UNIVERSITY OF KERALA

Career-related First Degree programme

Under CBCS System

GEOLOGY AND DIGITAL SURVEYING
(DOUBLE MAIN)

Programme Structure & Syllabus

(For those who join the Programme from the academic year 2020 onwards)

Foundation Courses, Core Courses (Main - 1 & Main - 2)

Open Courses, Project/Dissertation

2020

Foreword

The Board of Studies in Geology (Pass) and Board of Studies in Geography (Pass & PG) of the University of Kerala decided to frame the curriculum and syllabus of the Double Main Course B.Sc. Geology and Digital Surveying as per the instructions from the authorities of the University of Kerala and to be implemented with effect from the academic year 2020-21 as part of the efforts to introduce new UG/PG Programmes by the University of Kerala in its affiliated colleges to provide education and latest information to the students on new job oriented courses. Accordingly, the Boards of Studies in Geology (Pass) and Geography (Pass & PG) held series of discussions and an online workshop of two days duration in Google Meet Platform involving the Board members, Subject experts and teachers of colleges offering B.Sc. in the subjects of Geology and Geography, under the University of Kerala was held on the 5th and 6th of October 2020. A total of 22 teachers including the members of Board of Studies of Geology and Geography from different Colleges offering the two courses participated in the workshop. After detailed deliberations and incorporating the suggestions of experts such as Dr. Manju V. S., Professor, Department of Civil Engineering, College of Engineering Trivandrum, Prof. B. Thulasidharan Nair, Professor, Department of Civil Engineering, College of Engineering Trivandrum and Prof. Sabu P., Associate Professor, Department of Civil Engineering, College of Engineering Trivandrum, the syllabus was finalized. The draft syllabus was discussed and approved by the Board of Studies in the online meeting (Google Meet Platform) held on 9th October 2020. The following members of the two Boards of Studies were involved in the framing of the syllabus in the respective streams:

Main – 1: Geology

1) Dr. Gangadhar K., Chairman, Board of Studies in Geology (Pass)
2) Dr. Shinu N., Member
3) Dr. Shaji E., Member
4) Dr. K. Maya, Member

Main – 2: Digital Surveying

1) Smt. Bindu Somanathan, Chairperson, Board of Studies in Geography (Pass & PG)
2) Dr. V. K. Jayalekshmi, Member
3) Smt. Divya P., Member
4) Sri. Prasad Rajendran, Member

The Chairman of Board of Studies in Geology (Pass) and the Chairperson of the Board of Studies in Geography (Pass & PG) and Members of the Boards of Studies would like to place on record their gratitude to the entire faculty who took part in the discussion and contributed to the design of the syllabus, which will be effective from the academic year 2020-21. The Board

members themselves took great efforts to finalize the syllabus and their efforts are highly commendable. Chairman and Chairperson of the two Boards place on record their deep sense of appreciation to the authorities of University of Kerala who were concerned with the syllabus preparation, the Subject Experts and the teachers who participated in the workshop for their timely help and directions. Comments and suggestions for improvement are welcome.

Thiruvananthapuram
10-10-2020

Dr. Gangadhar K.
Chairman, BOS in Geology (Pass)
Smt. Bindu Somanathan
Chairperson, BOS in Geography (Pass & PG)

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Open Courses, Project/Dissertation

2020

Eligibility for admission to Career Related First Degree Programme in Geology and Digital Surveying (Double Main)

Candidates shall be admitted to the course provided he/she has passed Plus Two examinations of the State or Central Board with Science or Humanities with Geography Streams. The eligibility is a pass in Higher Secondary Examination of the State or an Examination accepted by the University as equivalent thereto with any two of the following subjects: Physics, Chemistry, Mathematics, Geology, Geography or Statistics.

Aim and Objectives

The Career related First Degree Programme in Geology and Digital Surveying is a two main programme with Geology as Core – 1 or Main – 1 and Digital Surveying as Vocational Core or Core – 2 or Main – 2 subjects and is designed to develop a scientific attitude and an interest towards the modern areas of Geological / Earth Science studies and Digital Surveying. It is aimed to get an aptitude in modern aspects of Digital Surveying and its application in the fields of Geology and Geography. It will help the students to become critical and curious in their outlook. The courses are designed to impart the essential basics in Geology, Digital Surveying and Geography. A student completing the course will be made eligible to apply to higher studies in PG in the respective areas of Geological Sciences and Geography and also he / she will be getting good training in the aspects of Digital Surveying so that he can try new job oriented avenues of Digital Surveying in private sector or government sector.

The programme consists of Language courses, Foundation courses, Core (Main – 1 & Main - 2) courses, Open courses and Project/Dissertation. There are two foundation courses, the first of which is focused on aspects of Contemporary issues based on Constitution / Human Rights. The second foundation course is to give a general introduction to Environmental Studies, Environmental Management and Impact.

The various courses in the programme are aimed to develop proficiency in the theory as well as practical experiments, common equipments, laboratory, along with the collection and interpretation and presentation of scientific data in proper manner. In addition to this, students will be equipped with knowledge in the modern areas of Geology and Digital Surveying their applications oil and mineral exploration, groundwater exploration, land use survey, etc. Apart from understanding Digital Surveying and its significance in modern world it will help the student to find the potentialities of using the knowledge for practicing in private and thereby earning revenue. Students, who pursue this programme and pass out successfully, will surely have an urge to continue higher studies in Geology and Digital Surveying and contribute significantly in the development both in academic field and research field.

The total minimum credits of the programme is **120** and the various courses and its corresponding credits are depicted in the following table, which is followed by the general structure and semester wise allocation of courses, its credits and contact hours.

The subject code is GLD (Geology & Digital Surveying)

1	-	Language
1.1	-	Additional Language
2	-	Foundation Courses
3	-	Core Course – 1 (Main – 1)
4	-	Open Course
5	-	Project/Dissertation – 1
6	-	Vocational Core Course – 2 (Main – 2)
7	-	Project/Dissertation – 2
8	-	Social Service/Extension Activities

Evaluation of Examination

Distribution of marks in theory and practicals between external and internal assessment is 80:20. Pass minimum of 40% for external and over all components.

Career Related First Degree Programme

GEOLOGY & DIGITAL SURVEYING

(DOUBLE MAIN)

Summary of courses

Study Components	No. of courses	Instructional Hours		Credits /course		Max / Total Credits
		T	P			
1. Languages						
1 **English**	4	20		3		**12**
2 **Additional Language**	2	10		3		**6**
2. Foundation Course	2			2-3		**5**
1 GLD1121: Contemporary issues on Constitution/Human rights (Main – 1)	1	3		3		**3**
2 GLD1221: Environmental Management and Impact Assessment (Main – 2)	1	2		2		**2**
3. Main - 1				2-5		**47**
Geology	16	35	22	L	P	**47**
1 GLD1141: General Perspectives of Geology		4	2	3		
2 GLD1241: Physical Geology and Geomorphology		4	2	3		
3 GLD1242: Practical – I (Practicals of 1 & 2)					2	
4 GLD1341: Crystallography & Mineralogy		3	2	3		
5 GLD1342: Fundamental Hydrogeology		3	2	3		
6 GLD1441: Paleontology		3	2	4		
7 GLD1442: Stratigraphy & Structural Geology		3	2	4		
8 GLD1443: Practical – II (Practicals of 4, 5, 6 & 7)					3	
9 GLD1541: Igneous Petrology		3	2	4		
10 GLD1542: Stratigraphy of India		3		4		
4. 11 GLD1551.1: Open Course: Geosciences and Environment		3		2		
GLD1551.2: Open Course: Disaster Management		3		2		
GLD1551.3: Open Course: Gemmology		3		2		
5. 12 GLD1661.1: Project / Study Tour / Field work			2			
13 GLD1641: Sedimentary and Metamorphic Petrology		3	2	5		
14 GLD1642: Economic Geology		3	2	5		
15 GLD1643: Practical – III (Practicals of 9, 13 & 14)					2	
16 GLD1661.1: Project / Study Tour / Field work			2		2	
6. Main - 2				1-5		**47**
Digital Surveying	16	35	23	L	P	**47**
1 GLD 1171: Introduction to General Geography		4		3		
2 GLD 1271: Basic Geodesy		4		3		

3	GLD1272: Practical – I: Geodetic Techniques			5		1	
4	GLD1371: Fundamentals of Surveying and Leveling		3		2		
5	GLD1372: Elements of Cartography		3		2		
6	GLD1373: Practical – II: Basic Surveying			4		2	
7	GLD1471: Principles of Remote Sensing		5		5		
8	GLD1472: Fundamentals of Photogrammetry		5		5		
9	GLD1571: Geographic Information System		5		5		
10	GLD1572: Practical – III: Remote Sensing and Photogrammetry			3		2	
11	GLD1573: Practical – IV: Techniques in GIS and Spatial Analysis			4		3	
12	GLD1671: Global Positioning System		3		4		
13	GLD1672: Techniques and applications of Digital Surveying		3		5		
14	GLD1673: Practical – V: Field Techniques in Digital Surveying			5		3	
7. 15	GLD1661.2: Project / Study Tour / Field work / Institute visit			2		2	
8. **16**	**Social Service and Extension Activities**					**1**	
	Total Credits						**120**

Study Components	**No. of courses**	**Instructional Hours**		**Credits /course**		**Max / Total Credits**
Open Courses of Main – 1 Geology	**1**	**T**	**P**	**T**	**P**	**2**
1 GLD1551.1: Geosciences and Environment		3		2		2
2 GLD1551.2: Disaster Management		3		2		2
3 GLD1551.3: Gemmology		3		2		2

T – Theory
P – Practical

SUMMARY OF SEMESTER WISE HOUR DISTRIBUTION

SEMESTER I

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University Exam*	*Marks for Evaluation*	
		T	*P*				*CE*	*ESE*
EN 1111	English	5		90	3	3 Hrs.	20	80
1111.1	Additional language	5		90	3	3 Hrs.	20	80
GLD1121	Foundation Course: Main – 1: Contemporary issues on Constitution/Human Rights	3		54	3	3 Hrs.	20	80
GLD1141	General Perspectives of Geology	4	2	108	3	3 Hrs.	20	80
GLD1171	Introduction to General Geography	4	2	108	3	3 Hrs.	20	80
	Total	21	4	450	15		**100**	**400**

Hour distribution: GL=9, D=6, LC=5+5; Total = 25

SEMESTER II

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University Exam*	*Marks for Evaluation*	
		T	*P*				*CE*	*ESE*
EN1211	English	5		90	3	3 Hrs.	20	80
1211.1	Additional language	5		90	3	3 Hrs	20	80
GLD1221	Foundation Course (Main – 2) Environmental Management and Impact Assessment	2		36	2	3 Hrs	20	80
GLD1241	Physical Geology & Geomorphology	4	2	108	3	3 Hrs	20	80
GLD1242	Practical – I (Practicals of GLD1141 & GLD1241)				2	3 Hrs	20	80
GLD1271	Basic Geodesy	4	3	126	3	3 Hrs	20	80
GLD1272	Practical – I Geodetic Techniques				1	3 Hrs	20	80
	Total	20	5	450	17		**140**	**560**

Hour distribution: GL=6, D=9, LC=5+5; Total = 25

SEMESTER III

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University Exam*	*Marks for Evaluation*	
		T	*P*				*CE*	*ESE*
EN1311	English	5		90	3	3 Hrs	20	80
GLD1341	Crystallography & Mineralogy	3	2	90	3	3 Hrs	20	80
GLD1342	Fundamental Hydrogeology	3	2	90	3	3 Hrs	20	80
GLD1371	Fundamentals of Surveying and Leveling	3		54	2	3 Hrs	20	80
GLD1372	Elements of Cartography	3		54	2	3 Hrs	20	80
GLD1373	Practical – II Basic Surveying		4	72	2			
	Total	17	8	450	15		**100**	**400**

Hour distribution: GL=10, D=10, LC=5; Total = 25

SEMESTER IV

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University Exam*	*Marks for Evaluation*	
		T	*P*				*CE*	*ESE*
EN1411	English	5		90	3	3 Hrs.	20	80
GLD1441	Paleontology	3	2	90	4	3 Hrs.	20	80
GLD1442	Stratigraphy & Structural Geology	3	2	90	4	3 Hrs.	20	80
GLD1443	Practical – II (Practicals of GLD1341, GLD1342, GLD1441 & GLD1442)				3	3 Hrs.	20	80
GLD1471	Principles of Remote Sensing	5		90	5	3 Hrs.	20	80
GLD1472	Fundamentals of Photogrammetry	5		90	5	3 Hrs.	20	80
	Total	21	4	450	24		**120**	**480**

Hour distribution: GL=10, D=10, LC=5; Total = 25

SEMESTER V

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University Exam*	*Marks for Evaluation*	
		T	*P*				*CE*	*ESE*
GLD1541	Igneous Petrology	3	2	90	4	3 Hrs	20	80
GLD1542	Stratigraphy of India	3		54	4	3 Hrs	20	80
GLD1551.1	Open course – 1: Geosciences and Environment	3		54	2	3 Hrs	20	80
GLD1551.2	Open course – 2: Disaster Management	3		54	2	3 Hrs	20	80
GLD1551.3	Open course – 3: Gemmology	3		54	2	3 Hrs	20	80
GLD1661.1	PROJECT AND STUDY TOUR/FIELDWORK (GEOLOGY)		2	36				
GLD1571	Geographic Information System	5		90	5	3 Hrs	20	80
GLD1572	Practical – III Remote Sensing and Photogrammetry		3	54	2	3 Hrs	20	80
GLD1573	Practical – IV Techniques in GIS and Spatial Analysis		4	72	3	3 Hrs	20	80
	Total	14	11	450	20		**120**	**480**

Hour distribution: GL=13, D=12; Total = 25

SEMESTER VI

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University Exam*	*Marks for Evaluation*	
		T	*P*				*CE*	*ESE*
GLD1641	Sedimentary and Metamorphic Petrology	3	2	90	5	3 Hrs.	20	80
GLD1642	Economic Geology	3	2	90	5	3 Hrs.	20	80
GLD1643	Practical – III (Practical of GLD1541, GLD1641, GLD1642)				2	3 Hrs.	20	80
GLD1661.1	PROJECT AND STUDY TOUR/FIELDWORK (GEOLOGY)		2	36	2		20	80
GLD1671	Global Positioning System	3		54	4	3 Hrs.	20	80
GLD1672	Techniques and applications of Digital Surveying	3		54	5	3 Hrs.	20	80
GLD1673	Practical – V Field Techniques in Digital Surveying		5	90	3	3 Hrs.	20	80
GLD1661.2	PROJECT AND STUDY TOUR/FIELDWORK (DIGITAL SURVEYING)		2	36	2		20	80
	Social Service and Extension Activities				1			
	Total	12	13	450	29		**160**	**640**

Hour distribution: GL=12, D=13; Total = 25

Total Work Load in Hours

Subjects	*Work Load in Hours*
Main – I : Geology (GL)	1080
Main – II : Digital Surveying (D)	1080
English	360
Second Language	180
Total	**2700**

Project/Dissertation is compulsory for each main, i.e., Main – 1: Geology and Main – 2: Digital Surveying. It can be carried out individually or by a group not exceeding five students. The topic of the project should be innovative and relevant to the fields of Geology / Digital Surveying. The topics are either to be allotted by the supervising teacher or to be selected by the students in consultation with the supervising teacher. The project report duly attested by the Supervising teacher and certified by the HOD has to be submitted on the day of Viva voce examination. The project shall be evaluated by two external examiners. The report (not less than 40 pages) should be prepared as per the following formats.

