

**PUNYASHLOK AHILYADEVJI HOLKARSOLAPUR  
UNIVERSITY, SOLAPUR**



**Name of the Faculty: Science & Technology**

**CHOICE BASED CREDIT SYSTEM**

**Syllabus: GEO-CHEMISTRY**

**Name of the Course: B.Sc. II (Sem.–III & IV)**

**(Syllabus to be implemented from June 2023)**

## **1) Preamble:**

Syllabus for B.Sc. II Geochemistry is designed to provide an insight of applications and concepts of basics geochemistry, its principles, physicochemical properties of minerals, solar system and dynamics of various spheres of the earth and chemistry of the earth. In the theory course student can acquire the knowledge about the chemical and atomic properties of mineral matter, integrated study of solar and earth system. Also emphasis has been given on the chemical properties and pollutions of spheres of the earth. The chemical process operating on the earth surfaces as well as chemical reactions, origin of various economic minerals has also included in the syllabus.

Practical course has been designed on the basis of theoretical approach and objectives of the course.

## **2) Objectives of the Course**

1. To introduce students to applications of chemical concepts to predict the outcome of geologic processes and use of chemical data to solve applied, real-world problems;
2. To introduce students to basic concepts of geochemistry and several up-to-date issues which are widely discussed in the field of geochemistry;
3. To orient students to the current status of numerous chemical analysis techniques commonly used in the field of geochemistry;
4. To provide students with opportunities to use available analytical instruments in the department;
5. To provide students with opportunity to discuss about their research topics in terms of geochemistry.
6. Understanding the basic principles of isotope geochemistry and to apply the fundamental principles to earth scientific processes.

## **3) Outcome of the Course**

1. Understand geochemical concepts operating within various spheres in the dynamic earth system.
2. Chemical analysis various ore minerals and its applications to mining industries.
3. Study of earth atmosphere.
4. Increase in the curiosity about events in the universe and its origin.
5. Understand the structure of crystals
6. To know about the environmental pollution

# Punyashlok Ahilyadevi Holkar Solapur University, Solapur

## Faculty of Science & Technology Choice Based Credit System (CBCS)

(w.e.f.2023-24)

### Draft Structure for B. Sc-II

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks/ Paper	UA	CA	Credits	
	Type	Name		L	T	P					
Class:	B.Sc.- II Semester - III										
Core	(*Students can opt any Three subjects among the Four Subjects offered at B.Sc.I. Out of Three Subjects offered One Subject will be the Core Subject <b>OR</b>	C-5	Paper-V	3.0	--	--	50	40	10	4.0	
				Paper-VI	3.0	--	--	50	40		10
		C-6	Paper-V	3.0	--	--	50	40	10	4.0	
			Paper-VI	3.0	--	--	50	40	10		
		C-7	<b>GEOCHEMISTRY</b>	<b>Paper-I</b> Introduction to Geochemistry	3.0	--	--	50	40	10	4.0
				<b>Paper-II</b> Introduction to Solar system and Geo-spheres	3.0	--	--	50	40	10	
			SEC-1								
			GE-3								
<b>Grand Total</b>				<b>18</b>	<b>--</b>	<b>--</b>	<b>300</b>	<b>240</b>	<b>60</b>	<b>12</b>	
Class :	B.Sc.- II Semester - IV										
Core	(*Students can opt any Three subjects among the Four Subjects offered at B.Sc.I. Out of Three Subjects offered One Subject will be the Core Subject <b>OR</b> Students can opt any Two subjects among the Four Subjects offered at B.Sc.I. Out of Two Subjects One Subject will be the Core Subject and any One Subject among the other will be Elective Subject	C-8	Paper-VII	3.0	--	--	50	40	10	4.0	
				Paper-VIII	3.0	--	--	50	40		10
		C-9	Paper-VII	3.0	--	--	50	40	10	4.0	
			Paper-VIII	3.0	--	--	50	40	10		
		C-10	<b>GEOCHEMISTRY</b>	<b>Paper-III</b> Principles of Geochemistry	3.0	--	--	50	40	10	4.0
				<b>Paper-IV</b> Chemistry of the Earth	3.0			50	40	10	
			SEC-2								
			GE-4								
		Environmental Studies		3.0	--	--	50	40	10	NC	
<b>Total (Theory)</b>				<b>18</b>	<b>--</b>	<b>--</b>	<b>300</b>	<b>240</b>	<b>60</b>	<b>12</b>	
Practical		C-5 & C-8	Pr. III&IV	--	--	8	200	160	40	4.0	
		C-6 & C-9	Pr. III&IV	--	--	8	200	160	40	4.0	
		C-7 & C-10	Pr. III&IV <b>Geochemistry</b>	--	--	8	200	160	40	4.0	
		GE-3 & GE-4									
<b>Total (Practical)</b>						<b>24</b>	<b>600</b>	<b>480</b>	<b>120</b>	<b>24</b>	
<b>Grand Total</b>				<b>36</b>		<b>24</b>	<b>1200</b>	<b>960</b>	<b>240</b>	<b>48</b>	

