ST. XAVIER'S COLLEGE, MUMBAI

Est. 1869 | YEARS

Syllabus
For IInd Semester Courses in
M.Sc. Geology
(November 2019 onwards)

Courses:

SGEO0801 – Remote Sensing and Digital Image Processing

SGEO0802 - Igneous Petrology

SGEO0803 – Metamorphic Petrology

SGEO0804 – Sedimentary Petrology

Practical Course:

SGEO0801PR, SGEO0802PR, SGEO0803PR and SGEO0804PR. (Pertinent to the above-mentioned theory courses)

M.Sc-I Geology Course: SGEO0801
Title: Remote Sensing and Digital Image Processing

Learning Objectives:
Understand the analytical aspects of image processing with special emphasis on processing remotely sensed imagery for geological data interpretation and field mapping.
Additional requirements: personal Laptop computer.

Number of lectures: 60

UNIT 1 **(15 lectures)**

Concepts of Remote Sensing:
Satellite imaging technology - Definitions of: Resolution, Geolocation , georeferencing and geocoding., Image products.
Principles: Satellite Orbits, Geometry of a single image, Acquisition of stereoscopic data.
History of optical sensors in space
Principles of High-Resolution Optical Sensors:
Across track stereo, Along track stereo,
Spatial and radiometric aspects,
Sensor optics,
Data recording and transmission,
Sensors with GSD 1m to 16m and 1m or less.
Remote Sensing Systems:
Instrument systems - Radar, Lidar.
Indian Remote Sensing Systems

UNIT 2 **(15 lectures)**

Introduction to Digital Image Processing:
Introduction.
Image Rectification and Restoration.
Image Enhancement.
Contrast Manipulation.
Spatial Feature Manipulation.
Multi-Image Manipulation.

UNIT 3 **(15 lectures)**

Digital Imaging classification :
Image Classification: Supervised Classification.
The Classification Stage: Minimum-Distance to Means Classifier, Parallelepiped Classifier, Gaussian Maximum Likelihood Classifier.
The Training Stage.
Unsupervised Classification.
Subpixel classification,
Hyperspectral Image Analysis
Classification Accuracy Assessment.

UNIT 4 **(15 lectures)**

Remote Sensing in Geologic Mapping and Resource Exploration

Recognising rock type, Recognising structure, Stratigraphic and Compositional mapping, remote geochemistry, Remote sensing in petroleum and mineral exploration.

Exploitation, Hydrologic and Engineering Remote Sensing:

Resource exploitation projects, Hydrology, Logistics and Engineering.

Environmental Remote Sensing:

Environmental baseline monitoring, Geobotanical remote sensing.

Astrogeology:

Mapping planetary - structure, stratigraphy and resources.

List of Recommended Reference Books

1. Prost G. L., (2014), Remote Sensing for Geoscientists – Image Analysis and Integration., 3rd ed., CRC Press
2. Dowman Ian., Karsten Jacobsen., Gottfried Konecny and Rainer Sandau (2012), High Resolution Optical Satellite Imagery., Whittles Publishing.
3. Schowengerdt Robert A., (2007), Remote Sensing – Models and Methods for Image Processing, 3rd ed., Elsevier (Academic Press).
4. Lillisand T. M., Ralph W. Kiefer and Jonathan W. Chipman (2007), Remote Sensing and Image Interpretation, 6th ed, Wiley.
5. Jensen John R. (2000), Remote Sensing of the Environment – An Earth Resource perspective, Pearson Education Series, Low Price Edition.
6. Drury S.A., (1993), Image Interpretation in Geology, 2nd ed., Chapman and Hall, London.
7. Ramasamy S.M., (2005), Remote Sensing in Geomorphology, New India Publishing Agency.
8. Mather Paul M., (2004), Computer Processing of Remotely Sensed Images- An Introduction, 3rd ed., John Wiley.

Practical Course:

Remote Sensing and Image Processing

- Interpretation of Satellite imagery for: Landuse/Landcover, Geomorphology, Geology.
- Mapping the neighbourhood (on imagery)
- Digital Image Processing (using number matrix): enhancement, manipulation and classification.
- Digital image processing on Computer (using QGIS)
  - Display of various types of image formats
  - Pallets and Display elements
  - Georeferencing
  - Image enhancement
  - Image classification
  - Mapping the neighbourhood – Digital mapping

M.Sc-I Geology Course: SGEO0802
Title: Igneous Petrology

Course Objectives: To understand the principles and processes involved in the evolution and formation of Igneous rocks and provinces, and their significance in deciphering the Earths evolution.