1. Title page
2. Declaration by the student
3. Certificate (Supervising teacher and HOD)
4. Acknowledgement if any
5. Table of contents
6. Abbreviations if any
7. Introduction and Review of literature
8. Materials and Methods
9. Results and Discussion
10. Summary and Conclusions
11. References

Care should be taken to represent the data in tables/graphs /figures.

Project / Dissertation: Main – 1: Geology. In Semester V, GLD1661.1: Project / Dissertation, has been allotted 2 hours with no credits; the project work can be commenced in the V Semester. In Semester VI, the same Course GLD1661.1: Project / Study Tour / Field work, can be continued and has been allotted 2 hours with 2 credits. The Project will be evaluated in the Semester VI as per University rules with Internal = 20 marks; Project Report = 60 marks and Viva = 20 marks.

Project / Dissertation: Main – 2: Digital Surveying. In Semester VI only, Course GLD1661.2: Project / Dissertation, has been allotted 2 hours with 2 credits. The Project will be evaluated in the Semester VI itself as per University rules with Internal = 20 marks; Project Report = 60 marks and Viva = 20 marks.

Field visit: It is compulsory that every student has to undertake a field study tour of not less than one week for observing geological features under the guidance of teachers of the Department during V or VI semester. Moreover, they have to submit a tour report countersigned by the Head of the department during the practical examination of GLD1643. If a student fails to undergo the study tour he/she may not be permitted to attend the examination.

Industry or Institute visit: It is also compulsory that every student has to undertake an Industry or Institute visit as part of their Digital Survey curriculum. They have to submit the report of the same, duly certified by the Head of the Department during the practical examination of GLD1673.

Main – 1: GEOLOGY

Semester I

FOUNDATION COURSE (Main – 1)
GLD1121: CONTEMPORARY ISSUES ON CONSTITUTION/HUMAN RIGHTS

Semester	Hours/Week		Hours /Semester	Exam	Marks			Credits
I	T	P	54 Hours	3 Hours	Internal	External	Total	3
	3	-			20	80	100	

COURSE OUTCOMES

CO 1: Understand the political structure, both constitutional and administrative.
CO 2: Understand the rights and privileges granted by the constitution.
CO 3: Understand the concept and significance of human rights and the state of human rights in India.
CO 4: Understand the legal framework relating to water rights, mineral policy and pollution in India, which includes constitutional provisions, legislation as well as judicial decisions.

SYLLABUS

Module – I An introduction to Indian constitution. Major features of the Government of India Act of 1935. Basic features of the Constitution, Preamble. Fundamental rights, Directive principles of state policy, Fundamental duties, Electoral system. **(10 Hours)**

Module – II Union Government and State Government. Executives, Parliament, Judiciary; Governor – Functions and Powers, High court and subordinate courts. **(10 Hours)**

Module – III Contemporary issues in India under constitutional law – Constitutional Morality as a Challenge, Data Protection Bill and Right to Privacy, Constitutional Supremacy or Parliamentary sovereignty. **(10 Hours)**

Module – IV Human rights concept and significance. Evolution and nature of human rights, UN and human rights. Human rights in India. NHRC, SHRC, Organization powers and functions. Role of judiciary, Human rights courts, Police and human rights, NGOs in human rights. Human rights issues in India. Human rights of socially excluded groups – Dalits, Women, Children, Economically Weaker, LGBT (Lesbian, Gay, Bisexual, Transgender). **(15 Hours)**

Module – V Introduction to Water rights and constitutional provisions. The Evolution of the Indian Regulation on Fresh Water Resources. Prevention and Resolution of Water-Related Disputes. Water (Prevention and Control of Pollution) Act, 1974.Guidelines to regulate and control Ground Water Extraction in India; National Mineral Policy and National Water Policy. **(9 Hours)**

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Semester I

CORE COURSE (Main – 1)
GLD1141: GENERAL PERSPECTIVES OF GEOLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
I	T	P	T	P	3 Hours	Internal	External	Total	3
	4	2	72	36		20	80	100	

COURSE OUTCOMES

CO 1: Understand the significance of various branches of Geology, the concept of rock cycle; describe characteristics of earth and its origin in relation to the Solar System and the Geological Time Scale.

CO 2: Understand and explain endogenic processes, the theories and hypothesis of plate tectonics, Continental drift and Sea-floor spreading; ideas of plate boundaries, plate movements and associated geological features.

CO 3: Understand and explain Mountains and types, volcanoes, their classification, products and global distribution; and earthquakes, types, causes, effects; elastic rebound theory, seismic waves, scale of measures and seismic belts of world.

CO 4: Understand the various field methods in Geology, the principles and accessories.

SYLLABUS

Module–I Geosciences – introduction to various branches – Physical Geology, Geomorphology, Mineralogy, Structural Geology, Petrology, Global tectonics, Palaeontology, Stratigraphy, Engineering Geology, Marine Geology, Geochemistry, Applied Geophysics, Geochemistry, Hydrogeology, Meteorology,

Oceanography, Remote Sensing, Environmental Geology, Disaster Management and Economic Geology. The concept of rock cycle. Mountains – Types and origin; Isostasy. Geological Time Scale. **(10 Hours)**

Module – II Solar system, Planets, Theories of origin of Earth. Earth - Shape, size, age and rotation. Internal structure of earth; crust, mantle, core; density and chemical composition; major seismic discontinuities. **(15 Hours)**

Module –III Endogenic processes: Plate Tectonics. Continental drift hypothesis and Sea floor spreading- evidences. Lithospheric plates, types of plate boundaries, plate movements and associated geological features, mid-ocean ridges, rift valleys, trenches, transform faults, island arcs, volcanic arcs, Benioff zones, Mantle plumes, Aseismic ridges. **(15 Hours)**

Module –IV Volcanoes and their classification. Volcanic eruption – Types, Products and effects. Global distribution of volcanoes. Earthquakes - types and causes, propagation of seismic waves, focus and epicenter, elastic rebound theory, seismograph and seismogram. Intensity and magnitude of earthquakes, effect of earthquakes, seismic belts of the world, Earthquake hazard zonation of India. **(20 Hours)**

Module – V Field methodologies in Geology, Principles – Maps – Instruments – Clinometer, Brunton compass, Map Symbols, Toposheets, GPS, Aerial Photographs, Satellite imageries. **(12 Hours)**

PRACTICALS

FIELD METHODOLOGY (36 Hours)

1. Clinometer and Brunton Compass – Map orientation, Elements of Map Reading, Fore-bearing and Back-bearing.
2. Topographic Sheets: Scale, Legends – Types and Categories
3. Map symbols.
4. Determination of Epicentre of an Earthquake.

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8. Frederic H. Lahee Field Geology (Sixth edition, McGraw-Hill Book Company, 1961, pp. 926 + xxxi, 83*s*. 6*d*.)

Semester II

CORE COURSE (Main – 1)
GLD1241: PHYSICAL GEOLOGY AND GEOMORPHOLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
II	T	P	T	P	3 Hours	Internal	External	Total	3
	4	2	72	36		20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain exogenic processes, with emphasis on weathering, soils and mass wasting.

CO 2: Understand and describe the different geological agents, viz., streams, groundwater, oceans, glaciers, wind and lakes.

CO 3: Understand and illustrate the geological actions of the various geological agents and their associated landform features.

SYLLABUS

Module – I Exogenic Processes: Weathering – factors, types and products of weathering. Physical and chemical processes. Soil, factors affecting soil formation and soil profile. Laterite. Mass wasting – types, causes and control. **(17 Hours)**

Module – II Geological agents. Cycle of erosion. Streams – Stream as a geological agent. Drainage basin and drainage pattern. Stream erosion, transportation and deposition. Development and evolution of fluvial landforms – different stages of fluvial evolution – youth, mature and old age stages. Groundwater as a geological agent – erosional and depositional features. Karst topography, stalagmite, stalactite, caves. **(20 Hours)**

Module – III Oceans – salinity of ocean water. Waves, currents and tides. Coastal erosion, transportation and deposition. Classification of coastlines and coastal morphology. Eustatic sea level changes. Physiographic features of ocean floor: continental shelf, continental slope, continental rise, submarine canyons, abyssal plains, MORs, deep sea trenches, guyots, seamounts. Coral reefs – Types, Their formation and distribution. **(12 Hours)**

Module – IV Glaciers-Formation, movement and morphology. Types of glaciers. Erosion,

transportation and deposition by glaciers. Glacial landforms. Global warming and its effects on glaciers. **(12 Hours)**

Module – V Wind – Geological action of winds. Landforms of Aeolian origin. Lakes – Origin, Classification, geologic significance**.** **(11 Hours)**

PRACTICALS

PHYSICAL GEOLOGY AND GEOMORPHOLOGY (36 Hours)

PHYSICAL GEOLOGY

Topographic Sheets: Scale, Legends – Types and Categories, Interpretation of contours and Identification of Natural Landscape Elements, Scale Measurements, Slope Calculation. Determination of Latitude and Longitude from Toposheets. Measurement of distance between Two Points.

Determination of Epicentre of an Earthquake.

GEOMORPHOLOGY

Study of toposheets to identify different drainage pattern and its illustration.

Delineation of drainage basins and identification of stream order in toposheets and their illustration.

Identification and representation of different landforms in toposheets.

Diagrammatic representation of evolution of meandering stream, hydrologic cycle, drainage network and sand dunes.

Preparation of thematic maps (drainage, contour, land use, landforms, slope) from toposheets.

Morphometric analysis of drainage basins – stream ordering, drainage frequency, drainage density, bifurcation ratio and relief ratio.

Preparation of profile from contour maps and toposheets.

REFERENCES

1. Ahamed, E. (1972) Coastal Geomorphology of India. Orient Longman, New Delhi.
2. Thornbury, W. D. (1968). Principles of Geomorphology, Wiley.
3. Plummer, Carlson, McGeary (2003). Physical Geology. McGraw Hill.
4. Weisberg, J, and Parish, H. (1974). Introductory Oceanography. McGraw Hill.
5. Arthur Holmes (1977) Principles of Physical Geology (Edinburgh: Thomas Nelson and Sons, 1944 and New York: Ronald Press, 1945.
6. Bloom, A. (2004) Geomorphology – A Systematic analysis of Late Cenozoic Landforms (Third edition) Wavel and Press Inc.
7. Vishwas S. Kale and Avjit Gupta (2000). Introduction to Geomorphology, Orient Black Swan.
8. Sparks B. W. (1969). Geomorphology, Longman.

Semester II

CORE COURSE (Main – 1)
GLD1242: PRACTICAL – I (Practicals of GLD1141 and GLD1241)

Semester	Hours /Semester	Exam	Marks			Credits
			Internal	External	Total	
II	36 Hours	3 Hours	20	80	100	2

COURSE OUTCOMES

CO 1: Understand and acquire skill in instrumentation and field methodologies related to geological studies.

CO 2: Acquire knowledge and skill in identification of features in toposheets, diagrammatic representation of geomorphological features, preparation of thematic maps and contour maps.

SYLLABUS

GLD1141: FIELD METHODOLOGY (36 Hours)

1. Clinometer and Brunton Compass – Map orientation, Elements of Map Reading, Fore-bearing and Back-bearing.
2. Topographic Sheets: Scale, Legends – Types and Categories
3. Map symbols.
4. Determination of Epicentre of an Earthquake.

GLD1241: PHYSICAL GEOLOGY & GEOMORPHOLOGY (36 Hours)

1. Topographic Sheets: Scale, Legends – Types and Categories, Interpretation of contours and Identification of Natural Landscape Elements, Scale Measurements, Slope Calculation. Determination of Latitude and Longitude from Toposheets. Measurement of distance between Two Points.
2. Study of toposheets to identify different drainage pattern and its illustration.
3. Delineation of drainage basins and identification of stream order in toposheets and their illustration.
4. Identification and representation of different landforms in toposheets.
5. Diagrammatic representation of evolution of meandering stream, hydrologic cycle, drainage network and sand dunes.
6. Preparation of thematic maps (drainage, contour, land use, landforms, slope) from toposheets. Morphometric analysis of drainage basins – stream ordering, drainage frequency, drainage density, bifurcation ratio and relief ratio.
7. Preparation of profile from contour maps and toposheets.

Semester III

CORE COURSE (Main – 1)
GLD1341: CRYSTALLOGRAPHY AND MINERALOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
III	3	2	54	36	3 Hours	Internal	External	Total	3
						20	80	100	

COURSE OUTCOMES

CO 1: Understand the significance and application of crystallography in mineralogy as well as the elements of crystallography and different crystal systems.

CO 2: Understand and explain minerals, structure, classification, their physical, chemical and optical properties and their identification.

