Syllabus
for B.Sc VIth Semester Courses in Geology
(November 2019 onwards)

Contents:

- Theory Syllabus for Courses:
  - SGEO0601 – Phanerozoic Geology of India
  - SGEO0602 - Sedimentary Petrology
  - SGEO0603 - Engineering Geology
  - SGEO0604 - Photogrammetry, Photo Interpretation & Fundamentals of GIS
  - SGEO06AC- Gemmology
- Practical Course Syllabus for SGEO06PR
- Practical Course Syllabus for SGEO06ACPR
- Evaluation and Assessment guidelines.

T.Y. B.Sc. Geology **Course: SGEO0601**
Title: Phanerozoic Geology of India

Learning Objectives: To bring about an understanding of the principals of stratigraphy and Understand the Phanerozoic stratigraphy of India.

Unit 1: **(15 lectures)**
Palaeozoic History
Tectonic History
Precambrian Cambrian Boundary
Marine Palaeozoic Formations of India
- Kashmir Basin
- Spiti Basin
- Krol Basin

Unit 2: **(15 lectures)**
Mesozoic History
Tectonic History
Permian Triassic Boundary
Marine Mesozoic Formations of India - Spiti Basin
Marine Transgressive Sequences of Kachchh, Jaisalmer and Tiruchirapalli.

Unit 3: **(15 lectures)**
Gondwana Sequence of India
Sedimentation and Palaeoclimates
Lower Gondwana Sequence of different basins.
Upper Gondwana Sequence of different basins.

Unit 4: **(15 lectures)**
Cenozoic History
Tectonic History
Boundary Problems
Indian Palaeogene - Neogene Formations:
- Siwalik Supergroup
- Assam –Arakan Region
- Andaman-Nicobar Islands
- Sirmur Group

Timeline of evolution of Himalayan orogenic belt
Geology and Stratigraphy of Maharashtra
- Deccan Flood Basalts.
- Geology of Mumbai and Suburbs

Reference Books:

1. Valdiya, K.S (2010) Making of India- The Geodynamic evolution, Springer Cham Heidelberg, New York.
2. Vaidhyanadhan, R. and Ramakrishnan, M. (2008) Geology of India - Vol. 2, Geological Society of India, Bangalore.
3. Dasgupta, A. (2010) Phanerozoic Stratigraphy of India; World Press, Kolkata.
4. Deshpande, G.G. (1998) Geology of Maharashtra; Geological Society of India, Bangalore.
5. Directorate of Geology and Mining, Nagpur. (2000) Geology and Mineral Resources of Maharashtra.
6. Krishnan, M.S. (1982) Geology of India and Burma; 6th Ed. CBS Publishers & Distributors (India).
7. Kumar, R. (1996) Fundamentals of Historical Geology and Stratigraphy of India, 4th ed., New Age International (P) Limited, Publishers.
8. Lemon, R.R. (1990) Principles of Stratigraphy; Merrill Publishing Company, Ohio.
9. Prasad, C.V.R.K. (2005) Elementary Exercises in Geology; Universities Press (India) Pvt. Ltd, Hyderabad.
10. Wadia, D.N. (1984) Geology of India, 4th ed., Tata McGraw-Hill Publishing, New York.

Practical Course:

Stratigraphy and Geology of India, Maharashtra and Mumbai

I) Study of characteristic index fossils of a particular stratigraphic horizon.

II) Biostratigraphic correlation exercises

III) Lithostratigraphy and stable isotope composition of phanerozoic carbonate sequences

IV) Isopach, Isolith and structural contour maps

V) ^{14}C dating and OSL dating- principals and numericals

VI) Study of Geological maps with geological history of the area in chronological order.

VII) Problems:

d) Stratigraphic sequence from geological section.

e) Interpretation of depositional environments for stratigraphic sequences.

f) Understanding Phanerozoic Time Scale.

T.Y B.Sc. Geology **Course: SGEO0602**

Title: Sedimentary Petrology

Learning Objectives:
To understand the various provenances, processes of formation and environments of deposition of sedimentary rocks.