**\*Core Subjects:**

**Chemistry / Physics / Electronics / Computer Science / Mathematics / Statistics / Botany / Zoology / Microbiology / Geology / Geography / Psychology**  
**Core Subjects- (Additional)-Geochemistry / Biochemistry / Meteorology / Plant Protection**

## Summary of the Structure of B.Sc. Programme

Class	Semester	Marks- Theory	Credits- Theory	Marks- Practical	Credits- Practicals	Total - credits
<b>B.Sc.-II</b>	III	300	12	--	--	12
	IV	350	12	--	--	12
<b>Total</b>		650	24	600	24	48

### **B.Sc. Programme:**

**Total Marks:** Theory + Practical's = 650 + 600 = 1250

**Credits:** Theory + Practical's = 24 + 24 = 48

<b>Number of Papers</b>	Theory: Ability Enhancement Course (AECC)	00
	Theory: Discipline Specific Elective Paper (DSE)	00
	Theory: CC	06
	Skill Enhancement Courses	00
	GE	00

Total:	Theory Papers	06
	Practical Papers	02

### Abbreviations :

L:	Lectures
T:	Tutorials
P:	Practicals
UA:	University Assessment
CA:	College Assessment
DSC / CC:	Core Course
AEC:	Ability Enhancement Course
DSE:	Discipline Specific Elective Paper
SEC:	Skill Enhancement Course
GE:	Generic Elective
CA:	Continuous Assessment
ESE:	End Semester Examination

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**  
**CBCS Pattern Syllabus of B. Sc. (Part-II), (w. e. f. June 2023)**

**Geo-chemistry**  
**DSC/CC – Theory course**  
**SEMESTER – III**

Title of the Paper – **I. Introduction to Geochemistry**

Contact hours – 30

Total Marks 50 (UA – 40 + CA – 10) (Credit 2)

<b>Unit</b>	<b>Topic</b>	<b>Contact Hrs</b>
<b>Unit 1</b>		
	A. Gibbs phase rule, applications of phase rule to one component system (water system and Sulphur system), Goldschmidt's Mineralogical phase rule	(07)
	B. The states of matter, the crystalline state, principles of crystal structure, formation of crystal, lattice energy of crystals, radius ratio, coordination number, structure of Sodium Chloride, Cesium Chloride, Zinc Sulphide. Brief idea of radii of common ions in rock forming minerals. General rules of the three dimensional structure with the help of solid geometry.	(08)
<b>Unit 2</b>		
	A. Chemistry of carbon compounds, General characteristics of organic compounds, classification of organic compounds, homologous series, empirical and molecular formula of organic compound.	(07)
	B. Colloids-Definition, kinds of colloidal system, electrical, mechanical and optical properties of colloids, electrical charges on colloids, silica as chemical sediment, clay minerals as colloids, geological evidences of silica and clay minerals.	(08)

**Reference Books:**

1. Brian Mason - Principles of Geochemistry
2. H.H. Read (ed.) - Rutley's Elements of Mineralogy
3. K B Krauskopf - Introduction to Geochemistry
4. H R Rollinson - Using geochemical data: Evaluation, Presentation, and Interpretation. Longman.

Title of the Paper – **II. Introduction to solar system and Geo-spheres**

Contact hours – 30

Total Marks 50 (UA – 40 + CA – 10) (Credit 2)

<b>Unit</b>	<b>Topic</b>	<b>Contact Hrs</b>
<b>Unit 1</b>		
	A. Nature of solar system, composition of the sun; Composition of Meteorites and their types; Cosmic abundance of the elements	(08)
	B. Zonal structure of the earth, Composition of the crust; Composition of the earth as a whole; primary differentiation of the elements, geochemical classification of the elements.	(07)
<b>Unit 2</b>		
	A. Structure of atmosphere, composition of the atmosphere, variable constituents of the atmosphere; Evolution of the atmosphere and composition of the primeval atmosphere; Atmospheric additions and losses during geological time	(08)
	B. Nature of the hydrosphere, composition of seawater, composition of terrestrial waters; Gains and losses of elements in the oceanic water	(07)