SYLLABUS

Module – I Significance of crystallography in mineralogy. Elements of crystallography: crystalline state and crystals. Morphology of crystals, faces, edges, vertex, forms and zones. Classification of crystals into systems and classes. Nomenclature of crystal faces: intercepts, parameters, unit face, Weiss notation, Miller indices. Systematic crystallography: The study of symmetry, simple forms and combinations of the normal class of the following crystal systems – Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and triclinic systems. Twinning in crystals. **(10 Hours)**

Module – II Mineral - definition of Mineral and Mineraloid, scope and aim of Mineralogy. Physical mineralogy: physical properties of minerals. Electrical, magnetic and radioactive properties of minerals. Types of Bonds, ionic radii, ionic ratios, Polymorphism, isomorphism, pseudomorphism, solid solution and exsolution in minerals. Ordinary and polarized light, polarization of light, refractive index, critical angle and total internal reflection. Polarization by reflection, absorption, refraction. Double refraction, Isotropic and anisotropic substances. Petrological microscope - parts and functions. Optical accessories – mica plate, gypsum plate and quartz wedge. Birefringence, uniaxial and biaxial minerals, optic sign, relief, pleochroism, interference colour and its order, extinction. **(15 Hours)**

Module – III Classification of minerals. Rock forming and ore forming minerals. Silicates – Structure and classification of silicate minerals. **(4 Hours)**

Module – IV Physical, chemical and optical properties of the following: olivines, garnets, pyroxenes amphiboles, micas, feldspars, feldspathoids, quartz, aluminosilicates, epidote, clay minerals, zeolite group and beryl tourmaline and cordierite.

(15 Hours)

Module – V Systematic study of the important non-silicate minerals - calcite, dolomite. diamond, graphite, sulphur, gold, silver, copper, realgar, orpiment, stibnite, molybdenite, cinnabar, sphalerite, galena, chalcopyrite, pyrite, magnetite, hematite, marcasite, barite, gypsum, halite, flourite, corundum, cuprite, chromite, rutile, cassiterite, ilmenite, monazite, psilomelane, pyrolusite, goethite, limonite, bauxite, aragonite, magnesite, malachite and azurite**.** **(10 Hours**)

PRACTICALS (36 Hours)

MINERALOGY

Megascopic study and identification of following minerals:

Quartz, smoky quartz, milky quartz, amethyst, chalcedony, agate, jasper, chert, opal, orthoclase, microcline, plagioclase, perthite, nephelene, leucite, enstatite, bronzite, hypersthene, diopside, augite, wollastonite, anthophyllite, tremolite, actinolite, hornblende, olivine, serpentine, muscovite, biotite, vermiculite, phlogopite, chlorite, epidote, garnet, natrolite, stilbite, apophyllite, talc, gypsum, apatite, steatite, andalusite, kyanite, sillimanite, staurolite, cordierite, apatite, beryl, topaz, calcite, dolomite, tourmaline, zircon, fluorite, magnetite, haematite, chromite, sphalerite, psilomelane, pyrolusite, graphite, corundum.

Microscopic study of following minerals:

Quartz, microcline, orthoclase, albite, oligoclase, labradorite, nepheline, leucite, enstatite, hypersthene, augite, diopside, hornblende, tremolite, actinolite, anthophyllite, biotite, muscovite, olivine, epidote, garnet, chlorite, cordierite, andalusite, sillimanite, kyanite, staurolite, calcite, apatite, zircon, tourmaline.

REFERENCES

1. Dana, E. S. (1955) A Textbook of Mineralogy. Asia Publishing House, Wiley.
2. Read, H. H. (1984) Rutley's elements of Mineralogy. CBS Publishers, Delhi.
3. Mason, B. and L.G. Berry (1968) Elements of Mineralogy. W. H. Freeman & Co.
4. Deer, W.A., Howie, R.A. and J. Zuessman - An introduction to rock forming minerals. Longman.
5. Berry, L.G., Mason, B. and Dietrich, R.V. (2004) Mineralogy.CBS Publishers and & Distributors, New Delhi, India.
6. Cornelius Klein and Cornelius S. Hurlbut (1985) Manual of Mineralogy. John Wiley & Sons.
7. Winchel, N.H and A.H. Winchel (1929) Elements of Optical Mineralogy.
8. William D. Nesse (2008) Introduction to Mineralogy. Oxford University Press.
9. Kerr, P.F. (1977) Optical Mineralogy. McGraw Hill Book Company, New York.
10. Perkins Dexter (2006) Mineralogy. Pearson Education; Prentice Hall.
11. Perkins Dexter and Henke Kevin, R. (2007) Minerals in Thin Section. Pearson Education.

Semester III

CORE COURSE (Main – 1)
GLD1342: FUNDAMENTAL HYDROGEOLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
III	3	2	54	36	3 Hours	Internal	External	Total	3
						20	80	100	

COURSE OUTCOMES

CO 1: Understand groundwater in relation to hydrological cycle and explain hydrometeorology and its significance; describe hydrological measurements of important parameters.

CO 2: Understand and describe the occurrence of groundwater, the properties of aquifers and their types; define and explain the Darcy's law governing groundwater movement and flow directions.

CO 3: Understand and describe the groundwater investigation techniques and pumping tests for determination of aquifer parameters.

CO 4: Understand and describe the groundwater provinces of India and the groundwater conditions in Kerala.

SYLLABUS

Module – I Hydrological cycle and hydrometeorology. Global distribution of fresh water, Hydrological measurements – precipitation, evaporation, soil moisture, soil infiltration and river flow. **(10 Hours)**

Module – II Zones of aeration and saturation, water table and potentiometric surfaces, porosity, permeability, aquifer, aquiclude, aquifuge. Types of aquifers – confined and unconfined; Artesian aquifers; Perched aquifers, Leaky or Semi-confined aquifers; Darcy's law, hydraulic head and groundwater flow directions. Water table contour maps. **(13 Hours)**

Module – III Groundwater investigation techniques – geophysical exploration methods with special emphasis on electrical resistivity method, well logging, tracer techniques. **(10 Hours)**

Module – IV Water quality standards proposed by WHO and BIS. Physical and chemical parameters of water; water pollution; remedial measures. Diseases and bio-contamination of groundwater and surface water: remedies. Basic diagrams for representing groundwater quality. **(9 Hours)**

Module – V Water conservation practices; well design; well development; dug wells, tube wells, bore wells. Watershed management – rain water harvesting; artificial

recharge; surangams; sea water intrusion**.** Hydrogeological provinces of India. Groundwater status in India. Major aquifers and groundwater exploitation in Kerala. **(12 Hours)**

PRACTICALS

FUNDAMENTAL HYDROGEOLOGY (36 Hours)

1. Schematics of Hydrological cycle, subsurface distribution of groundwater and Types of Aquifers.
2. Preparation of Water table contour maps.
3. Preparation of basic diagrams for groundwater quality: Stiff's Pattern Diagram, Circular diagram, Bar graphs and Vector diagrams.
4. Identification and demarcation of groundwater provinces of India in a map.

REFERENCES

1. Todd, D.K. (1980). Groundwater Hydrology. John Wiley & Sons.
2. Todd, D.K. and L.W. Mays (2004). Groundwater Hydrology. 3rd Edn. John Wiley & Sons.
3. Davis, S.N. & Deweist, R.J.M. (1966). Hydrogeology, John Wiley & Sons, New York.
4. Ragunath, H.M (2007). Groundwater, New Age International Publishers, Delhi
5. Karanth, K.R. (1987). Groundwater Assessment, Development & Management, Tata Mc-Graw Hill.
6. Ramakrishnan, S. (1998). Groundwater. K.G. Graph Arts, Chennai.

Semester IV

CORE COURSE (Main – 1)
GLD1441: PALEONTOLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
IV	3	2	54	36	3 Hours	Internal	External	Total	4
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain significance of palaeontology, the conditions and methods of fossilization, classification and nomenclature of fossils and the basic principles of Taxonomy, Systematics and Binomial nomenclature.

CO 2: Understand and explain the morphology, classification, geological history and stratigraphic importance of Phylum Protozoa, Phylum Coelenterata: Class Anthozoa, Phylum Brachiopoda, Phylum Mollusca: Classes Pelecypoda, Gastropoda, Cephalopoda.

CO 3: Understand and describe the morphology, classification, geological history and stratigraphic importance of Phylum Arthropoda: Class Trilobita, Phylum Echinodermata: Class Echinoidea and Phylum Hemichordata: Class Graptolithina.

CO 4: Understand the basic ideas of Micropalaeontology and describe the characteristics of important plant fossils.

SYLLABUS

Module – I Scope and subdivisions of paleontology. Conditions and methods of fossilization, body fossils, trace fossils and micro fossils, Classification and nomenclature of fossils. Basic principles of Taxonomy and systematics. Binomial nomenclature, type specimens and kinds – holotype, genotype: Uses of fossils. **(6 Hours)**

Module – II Phylum Protozoa: Morphology, Classification, geological history and stratigraphic importance. Phylum Coelenterata – Class Anthozoa – Morphology, Classification and stratigraphic range and important fossils. **(10 Hours)**

Module – III Phylum Brachiopoda: General morphology, classification and geological history. Phylum Mollusca – Class Pelecypoda, Cephalopoda, Gastropoda. General characters – dental patterns, ornamentation, classification, geological history and important fossils. **(20 Hours)**

Module – V Phylum Arthropoda, Class – Trilobita: General morphology: classification, geological history and important fossils.

Phylum Echinodermata: Class Echinoidea: General morphology, Regular and irregular echinoids – classification – geological history and important fossils.

Phylum Hemichordata – Class Graptolithina: general morphology, geological history and important fossils. **(12 Hours)**

Module – VI Micropalaeontology and Palynology: an introduction. Brief account of the following plant fossils – Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepidodendron and Sigillaria. **(6 Hours)**

REFERENCES

1. Woods, H. (1961) Invertebrate Palaeontolgy. Cambridge University Press.
2. Romer, A.S. (1966) Vertebrate Palaeontology. 3rd Edn., Chicago Univ. Press.
3. Arnold C. A. (1947) An Introduction to Palaeobotany. McGraw Hill.
4. Haq, B.U. and Boersma, A. (1978) Introduction to marine Micropalaeontology. Elsevier, Netherlands.
5. Raup, D.M. and Stanely, M.S. (1978) Principles of Palaeontology. CBS Publishers.
6. Moore, R.C., Lalicker, C.G. and Fishcher, A.G. (1952) Invertebrate Fossils, Mc-Graw Hill.
7. Shrock, R.R. and Twenhofel, W.H. (1953) Principles of Invertebrate Palaeontology. 2nd Edn. Mc-Graw Hill.
8. Brasier, M.D. (1980) Microfossils. George Allen & Unwin.

9. Bignot, G. (1985) Elements of Micropaleontology. IHRDC-Boston.
10. Nield, E.W.; Tucker, V.C.T. (1985) Palaeontology – An Introduction. Pergamon Press, Oxford, England.
11. Anis Kumar Ray, (2008) Fossils in Earth Sciences, Prentice-Hall of India Pvt. Ltd, New Delhi.

PRACTICALS
PALAEONTOLOGY (36 Hours)

Megascopic: Identification, drawing and description of the following fossils:

1. **Anthozoa**: Calceola, Zapherentis, Lithostrotion, Favosites, Halysites, Montlivaltia, Isastrea, Thecosmilia.
2. **Brachiopoda:** Spirifer, Productus, Terebratula, Rhynchonella, Lingula,
3. **Echinodermata**: Cidaris, Hemicidaris, Micraster, Hemiaster,
4. **Lamellibranch**: Arca, Cardita, Pecten, Trigonia, Megaladon, Gryphea, Exogyra, Ostrea, Inoceramus, Alectryonia, Hippurites.
5. **Gastropods:** Natica, Trochus, Turritella, Conus, Murex, Physa, Bellerophon, Cyprea
6. **Cephalopods:** Nautilus, Ceratites, Acanthoceras, Turrilites and Belemnites
7. **Trilobites:** Paradoxides, Calymene, Phacops, Olenus, Olenellus.
8. **Graptolites**: Phyllograptus, Tetragraptus, Diplograptus, Monograptus
9. **Plant Fossils:** Glossopteris, Gangamopteris, Ptilophyllum, Lepidodendron, Sigillaria, Calamites.

Semester IV

CORE COURSE (Main – 1)
GLD1442: STRATIGRAPHY AND STRUCTURAL GEOLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
IV	3	2	54	36	3 Hours	Internal	External	Total	4
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and describe the basic principles of Stratigraphy and breaks in stratigraphic successions and their significance; understand and explain the elements of stratigraphic classification, Geological Time Scale, Stratigraphic correlation and define typical terms related to stratigraphic studies.

CO 2: Understand and describe the basic terminologies in Structural Geology, the Rule of V's

and characteristics of primary and secondary structures.

CO 3: Understand and describe rock deformation, the different stages; concepts and applications of stereographic projection in Structural Geology, foliations and lineations; and geological mapping techniques and procedures.

CO 4: Understand and describe the folds, faults and joints with reference to their origin, terminologies, classification and geological significance.

SYLLABUS

Module – I Scope and basic principles – Uniformitarianism, Superposition, Lateral continuity, Original horizontality, faunal succession, faunal assemblage – Breaks in stratigraphic successions – Hiatus – unconformities – nonsequences – diastems and their significance. **(8 Hours)**

Module – II Elements of lithostratigraphic, chronostratigraphic and biostratigraphic classification. Type area, Transported and leaked fossils. Geologic time scale and time units, Stratigraphic correlation, criteria and methods. Index fossils, Overlap and offlap. **(10 Hours)**

Module – III Introduction: Attitude of planar linear structures Strike, Dip, Plunge and Pitch. Width of outcrops. Outlier and Inlier. Overlap and offlap. Rule of V's. Primary and secondary structures. Use of primary structures in determining top of beds.
Foliation and Lineation – Introduction and types. Geological Mapping – Procedures and equipments in mapping. Rock deformation – Stress and strain. Stages of rock deformation. Basic concept of spherical and stereographic projections in Structural Geology. Wulff net and Schmidt net. **(16 Hours)**

Module – IV Fold: Terminology. Classification of folds – Geometric and genetic. Recognition of folds in field and map. Unconformities: Types and their recognition in the field and in the maps. **(10 Hours)**

Module – V Faults: Terminology and classification; Mechanics of faulting. Criteria for recognition of faults in field and map. Joints: Nature, Origin, Classification and their geological significance. **(10 Hours)**

REFERENCES

1. Billings (1974) Structural Geology. 11th edition, Prentice Hall.
2. Park R. G. (1997) Foundations of Structural Geology 3rd, Chapman & Hall.
3. Hills, E. S. (1961) Elements of Structural Geology, Asia Publishing House.
4. Hobbs, Means and Williams (1976). An Outline of Structural Geology. John Wiley.
5. John Robberts (1982) Introduction to Geological Maps and Structures, Pergamon Press.
6. Ken McClay (1991) The mapping of Geological Structures. Geological Society of London. Wiley, New edition.
7. R. J. Twiss and E M Moore (2007) Structural Geology 2nd edition. Freeman & Company.

