

# **Semester IV**

Programme	B. Sc. Geology				
Course Code	GEL4CJ203				
Course Title	<b>GEOINFORMATICS &amp; FIELD GEOLOGY - I</b>				
Type of Course	Major				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Students should have completed all the core courses in the previous 3 semesters.				
Course Summary	Field Geology is a hands-on course designed to provide undergraduate students with practical experience in geological fieldwork. Through field trips, mapping exercises, and data collection activities, students will learn essential field techniques, geological mapping skills, and interpretation of geological features and structures.				

#### Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Demonstrate proficiency in field techniques for geological mapping and data collection.	U	F	Exam
CO2	Identify and describe geological formations, rock types, and structural features in the field.	Ap	C	Quiz
CO3	Apply the techniques of GIS for map making	An	P	Assignment
CO4	Apply the techniques of remote sensing for field based studies	E	M	Viva
CO5	Collaborate effectively in fieldwork teams and communicate geological findings through field reports and presentations.	Ap	F	Assignment
CO6	Develop critical thinking and problem-solving skills through hands-on field experiences.	E	M	Assignment
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

## Detailed Syllabus: GEOINFORMATICS & FIELD GEOLOGY -I

Module	Unit	Content	Hrs	Marks
I	<b>Introduction</b>		<b>6</b>	<b>10</b>
	1	Importance of field work in geological exploration	1	
	2	Introduction to field equipment and tools	1	
	3	Principles of geological mapping	1	
	4	Topographic map interpretation	1	
	5	Compass and GPS navigation techniques	2	
II	<b>Geological Mapping</b>		<b>10</b>	<b>16</b>
	6	Use of Brunton Compass	2	
	7	Measurement and recording of structural data in the field – Strike & Dip	2	
	8	Introduction to structural map symbols	2	
	9	Field identification of common minerals	2	
	10	Hand specimen identification – important textures in igneous, sedimentary & metamorphic rocks	2	
III			<b>14</b>	<b>24</b>
	11	Topographical maps, Thematic maps, Geologic maps & Existing digital map sources	2	
	12	Data models in GIS. Spatial data model – Raster & Vector. Attribute data model – hierarchical, network, relational.	3	
	13	Data base management system. Data management in GIS	3	
	14	Data editing: Detecting and correcting errors;	2	
	15	Data reduction, Generalization, Transformation;	2	
	16	Rubber Sheeting and edge matching	2	
IV	<b>Geological structures &amp; Measurements</b>		<b>15</b>	<b>20</b>
	17	Types of platforms – Groundborne, Airborne, Spaceborne.	2	
	18	Orbital elements - six elements of Keplerian orbit.	2	
	19	Types of satellite orbits – Sun-synchronous, Geosynchronous	2	
	20	GNSS – GPS, GAGAN	4	
	21	Classification of sensors. Multispectral sensors – pushbroom & whiskbroom scanners. Atmospheric sensors, SONAR, LiDAR	2	
	22	Sensor parameters – spatial, spectral, radiometric, temporal. Hyperspectral imaging	3	
V	<b>Practical</b>		<b>30</b>	<b>10</b>
	The practical component of this course will be carried out as a fieldwork programme covering various geological formations across India. The actual days of field work should be 6 to 7 days excluding travel period.			

### Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	-	-							
CO 2	2	3	-	-	-	-							
CO 3	-	-	1	-	-	-							
CO 4	-	-	2	3	-	-							
CO 5	-	1	-	-	-	-							
CO 6	-	-	-	3	-	-							

### Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

### Assessment Rubrics:

External evaluation: 70 marks. Internal Evaluation: 30 marks

INTERNAL MARK SPLIT-UP (TOTAL 30 MARKS)			
	Components of Internal Evaluation	4 Theory Modules (10)	Practical (20)
1	Test paper/ Mid semester Exam	5	Mark for practical work will be awarded based on students' performance during field work.
2	Seminar/ Viva/ Quiz	3	
3	Assignment	2	

### Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6			✓	

**References:**

1. Basic Geological Mapping. Richard J. Lisle, Peter Brabham, and John W. Barnes (2011), Wiley-Blackwell. ISBN: 978-0470686345
2. Geological Field Techniques. Tom McCann (2012). Springer. ISBN: 978-9400739156
3. Field Geology Illustrated. Terry S. Maley (1994), Mineral Land Publications ISBN: 978-0962517130
4. Geology in the Field. Robert R. Compton (1985) John Wiley & Sons, ISBN: 978-0471842245
5. Field Geology. Frederic H. Lahee (1961) McGraw-Hill, ISBN: 978-0070355918.