**Reference Books:**

1. Brian Mason and C.B. Moore - Principles of Geochemistry
2. Krauskopf - Introduction to Geochemistry
3. Standard Manuals - Procedures for analysis and estimations of ores, minerals & rocks

**DSC/CC – Theory course  
SEMESTER – IV**

Title of the Paper – **III Principles of Geochemistry**

Contact hours – 30

Total Marks 50 (UA – 40 + CA – 10) (Credit 2)

<b>Unit</b>	<b>Topic</b>	<b>Contact Hrs</b>
<b>Unit 1</b>		
	A. Chemical equilibrium – The law of mass action, an example of equilibrium, hydrogen chloride, the effect of temperature, other examples as CO <sub>2</sub> in water and calcium sulphate. Le Chatelier's rule, stability, Van't Hoff isotherm equation	(08)
	B. Acids and bases- Chemical definition, Geological usage, pH, Hydrolysis of Na <sub>2</sub> CO <sub>3</sub> ; Estimation of ionic concentration, carbonate equilibrium, Temperature changes; Changes in pressure & organic activity	(07)
<b>Unit 2</b>		
	A. Organic material in sediments- organic reactions, carbon in rocks, origin of petroleum, origin of coal, organic matter in black shale, carbon compounds as reducing agents	(08)
	B. Elements of geochemical thermodynamics, Isotope geochemistry: Kinds of isotopes, radioactive and radiogenic isotopes, strontium and lead; stable isotopes.	(07)

**Reference Books:**

1. Brian Mason and C.B. Moore - Principles of Geochemistry
2. K B Krauskopf - Introduction to Geochemistry
3. Kula C. Misra. 2012. Introduction to Geochemistry: Principles and Applications. Wiley and Blackwell
4. Rollinson, H.R., 1993. Using geochemical data: Evaluation, Presentation, and Interpretation. Longman.

Title of the Paper – **IV. Chemistry of the Earth**

Contact hours – 30

Total Marks 50 (UA – 40 + CA – 10) (Credit 2)

<b>Unit</b>	<b>Topic</b>	<b>Contact Hrs</b>
<b>Unit 1</b>		
	A. The Earth as a physicochemical system, Crust as a separate system, Geochemical cycle, Goldschmidt's geochemical classification of elements, Composition of Planets and meteorites. Isotopes geochemistry- Isotopes and its types –stable and radiogenic isotopes and its application, Radioactive decay and half-life, geochronology.	05
	B. Types of chemical bonds, coordination number and radius ratio, Elementary idea of periodic table, silicate structures, Isomorphism, Polymorphism and solid solution.	04
	C. Chemical and Mineralogical classification of Igneous, Sedimentary and Metamorphic rocks, and distribution of major, minor and trace elements in various categories of rocks. Products of sedimentation. Order of stability of minerals.	06
<b>Unit 2</b>		
	A. Clay minerals-its formation, composition, structure and their classification; Colloids and colloids processes in geological system; Soil geochemistry-Physical and chemical properties, formation of soil, classification, soil analysis and soil types in India.	06
	B. Environmental pollution- Geological process causing environmental hazard: Distribution of elements in rocks and some geochemical associations, re-distributions of chemical elements by weathering. Radioactive elements in rocks, soils and water, environmental aspects of radionuclides. Different natural and anthropogenic sources contribute metal and mineral toxicants to the environment. Sources and types of trace elements and metal pollution in soils. Health effects of silica, asbestos exposure, coal.	09

**Reference Books:**

1. Brian Mason and C.B. Moore - Principles of Geochemistry
2. Khopkar S.M. - Environmental Pollution Analysis
3. K.S. Valdiya - Environmental Geology (Indian context)
4. Krauskopf - Introduction to Geochemistry
5. Standard Manuals - Procedures for analysis and estimations of ores, minerals and rocks



# Syllabus of B Sc. (Part-II) Geochemistry Laboratory Course

Marks – 160 + 40 = 200

Credit – 4

## Practical – I

### Section A Volumetric analysis and chromatography

#### Experiments

- Estimation of alumina in ore, Estimation of manganese in ore, Estimation of calcium and magnesium in carbonate rocks. (20)
- Analysis of natural waters and soils. Estimation of Ca, Mg-carbonates, bicarbonates, chlorides, and sulphates. (20)
- Detection of traces of metals by chromatography. (20)