PRACTICALS
STRUCTURAL GEOLOGY (36 Hours)

- Diagrammatic illustration of structural features - Attitude of beds - true and apparent dip, strike and dip symbols, rule of V, Types of folds, faults, joints and unconformities.
- Maps with suitable sections and geologic descriptions
  - Simple horizontal beds
  - Illustrating Rule of Vs
  - Simple dipping beds
  - Simple dipping beds with intrusions
  - Problems involving borehole data, thickness, dip and apparent dip
  - Dipping beds with unconformity
  - Folded beds
  - Maps with different types of faults
  - Combination maps (Unconformity, folds, faults, intrusions)
- Problems involving true and apparent dip, true vertical thickness and width of out crops.
- Three point problems. Stereographic projection of linear and planar features.

Semester IV

CORE COURSE (Main – 1)
GLD1443: PRACTICAL – II
(Practicals of GLD1341, GLD1342, GLD1441 & GLD1442)

Semester	Hours /Semester	Exam	Marks			Credits
	P		Internal	External	Total	
IV	36	3 Hours	20	80	100	3

COURSE OUTCOMES

CO 1: Understand and acquire skill in megascopic and microscopic study and identification of important rock forming minerals.

CO 2: Acquire knowledge and skill in diagrammatic representation of hydrological cycle, subsurface distribution of groundwater and Types of Aquifers; preparation of water table contour maps, diagrammatic representations of water quality and identification and representation of groundwater provinces of India in map.

CO 3: Understand and develop skill in megascopic identification, drawing and description of important fossils; diagrammatic illustrations of structural features, carrying out exercises in solving structural maps, determination of attitude of beds and solving three point problems in Structural Geology.

SYLLABUS

GLD1341: MINERALOGY (36 Hours)

Megascopic study and identification of following minerals:

Quartz, smoky quartz, milky quartz, amethyst, chalcedony, agate, jasper, chert, opal, orthoclase, microcline, plagioclase, perthite, nephelene, leucite, enstatite, bronzite, hypersthene, diopside, augite, wollastonite, anthophyllite, tremolite, actinolite, hornblende, olivine, serpentine, muscovite, biotite, vermiculite, phlogopite, chlorite, epidote, garnet, natrolite, stilbite, apophyllite, talc, gypsum, apatite, steatite, andalusite, kyanite, sillimanite, staurolite, cordierite, apatite, beryl, topaz, calcite, dolomite, tourmaline, zircon, fluorite, magnetite, haematite, chromite, sphalerite, psilomelane, pyrolusite, graphite, corundum

Microscopic study of following minerals:

Quartz, microcline, orthoclase, albite, oligoclase, labradorite, nepheline, leucite, enstatite, hypersthene, augite, diopside, hornblende, tremolite, actinolite, anthophyllite, biotite, muscovite, olivine, epidote, garnet, chlorite, cordierite, andalusite, sillimanite, kyanite, staurolite, calcite, apatite, zircon, tourmaline.

GLD1342: FUNDAMENTAL HYDROGEOLOGY (36 Hours)

1. Schematics of Hydrological cycle, subsurface distribution of groundwater and Types of Aquifers.
2. Preparation of Water table contour maps.
3. Preparation of basic diagrams for groundwater quality: Stiff's Pattern Diagram, Circular diagram, Bar graphs and Vector diagrams.
4. Identification and demarcation of groundwater provinces of India in a map.

GLD1441: PALEONTOLOGY (36 Hours)

Megascopic Identification, drawing and description of the following fossils:

- **Anthozoa**: Calceola, Zapherentis, Lithostrotion, Favosites, Halysites, Montlivaltia, Isastrea, Thecosmilia.
- **Brachiopoda:** Spirifer, Productus, Terebratula, Rhynchonella, Lingula,
- **Echinodermata**: Cidaris, Hemicidaris, Micraster, Hemiaster,
- **Lamellibranch**: Arca, Cardita, Pecten, Trigonia, Megaladon, Gryphea, Exogyra, Ostrea, Inoceramus, Alectryonia, Hippurites.
- **Gastropods:** Natica, Trochus, Turritella, Conus, Murex, Physa, Bellerophon, Cyprea
- **Cephalopods:** Nautilus, Ceratites, Acanthoceras, Turrilites and Belemnites
- **Trilobites:** Paradoxides, Calymene, Phacops, Olenus, Olenellus.
- **Graptolites**: Phyllograptus, Tetragraptus, Diplograptus, Monograptus
- **Plant Fossils:** Glossopteris, Gangamopteris, Ptilophyllum, Lepidodendron, Sigillaria, Calamites.

GLD1442: STRATIGRAPHY AND STRUCTURAL GEOLOGY (36 Hours)

- Diagrammatic illustration of structural features - Attitude of beds - true and apparent dip, strike and dip symbols, rule of V, Types of folds, faults, joints and unconformities.

- Maps with suitable sections and geologic descriptions
  - Simple horizontal beds
  - Illustrating Rule of V's
  - Simple dipping beds
  - Simple dipping beds with intrusions
  - Problems involving borehole data, thickness, dip and apparent dip
  - Dipping beds with unconformity
  - Folded beds
  - Maps with different types of faults\
  - Combination maps (Unconformity, folds, faults, intrusions)
- Problems involving true and apparent dip, true vertical thickness and width of outcrops.
- Three point problems. Stereographic projection of linear and planar features.

Semester V

CORE COURSE (Main – 1)
GLD1541: IGNEOUS PETROLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
V	3	2	54	36	3 Hours	Internal	External	Total	4
						20	80	100	

COURSE OUTCOMES

CO 1: Understand the basic concept of rock cycle, origin of igneous rocks from magma, the Bowen's reaction series; explain the important binary systems, the petrotectonic settings and diversity of igneous rocks in relation to various processes.

CO 2: Understand, classify and explain the forms of intrusive and extrusive igneous rocks and the different igneous structures and textures.

CO 3: Understand, classify and describe the different modes of classification of igneous rocks and explain CIPW norm and normative minerals.

CO 4: Understand and explain systematically the texture, mineralogy, classification, occurrence and origin of granites and basalts; and describe the brief petrographic character of common igneous rocks.

SYLLABUS

Module – I Rock – definition, types, rock cycle, plutonic, hypabyssal and volcanic igneous rocks. Origin of magma; primary and parental magmas. Cooling history of igneous rocks, melting and crystallization. Bowen's reaction series. Study of following binary systems: Diopside-Anorthite (Eutectic), Albite-anorthite (solid solution), Forsterite-silica (Incongruent). **(12 Hours)**

Module – II Petrotectonic settings, partial melting and magma generation (mid oceanic ridges and subduction zones only), Diversity of igneous rocks – magmatic differentiation process, fractional crystallization, liquid immiscibility and assimilation / contamination. **(8 Hours)**

Module – III Forms of Intrusive igneous rocks: Concordant forms – sill, laccolith, lopolith and phaccolith. Discordant forms – dykes, cone sheets, volcanic neck, ring dyke, batholiths, stocks, bosses and bysmaliths. Forms of extrusive igneous rocks: lava flows, pyroclastic deposits – agglomerate, lapilli, volcanic ash and pumice.

Igneous structures: Vesicular and amygdaloidal structures, blocky lava, ropy lava, pillow structure, flow structure, sheet joints, mural jointing, and columnar jointing. Textures: definition and description; Crystallinity – crystallites, microlites, devitrification; Granularity – absolute and relative grain size; Shapes of crystals; Mutual relations – Equigranular textures: allotriomorphic, hypidiomorphic, Panidiomorphic, Inequigranular textures: porphyritic and poikilitic textures, Intergrowth texture – perthite, antiperthite, graphic, vermicular textures, Overgrowth textures – orbicular structure, Reaction textures – coronas, Directive textures – trachytic texture, spherulitic structure and perlitic fracture.

(18 Hours)

Module – IV Classification: basis of classification – texture, mineralogy and chemistry. Classification based on mineralogy – felsic and mafic minerals, mode, colour index and IUGS classification - QAP classification of plutonic and volcanic rocks and ultramafic rock classification. Chemical classification – Based on silica saturation and based on alkali & silica (brief introduction of alkalic, subalkalic, calc-alkalic and tholeiitic groups only) – Total alkali vs silica classification for volcanic rocks. A short account of CIPW norm and normative minerals.

(9 Hours)

Module – V Texture, mineralogy, classification, occurrence and origin of granites and basalts. Brief petrographic character of common igneous rocks – syenite, diorite, gabbro, andesite, rhyolite, pegmatites, lamprophyres, carbonatite, dunite, peridotite, anorthosite and kimberlite. **(7 Hours)**

REFERENCES

1. Tyrrell, G.W. (1978) Principles of Petrology. Chapman and Hall Ltd., London.
2. Bowen, N.L.M. (1956) The Evolution of the Igneous Rocks. Dover publication, Inc, New York.
3. Barth, T.W. (1962) Theoretical Petrology. Wiley.
4. Walstrom, E.E. (1961) Theoretical Igneous Petrology, Wiley.
5. Turner, F.J. and Verhoogen, J. (1960) Igneous and Metamorphic Petrology. McGraw Hill.
6. Hatch, F.H. and A.K. Wells (1949) Petrology of Igneous Rocks. Thomas Murby &

Wells, M.K.(Publ.)
7. Johannsen, A (1962) Descriptive Petrography of Igneous Rocks. Vols. I to IV, Allied Pacific. Allied Pacific.
8. Mackenzie, W.S., Donaldson, C.H. and C. Guilford (1988) Atlas of Igneous rocks and their textures. ELBS Longman.
9. Winter, J.D. (2001) An introduction to Igneous and Metamorphic Petrology. Prentice Hall, New Jersey.
10. Ehlers, G.E. and Blatt, H. (1999) Petrology – Igneous, Sedimentary and Metamorphic. CBS Publishers and Distributors, New Delhi.
11. Hyndman, D.W. (1972) Petrology of Igneous and Metamorphic Rocks. MC-Graw Hill.
12. Wilson, M. (1989) Igneous Petrogenesis: A Global Tectonic Approach. Unwin Hyman, London Inc., USA.
13. John D. Winter (2012) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.

Semester V

CORE COURSE (Main – 1)
GLD1542: STRATIGRAPHY OF INDIA

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
V	3	-	54	-	3 Hours	Internal	External	Total	4
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and describe the physiographic and geological divisions of India and acquire knowledge about cratons and mobile belts.

CO 2: Understand and describe the Early Precambrian and Late Precambrian formations of India with emphasis on lithology, classification, age, structure, syn- and post- tectonic intrusives, organic remains, radiometric age and economic resources.

CO 3: Understand and describe the important Palaeozoic, Mesozoic and Cenozoic formations of India with reference to their distribution, lithology, classification, fossils and age.

CO 4: Understand and describe the stratigraphy of Kerala and explain the characteristics of the Precambrian terrain of Kerala.

SYLLABUS

Module I Brief study of the physiography divisions of India – Major geological divisions of India. Concept of Cratons and mobile belts. **(6 Hours)**

Module II General study of the distribution and nomenclature of Early Precambrians of India. Major cratons and fold belts of the Indian shield. Detailed study of the lithology, classification, age, structure, syn- and post- tectonic intrusives, organic remains, radiometric age and economic resources of Dharwar Craton – Sargur Schist Complex, Peninsular Gneiss, Dharwar Supergroup, Aravalli Supergroup of Rajasthan. **(12 Hours)**

Module III General study of the Late Precambrian terrains of India and study of the lithology, classification, structure, associated intrusives, organic remains, radiometric age and economic resources of the following – Delhi Supergroup, Cuddapah Supergroup, Vindhyan Supergroup and Kurnool Group. **(12 Hours)**

Module IV A brief study of the distribution of marine Paleozoic and Mesozoic successions of India and detailed study of the following – Paleozoic and Triassic successions of Spiti, Jurassic of Spiti and Kutch. Cretaceous of Trichinopoly and Narmada valley, Gondwana Supergroup – Distribution, lithology, classification, age, structural features, fossils and coal resources. **(10 Hours)**

Module V: Deccan Traps and associated sedimentaries, their distribution, lithology, classification, fossils and age. A brief study of the distribution of Cenozoic of Assam, Cuddalore Sandstone formations, Siwalik Supergroup.

Stratigraphy of Kerala, Precambrian terrain of Kerala, Tertiaries of Kerala, Karewas of Kashmir, Indo-Gangetic Alluvium. **(14 Hours)**

REFERENCES

1. Krishnan, M.S. (1982) Geology of India and Burma, 6th Edition, CBS.
2. Wadia, D.N. (1944) Geology of India, Tata McGraw–Hill.
3. Ravindra Kumar (2020) Fundamentals of Historical Geology and Stratigraphy of India. 2nd edition, New Age International Private Limited.
4. Pascoe, E.H. (1954) A Manual of the Geology India and Burma, Govt. of India Publications.
5. Vaidyanathan and Ramakrishnan (2008). Geology of India (Vol. I & II). Geological Society of India, Bangalore.
6. Soman, K. (2013) Geology of Kerala, Geological Society of India, Bangalore.
7. Radhakrishna, B.P and R. Vaidyanadhan (1997) Geology of Karnataka, Geological Society of India, Bangalore.
8. Sanjib Chandra, Sarkar, Anupendra Gupta (2012). Crustal evolution and Metallogeny in India. Cambridge University Press, Delhi, India.
9. Amal Das Gupta (2006). An introduction to Earth Science, World Press Private Limited, Kolkata.

Semester V

OPEN COURSE – I
GLD1551.1: GEOSCIENCES AND ENVIRONMENT

Semester	Hours/Week	Hours /Semester		Exam	Marks			Credits
	T	T	P		Internal	External	Total	
V	3	54	-	3 Hours	20	80	100	2

COURSE OUTCOMES

CO 1: Understand and explain the subject meaning of Geology and its branches; describe the characters of earth; explain hydrologic cycle and role of groundwater.

CO 2: Understand and describe the various exogenic and endogenic processes that form a part of earth system, including earthquakes and volcanoes; and explain the role played by the geological agents in shaping earth.

CO 3: Understand and describe the natural resources and their classification; resources management and associated problems.

CO 4: Understand and describe Global climate change, causes and effects; explain the significance of pollution and waste disposal.

SYLLABUS

Module – I Introduction to Geology – branches of Geology, the earth – size, shape, density, volume and internal structure. Hydrologic cycle, groundwater - Infiltration, zones of groundwater, ground and perched water tables, open wells and bore wells.