Programme	B. Sc. Geology				
Course Code	GEL4CJ204				
Course Title	MINERALOGY				
Type of Course	Major				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	GEL1CJ101 – Introduction to Geology				
Course Summary	This course introduces the students to the world of minerals. The microscopic observation and description of important rock forming silicates are the core of this course.				

### Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will develop proficiency in identifying hand specimens of minerals.	U	F	Exam
CO2	Students will develop proficiency in using petrographic microscopes and identify minerals in thin sections	Ap	C	Quiz
CO3	Students will learn to identify common rock-forming minerals based on their optical properties	An	P	Assignment
CO4	Students will be able to classify minerals into appropriate mineral groups based on their chemical composition and other important properties.	E	M	Viva
CO5	Students will understand the significance of mineralogy in the context of geological processes	Ap	F	Assignment
CO6	Students will understand the role of minerals in rock and ore formation.	E	M	Assignment
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

## Detailed Syllabus: MINERALOGY

Module	Unit	Content	Hrs	Marks
I	<b>Physical and Chemical Mineralogy</b>		<b>9</b>	<b>15</b>
	1	Definition of Mineral . Scope and aim of Mineralogy.	2	
	2	Crystal Coordination - the making of minerals	1	
	3	Compositional variation and coupled ionic substitution, Isomorphism, Polymorphism, Pseudomorphism.	2	
	4	Solid solution and ex- solution in minerals.	1	
	5	Physical properties of minerals- form, colour, streak, lustre, hardness, cleavage, fracture, specific gravity, tenacity, transparency	2	
	6	Electrical and gagnetic properties- pyro and piezo electricity, ferri-, para-, and diamagnetism.	1	
II	<b>Petrological Microscopy and Optical Properties of Minerals</b>		<b>10</b>	<b>20</b>
	7	Nature of light, Ordinary and polarized light, Refraction and reflection	1	
	8	Refractive index, critical angle, and total internal reflection	1	
	9	Polarisation ,double refraction, Nicol Prism	2	
	10	Petrological microscope and its parts	1	
	11	Optical properties of minerals	2	
	12	Properties under open & crossed nicols	2	
	13	Isotropic and anisotropic minerals	1	
III	<b>Study of mineral groups</b>		<b>6</b>	<b>10</b>
	14	Classification and structural diversity of silicate minerals	2	
	15	Chemistry, structure, and physical properties of Olivine & Garnet families	2	
	16	Chemistry, structure, and physical properties of Epidote group & Aluminium silicates	2	
IV	<b>Study of mineral groups</b>		<b>20</b>	<b>25</b>
	17	Chemistry, structure, and physical properties of Pyroxenes & Pyroxenoids	3	
	18	Structure, chemistry and physical properties of Amphibole family	3	
	19	Structure, chemistry, and physical properties of Mica, Chlorite, and polymorphs of Quartz.	3	
	20	Structure, chemistry, and physical properties of Feldspars, Feldspathoids, and Spinel.	4	
	21	Chemistry, optical and physical properties of Scapolite, Cordierite, Talc, Serpentine, Calcite, Dolomite, Topaz, Staurolite, Beryl, Tourmaline, Fluorite, Apatite, Zircon, Rutile, Sphene, Zeolites, and Corundum	4	
	22	Modes of occurrences and industrial uses.	3	
V	<b>Practical</b>		<b>30</b>	<b>10</b>
	1	Identification of hand specimens of important rock forming minerals	15	
	2	Identification of thin sections of important rock forming minerals	15	

### Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	-	-							
CO 2	2	3	-	-	-	-							
CO 3	-	-	1	-	-	-							
CO 4	-	-	2	3	-	-							
CO 5	-	1	-	-	-	-							
CO 6	-	-	-	3	-	-							

### Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

### Assessment Rubrics:

External evaluation: 70 marks. Internal Evaluation: 30 marks

INTERNAL MARK SPLIT-UP (TOTAL 30 MARKS)			
	Components of Internal Evaluation	4 Theory Modules (10)	Practical (20)
1	Test paper/ <b>Continuous Evaluation of Practical Exercises</b>	5	<b>10</b>
2	Seminar/ <b>End Sem Exam &amp; Viva-Voce</b>	3	7
3	Assignment / <b>Lab Record</b>	2	<b>3</b>

### Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6			✓	

**References:**

1. Dyar, M.D., Gunter, M.E., 2007. Mineralogy and Optical Mineralogy. Min. Soc. America, 705p.
2. Demange, M., 2012. Mineralogy for Petrologists: Optics, Chemistry, and Occurrence of Rock Forming Minerals. CRC Press (Taylor & Francis Group), 182p.
3. Nesse, W.D., 2012. Introduction to Optical Mineralogy. Oxford University Press; 4 E dition, 384p.
4. Pichler, H., Riegraf, C.S., 2011. Rock-forming Minerals in Thin Section. Springer, 220 p.
5. Deer, W.A., Howie, R.A., Zussman, J., 2013. Introduction to the Rock-forming Minerals. Mineralogical Society of Great Britain & Ireland, 510 p.

Programme	B. Sc. Geology				
Course Code	GEL4CJ205				
Course Title	<b>SEDIMENTARY PETROLOGY &amp; PALAEOLOGY</b>				
Type of Course	Major				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic knowledge on sedimentation, invertebrate organisms, and taxonomic classification of organisms				
Course Summary	The course deals with various sedimentary processes, sedimentary textures & structures, and classification of sedimentary rocks. It also discusses the taxonomic classification, geological history, and stratigraphic importance of the invertebrate fossils of Protozoa, Coelenterata, Hemichordata, Mollusca, Brachiopoda, Echinodermata and Arthropoda.				

#### Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Illustrate various sedimentary processes, sedimentary textures and structures, and classify the sedimentary rocks	U	F&C	Class tests/Quiz
CO2	Distinguish different sedimentary depositional environments and sedimentary deposits	U	C	Class tests/Quiz/ Seminars
CO3	Discuss the general morphology, classification and the stratigraphic importance of the phylum: Protozoa, Coelenterate and Hemichordata	R	F	Class tests/ Assignments
CO4	Illustrate the general morphology, classification and the stratigraphic importance of the phylum: Mollusca, and Brachiopoda	R	F	Class tests/ Assignments
CO5	Describe the general morphology, classification and the stratigraphic importance of the phylum: Echinodermata and Arthropoda	R	F	Class tests/ Assignments
CO6	Distinguish the			

	sedimentary rocks based on their physical and optical properties, and identify the fossils of invertebrate organisms	Ap	F&P	Lab tests
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge (F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus: SEDIMENTARY PETROLOGY & PALAEOLOGY