Number of lectures: 60

Unit 1: (15 lectures)

Role of Magma in Geological Processes

Magma definition, its physical property- Geothermal gradient and heat source.
Magmatism and plate tectonics.
Igneous texture and structure and their genetic significance.
Classification of Igneous rocks - historic perspective and the IUGS systematic
Igneous activity at the present day

Unit 2: (15 lectures)

Geochemical Tracers of Mantle Process

Introduction
Continental and Oceanic mantle Lithosphere.
MORB and depleted mantle.
OIB and enriched mantle.
Island arc basalt.
Concept of Hot Spots
Mantle Plumes- theory and structure
Trace Elements in Igneous processes- Melting and crystallization models- Application of trace elements to petrogenesis

Unit 3: (15 lectures)

Magma Evolution and Crystallisation

Igneous processes and diversity in igneous rocks.
Compositional variation in magmas
Magmatic differentiation
Mixing of magma
Assimilation of magma
Phase relations of silicates and silicate melt.
Binary and ternary system.
Partial melting

Unit 4: (15 lectures)

Petrogenetic Provinces

Large Igneous Provinces: Basaltic associations of continental areas, Basaltic rocks of the Ocean Basins.
Ophiolites.

Layered Gabbroic Intrusions.
Alkaline rocks, Nephelinites and Ijolites, Lamprophyres.
Carbonatites ,Anorthosites, Kimberlites, Lamproites : Geology and Distribution in India.
Granites and Granitic rocks

Practical Course:

1. Megascopic and Microscopic identification of igneous rocks.
2. CIPW normative calculation of igneous rocks.
3. Application of trace elements in igneous petrology.

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.

M.Sc-I Geology Course: SGEO0803
Title: Metamorphic Petrology

Learning Objectives: To understand the metamorphism and its controlling factors, to understand concept of metamorphic facies and significance of metamorphic mineral assemblages. To relate metamorphic textures with deformation conditions and to understand role of global tectonics in metamorphism.

Number of lectures: 60
Unit 1: (15 lectures)
Metamorphism and its controlling factors
Metamorphism and its limits
Metamorphic agents and changes: Role of temperature, pressure, stress and fluids
Types of metamorphism
Types of protolith
Classification of metamorphic rocks
Structures and textures of metamorphic rocks
Analysis of polydeformed and polymetamorphosed rocks
Analytical techniques

Unit 2: (15 lectures)
Thermodynamics and metamorphism
Phase rule and phase diagram
Calculations on entropy, enthalpy and Gibb's free energy.
Chemographic diagrams: Basic concepts and common diagrams in metamorphic petrology
Projections in chemographic diagrams
Metamorphic facies and facies series
Types of metamorphic reactions
Petrogenetic grids
P-T-t paths
Calculation of equilibrium curve for metamorphic reactions
Examples of thermometry and barometry

Unit 3: (15 lectures)
Types and products of metamorphism-1
Metamorphism of pelitic rocks
Migmatites: Types and formation processes
Metamorphism of carbonate rocks
Metamorphism of mafic rocks

Unit 4: (15 lectures)
Types and products of metamorphism-2
Metamorphism of granitoids.
Charnockites
Metamorphic fluids, mass transport and metasomatism.
Impact metamorphism and Retrograde metamorphism.

Tectonics and metamorphism, Paired metamorphic belts

Practical Course:

Metamorphic petrology

- Plotting rock compositions on chemographic diagrams: ACF, AKF and AFM.
- Study of hand specimen of metamorphic rocks

Slate, Phyllites, Quartzite, Schists, Gneisses, Granulites, Khondalite, Leptynite, Charnockite, Eclogite, Amphibolite, Migmatite, Blueschist, Breccia, Mylonite,

- Study of thin sections of

a) Metapelitic rocks

b) Metabasic rocks

c) Granulites and eclogite

d) Marbles

List of Recommended Reference Books

1. Winter, John D. (2010): Principles of igneous and metamorphic petrology, PHI learning Pvt. Ltd.
2. Philpotts, A and Ague, J (2009): Principles of igneous and metamorphic petrology, Cambridge University Press
3. Williams H, Turner F.J & Gilbert C.M. (1955), Petrography, W.H. Freeman and company. San Francisco, 406p.
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. Passicher C.W, Myers J.S and Kroner A. (1990), Field geology of high grade gneiss terraines; Narosa Publishing house, Springer Verlag and IUGS
6. Yardley Bruce W.D. (1989), An Introduction to Metamorphic Petrology, Longman Singapore Publishers (Pvt.) Ltd.
7. Miyashiro A. (1998), Metamorphism and Metamorphic Belts, George Allen & Unwin, New York.
8. Mason Roger (1984), Petrology of the Metamorphic Rocks, CBS Publishers and Distributors, New Delhi.
9. Winkler Helmut G.F. (1987), Petrogenesis of Metamorphic Rocks (Fifth Edition), Narosa Publishing House, New Delhi.