(8 Hours)

Module – II Exogenic processes: Weathering – agents, types and products of weathering. Mass wasting – types, Landslides. Brief ideas of role played by streams, oceans, wind and glaciers on earth's surface. **(10 Hours)**

Module – III Endogenic processes: Volcanoes – types and distribution of major volcanoes, products of volcanism – gas, dust, lava and pyroclastics.

Earthquakes – Seismic waves and propagation, epicenter and focus, intensity and magnitude scales, Seismographs and seismogram, Tsunami. **(16 Hours)**

Module – V Natural resources – Renewable and non renewable resources – Natural resources management and associated problems. Soil, Water and Mineral/Rock resources, Fossil fuels – Coal and Petroleum. **(10 Hours)**

Module – VI Global Climate change: Greenhouse effect, Global warming, Ozone depletion – causes and effects. Pollution and waste disposal – air, water and land pollution; brief ideas of causes and effects. **(10 Hours)**

REFERENCES

1. Carlson, D. and Plummer, C. (2010) Physical Geomorphology: Earth Revealed. 9th Edn., Mc-Graw Hill Co.
2. Bloom, A. L. (1992) Geomorphology, Second Edition, Prentice Hall India Pvt. Ltd., New Delhi.
3. Holmes, A. (1981) Principles of Physical Geology, ELBS, Third Edition. Thomas Nelson.
4. Judson, S. and Kauffman, M. E. (1990) Physical Geology. Eighth Edition, Prentice Hall, New Jersey.
5. Parbin Singh (2012) General and Engineering Geology. S. K. Kataria and Sons.
6. Mukherjee, P.K. (1984) A Text Book of Geology, World Press.
7. Valdiya, K.S. (1987) Environmental Geology: Indian Context, Tata Mc-Graw Hills.
8. Strahler, A.N. and Strahler, A.H. (1973) Environmental Geosciences: Interaction between natural systems and man. John Wiley & Sons Inc.
9. Donald R Caotes (1981) Environmental Geology. John Wiley and Sons.
10. Keller, E.A. (1978) Environmental Geology. Bell and Howell, Prentice Hall, USA.
11. Bryant, E. (1985) Natural Hazards. Cambridge University Press.
12. Coates, D.R. (1985) Geology and Society. Chapman and Hall Publishers, New Delhi.

Semester V

OPEN COURSE – II
GLD1551.2: DISASTER MANAGEMENT

Semester	Hours/Week	Hours /Semester		Exam	Marks			Credits
	T	T	P					
V	3	54	-	3 Hours	Internal	External	Total	2
					20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain the basic concepts, terminologies and classification of Hazard and Disaster; Disaster Management and Disaster Management Plan.

CO 2: Understand and describe the various natural disasters with suitable examples; Understand and explain the Environmental disasters by citing suitable examples; Describe facts related to climate change, causes and effects.

CO 3: Understand and describe the Disaster Risk management strategies; the institutional frameworks; explain the application of IT in Disaster Risk management; understand, categorize and describe disaster relief and its components; and explain Disaster Management Act and Policy.

CO 4: Understand and describe Hazard and vulnerability situation in India and Kerala; types

of disasters in Kerala; explain accident related disasters, their prevention and mitigation; the application of GIS in Disaster management; and describe the significance of Emergency procedures and warning systems.

SYLLABUS

Module – I Introduction – Hazard and Disaster: Definition and Terminologies – Classification. Concept of Disaster management – Comprehensive Disaster Management Plan. Elements of Disaster Management Plan. **(8 Hours)**

Module – II Natural Disasters - Earthquake, Landslide, Avalanches, Volcanic eruptions – Their case studies. Heat and Cold Waves, Coastal disasters, Coastal regulation Zone, Cyclone, Flood, Drought, Tsunami. **(12 Hours)**

Module – III Environmental Disasters – Dam collapse and Mitigation measures. Nuclear disasters, Chemical Disasters, Biological Disasters, Forest fire and Oil fire.

Climate change: global warming, sea level rise, ozone depletion, carbon sink and sources – causes and effects. **(14 Hours)**

Module – IV Disaster Risk Management; Institutional arrangement: Prevention, Preparedness, and Mitigation; Disaster Preparedness Plan. Application of Information Technology in Disaster Preparedness. Hazards and Vulnerablity scenario in India; Disaster relief and its components – water, food, sanitation, shelter, health and waste management; Disaster Management Act and Policy. **(10 Hours)**

Module – V Kerala and disasters: types – Flood, Drought, Coastal erosion, Landslides, Pesticide contaminations. Accident related disasters, their prevention and mitigation. Application of GIS in Disaster Management. Emergency procedures and warning systems. **(10 Hours)**

REFERENCES

1. David Alexander (1993) Natural Disasters, UCL Press, London.
2. Edward Bryant (2005) Natural Hazards, Cambridge University Press.
3. Patrick L. Abbott (2008) Natural Disasters, McGraw Hill International edition.
4. Rajib Shaw and Krishnamurthy R.R. (2008) Disaster management: Global Challenges and Local Solutions, Universities Press, Hyderabad, India.
5. Govt. of India (2005) Disaster Management Act, New Delhi.
6. Govt. of India (2009) National Disaster Management Policy.
7. Gupta, A.K. and Nair, S.S. (2011) Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi.
8. Murthy, R.K. (2012) Disaster management, Wisdom Press, New Delhi.
9. Vasudevan, V., Krishnan, K.R.S., Baba, M. and Kumar, P. (Eds.) (2006) Natural Hazards and Management Strategies, XVIII Kerala Science Congress – 2006, KSCSTE.

Semester V

OPEN COURSE – III
GLD1551.3: GEMMOLOGY

Semester	Hours/Week	Hours /Semester		Exam	Marks			Credits
	T	T	P					
V	3	54	-	3 Hours	Internal	External	Total	2
					20	80	100	

COURSE OUTCOMES

CO 1: Understand the basic ideas of Gemmology; describe the characteristics of gemstones; explain Navaratnas and their significance; understand and describe valuing and grading of gemstones and explain techniques of cutting and polishing of gemstones.

CO 2: Understand and describe the various techniques of gemstone treatments; explain the differences of natural, artificial and synthetic gemstones; describe the physical properties and classification of gemstones.

CO 3: Understand and describe the properties of important gemstones like Diamond, ruby, sapphire, emerald, jade, garnet, amethyst, topaz, quartz, tourmaline etc.

CO 4: Understand and describe the industrial application of gemstones; understand and categorize the Indian and World industrial gemstone centres; explain the distribution of gemstones in India and in Kerala.

SYLLABUS

Module – I Gemmology – Definition and scope, Characteristics of gemstones – color – cut – carat, chatoyancy. Navaratnas and their significance.
Value and grading of gemstones, Cutting and polishing of gemstones. **(14 Hours)**

Module – II Treatments Applied to gemstones – Heating, radiation. waxing, oiling. Fracture filling. Natural, Synthetic and Artificial gemstones. **(12 Hours)**

Module – III Physical properties of gemstones, Classification of gemstones – Precious and semiprecious. **(10 Hours)**

Module – IV Diamond – ruby – sapphire – emerald – jade – garnet – amethyst – topaz – quartz – tourmaline – their properties as gemstones. **(10 Hours)**

Module – V Industrial applications of gemstones. Gem industrial centres in India and world. Gemstone distribution in India. Gemstones of Kerala. **(8 Hours)**

REFERENCES

1. Read, Peter G. (2005) Gemmology. 3rd ed. Elsevier, Amsterdam; New York.
2. Liddicoat, R.T. (1969) Handbook of gem identification, Gemological Institute of America.
3. Read, P.G. (1982) Dictionary of Gemology, Butterworths Scientific, London.

4. Arthur Thomas (2008) Gemstones: Properties, Identification and Use, New Holland Publishers.
5. Michael O'Donoghue and Butterworth-Heinemann (2006) Gems: Their Sources, Descriptions and Identification, 6th Edn. NAG Press.
6. Karanth, R. V. (2000) Gems and Gem Industry in India. Geological Society of India, Bangalore, India.
7. Karanth, R. V. (2008) Gemstones: Enchanting Gifts of Nature. Geological Society of India, Bangalore, India.
8. Kurt Nassau (1994) Gemstone Enhancement - History, Science and State of Art – 2nd Edition. Oxford: Butterworth-Heinemann.

Semester VI

CORE COURSE (Main – 1)
GLD1641: SEDIMENTARY AND METAMORPHIC PETROLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
VI	3	2	54	36	3 Hours	Internal	External	Total	5
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain the basic concept of origin of sedimentary rocks, their classification, textures and structures.

CO 2: Understand, classify and explain the categorization of sedimentary rocks, describe the characteristics and classification of important sedimentary rocks like sandstone, limestone and acquire ideas of chemical and biochemical sedimentary rocks.

CO 3: Understand the concept of metamorphism and metamorphic rocks; explain the origin of metamorphic rocks, the factors, limits and types of metamorphism; and categorize and describe the metamorphic grade concept, metamorphic mineral zone concept and metamorphic facies concept.

CO 4: Understand and explain metamorphic textures and structures; describe the metamorphism of pelitic, carbonate and mafic rocks; illustrate and describe the petrography of some important metamorphic rocks.

SYLLABUS

Module – I Origin of sediments. Diagenesis – Compaction, cementation, authigenesis, recrystallization and replacement. Classification of sedimentary rocks – Clastic and non-clastic rocks. Clastic texture - concept of size, Udden-Wentworth and Phi

scale scheme. Grain shape, morphology and fabric. Non- clastic texture – different types of crystalline texture. Brief study of the following: Primary, secondary and organic structures. **(14 Hours)**

Module – II Categorization of mechanical rocks: Argillaceous, arenaceous and rudaceous rocks. Introduction to the following: sandstone, shale, conglomerate and breccias. Introduction to limestone, Classification of limestone – Folk and Dunham scheme. Brief study of the following chemical and biochemical sedimentary rocks: Calcareous, ferruginous, siliceous, phosphatic and evaporates. **(16 Hours)**

Module – III Definition of metamorphism. Factors of metamorphism – pressure, temperature, chemically active fluids, time and parent rock chemistry, Limits of metamorphism. Anatexis, palingenesis and migmatites. Metasomatism. Types of metamorphism – Contact metamorphism, Regional metamorphism – orogenic and ocean floor, Burial metamorphism, Cataclastic metamorphism, hydrothermal metamorphism Impact/shock metamorphism and plutonic metamorphism**.** **(14 Hours)**

Module – IV Metamorphic grade concept. Progressive and retrogressive metamorphism. Stability of minerals in P-T field. Metamorphic mineral zone concept – index minerals and Isograd, Metamorphic facies concept. **(14 Hours)**

Module – V Metamorphic textures – Crystalloblastic and Relict textures. Metamorphic structures – foliations, lineations, cataclastic and miscellaneous. Metamorphism of pelitic, carbonate and mafic rocks. Petrography of the following metamorphic rocks: Slate, Phyllite, Quartzite, Marble, Schists, Amphibolite, Gneisses, Eclogite, Blueschist, mylonite, Hornfels and Granulites – Charnockite (massive, incipient), Khondalite and Leptynite. **(14 Hours)**

REFERENCES

1. Tyrrell, G.W. (1978) Principles of Petrology. Chapman and Hall Ltd., London.
2. Pettijohn, F.J. (1983) Sedimentary Rocks. Harper & Bros.
3. Harker, A. (1964) Petrology for Students. Cambridge.
4. Folk, R.L. (1981) Petrology of Sedimentary Rocks. Hemphils Pub. Co.
5. Greensmith, J. (1989) Petrology of the Sedimentary Rocks. 7th Edn., CBS Publishers, Delhi.
6. Winter, J.D. (2001) An introduction to Igneous and Metamorphic Petrology. Prentice Hall, New Jersey.
7. Winkler, H.G.F. (1974) Petrogenesis of Metamorphic Rocks, 5th, 6th and 7th eds. Springer Verlag.
8. Yardley, B.W.D. (1989) Textbook of Metamorphic Petrology. Longman.
9. Turner, F.J. and Verhoogen, J. (1960) Igneous and Metamorphic Petrology. McGraw Hill.
10. Williams, H., Turner, F.J. and Gilbert, C.M. (1982) – Petrography. W. H. Freeman and Company, San Francisco, CA.

PRACTICAL
IGNEOUS PETROLOGY &
SEDIMENTARY AND METAMORPHIC PETROLOGY (72 Hours)

Megascopic identification of the following rocks:

Granite (Different Types), Graphic granite, Granite Porphyry, Pegmatite, Aplite, Syenite, Syenite-porphyry, Diorite, Gabbro, Anorthosite, Dunite, Dolerite, Basalt, Rhyolite, Nepheline Syenite, Pyroxenite, Peridotite.

Slate, Phyllite, Schist (different types), Gneiss (different types), Quartzite, Marble, Amphibolite, Ecologite, Leptynite, Charnockite, Khondalite, Mafic Granulite, Schorl rock, Banded Magnetite Quartzite.

Conglomerate, breccia, sandstone (coarse, medium, fine), limestone (micritic, dolomitic, marl, oolitic, fossiliferous), Shale, Laterite.

Microscopic identification and description of the following rocks:

Mica Granite, Hornblende Granite, Graphic Granite, Granite–porphyry, Syenite, Nepheline Syenite, Diorite, Gabbro, Dunite, Pyroxenite, Dolerite, Anorthosite, Basalt, Peridotite.

Schist, Gneiss, Quartzites, Charnockite, Amphibolite and Marble.

Sandstone (different types), Limestone (different types), Shale, Conglomerate, Breccia.

Semester VI

CORE COURSE (Main – 1)
GLD1642: ECONOMIC GEOLOGY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
VI	3	2	54	36	3 Hours	Internal	External	Total	5
						20	80	100	

COURSE OUTCOMES

CO 1: Understand history of development of Economic Geology, the terminologies associated with the subject and the classification schemes of economic mineral deposits.

CO 2: Understand and explain the various processes of formation of ore mineral deposits, both internal processes and external processes.

CO 3: Understand and describe metallogenic epochs and provinces with reference to India and mode of occurrence, distribution in India and important economic uses of important ore minerals; understand and describe materials for Abrasives, Refractories, Ceramics and Cement; Gemstones; Strategic and Critical minerals.

CO 4: Understand and describe the Mineral Policy of India; the detailed account of the fuel minerals coal and petroleum, with reference to their origin, mode of occurrence and distribution in India.