Module	Unit	Content	Hrs	Marks
I	<b>Sedimentary processes, sedimentary textures &amp; structures, and sedimentary rocks</b>		<b>10</b>	<b>15</b>
	1	Sedimentary processes: disintegration & decomposition of rocks, transportation, deposition, diagenesis	3	
	2	Textures of sedimentary rocks: clastic and non-clastic textures	2	
	3	Structures of sedimentary rocks: mechanical, chemical, and organic structures	2	
	4	Classification of sedimentary rocks	3	
II	<b>Depositional Environments and Types of Sedimentary Deposits</b>		<b>12</b>	<b>20</b>
	5	Introduction to depositional environments: terrestrial, marine, and transitional	4	
	6	Mechanical sedimentary deposits: rudaceous, arenaceous, and argillaceous	2	
	7	Chemical sedimentary deposits: siliceous, carbonaceous, ferruginous, and salt deposits	2	
	8	Organic sedimentary deposits: calcareous, siliceous, phosphatic and carbonaceous deposits	2	
	9	Residual sedimentary deposits: terra rossa, clay, laterite, bauxite, and soils, and heavy mineral deposits	2	
III	<b>Invertebrate Paleontology - Protozoa, Coelenterata, and Hemichordata</b>		<b>10</b>	<b>20</b>
	10	Fossils & Fossilisation: Petrification, permineralization, carbonization, recrystallization, silicification, amber preservation, mummification. Types and uses of fossils.	4	
	11	Phylum Protozoa - Order Foraminifera General morphology - chitinous test, septa, arrangement of chambers, suture, aperture; and dimorphism of foraminifera. Classification, geological history, and stratigraphic importance of Foraminifera	2	
	12	Phylum Coelenterata - Class Anthozoa Zoological features, general morphology: corallum, corallite, theca, chambers, septa, fossula, columella; and septal developments	2	
	13	Classification of corals - tabulate corals and rugose corals, their evolution, geological distribution and stratigraphic importance	1	
	14	Subphylum Hemichordata - Class Graptozoa. General morphology: rhabdosome, stipe, theca, common canal, nema, virgula, sicula, angle of divergence, and central disc Classification, geological distribution and stratigraphic importance of Graptozoa	1	
IV	<b>Invertebrate Paleontology - Mollusca and Brachiopoda</b>		<b>13</b>	<b>20</b>

	15	Phylum Mollusca - Class Pelecypoda Morphology: umbo, hinge line, ligament, lunule, escutcheon, adductor impressions, pallial line, pallial sinus, dental patterns, ornamentation	2	
	16	Classification and geological history of Pelecypoda	1	
	17	Phylum Mollusca - Class Gastropoda General morphology: shell forms, whorl, spire, spiral angle, suture, aperture, columella, umbilicus, peristome and types of coiling Classification and geological history of Gastropoda	2	
	18	Phylum Mollusca - Class Cephalopoda General morphology, siphuncle, septa, septal necks, connecting rings, chambers, suture lines, shell forms and ornamentation	2	
	19	Classification and geological history of Cephalopoda	1	
	20	Phylum Mollusca - Phylum Brachiopoda General morphology: umbo, hinge line, pedicle opening, delthyrium, deltidium, pseudo deltidium, brachial skeleton and ornamentation	2	
	21	Classification and geological history of Brachiopods	1	
	22	Phylum Arthropoda - Class Trilobita General morphology: Cephalon, thorax and pygidium Classification and geological history of Trilobites	2	
	<b>Practical</b>		<b>30</b>	<b>10</b>
<b>v</b>	1	Megascope and microscopic identification of sedimentary rocks	20	
	2	Megascope identification of invertebrate fossils	10	

### Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	-	-							
CO 2	2	3	-	-	-	-							
CO 3	-	-	1	-	-	-							
CO 4	-	-	2	3	-	-							
CO 5	-	1	-	-	-	-							
CO 6	-	-	-	3	-	-							

### Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

External evaluation: 70 marks. Internal Evaluation: 30 marks

<b>INTERNAL MARK SPLIT-UP (TOTAL 30 MARKS)</b>			
	<b>Components of Internal Evaluation</b>	<b>4 Theory Modules (10)</b>	<b>Practical (20)</b>
1	Test paper/ <b>Continuous Evaluation of Practical Exercises</b>	5	<b>10</b>
2	Seminar/ <b>End Sem Exam &amp; Viva-Voce</b>	3	7
3	Assignment / <b>Lab Record</b>	2	<b>3</b>

**Mapping of COs to Assessment Rubrics :**

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4				✓
CO 5		✓		✓
CO 6	✓			✓

**References:**

1. Boggs, S., 2016. Principles of Sedimentology and Stratigraphy. Pearson Education. 568p.
2. Prothero, D.R., Schwab, F., 2013. Sedimentary Geology. W.H. Freeman, 593 p
3. Henry Woods: Invertebrate palaeontology – Cambridge.
4. Raup, D.M. and Stanley, M.S.: Principles of Palaeontology, CBS Publishers.
5. Moore, R.C., Laliker, C.G. & Fisher, A.G.: Invertebrate Fossils, Harper brothers
6. Shrock, R.R. and Twenhofel, W.H – 1953: Principles of invertebrate Palaeontology, Arnold publication