### Section B Qualitative and Colorimetric Analysis

- Qualitative analysis of representative ores and minerals. (20)
- Colorimetric determinations: (20)
  - a) Estimation of alumina    b) Estimation of manganese,
  - c) Estimation of total Iron    d) Estimation of copper

## Practical – II

### Section C Mineral and Rock Calculations

experiments

- Pyroxene- Hess calculation from given chemical data. (12)
- Plagioclase- Feldspar calculations (14)
- Norm calculations from given chemical data (Persalic type only) (24)

### Section D Mineral identification

Identification and description of following ores and industrial Minerals - Hematite, magnetite, pyrolusite, psilomelane, galena, graphite, chalcopyrite, malachite, chromite, bauxite, coal, muscovite, biotite, calcite, dolomite, garnet, quartz, olivine, tourmaline, talc, barytes, kyanite, asbestos, plagioclase, orthoclase, and gypsum. (20)

## Practical Record

- Certified record of the practical done by the student should be maintained as a journal and must be submitted at the time of annual practical examination.
- Certified report of Field visit / Project / Oral / Seminar / Group discussion should be submitted before annual practical examination.
- Demonstration of GM counter.

# Punyashlok Ahilyadevi Holkar Solapur University, Solapur

## Syllabus for B.Sc. II- Geochemistry - (IDS)

### Semester System

### Choice Based Credit System (CBCS) Pattern

To be implemented from Academic Year- 2023 - 24

Course Structure –Total Credit 12 - (Theory (4 x 2) = 12+Practical (1 x 4) = 4)

Sr. No.	Semester	Paper No.	Title	No. of Contact Hrs/sem.	Credit Point	Total Marks (UA + CA)
1	Semester III	I	Introduction to Geochemistry	30	02	50 = 40+10
		II	Introduction to Solar system and Geo-spheres	30	02	50 = 40+10
2	Semester IV	III	Principles of Geochemistry	30	02	50 = 40+10
		IV	Chemistry of the Earth	30	02	50 = 40+10
3	Semester III and IV	Practical Course	Practical Examination (Two Days) (Annual Pattern)	60	04	200 = 160 + 40
				Total	12	400 = 320 +80

### IMPORTANT TO NOTE:

1. 40 marks for university examinations (UA) + 10 marks internal examinations (CA) = 50 marks
2. Minimum passing percentage = 40%
3. Separate passing for both university (UA) and internal examinations (CA) in Theory and Practical examinations

#### 4. Distribution of each Theory paper (Marks 50)

University Assessment (UA) :40 Marks

College Assessment (CA) :10 Marks

#### 5. Distribution of each Practical Marks (200)

Practical examination will be conducted annually i.e. at the end of fourth semester. It will be conducted for 160 marks (UA) and 40 marks (CA).

160 (UA) + 40 (CA) = 200 marks

**University Practical Examination for 160 Marks (UA):**

**1<sup>st</sup> day – Practical I****Total-100 marks**

<b>Section A</b>	A1	Estimation	25 marks	Total 50
	A2	Chromatography	25 marks	
<b>Section B</b>	B1	Colorimetric	25 marks	Total 50
	B2	Qualitative analysis	25 marks	

**2<sup>st</sup> day – Practical II****Total-100 marks**

<b>Section C</b>	C1.	Pyroxene (One example)	14 marks	Total 60
	C2.	Norm (One example)	28 marks	
	C3.	Feldspars, ACF, AKF (Two examples)	18 marks	
<b>Section D</b>	D1.	Identification of minerals	25 marks	Total 40
	D2.	Certified Journal submission	15 marks	

- **Theory internal continuous assessment (CA):**
- 10 marks - home assignment and 10 marks - unit test.
- Total 20 marks for each paper / semester
- **Practical internal continuous assessment (CA):**
- Practical exam of 20 marks covering topics of Paper I and II.
- Practical exam of 20 marks covering topics of Paper III and IV.
- Submission of report of ecological Field excursion / project / Oral / Seminar / groupdiscussion is compulsory.

## Equivalent Subject for Old Syllabus

Sr. No.	Name of the Old Paper	Name of the New Paper
1.	PI – Introduction to Geochemistry	PI – Introduction to Geochemistry
2.	PII – Introduction to Solar system and Geo-spheres	PII – Introduction to Solar system and Geo-spheres
3.	PIII – Principles of Geochemistry	PIII – Principles of Geochemistry
4.	PIV – Chemistry of the Earth	PIV – Chemistry of the Earth

**All courses (Papers) from old and new syllabus are same. Hence, there is complete equivalence between old and new syllabus.**