SYLLABUS

Module – I Definition – scope and historical development of Economic Geology, ore minerals and gangue minerals, tenor and grade of ores. Primary and secondary classification of mineral deposits – Bateman's classification. **(10 Hours)**

Module – II Processes of formation of mineral deposits: Origin due to internal processes – Magmatic deposits, Hydrothermal deposits, Contact metasomatic deposits, Metamorphic deposits.

Processes of formation of mineral deposits: Origin due to External / Surface processes – Evaporite deposits, Sedimentary deposits - mechanical concentration, residual concentration, Oxidation and Supergene enrichment, Volcanic exhalative deposits. **(24 Hours)**

Module – III Metallogenic Epochs and Provinces with particular reference to India. A brief study on mode of occurrence, distribution in India and important economic uses of ore minerals of the following - Aluminium, Chromium, Gold, Iron, Copper, Lead, Manganese, Silver, Thorium, Titanium, Uranium and Zinc. Mineral resources of Kerala. **(15 Hours)**

Module – IV Materials for Abrasives, Refractories, Ceramics and Cement. Gemstones. Strategic and Critical minerals. Mineral Policy of India. **(11 Hours)**

Module – V Fuel minerals: Coal – origin, theories of origin; coal resources in India – classification and distribution. Petroleum – origin and brief study on the petroliferous basins of India**;** theories of origin – Source rocks – Cap rocks – Traps – Structural – Stratigraphic - Distribution. **(12 Hours)**

REFERENCES

1. Anthony M. Evans (1980). An introduction to Ore Geology, second edition, ELBS.
2. Gokhale, K. V. G. K. and Rao, T.C. (1978) Ore Deposits of India. Thomson Press (India).
3. Krishnaswamy, S. (1988) Indian Mineral Resources. South Asia Books.
4. Mead L. Jensen and Alan M. Bateman (1981). Economic Mineral Deposits, John Wiley & Sons Third edition, revised printing.
5. Park and Macdiarmid (1964). Ore Deposits, Freeman.
6. Roy Chacko (ed.) (2005) Mineral Resources of Kerala. Dept of Mining and Geology.
7. Soman, K. (2002) Geology of Kerala, Geological Society of India, Second revised edition.
8. Umeshwer Prasad (1996). Economic Mineral Deposits, CBS Publishers.
9. Wadia, D.N. (1994) Minerals of India, National Book Trust, India, 5th edition.
10. Leverson (1967). Geology of Petroleum, McGraw Hill.

PRACTICAL
ECONOMIC GEOLOGY (36 Hours)

Megascopic identification and description, Indian occurrence and uses of the following ore and industrial minerals:-

1. Sulphides: Realgar, Orpiment, Stibnite, Galena, Sphalerite, Chalcopyrite, Pyrite.
2. Sulphates: Barite, Celestite, Gypsum.
3. Oxides: Corundum, Hematite, Ilmenite, Magnetite, Chromite, Pyrolusite, Psilomelane, Bauxite.
4. Carbonates: Calcite, dolomite, Magnesite, Argonite, Azurite, Malachite.
5. Industrial minerals: Halite, Fluorite, Monazite, Graphite, Asbestos.

Semester VI

CORE COURSE (Main – 1)
GLD1643: PRACTICAL – III
(Practicals of GLD1541, GLD1641, GLD1642)

Semester	Hours /Semester	Exam	Marks			Credits
VI	36	3 Hours	Internal	External	Total	2
			20	80	100	

COURSE OUTCOMES

CO 1: Acquire skill in megascopic and microscopic identification of Igneous, Sedimentary and Igneous rocks.

CO 2: Acquire knowledge and skill in megascopic identification and description, Indian occurrence and uses of the important ore and industrial minerals.

SYLLABUS

IGNEOUS, SEDIMENTARY & METAMORPHIC PETROLOGY (72 Hours)

Megascopic identification of the following rocks:

Granite (Different Types), Graphic granite, Granite Porphyry, Pegmatite, Aplite, Syenite, Syenite-porphyry, Diorite, Gabbro, Anorthosite, Dunite, Dolerite, Basalt, Rhyolite, Nepheline Syenite, Pyroxenite, Peridotite.

Slate, Phyllite, Schist (different types), Gneiss (different types), Quartzite, Marble, Amphibolite, Ecologite, Leptynite, Charnockite, Khondalite, Mafic Granulite, Schorl rock, Banded Magnetite Quartzite.

Conglomerate, breccia, sandstone (coarse, medium, fine), limestone (micritic, dolomitic, marl, oolitic, fossiliferous), Shale, Laterite.

Microscopic identification and description of the following rocks:

Mica Granite, Hornblende Granite, Graphic Granite, Granite–porphyry, Syenite, Nepheline Syenite, Diorite, Gabbro, Dunite, Pyroxenite, Dolerite, Anorthosite, Basalt, Peridotite.

Schist, Gneiss, Quartzites, Charnockite, Amphibolite and Marble.

Sandstone (different types), Limestone (different types), Shale, Conglomerate, Breccia.

ECONOMIC GEOLOGY (36 Hours)

Megascopic identification and description, Indian occurrence and uses of the following ore and industrial minerals:-

1. Sulphides: Realgar, Orpiment, Stibnite, Galena, Sphalerite, Chalcopyrite, Pyrite.
2. Sulphates: Barite, Celestite, Gypsum.
3. Oxides: Corundum, Hematite, Ilmenite, Magnetite, Chromite, Pyrolusite, Psilomelane, Bauxite.
4. Carbonates: Calcite, dolomite, Magnesite, Argonite, Azurite, Malachite.
5. Industrial minerals: Halite, Fluorite, Monazite, Graphite, Asbestos.

Semester V & Semester VI

CORE COURSE (Main – 1)
GLD1661.1: PROJECT OR DISSERTATION / STUDY TOUR / FIELDWORK
(2 Credits)

Study Tour / Fieldwork: It is compulsory that every student has to undertake a field study tour of not less than one week for observing geological features under the guidance of teachers of the Department during V or VI semester. Moreover, they have to submit a tour report countersigned by the Head of the department during the practical examination of GLD1643. If a student fails to undergo the study tour he/she may not be permitted to attend the examination.

Project / Dissertation Work: The Project work will be carried out by the student as an individual Geology Project. The student has to commence the project work in the Fifth Semester and continue in the Sixth Semester. The Project Report has to be submitted during the Sixth semester examinations which will form a component for the 2 Credits of the Course GLD1661.1. The Project / Dissertation work with credit of 2 in the VI semester examinations will have both internal and external assessment components of 20 marks and 80 marks respectively.

Main – 2: DIGITAL SURVEYING

Semester I

CORE COURSE
GLD1171: INTRODUCTION TO GENERAL GEOGRAPHY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
I	T	P	T	P	3 Hours	Internal	External	Total	3
	4		72			20	80	100	

COURSE OUTCOMES

CO 1: Understand the basic concept of Geography, relation of the subject with other subjects, facts and figures related to earth, its structure and composition and various morphological features.

CO 2: Acquire knowledge and understand the process of gradation, the agents and the various types of landforms created by these agents.

CO 3: Understand and describe the various aspects of Climatology and Oceanography related to our world.

SYLLABUS

Module – I Meaning and concept of Geography – Relationship of Geography with other subjects – Origin of earth – Gaseous hypothesis, Nebular hypothesis – Planetesimal hypothesis – Tidal hypothesis – Binary star theory – Interstellar hypothesis – Size and shape of earth – Structure and composition of earth.

(12 Hours)

Module – II Major relief features of the earth:- Mountains – Plains – Plateaus – Endogenic and exogenic forces – Types of folds – Faults – Volcanoes – Earthquakes – Continental drift theory and Plate tectonics. **(14 Hours)**

Module – III Gradation – Agents of gradation – Erosional and depositional landforms due to the work of running water, glaciers, wind, and underground water and sea waves.

(14 Hours)

Module – IV Climatology – Atmosphere – Insolation – Temperature – Pressure – Wind – Humidity – Forms of condensation and precipitation – Types and distribution of rainfall – Cyclones. **(18 Hours)**

Module – V Oceanography – Land and sea distribution – Bottom topography of oceans – Temperature – Salinity, Currents – Tides – Coral reefs.

(14 Hours)

REFERENCES

1. Bloom A. L., 2003: Geomorphology: A Systematic Analysis of Late Cenozoic Landforms, Prentice-Hall of India, New Delhi.
2. Christopherson, Robert W., (2011), Geosystems: An Introduction to Physical Geography, 8 Ed., Macmillan Publishing Company
3. Thornbury W. D., 1968: Principles of Geomorphology, Wiley.
4. Lal, D. S. (2006): Jalvayu Vigyan, Prayag Pustak Bhavan, Allahabad.
5. A. N. Strahler and A. N. Strahler – Modern Physical Geography, John Wiley and Sons Publishers.
6. Pickard, G. L. 1963. Description Physical Oceanography. Pergamon Press, London.
7. Yasso, W. E. 1965. Oceanography. Holt, Rinehert and Winston, Inc., New York.

Semester II

FOUNDATION COURSE (Main – 2)
GLD1221: ENVIRONMENTAL MANAGEMENT AND IMPACT ASSESSMENT

Semester	Hours/Week		Hours /Semester	Exam	Marks			Credits
II	T	P	36 Hours	3 Hours	Internal	External	Total	2
	2	-			20	80	100	

COURSE OUTCOMES

CO 1: Understand various aspects of Environmental Studies, Components and relations of environment and ecosystem, man in relation to environment; acquire knowledge and describe different aspects and regimes of environmental quality.

CO 2: Understand the ideas of environmental monitoring and management and significance of National Environment Policy.

CO 3: Acquire knowledge and understand the significance of EIA, the methodologies, analysis and models; understand the framing and reviewing of EIA reports; impact studies on various strata of human society and relevance of EMP.

SYLLABUS

Module – I Nature and Scope of Environmental Studies – Components of Physical Environment: Interdependence and Inter-relations – Concept of Ecosystems: Components and Structure of Ecosystem – Man and Environment Relationship – Environmental Ethics. **(5 Hours)**

Module – II Environmental Quality – Environmental Degradation and Manifestations: Land, Water (Surface & Ground) and Air-Pollution control vs Pollution Prevention – Stages and approaches of Pollution Prevention – Source reduction, Raw material substitution, Toxic use reduction and elimination, Process modification.

(6 Hours)

Module – III Environment – Development Debate – Environmental Monitoring – Concept of Management of the Environment: Role of Public and Private Sectors – National Environment Policy. **(6 Hours)**

Module – IV Environmental Impact Assessment: The Need for EIA – The EIA Cycle and Procedures – Components of EIA-EIA Methodologies: Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods – Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment. **(10 Hours)**

Module – V Reviewing the EIA Report – Construction Stage Impacts – Project Resource Requirements and Related Impacts – Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment – Integrated Impact Assessment – Review of EMP and Monitoring – Environmental Management Plan – Mitigation Plans and Relief and Rehabilitation. **(9 Hours)**

REFERENCES

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., 1997.
2. David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003.
3. Hosetti B. B. & Kumar Eds A., Environmental Impact Assessment and Management, Daya Publishing House, 1998.
4. Anjaneyulu Y. and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.

Semester II

CORE COURSE (Main – 2)
GLD1271: BASIC GEODESY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
II	T	P	T	P	3 Hours	Internal	External	Total	3
	4		72	36		20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain geodesy, its history, facts regarding shape of earth, geoid and ideas related to geographic coordinates.

CO 2: Understand and describe the different reference systems related to geodesy, maps and map projections and to develop a clear idea of World Geodetic System; explain the techniques of measurement techniques directions, angles, slopes and areas; understand

the earth's gravity field, its measurement and instrumentation; explain mean sea level.

CO 3: Understand the various aspects of Land surveying, the organizations; to acquire knowledge of modern techniques in geodesy like satellite geodesy, Doppler positioning, Laser ranging, GPS/GNSS, Laser and Radar altimetry, InSAR; and their applications.

SYLLABUS

Module – I Introduction to Geodesy – Definitions – History of Geodesy – Shape and dimension of the Earth – Reference Surfaces and their relationship – Spherical Earth – Ellipsoidal Earth – Geoid – Geographical Coordinates – Directions and Azimuth – Influence of the Earth curvature to surveying. **(10 Hours)**

Module – II Datum and Coordinate Reference Systems – Vertical and Horizontal Datum – Cartesian vs. Geographic Coordinates – Maps and Map Projections – Scales – Geographic and Projected CRS – World Geodetic System – Grids and Graticule. **(12 Hours)**

Module – III Horizontal and vertical measuring of directions, Angles and Slopes – Earth's Gravity field – Linear measurement – Direct – Optical and Electronic measurement – Methods – accuracy – Horizontal and vertical control points – Measurement of Area – Orthometric Elevations vs. Ellipsoid Heights – Mean Sea Level. **(16 Hours)**

Module – IV Land Surveying – Classification – Topographic Surveying and Mapping – Triangulation – Traversing – Benchmarks – Contouring – Differential Survey – Great Trigonometrical Survey of India – Cadastral Surveying – Surveying organizations. **(18 Hours)**

Module – V Modern Techniques in Geodesy – Satellite geodesy – Measurement Techniques – Earth to space methods – Doppler Positioning – Passive optical tracking – Laser ranging – GPS/GNSS – Space to Earth methods – Laser altimetry – Radar altimetry – InSAR – Space-to-space methods – Applications. **(16 Hours)**

REFERENCES

1. PetrVanicek and Edward J., Geodesy: The concepts, North-Holland Publns. Co., 1991.
2. Tom Herring, "Geodesy, Elsevier, 2009.
3. Schwarze, V. S. Geodesy: The challenge of the 3rd millennium, Springer Verlag, 2002.
4. James R. Smith, "Introduction to Geodesy", John Wiley & Sons Inc. 1997.
5. Robinson A H et al, (1995) Elements of Cartography, Wiley.
6. http://www.fao.org/tempref/FI/CDrom/FAO_Training/General/x6707e/x6707e07.htm
7. Bomford, G., 2010. Geodesy, Oxford University Press.
8. Vanícek, P., Krakiwsky, E. J., 1987. Geodesy: The concept, 2nd Edition, Elsevier Science.
9. Torge, W., 2001. Geodesy, 3rd Edition, deGruyter, Berlin.

Semester II

CORE COURSE (Main – 2)
GLD1272: PRACTICAL – I : GEODETIC TECHNIQUES

Semester	Hours /Semester	Exam	Marks			Credits
			Internal	External	Total	
II	90 Hours	3 Hours	20	80	100	1

COURSE OUTCOMES

CO 1: Understand and acquire practical knowledge of factors related to shape of earth, scale and time.