Number of Lectures - 60

Unit 1: **(15 lectures)**

Introduction
Origin, transportation and deposition of sediments.
Classification of Sedimentary rocks
Basin, environment and facies concept.
Field techniques:
Sedimentary structures- Basic measurements and data records
Sedimentary Texture analysis:
Grain Size scales and laboratory methods of analysis
Shape analysis

Unit 2: **(15 lectures)**

Siliciclastic sedimentary rocks
Sandstones
Field observations
Petrography and classification
Heavy minerals and other provenance indicators
Concept of maturity
Diagenesis and authigenesis
Conglomerates and breccia
Classification and field observations
Mudrocks:
Field Observations: Textures, Structures, Colour, Nomenclature
Laboratory Studies: Mineral composition and provenance.

Unit 3: **(15 lectures)**

Limestones and dolomites
Field Observations
Components and mineralogy of limestones
Classification of limestones and petrography
Carbonate diagenesis
Dolomitization and dedolomitization
Silicification of limestone
Carbonate depositional environments

Unit 4: **(15 lectures)**

Other Types of Sedimentary Rocks:
Evaporites-
Origin of Giant Evaporite Deposits
Palaeoclimatic interpretation from evaporites
Bedded Cherts and Phosphate Rocks- Origin, mineralogy and types
Volcaniclastic sediments- Types and field characters.

List of Recommended Books:

1. Boggs, S. Jr. (2006) Principles of sedimentology and stratigraphy, (4th Edition) Pearson Prentice Hall, New Jersey.
2. Staw, A.V.D (2005), Sedimentary rocks in the field: A colour guide, Manson Publishing, London.
3. Nichols, G. (2009), Sedimentology and stratigraphy (2nd Edition), Wiley India.
4. Pettijohn F.J. (1984), Sedimentary Rocks (3rd Edition), CBS Publishers and Distributors, New Delhi.
5. Collinson J.D and Thompson D.B (2006), Sedimentary Structures (2nd Edition),
6. Tucker, M. E (2001), Sedimentary Petrology (3rd Edition), Blackwell Science Ltd. Unwin Hyman Ltd, Sydney.

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Practical Course

Megascopic and Microscopic description of Sedimentary Rocks.

Sedimentary Structures

1. Parallel bedding
2. Current Bedding
3. Graded Bedding
4. Ripple Marks
5. Rain Imprints
6. Concretions/Secretions

Grain size and shape analysis

Preparation of lithologs and sections

Paleocurrent analysis

Identification and description of heavy minerals

T.Y. B.Sc. Geology **Course: SGEO0603**
Title: Engineering Geology

Learning Objectives: To understand the engineering properties of rocks and their use as construction material. Detailed study of various geological and geotechnical investigations for various civil engineering projects. To understand the impact of Geological activities on the environment.

Number of lectures: 60

Unit 1: **(15 lectures)**

Engineering Properties of Rocks:

Specific Gravity
Porosity
Sorption
Compressive Strength
Tensile Strength
Elasticity of Rocks
Residual Stress and Shear Stress in Rocks.

Engineering properties of soil

Soil classification
Soil gradation
Compressive and shear strength
Atterberg limits
Consolidation and swelling of clays

Unit 2: **15 lectures)**

Rocks as Construction Materials:

Types of Rocks used in construction: How are they obtained in nature? Use of Rocks as facing stone. Factors influencing Engineering usefulness of Rocks.

Use of Rocks as aggregates: Use of rock as an aggregate in different types of constructions, sources of different grades of aggregates. Properties of aggregates (Shape, Size, Surface Texture, Roundness, Coating), Cement aggregate reaction, Thermal effects on aggregate. Highway aggregate, Rail – road ballast, Runway aggregate.

Source of Rock aggregate:

Types of quarries, Exploration for quarries, processing of aggregates.

Source of sand and gravel

Unit 3: **(15 lectures)**

Geological and Geotechnical investigations for Civil Engineering Projects:

Tunnels: Terminology, Geological conditions for tunnel sites, Tunnels in folded rocks and bedded rocks. Influence of divisional planes, Effects of faults, Crushed zones, Tunnels near slopes, Role of Groundwater in tunneling.

Landslides: Causes, types and prevention of landslides. Influence of divisional planes, effects of faults, Crushed zones.

Bridges: Classification, abutments, foundations, investigations for site selection.

Unit 4 **(15 lectures)**

Geological and Geotechnical investigations for Civil Engineering Projects:

Dams and Reservoirs: Geological conditions for the selection of dam and reservoir sites. Terminology associated with dams. Types of dams: Masonary Dams (Gravity Buttress and Arch types), Earthen dams. Types of spillways.

Case studies of the important dams and Hydro – electric projects in India- (Koyna, Bhakra-Nangal, Idukki, Tehri, Sardar Sarovar, Kadana)

Dam failures-causes and case studies.

List Of Recommended Reference Books

Engineering Geology

1. Parthasarathy, A., Panchapakesan, V. and Nagarajan, R. (2013) Engineering Geology, Wiley India.
2. Bansal, R. K. (2018) A textbook of strength of materials, Laxmi Publications, Delhi.
3. Narayanswami S.B.S. (2000), Engineering Geology, Dhanpat Rai & Co, India.
4. Legget F. R and Hatheway A.W. (1988), Geology and Engineering., 3rd ed. McGraw-Hill.
5. Gupte R.B. (1992), A Textbook of Engineering Geology.2nd ed. Pune Vidyarthi Griha Prakashan.
6. Krynine D.P. And Judd W.R (2003), Principles of Engineering Geology and Geotechniques, CBS Publishers.
7. Wahlstrom E.E. (1974), Dams, Dam Foundations and Reservoir Sites. Elsevier Scientific.
8. Dunn I.S., Anderson L.R and Kiefer F.W. (1980), Fundamentals of Geotechnical Analysis, John Wiley.
9. Maslov N.N. (1987), Basic Engineering Geology and Soil Mechanics. Mir Publishers.
10. Gokhale K.V.G.K and Rao D.M. (1981), Experiments in Engineering Geology. Tata McGraw-Hill.

Practical Course:

Engineering Geology

- Geological maps to demarcate and evaluate the suitability of sites for engineering projects such as Tunnels, Dams and Reservoir construction.
- Determining uniaxial compressive strength of rocks.
- Equal-area net

a) Locus of rotating line
b) Determining core-pole angle and orientation of plane in recovered core
c) Determining slope stability
d) Determining orientation of bed in rotational fault

T.Y. B.Sc. Geology **Course: SGEO0604**

Title: Photogrammetry, Aerial Photo Interpretation and Fundamentals of Geographical Information Systems

Learning Objectives:

1.To bring about an understanding of the principles of Photogrammetry and about the various analytical techniques used. To understand the construction and working of various instruments used in the process of aerial photo interpretation

2.Understand the principles of GIS and study its application in Earth Sciences.

Number of lectures: 60

Unit 1 **(15 lectures)**

Principles of Aerial Photography

Early history of aerial photography;
Aerial cameras, Film resolution.
Electronic Imaging, Aerial Videography.
Basic Geometric Characteristics of Aerial Photographs: Geometric types of Aerial Photographs, Taking Vertical Aerial Photographs, Geometric Elements of Vertical Photograph.
Photographic Scale.
Ground Coverage of Aerial Photographs.
Area Measurement on aerial photographs.

Unit 2 **(15 lectures)**

Principles of Photogrammetry:

Relief Displacement of Vertical Features in aerial photographs.
Characteristics of Relief Displacement,
Object height determination from Relief Displacement Measurement.
Correction for Relief Displacement.
Image Parallax: Characteristics of Image Parallax, Parallax Measurement.
Ground Control for Aerial Photography.
Mapping with Aerial Photographs: Stereoscopic Plotting Instruments, Orthophotos, Photogrammetric Work Stations.
Flight Planning.

Unit 3 **(15 lectures)**

Aerial Photo Interpretation:

Fundamentals of Visual Image Interpretation.
Basic Visual Image Interpretation Equipment- Construction and Working.
Land-use/Land cover mapping.
Geologic and Soil mapping.
Water Resource Applications.
Archaeological Applications.
Environmental Assessment
Principles of Landform Identification.

Unit 4 **(15 lectures)**

Basics of Geographical Information Systems

Definitions of GIS

The components of a geographical information system.
Basic requirements for a GIS.
Data Models: Conceptual models of real world geographical phenomena.
Conceptual models of space.
Geographical Data models: Vector models of Entities – Simple points, lines and polygons.
Raster Data Structures-The grid Cell Data Types: Boolean, Nominal, Ordinal, Integer, Real, Topological. Data Input: Sources of Geographical Data, Geographical data Collectors and providers.
Geo-referencing.

Reference Books:

1. Lillisand Thomas M., Ralph W. Kiefer and Jonathan W. Chapman, (2004), Remote Sensing and Image Interpretation, 5th ed., Wiley.
2. Jensen John R., (2007), Remote Sensing of the Environment – An Earth Resource perspective, 2nd ed. Pearson Education Series.
3. Linder Wilfried (2003), Digital Photogrammetry- Theory and Applications, Springer.
4. Ramasamy S.M. (2005), Remote Sensing in Geomorphology, New India Publishing Agency.
5. Misra R.P. and Ramesh A. (1999), Fundamentals of Cartography, 2nd ed., Concept Publishing Company. New Delhi.
6. Longley Paul A, Michael F. Goodchild, David J. Maguire and David W. Rhind (2005), Geographic Information Systems and Science, 2nd ed., Wiley
7. Nag P. and Sengupta Smita (2008), Introduction to Geographical Information System., Concept Publishing Company, New Delhi.
8. Burrough Peter A. and Rachael A. McDonnell (1998), Principles of Geographical Information Systems, Oxford University Press.
9. Chang K. (2002), Introduction to Geographical Information Systems, Tata McGraw-Hill Edition.
10. Morain Stan and Shirley Lopez Baros (ed.) (1996), Raster Imagery in Geographical Information Systems., Onward Press.
11. Davis Bruce E (1996), GIS – A Visual Approach., Onward Press.

Practical Course:

- Test and Exercise for Stereoscopic vision
- Determination of Photo Scale and numerical problems on photo scale.
- Orientation of Stereographic pair of aerial photographs under a mirror stereoscope and point transfer. Plotting of principal point, flight line and match line.
- Construction of stereogram
- Handling of a parallax bar and height calculation
- Numerical problems on height calculation using measured relief displacement on a single aerial photograph.
- Flight Planning: Calculations necessary to develop a flight plan and draw a flight map.
- Interpretation of aerial photographs: various landforms, erosion types , horizontally bedded sandstones, shale and limestone. Intrusive igneous rocks, extrusive (lava flows). Aeolian Landforms: transverse sand dunes, longitudinal sand dunes, loess. Glacial landforms: end moraine, basal moraine, drumlins, eskers. Fluvial Landforms: alluvial fans, deltas. Coastal landforms: beach ridges, beach cusps, dunes, surface expressions of anthropogenic activities.

Evaluation and Assessment : SGEO0601, 602, 603, 604 courses

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

CIA- 40 marks

CIA 1: Written test -20 marks

CIA 2: Field work (12 days, and Field report, Viva on Fieldwork, This will be for all the four courses, that is 20 marks outside Mumbai City)

End Semester Examination – 60 marks

One question from each Unit for 15 marks, with internal choice. Total marks per question with choice -21 to 22 marks.

Evaluation of SGEO06PR (Practicals) Total marks - 200.

*For the purpose of workload – fieldwork is to be considered as 4 hours per week per batch.

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Template for SGEO courses End Semester examination in Semester 6

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 -Autonomous, Mumbai

Department of Geology

Roll Number:_____

UID Number:_____

MARKS:____/20

Assessment Grid for SGEO06 CIA 2 (Field Work)

Parameters		Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 -40% Poor	0 – 20% Very Poor
Field Trip	Attendance, Field Discipline, Daily field Diary and work completion.	50					
Field Report and Viva		30					
Total		80					

Evaluators Names Signature and date

Name **Signature &date**