocks- Contact and regional

Charnockites and Khondalites-Granulites with reference to Indian examples

Porphyroblasts and Tectonism: pre-, syn- and post- tectonic porphyroblasts

Introduction to paired metamorphic belts

List of Recommended Books:

1. Winter J.D (2013) Principles of Igneous and Metamorphic Petrology (Second Edition), PHI Learning Private Limited, Delhi.
2. Williams H, Turner F.J & Gilbert C.M. (1955), Petrography, W.H. Freeman and company. San Francisco, 406p.
3. Greensmith J. (1989), Petrology of the Sedimentary rocks (7th Edition), C.B.C. Publishers, New Delhi.
4. Blatt H., Tracy R.J. and Owens B.E. (2006), Petrology – Igneous, sedimentary and Metamorphic (3rd Edition), W.H. Freeman and Company, New York.
5. Yardley Bruce W.D. (1989), An Introduction to Metamorphic Petrology, Longman Singapore Publishers (Pvt.) Ltd.
6. Harker Alfred (1974), Metamorphism, Chapman and Hall, London.
7. Turner F.J and Verhoogen J. (1960), Igneous and Metamorphic Petrology, Mc Graw-Hill.
8. Bayley B. (1996), Introduction to Petrology, Prentice Hall, New York.
9. Miyashiro A. (1998), Metamorphism and Metamorphic Belts, George Allen & Unwin, New York.
10. Mason Roger (1984), Petrology of the Metamorphic Rocks, CBS Publishers and Distributors, New Delhi.
11. Winkler Helmut G.F. (1987), Petrogenesis of Metamorphic Rocks (Fifth Edition), Narosa Publishing House, New Delhi.
12. Philpotts A and Ague J. (2009) Principles of Igneous and Metamorphic Petrology (Second Edition), Cambridge University Press, UK.

Practical Course:

Calculations of stable mineral composition at equilibrium

Megascopic and Microscopic Identification of Metamorphic Rocks.

Metamorphic Textures

1. Idioblastic
2. Porphyroblastic
3. Granuloblastic
4. Xenoblastic

Metamorphic Structures

1. Cataclastic
2. Slaty cleavage
3. Maculose
4. Granulose
5. Schistose
6. Gneissose

Metamorphic Rocks

1. Quartzite
2. Marble
3. Slate
4. Phyllite

5. Mica Schist (with Staurolite/ Garnet)
6. Actinolite/ Chlorite Schist
7. Mica- Gneiss
8. Hornblende Gneiss.
9. Granulite
10. Eclogite
11. Serpentinite
12. Khondolite
13. Charnockite

SGEO0501, 502, 503, 504 courses

Evaluation (Theory): Total marks per course - 100.

CIA- 40 marks

CIA 1: Written test -20 marks

CIA 2: Assignment -20 marks (Pre field report: This will be for all the four courses, that is 20 marks each,)

End Semester Examination – 60 marks

One question from each unit for 15 marks, with internal choice. Total marks per question with choice -20 to 22.

Evaluation of SGEO05PR (Practicals) Total marks per Practical course - 200.

Template for SGEO courses End Semester examination in Semester 5

UNITS	KNOWLEDGE	UNDERSTANDING	APPLICATION and ANALYSES	TOTAL MARKS- Per unit
1	08	04	03	15
2	08	04	03	15
3	08	04	03	15
4	08	04	03	15
-TOTAL - Per objective	32	16	12	60
% WEIGHTAGE	53	27	20	100%

Template for Evaluation of course SGEO05 CIA 2

St. Xavier's College, Mumbai

Course: SGEO0501/502/503/504

Department of Geology

Roll Number: _____

UID Number: _____

MARKS: ____/20

Evaluation Grid for Course: SGEO0501/502/503/504 - CIA 2 - Assignment

REPORT (Parameters)	Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0 – 20% Very Poor
Reference Papers reviewed	10					
Stratigraphy/ Petrology/ Structural Geology/ Maps /Imagery prepared	10					
Total	20					

Evaluator's Name Signature and date

Name

Signature & date