CO 2: Understand and development of skills in map projections, datum and coordinate reference systems; and to know the details of World Geodetic System 84.

CO 3: Understand and develop basic skills of topographic surveying and mapping and calculation of distance and area from Topographic maps, and understand the concept of slope and gradient.

SYLLABUS

Module – I Shape and dimension of the Earth – Spheroid – Ellipsoid – Geoid – Latitude and Longitude – Local and Standard Time – Scales: Plain Scale – Comparative Scale – Diagonal Scale. **(20 Hours)**

Module – II Maps and Map Projections – Introduction to Map Projections – Principles – Classification – Graphical Construction, properties, uses and limitations of the following projections: Conical – Simple Conical Projection with one standard parallel – Conical Projection with two standard parallels, Bonne's Projection – Polyconic Projection – Sinusoidal Projection. **(35 Hours)**

Datum and Coordinate Reference Systems – Geographic and Projected CRS – Coordinate Conversion – Projection Transformation – World Geodetic System 84.

Module – III Topographic Surveying and Mapping: Calculation of Distance, Area from Topographical Maps – Representation of major relief features by Contour – Concept of Slope and Gradient. **(35 Hours)**

REFERENCES

1. Monkhouse and Wilkinson: Maps and Diagrams, Methuen and Company.
2. Kellaway George P: Map Projections, Bibliobazar, 2011.
3. Singh R L: Elements of Practical Geography, Kalyani Publishers.
4. Gopal Singh: Map work and Practical Geography, Vikas Publishing House Pvt. Ltd.
5. M.Z.A. Khan: Text Book of Practical Geography, Concept Publishing House.
6. Lev M. Bugayevskiy and Snyder J: Map Projections - A Reference Manual, Taylor and Francis.
7. Eric W. Garfarend and Friedrich W. Krumm: Map Projections - Cartographic Information.

Semester III

CORE COURSE (Main – 2)
GLD1371: FUNDAMENTALS OF SURVEYING AND LEVELLING

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
III	3		54		3 Hours	Internal	External	Total	2
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and apply the principles, objectives, uses, measurements, errors and stages of surveying, measurement of directions and angles, meridians and bearings; traverse survey, types and procedures.

CO 2: Understand and describe levelling and its applications, types of instruments; understand various aspects of table surveying, its principles and methods; computation of volumes.

CO 3: Understand the various aspects of theodolite surveying and methods of running a theodolite survey.

SYLLABUS

Module I Surveying: Introduction – principles – objectives – Uses. Units of measurement – surveying measurement and errors – Types of errors and their corrections – accuracy and precision, Stages of survey operations – Linear Measurement – Distance measurement devices: Chain, tape – Merits and demerits. **(10 Hours)**

Module II Measurement of Directions and Angles – Meridians – Bearings – Magnetic and True bearings – Compasses: Prismatic and Surveyor's. Types of traverse – procedures – Control establishments – Traverse Survey and Computations of interior angles of a closed Traverse – Adjustment of closing error. **(10 Hours)**

Module III Levelling and its application: Introduction to Levelling – Types of instruments – Use of Dumpy level, Auto level, Digital level and Laser level – Principle axes of Dumpy level: Temporary and Permanent adjustments. **(10 Hours)**

Module IV Table Surveying: Definition, Principles – accessories – Temporary adjustments – Methods of Plane table surveying – Area: Trapezoidal rule, average ordinate rule, Simpson's 1/3 rule – Coordinate methods. Planimeter: Types Area of zero circle – uses of Planimeter. Volume: Computation of volume by trapezoidal and prismoidal formula – Volume from spot levels, Volume from contour plans. **(12 Hours)**

Module V Theodolite Traversing: Various parts and axis of transit – Temporary and Permanent adjustments of a transit – Horizontal and Vertical angles – Methods of repetition and reiteration. Methods of running a theodolite traverse – Latitudes and departures – Rectangular Coordinates – Traverse adjustments by Bowditch's

– Transit and modified transit rules – Gales Traverse Table – Numerical Problems. **(12 Hours)**

REFERENCES

1. Prof. T. P. Kenetkar & Prof. S. V. Kulkarni - Surveying and Levelling, PVG Prakashan, 2004.
2. N. N. Basak, Surveying and Levelling, McGrawHill Education.
3. R. Agor - A Text book of Surveying and Levelling, Khanna Publishers, 2005.
4. Venkatramaiah, Textbook of Surveying, Universities Press (India) Private Limited 2011.
5. James M Andersen, Edward M Mikhail, Surveying Theory and Practice, McGraw Hill Education.
6. Dr. B. C. Punmia, Ashok Kumar Jain & Arun Kumar Jain - Surveying, Laxmi Publications.
7. S. K. Duggal – Surveying, Vol. I, Tata McGraw Hill Ltd, Reprint 2015.

Semester III

CORE COURSE (Main – 2)
GLD1372: ELEMENTS OF CARTOGRAPHY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
III	3		54		3 Hours	Internal	External	Total	2
						20	80	100	

COURSE OUTCOMES

CO 1: Understand the nature and scope of cartography, its history, branches and its significance to human communication. .

CO 2: Understand and describe process of map making, compilation, generalization, types of mapping and problems; understand and explain map design and layout, symbolization, the constraints, etc.

CO 3: Understand and explain aspects of lettering and toponomy, mechanics of map construction, the drawing materials and equipments; understand the process of map reproduction, automated and computer cartography and acquire knowledge about Planning and Designing Maps for various levels of consumers.

SYLLABUS

Module I Nature and Scope of Cartography – History of Cartography: Ancient Period, Late Medieval Period, Early Modern Period, Recent Period – Meaning of Maps –

Classification of – Artistic learning and scientific bases of Cartography – Cartography as a Science of Human Communication – Branches of Cartography.

(8 Hours)

Module II Process of Map Making: Map Compilation – Enlargement and Reduction of Maps – Generalization – Procedure for Compilation – Thematic and Complex Mapping – Types and problems. **(10 Hours)**

Module III Map Design and Layout: Principles of Map Design – Constraints in Map Design – Symbolization – Format of a Map. **(12 Hours)**

Module IV Lettering and Toponomy: Lettering: Style, Form, Size – Mechanics of Lettering – Mechanics of map construction: Drawing materials, Drawing equipments.

(12 Hours)

Module V Map Reproduction: Automated and Computer Cartography – Special Purpose Maps: Planning and Designing Maps for a) Blind b) Children c) Neo-literates d) Business and Commercial Organizations. **(12 Hours)**

REFERENCES

1. Misra R. P. and Ramesh A., (1989) Fundamentals of Cartography. Concept Publishing Company, ND.
2. Robinson A. H. et al, (1995) Elements of Cartography, Wiley.
3. Jan Kraak, Menno and Ormeling, F. (2003) Cartography: Visualization of Geospatial Data, Prentice Hall.
4. Deetz, Charles Henry (2005) Cartography, University Press of Pacific.

Semester III

CORE COURSE (Main – 2)
GLD1373: PRACTICAL – II : BASIC SURVEYING

Semester	Hours /Semester	Exam	Marks			Credits
			Internal	External	Total	
III	72 Hours	3 Hours	20	80	100	2

COURSE OUTCOMES

CO 1: Understand and acquire practical knowledge in Chain Surveying and Plane Table Surveying, the instruments used and plotting, measurement of area of plots. .

CO 2: Understand and development of practical skills in Compass Surveying, methods of plotting and correction of errors.

CO 3: Understand and get trained to use dumpy levels for surveying and drawing of profiles.

SYLLABUS

Module I Chain Surveying: Study of instruments used in Chain Surveying – Plotting of a building using Chain Survey – Measurement of area of a given plot.

Plane Table Surveying: Plotting various objects in a given field using Radiation method – Determination of horizontal distance between two inaccessible points by intersection method – Indian Clinometer – Use of Clinometers with plane table. **(32 Hours)**

Module II Compass Surveying: Plotting of a given Traverse – Radiation method – Intersection method – Closed traverse – Correction of error. **(22 Hours)**

Module III Dumpy Level – Drawing of profiles. **(18 Hours)**

REFERENCES

1. Singh R. L.: Elements of Practical Geography, Kalyani Publishers.
2. Gopal Singh: Map work and Practical Geography, Vikas Publishing House Pvt. Ltd.
3. www.levelling.uhi.ac.uk.
4. Bhavikatti S. S.: Surveying and Levelling, Vol. I, IK International Publishing House, New Delhi, 2009.
5. Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.
6. Roy S. K., "Fundamentals of Surveying", 2nd Edition, Prentice-Hall of India, 2004.
7. Arora K. R., Surveying Vol. I & II, Standard Book House, 10th Edition 2008.

Semester IV

CORE COURSE (Main – 2)
GLD1471: PRINCIPLES OF REMOTE SENSING

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
IV	5		90		3 Hours	Internal	External	Total	5
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain the basic concepts and principles of Remote Sensing, EMR and its characteristics, advantages and limitations of remote sensing; understand and acquire knowledge of the different Remote sensing platforms, the orbits; sensors and types; types of satellite imageries, explain the remote sensing programmes of India and other developed countries.

CO 2: Understand and explain the various aspects of Microwave, Infra-red, Hyper Spectral, Lidar, Thermal, and Radar based remote sensing and their applications; sources of remote sensing data.

CO 3: Understand and describe the different aspects of Visual and Digital Image processing, Image rectification, restoration, corrections, interpretation and classification.

CO 4: Understand the Application of Remote Sensing in various fields like Geology, Hydrology, Agriculture, Disaster management, etc.

SYLLABUS

Module I Definition and components of remote sensing – Active and Passive Remote sensing; Electromagnetic radiation and its characteristics – energy interaction with atmosphere and earth surface features – Spectral bands – Atmospheric window – Spectral signature – spectral reflectance profile for vegetation, soil and water; Advantages and limitations of remote sensing – Real and Ideal remote sensing system. **(15 Hours)**

Module II Remote sensing platforms – ground based, air borne, space borne – Orbits – geostationary and sun-synchronous – Across track scanning – Along track scanning – Sensors and its types – Resolution of sensors – spatial, spectral, radiometric and temporal, resolutions – Satellite imageries – Digital, analogue – Row/Path – Remote sensing programmes of India, U.S.A and France – SPOT – IKONOS – Digital Globe. **(20 Hours)**

Module III Microwave, Infra-red, Hyper Spectral, Lidar, Thermal, and Radar based remote sensing and their applications – Online sources of remote sensing data – USGS Earth Explorer, GloVis, Bhuvan – Indian Geo-Platform of ISRO, Copernicus Data Hub. **(20 Hours)**

Module IV Visual and Digital image processing: Elements of visual image interpretation; Digital image processing in remote sensing – Image rectification and restoration – Geometric correction, radiometric correction, noise removal; Image enhancement; Image classification – Supervised and unsupervised classification. **(20 Hours)**

Module V Application of Remote Sensing: Applications of remote sensing – Geology – Hydrology – Environmental monitoring – Agriculture – Urban planning – Disaster management. **(15 Hours)**

REFERENCES

1. Lillesand T. M. and Kiefer R. W., Remote sensing and Image Interpretation, John Wiley and Sons.
2. Campbell, James, Introduction to Remote Sensing, Gullifor Press.
3. Jensen J. R. Introductory Digital Image Processing – A Remote Sensing Perspective, Prentice Hall.

4. Dong, Pinliang and Qi Chen, LIDAR (2018) Remote Sensing and Applications, CRC Press, 200 pp. Taylor & Francis Series in Remote Sensing Applications.
5. https://geoawesomeness.com/list-of -top- 10-sources -of-free-remote-sensing-data/

Semester IV

CORE COURSE (Main – 2)
GLD1472: FUNDAMENTALS OF PHOTOGRAMMETRY

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
IV	5		90		3 Hours	Internal	External	Total	5
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain the basic concepts and principles aerial photography, types of aerial photographs and their scale; understand and explain the flight planning and procedures of aerial photography; describe the errors and rectifications in aerial photography.

CO 2: Understand and describe the geometrical characteristics of aerial photographs, their measurements and the instrumentations.

CO 3: Understand and explain stereophotogrammetry, the basics of Analytical Photogrammetry and the concept of Rotation Matrix.

CO 4: Understand and describe the different aspects of Digital Photogrammetry; the concepts and procedures and the instrumentations; get knowledge of the various outputs.

SYLLABUS

Module I Basics of aerial Photography – Basic Geometry of Aerial Photograph, Central and orthographic projection, Difference between map and aerial photograph, Types of Aerial photographs – wide angle, narrow angle, Horizontal, Vertical, Oblique – Scale and Ground coverage of aerial photographs. **(12 Hours)**

Module II Flight Planning – Crab & Drift – Computation of flight plan – Specification for Aerial photography – Basic horizontal and vertical control – Pre pointing and Post pointing – Planning for Ground Control survey. **(13 Hours)**

Module III Relief Displacement in aerial photographs and its characteristics – Geometry of vertical photographs – scale of vertical photograph over flat and variable terrain – Isocentre – Nadir point– Principal point – Tilt Displacement – Parallax and Height Measurement – Stereo Model – Photomosaic – Base-height ratio – Stereoscopes, Stereoscopic parallax, Parallax bar, Floating mark. **(20 Hours)**

Module IV Stereophotogrammetry – Orientation of aerial photographs – Inner, Relative and Absolute orientation – Basics of Analytical Photogrammetry – Collinearity and Coplanarity conditions – Concept of Rotation Matrix. **(20 Hours)**

Module V Digital Photogrammetry – Digital data input – Photogrammetric scanners – Digital Photogrammetric camera, H/W and S/W requirements – Photogrammetric triangulation in Digital Photogrammetric Workstation (DPWS), Stereo view in DPWS, feature extraction on DPWS – Concept of DEM, DSM and DTM, DEM extraction and Orthoimage generation – Concept of Image Matching, Automatic DEM generation, Digital maps and their characteristics. **(25 Hours)**

REFERENCES

1. Paul R. Wolf and Bon A. DeWitt, 2000. "Elements of Photogrammetry with Application in GIS" McGraw Hill International Book Co., 3rd Edition.
2. E. M. Mikhail and J. C. McGlone, 2001. "Introduction to Modern Photogrammetry", Wiley Publisher.
3. Gollfried Konecny, 2002. Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 1st Edition.
4. Sanjib K. Ghosh. 2005. Fundamentals of computation Photogrammetry. Concept Publishing, New Delhi.