M.Sc. Geology Course: SGEO0804
Title: Sedimentary Petrology

Course Objectives:
Understanding different sedimentary processes, rocks and structures and their associated environment.
Application of Sedimentary petrology in understanding different geological processes.

Number of lectures: 60

Unit-1 (15 lectures)
Weathering and weathering indices
Sediment transport and deposition, fundamentals of fluid dynamics
Sedimentary textures: grain size, sorting, shape, etc.
Sedimentary structures: lamination, ripples, cross-bedding etc.

Unit-2 (15 lectures)
Siliciclastic diagenesis
Siliciclastic marine environments- Deltaic and beach barrier island environments
Estuarine, lagoonal and tidal environments
Fluvial depositional environment

Unit -3 (15 lectures)
Carbonate sedimentary rocks, classification and diagenesis
Carbonate marine environments
Biochemical and evaporitic rocks

Unit-4 (15 lectures)
Eolian and lacustrine environments
Glacial environment
Sediment gravity flow deposits- Turbidites and alluvial fans-classification, textures and structures

Practical Course:
Calculation of weathering indices
Siliciclastic and carbonate sedimentary rocks and their classifications, hand specimen and thin section descriptions
Heavy minerals and provenance determination
Grain Size analysis
Paleocurrent analysis

List of Recommended Reference Books

1. Leeder, M. (2009) Sedimentology and sedimentary basins- From Turbulence to Tectonics
2. Miall, A.D. (2000): Principles of Basin Analysis, Springer-Verlag.
3. Pettijohn; F.J. (1975): Sedimentary Rocks (3rd Ed.), Harper and Row Publ., New Delhi.
4. Reading, H.G. (1997): Sedimentary Environments and facies, Blackwell Scientific Publication.
5. Reineck, H.E. and Singh, I.B. (1973): Depositional Sedimentary Environments, Springer-Verlag.
6. Selley, R. C. (2000) Applied Sedimentology, Academic Press.
7. Tucker, M.E. (2001): Sedimentary Petrology: An Introduction, Wiley and Sons, New York.
8. Tucker, M.E. (1990): Carbonate Sedimentology, Blackwell Scientific Publication
9. Stow Dorrik A.V(2011): Sedimentary Rocks in the Field , A Colour guide. Manson Publishing House Ltd.
10. Nichols G. (2009): Sedimentology and Stratigraphy., Wiley India.

Evaluation and Assessment: SGEO0801, 0802, 0803 and 0804 courses

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

Continuous Internal Assessment (CIA) - 40 marks

CIA 1: Written test -20 marks

CIA 2: 12 days Geological Field work with field report and viva on the fieldwork. - 20 marks per course (20 X 4 courses = 80 marks)

End Semester Examination – 60 marks

One question from each unit for 20 marks, with internal choice. Total marks per question with choice -28 to 30.

Evaluation of SGEO08PR (Practicals) Total marks for Per Practical course - 50.
Total marks for four practical courses : 200

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Template for SGEO courses End Semester examination in Semester 1

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%**

St. Xavier's College, Mumbai **Course: SGEO0801/0802,0803,0804**

Department of Geology

Roll Number: _____
UID Number:_____

MARKS:____/20

Date:_____

Assessment Grid for Course: SGEO courses CIA 2 (Field Work)

Parameters Category	Details of Assessment	80 – 100 % Excellent	60 – 80 % Good	40 – 60 % Satisfactory	20 –40 % Poor	0 - 20 % Very Poor
Field Work (30 %)	1. Equipment – field diary, hammer, chisel, hand lens, map, Field discipline.(02)					
	2. Sample Collection and Instrument handling (01)					
	3. Prior Preparation (03)					
Field Report (60 %)	1. Field Diary (04)					
	2. Content, Presentation and Technical correctness (08)					
Viva Voce (10 %)	1. Ability to answer questions. (02)					
Total Marks/20						

Name, Signature of Course Instructor

Date: