



Syllabus

Ist Semester Courses in BSc

Department of Geology (June 2023 onwards)

- **Core Course:**
 - USGEO4501CR1: Introduction to Earth System Science.
 - USGEO4501CR1PR: Structural and Field Geology Practical.
- **Vocational Skill Course**
 - USGEO4501VS1: Cartography - The science of Maps, their creation and interpretation.
- **Skill Enhancement Course**
 - USGEO4501SE1: Cartography unveiled– Maps, their creation and interpretation.
- **Open Elective Course:**
 - USGEO4501OE1: Gemmology – The art and science of gem identification
- Evaluation and Assessment guidelines

Shinde

PRINCIPAL
ST. XAVIER'S COLLEGE
(AUTONOMOUS)
MUMBAI - 400 001.



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B.Sc. Geology		
Course Title: Introduction to Earth System Science.		
Course Code: USGEO4501CR1		
Credits 3: Theory - 45 hr		
No.	Course Objectives	
1	To know the various theories of origin of the universe and our solar system.	
2	To understand an interior and the energy that drive the process on earth.	
3	To understand the linkage between earth's interior and the atmospheric circulation.	
4	Understanding the oceanic circulation.	
5	Understanding the internal and external processes on planet earth and how various structures within rocks form due to earth's internal forces	
CO	Course Outcomes On completing the course, the learner will be able to	Bloom's Taxonomy Level (BT level)
1	Recall the key theories related to the origin of the universe, solar system, and Earth.	Remembering
2	Explain the linkages between geology and other Earth science disciplines.	Understanding
3	Use a Brunton/Clinometer compass to measure dip and strike in the field.	Applying
4	Differentiate between various types of folds, faults, and unconformities based on their geometric classifications and structural features.	Analysing
5	Assess the proofs and mechanisms of plate tectonics and magnetic pole reversals to understand Earth's dynamic processes	Evaluating

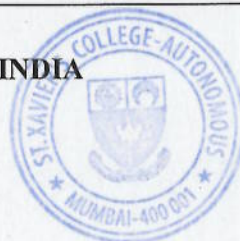
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UNIT I	<p>Scope of geology in earth sciences: Linkages between geology and all other subjects.</p> <p>Origin of the universe, solar system and earth (Theories), Earth's internal structure, and types of crust: Convection, temperature gradient, seismic velocities.</p> <p>Plate Tectonics: The theory, proofs and mechanism.</p> <p>Earth's magnetic field: Origin and causes of variation, Reversal of magnetic poles – proofs thereof.</p> <p>Age of the universe and age of our earth. Oldest rocks, Oldest mineral</p>	(15)
UNIT II	<p>Earth's Atmosphere: Its origin, composition and variations through the past., Atmospheric circulation, temperature variation with altitude.</p> <p>Earth's Oceans: Origin, Physical and Chemical properties of oceanic waters.</p> <p>Land – Ocean Interface: Tides and its causes.</p> <p>Oceanic circulation: Generation of oceanic currents, types of currents, Global oceanic conveyor belt system.</p>	(15)
UNIT III	<p>Structural Geology:</p> <p>Stratification; Dip and Strike; Brunton/Clinometer compass its use.</p> <p>Outcrop pattern of horizontal, dipping and vertical strata on various types of topography.</p> <p>Outliers, Inliers.</p> <p>Folds: Definition, Morphology, anticline and syncline.</p> <p>Types of folds: symmetrical, asymmetrical, recumbent, overturned, isoclinal, plunging, doubly plunging, structural dome and basin, monocline, structural terrace, chevron, fan, anticlinorium, synclinorium, Importance of folds.</p> <p>Joints: Definition, geometric classification and importance.</p> <p>Faults: morphology; geometric classification based on relation to affected rocks, angle of dip, apparent movement and relative movement; distributive faulting: horst, graben and step faults; nappes.</p> <p>Unconformities: nature, types and importance; overlap and off-lap.</p>	(15)

List of recommended reference books:

1. Butz S. (2007) Science of Earth Systems., 2nd edn., Thomas Delmar.
2. Billings M.P. (1987), Structural Geology., 3rd edn, Prentice-Hall, India Pvt. Ltd
3. Compton R.R. (1985), Geology in The Field., J. Wiley & Sons
4. Holmes A. (1993), Principles of Physical Geology., ed by David Duff, Nelson Thornes Ltd
5. Siddhartha K., (1999) , Oceanography - A Brief Introduction., Kisalaya Publ., India
6. Skinner B.J., Porter S.C. and Botkin D.B. (1999), The Blue Planet., 2nd edn. J. Wiley & Sons.



Evaluation (Theory, USGEO4501CR1): Total marks per course – 100

Formative Assessment ‘for’ Learning

(continuous internal assessment - CIA to improve learning).

CIA - 40 marks

CIA 1: Written test - 20 marks.

CIA 2: Fieldwork /Assignment / Presentations / Infographics / Quiz / as prescribed - 20 marks.

Summative Assessment ‘of’ Learning

(focus on outcomes, quantitative data for outcomes of instruction)

End Semester Examination - 60 marks

One question from each unit for 20 marks, with internal choice.

Total marks per question with choice 30 - 40 marks.

Distribution of Bloom’s Taxonomy levels for the course assessment

Learning Levels	Remember	Understand	Apply	Analyze	Evaluate
*Percentage	0-5%	15-20%	20-30%	20-30%	10-20%

Field work assessment rubric

St. Xavier’s College, Mumbai

Course: US01GEO4501CR1

Department of Geology

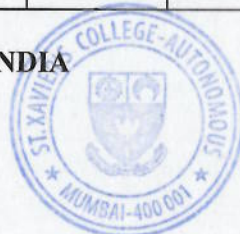
UID Number: _____

MARKS: ____/20

Date: _____

Assessment Grid 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:

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B.Sc. Geology		
Course Title: Structural and Field Geology practical.		
Course Code: USGEO4501CR1PR		
Credits I: Practical - 30 hr		
No.	Course Objectives	
1	To develop proficiency in using Clinometer and Brunton compasses for field measurements of geological structures.	
2	To enhance skills in interpreting geological maps and constructing vertical cross sections of geological formations.	
3	To apply theoretical knowledge of structural geology to solve practical problems involving strike, dip, and thickness calculations.	
CO	Course Outcomes On completing the course, the learner will be able to	Bloom's Taxonomy Level (BT level)
1	Accurately use Clinometer and Brunton compasses to measure strike and dip in the field.	Applying
2	Analyze and interpret geological maps to draw vertical cross sections involving various geological structures such as horizontal strata, dipping strata, and faults.	Analysing
3	Evaluate the geological data collected in the field and from maps to solve structural geology problems involving strike, true dip, apparent dip, and thickness of strata.	Evaluating
4	Create detailed and accurate laboratory journals that document practical exercises, solutions to structural geology problems, and graphical interpretations of geological structures	Creating

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<u>Practical: (one session of two hours per week)</u>		
1.		Use of Clinometer and Brunton compasses
2.		Description and drawing of vertical cross section of simple geological maps involving horizontal or dipping strata with vertical faults, folded (non-plunging and non-faulted) strata and strata involving angular unconformity.
3.		Graphical solution of structural geology problems involving
	a.	Strike, true dip and apparent dip
	b.	Thickness and width of outcrop.

List of Recommended Reference Books:

1. Bennison, G. M., & Moseley, K. A. (2013). An Introduction to Geological Structures and Maps (8th ed.). Routledge.
2. Davis, G. H., Reynolds, S. J., & Kluth, C. F. (2011). Structural Geology of Rocks and Regions (3rd ed.). Wiley.
3. Lisle, R. J., Brabham, P., & Barnes, J. W. (2011). Basic Geological Mapping (5th ed.). Wiley-Blackwell.
4. Marshak, S. (2016). Earth: Portrait of a Planet (5th ed.). W.W. Norton & Company.

Evaluation (Practical, USGEO4501CR1PR): Total marks practical course - 50

End Semester Practical Examination - 30 marks.

Distribution of Bloom's Taxonomy levels for the practical assessment

Learning Levels	Remember	Understand	Apply	Analyse	Evaluate	Create
*Percentage	NA	NA	25-30%	25-30%	25-30%	25-30%

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B.Sc. Geology		
Course Title: Cartography – The science of maps, their creation and interpretation.		
Course Code: USGEO4501VS1		
Credits 2: Theory + Practical – 15 + 30 hr		
No.	Course Objectives	
1	To be able to prepare, read and interpret maps.	
2	To be able to create simple topographical cross sections.	
3	To understand basic survey methods and be able to use the basic instruments used in land surveying including GPS.	
4	To understand various map projection techniques.	
5	To be able to understand the use of the Survey of India map catalogue system for acquiring maps of India, and our National Geospatial Policy 2022.	
CO	Course Outcomes On completing the course, the learner will be able to	Bloom's Taxonomy Level (BT level)
1	Define and explain key cartographic concepts and the historical development of cartography, including Indian contributions and the Survey of India Map Catalogue System.	Remembering
2	Describe the components of topographical maps, including scales, map symbols, grids, and contour patterns, and explain their significance in interpreting landforms and geological features.	Understanding
3	Utilize basic land surveying instruments such as tape and compass, plane table, level, GPS, and drone aerial photography to conduct surveys and gather spatial data.	Applying
4	Interpret topographical maps to recognize landforms, geological features, and drainage patterns, and draw simple topographical cross sections based on contour patterns.	Analysing
5	Assess the accuracy and reliability of various land surveying methods and virtual globes/digital maps in representing geographical and geological information.	Evaluating
6	Develop and produce simple topographical maps and cross sections using basic survey methods and instruments, demonstrating a comprehensive understanding of cartographic principles and techniques	Creating

UNIT I	<p>What are Maps? Types, Uses. History of Cartography – Indian Maps, Indian Cartography. Survey of India – Map catalogue system, National Geospatial Policy 2022. Reading of Topographical maps: scale, map symbols, grids. Interpretation of topographical maps: understanding contour patterns and its relationship to landforms and geology, drainage pattern recognition. Understanding virtual globes.</p>	(15)
UNIT II	<u>Practical-</u>	
	<p>(one practical session of two hours per week for 15 weeks) Understanding Survey of India Map Catalogue System and related numerical problems. Numerical problems on Scale of maps. Interpretation of Topographical maps – Drawing simple topographical cross sections. Demonstration of Land Surveying methods: a. Tape and Compass survey, b. Plane Table survey, c. Levelling d. GPS survey e. drone aerial photography .f. Using virtual globes/digital maps. Introduction to geological mapping.</p>	

List of recommended reference books:

1. Drone Rules 2022 – Ministry of Civil Aviation:
<https://www.civilaviation.gov.in/ministry-documents/rules>
2. Gupta, K. K. and Tyagi, V. C., (1992), Working with Maps- A book for senior secondary level, 105 (DLI) Printing Group, Survey of India, Department of Science and Technology
3. Map Education, (1993), Survey of India, Department of Science and Technology
4. Maps in Everyday Life- Geo Informatics for Local Level Planning. 2004. Natural Resources Data Management System (NDMS), Department of Science and Technology, Government of India, New Delhi
5. National Geospatial Policy 2022 – Gazette Notification:
<https://www.surveyofindia.gov.in/webroot/UserFiles/files/National%20Geospatial%20Policy.pdf>
6. Robinson. A, Morrison. J, Muehrcke. P, Kimerling. A, Guptill. S., (1995), Elements of Cartography, 6 ed, J. Wiley & Sons

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Evaluation (Theory, USGEO4501VS1): Total marks per course – 50

Formative Assessment 'for' Learning

(continuous internal assessment - CIA to improve learning).

CIA : Written Test / Assignment / Presentations / Infographics / Quiz / as prescribed - 20 marks.

Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction)

End Semester Examination - 30 marks

One question from each unit for 15 marks, with internal choice.

Total marks per question with choice 20 - 30 marks.

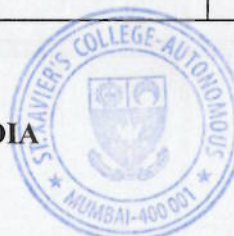
Distribution of Bloom's Taxonomy levels for the course assessment

Learning Levels	Remember	Understand	Apply	Analyze	Evaluate	Create
*Percentage	0-5%	5-10%	15-20%	10-20%	10-20%	10-20%

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B.Sc. Geology		
Course Title: Cartography Unveiled – Maps, their creation and interpretation.		
Course Code: USGEO4501SE1		
Credits: 2. Theory + Practical – 15 + 30 hr		
No.	Course Objectives	
1	To be able to prepare, read and interpret maps.	
2	To be able to create simple topographical cross sections.	
3	To understand basic survey methods and be able to use the basic instruments used in land surveying including GPS.	
4	To understand various map projection techniques.	
5	To be able to understand the use of the Survey of India map catalogue system for acquiring maps of India, and our National Geospatial Policy 2022.	
CO	Course Outcomes On completing the course, the learner will be able to	Bloom's Taxonomy Level (BT level)
1	Define and explain key cartographic concepts and the historical development of cartography, including Indian contributions and the Survey of India Map Catalogue System.	Remembering
2	Describe the components of topographical maps, including scales, map symbols, grids, and contour patterns, and explain their significance in interpreting landforms and geological features.	Understanding
3	Utilize basic land surveying instruments such as tape and compass, plane table, level, GPS, and drone aerial photography to conduct surveys and gather spatial data.	Applying
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UNIT II	<p><u>Practical-</u> (one practical session of two hours per week for 15 weeks)</p>	
	<p>Understanding Survey of India Map Catalogue System and related numerical problems. Numerical problems on Scale of maps. Interpretation of Topographical maps – Drawing simple topographical cross sections. Demonstration of Land Surveying methods: a. Tape and Compass survey, b. Plane Table survey, c. Levelling d. GPS survey e. drone aerial photography .f. Using virtual globes/digital maps. Introduction to geological mapping.</p>	

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3. Map Education, (1993), Survey of India, Department of Science and Technology
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B.Sc. Geology		
Course Title: Gemmology- The Art and Science of Gem Identification.		
Course Code: USGEO4501OE1		
Credits: 2. Theory - 30 hr		
No.	Course Objectives	
1	To introduce the fundamental concepts of gemmology and the essential characteristics of gemstones.	
2	To develop an understanding of the crystallographic properties that define gemstones.	
3	To familiarize students with the various physical and optical properties of gemstones.	
4	To train students in the use of basic gemmological instruments for gemstone identification.	
5	To provide knowledge about the varieties, occurrence, and care of gemstones, particularly in the Indian context.	
CO	Course Outcomes On completing the course, the learner will be able to	Bloom's Taxonomy Level (BT level)
1	Define basic gemmological terms and the essential characteristics of gemstones.	Remembering
2	Explain the crystallographic and physical properties that distinguish different types of gemstones.	Understanding
3	Demonstrate the use of gemmological instruments to identify various gemstones.	Applying
4	Differentiate between natural, synthetic, artificial, and simulant gemstones based on their properties and identification techniques.	Analysing
5	Assess the quality and authenticity of gemstones using standard gemmological techniques.	Evaluating
6	Prepare a comprehensive report on a selected gemstone, detailing its properties, identification methods, and occurrence in India.	Creating

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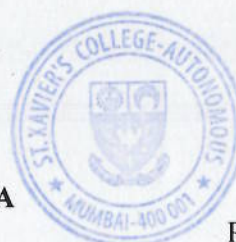


UNIT I	Basic Gemmology	(15)
	<p>What is Gemmology? What is a gemstone? Basic crystallography Essential characteristics of gemstones. Hardness, cleavage, fracture, hardness, density/specific gravity, colour, lustre, sheen, transparency, interference, chatoyancy, asterism, iridescence, labradorescence, orient, play of colour, opalescence, aventurescence, adularescence, brilliance, fire, scintillation.</p>	
UNIT II	Gem instruments and gemstone varieties	(15)
	<p>Basic instruments used for identification of gemstones. Loupe, Chelsea filter, dichroscope, polariscope, spectroscope, UV lamp, refractometer, gem microscope, reflectivity meter, electronic diamond tester Varieties of important gemstones: (natural, synthetic, artificial and simulants). Corundum (ruby and sapphire) varieties, chrysoberyl varieties, beryl varieties, quartz varieties, garnet varieties, feldspar varieties, tourmaline varieties, peridot, spinel, coral, pearl, ivory. Units of weight, Care of gemstones. Occurrence of gem minerals in India Indian gemstone industry – locations and specialty.</p>	

List of recommended reference books:

1. Karanth, R. V. (2000). *Gems and gem industry in India* (Memoir 45). Geological Society of India
2. Matlins, A. L., & Bonanno, A. C. (2016). *Gem identification made easy* (6th ed.). Gemstone Press.
3. O'Donoghue, M. (2006). *Gems* (6th ed.). Elsevier Butterworth-Heinemann.
4. Pedersen, M. C. (2004). *Gem and ornamental materials of organic origin*. Elsevier Butterworth-Heinemann.
5. Read, P. G. (2005). *Gemmology* (3rd ed.). Elsevier Butterworth-Heinemann.
6. Schumann, W. (2009). *Gemstones of the world* (5th ed.). Sterling.
7. Shyamala, F., & Choudhary, G. (2010). *Understanding rough gemstones*. Indian Institute of Jewellery (A division of Modern India Ltd).

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Evaluation (Theory, USGEO4501OE1): Total marks per course – 50

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