Semester V

CORE COURSE (Main – 2)
GLD1571: GEOGRAPHIC INFORMATION SYSTEM

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
V	5		90		3 Hours	Internal	External	Total	5
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and explain the basic concepts Geography and Spatial Sciences with respect to GIS, its definition and components; acquire knowledge about the GIS data types and their characteristics.

CO 2: Understand, classify and explain spatial data sources, attribute data and sources; the data formats and data models; the file formats, etc.

CO 3: Understand and describe the various aspects and procedures of GIS data input methods; types of Spatial and Attribute Data Errors and error rectification methods.

CO 4: Understand and describe the various GIS softwares, basic measurements in GIS, analytical tools in GIS and explain the different recent developments in GIS.

SYLLABUS

Module I Basic Concepts in Geography / Spatial Sciences – Space Place, Location, Time, Scale Distance and Direction – Data, Information and Knowledge: Definition and Relationship – Information System – Definition and Components – GIS – Definition and Components. **(15 Hours)**

Module II Data in GIS – Types – Spatial and Attribute data; Definition and Characteristics of Spatial Data and Attribute data – Spatial Data: Datum, Projection and Co ordinate system – Database, spatial database and Geo database: Definition and characteristics. **(15 Hours)**

Module III Spatial data sources – Field Survey, Aerial Photos, Satellite Imagery, GPS – Attribute Data Sources – Census, Surveys, Aerial Photos, Satellite Imagery; Topographic maps, cloud data sources – Data format – Raster and Vector format – their structure, advantages and disadvantages. Topological and Spaghetti data model for vector data – Raster data encoding – Run length and Cell by cell – File formats for Raster and Vector data: Raster (.jpeg, .bmp, .tiff .rrd), Vector (.dxf, .shp, .xml, .kml) Other file formats (.csv, .xls, .mdb, .gdb). **(25 Hours)**

Module IV Data Input Methods: Key board entry, scanning, digitization (manual and automatic), Raster to Vector Conversion, Electronic Data Transfer – Errors in Data Entry: Types of Spatial and Attribute Data Errors, Error rectification methods for spatial and attribute data errors in raster and Vector Format.

(20 Hours)

Module V Popular GIS Software: Q GIS and Arc GIS – Basic Measurements using GIS – Length, perimeter and area calculation in raster and vector GIS – Analytical Tools in GIS: Query models, Buffer Analysis, Overlay Analysis – Recent Advances in GIS – Web GIS, Mobile GIS, The Concept of Data cube. **(15 Hours)**

REFERENCES

1. Haywood, Ian, Cornelius, Sarah & Carver, Steve (any edition), 'An Introduction to Geographical Information Systems', Prentice Hall, Pearson Education, U.K.
2. http://otec.uoregon.edu/data-wisdom.htm
3. http://catalog.flatworldknowledge.com/bookhub/reader/3798?e=campbell_1.0- ch03_s01
4. Konecny Gottified, 2003. 'Geoinformation: Remote Sensing, Photogrammetry and Geographic Information Systems', Taylor and Francis, London.
5. The GIS Glossary, Environmental System Research Institute, Canada, 1996.
6. Longley, Paul A. et al. 2005. 'Geographic Information Systems and Science, John Wiley, England, 2005.

Semester V

CORE COURSE (Main – 2)
GLD1572: PRACTICAL – III : REMOTE SENSING AND PHOTOGRAMMETRY

Semester	Hours /Semester	Exam	Marks			Credits
			Internal	External	Total	
V	54 Hours	3 Hours	20	80	100	2

COURSE OUTCOMES

CO 1: Understand and acquire skills in identification features in aerial photographs, visual interpretation of different aspects and determination of heights.

CO 2: Understand and develop expertise in interpretation of satellite imageries; the physical and cultural aspects and acquire skills in preparation of land use and land cover maps.

CO 3: Understand and get trained in Digital Image processing.

SYLLABUS

Module I Aerial photographs – Stereo vision – Feature Identification – Determination of Height – Visual interpretation of Physical and Cultural details. **(12 Hours)**

Module II Satellite images – Greyscale Images – False Colour Composites – Interpretation of Physical and Cultural details – Preparation of land use/ land cover maps. **(17 Hours)**

Module III Digital image processing – Image enhancement – image classification techniques – unsupervised and supervised classification. **(25 Hours)**

REFERENCES

1. Richards John A. & Xiuping Xia, 2006. Remote Sensing Digital Image Analysis: An Introduction.
2. Campbell John B. Introduction to Remote Sensing, Taylor & Francis, London.
3. Sabins Floyd F. Remote Sensing and Principles of Image Interpretation, W H Freeman, New York.
4. Kasser Michel and Egles Yves. Digital Photogrammetry. Taylor & Francis. London & New York.
5. Sanjib K. Ghosh, 1979: Analytical Photogrammetry, New York: Pergamon Press.
6. Sanjib K. Ghosh. 2005. Fundamentals of computation Photogrammetry. Concept Publishing, New Delhi.
7. Schmidt, O. and Rayner William Horace. Fundamentals of Surveying. Van Nostrand Reinhold Company.
8. Leick Alfred, 1995: GPS Satellite Surveying, Wiley Interscience.

Semester V

CORE COURSE (Main – 2)
GLD1573: PRACTICAL – IV : TECHNIQUES IN GIS AND SPATIAL ANALYSIS

Semester	Hours /Semester	Exam	Marks			Credits
			Internal	External	Total	
V	72 Hours	4 Hours	20	80	100	3

COURSE OUTCOMES

CO 1: Understand and acquire skills in GIS Spatial Data input; develop expertise in map layer creation, digitization / Vectorization; and develop expertise in GIS data editing and preparation of chloropeth / thematic maps.

CO 2: Understand and familiarize with the basic GIS tools; acquire skills in GIS Querying, Calculations and basic GIS analysis.

SYLLABUS

Module I Spatial Data Input in GIS: Introduction to the QGIS/ ArcGIS GUI – Scanning Maps – Exporting from online data sources – Geo-referencing toposheets and Google earth imagery – Choice of datum, control points and co-ordinates.

(25 Hours)

Module II Map Layer Creation – Digitization / Vectorization – Point, line and polygon features – Data editing – Map Composer – Layout and elements of map – Preparation of Choropleth maps / thematic maps. **(30 Hours)**

Module III Familiarizing with basic GIS tools – Export, Import – Geo processing tools – Clip, Select, Dissolve, Union, Intersect, Merge, Query Builder – Polygon Area Calculation – Length calculation for linear features – Basic GIS Analysis: Buffer Analysis – Terrain Analysis. **(17 Hours)**

REFERENCES

1. https://www.qgistutorials.com/en/docs/learning_resources.html
2. https://docs.qgis.org/testing/en/docs/training_manual/
3. https://desktop.arcgis.com/en/arcmap/latest/get-started/introduction/arcgis-tutorials.htm

Semester VI

CORE COURSE (Main – 2)
GLD1671: GLOBAL POSITIONING SYSTEM

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
VI	3		54		3 Hours	Internal	External	Total	4
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and describe the history and development of GPS – the law and concept governing it, and the various GPS system that are in operation; explain the application of GPS.

CO 2: Understand and explain the GPS design objectives, components of GPS, its errors and accuracy; describe the GPS signal structure and characteristics, types and structures of GPS receivers and explain the principles of GPS position fixing.

CO 3: Understand and describe the different GPS survey methods, the procedures adopted, positioning, accuracy checking and post processing measures; understand and explain the GIS and GPS data integration.

CO 4: Acquire information and explain the various applications of GPS technology in modern world.

SYLLABUS

Module I Introduction to GPS – History and Development – Kepler's Law – Doppler effect – Positioning concept – Transit, Timation – SECOR-NAVSTAR GPS-GNSS-GLONASS system, Galileo System – Advantages and current limitations of GPS – Applications of GPS. **(10 Hours)**

Module II GPS design objectives – Components of GPS – Space Segment – Control Segment – User Segment – satellite configuration – Orbit determination – GPS Error and Accuracy. **(10 Hours)**

Module III GPS Signal Structure and Characteristics – Structure of GPS Signal, Frequency, P Code, C/A code and data format – Generation of C/A code – Navigation data bits – GPS receiver: Types and Structure of receivers, Principles of GPS position fixing – Pseudo ranging. **(12 Hours)**

Module IV GPS Survey Methods – Single Point or Point Vs Relative, Static Vs Kinematic, Real time Vs Post mission. Practical GPS survey field procedures: Code and Carrier-based positioning, Accuracy and recording time GPS Data Processing – Ambiguity resolution – Post processing – real-time processing – Accuracy measures – software modules – GIS and GPS data integration. **(12 Hours)**

Module V Applications of GPS Technology – Navigation vs. Mapping vs. Surveying – Environmental Monitoring – Commercial Applications – Engineering – Agricultural Applications – Precision Navigation – Military Applications.

(10 Hours)

REFERENCES

1. G. S. Rao, 2010. Global Navigation Satellite Systems. Tata McGraw Hill Education Pvt. Ltd.
2. Guocheng Xu, 2003. "GPS Theory, Algorithms and Applications" Springer-Verlag.
3. Gunter Seeber, 1993. Satellite Geodesy, Copy Right 2003 By Walter De Gruyter, ISBN: 3- 11-017549.
4. Hofmann W. B., Lichtenegger. H, Collins J., 2008. Global Positioning System – Theory and Practice – Springer Verlag Wein, New York.
5. Alfred Leick, 2004. GPS Satellite Surveying, 3rd Edition, John Wiley and Sons.

Semester VI

CORE COURSE (Main – 2)
GLD1672: TECHNIQUES AND APPLICATIONS OF DIGITAL SURVERYING

Semester	Hours/Week		Hours /Semester		Exam	Marks			Credits
	T	P	T	P					
VI	3		54		3 Hours	Internal	External	Total	5
						20	80	100	

COURSE OUTCOMES

CO 1: Understand and describe the different aspects of digital surveying, its nature and scope and objectives.

CO 2: Understand and explain the different Digital Survey techniques, principles and measurements; understand and describe the errors and accuracy in digital surveying.

CO 3: Understand and describe the digital mapping techniques; explain digital photogrammetry and methods.

CO 4: Understand and explain the applications of digital surveying in various fields in modern world.

SYLLABUS

Module I Introduction to digital surveying – Definition – Nature and Scope – objectives.

(6 Hours)

Module II Modern Survey equipments – Digital level – EDMI – Electronic Theodolite –

Tellurometer – Total station – GPS/GNSS RTK systems – 3D Laser Scanners – Airborne Lidar – Drone – CAD software/QGIS. **(12 Hours)**

Module III Digital Survey techniques – Principle of EDMI – Angle Measurement – Triangulation – Leveling – Determination of positions – Reference networks – Errors and accuracy. **(12 Hours)**

Module IV Digital mapping – Techniques – Planimetry – DEM – DTM – Baseline Thematic Mapping – Topographic Mapping – EOS – HSRS – SAR – INSAR – GPR – Digital Photogrammetry. **(14 Hours)**

Module V Applications of Digital Surveying – Cadastral – Control Surveying – Construction – Engineering – Hydrography – LOMA – Mining – Topographic Survey – Defence – Forestry – Natural resource management – Land use/land cover – Urban Planning – Transport and communication. **(10 Hours)**

REFERENCES

1. Satheesh Gopi, R. Sathikumar and N. Madu, 2007. Advanced Surveying, Pearson.
2. S. K. Duggal, 2013. Surveying, McGraw Hill Education (India).
3. Ndukwe K. Ndukwe, 2001. Digital Technology in Surveying and Mapping, RhyceKerex Publishers.
4. Wilfried Linder, 2013. Digital Photogrammetry – Theory and Applications, Springer.
5. J. Paul Guyer, 2018. An Introduction to Total Station Topographic Survey Procedures, Independently Published (25 February 2018).

Semester VI

CORE COURSE (Main – 2)
GLD1673: PRACTICAL – V : FIELD TECHNIQUES IN DIGITAL SURVEYING

Semester	Hours /Semester	Exam	Marks			Credits
			Internal	External	Total	
VI	90 Hours	3 Hours	20	80	100	3

COURSE OUTCOMES

CO 1: Understand and acquire skills in the field procedures in digital surveying, the instrument characteristics and measurement techniques, and correction of errors.

CO 2: Understand and familiarize with the field survey techniques using Automated Dumpy level, Digital level, Micrometer Theodolite and making measurements in the field after required corrections; acquire knowledge and expertise in Surveying with GPS, the field procedures, mapping, leveling, error corrections, data transfer and preparation of layouts.

SYLLABUS

Module I EDMI – Instrument characteristics – Field procedures – focusing and sighting – measurement techniques – Error correction. **(20 Hours)**

Module II Field survey techniques using automatic level – Automated Dumpy level – Digital level – Micrometer Theodolite – Field procedures – Measuring single angles, Sets of direction and vertical angles – Horizontal collimation error and its adjustments. **(35 Hours)**

Module III Surveying with GPS – Elements of GPS Survey – Survey design – Field procedure – measuring techniques – RTK systems – Integrating GPS and GIS – Mapping and map layout – Surveying using Total Station – Field Procedure – Measurements – Traversing – Controlling errors – data transfer – Preparation of layout – Trigonometric leveling. **(35 Hours)**

REFERENCES

1. B. C. Punmia: Surveying & leveling Vol. I & II.
2. R. Subramanian: Surveying and Leveling.
3. A. M. Chandra: Advanced Surveying.
4. Barry Kawanagh: Surveying with Construction Applications.
5. S. K. Duggal: Surveying Vol. I & II.

Semester VI

CORE COURSE (Main – 2)

GLD1661.1: PROJECT / STUDY TOUR / FIELDWORK / INSTITUTE VISIT

(2 Credits)

Study Tour / Fieldwork / Institute Visit: It is compulsory that every student has to undertake an institute or field visit study tour of not less than one week for acquiring knowledge of modern trends in Digital Surveying, under the guidance of teachers of the Department during the VI semester. Moreover, they have to submit a report countersigned by the Head of the department during the practical examination of GLD1673. If a student fails to undergo the field / institute visit he/she may not be permitted to attend the examination.

Project / Dissertation Work: The Project work will be carried out by the student either as an individual Project with the Digital Surveying aspect. The student has to commence the project work in the Sixth Semester. The Project Report has to be submitted during the Sixth semester examinations which will form a component for the 2 Credits of the Course GLD1661.2. The Project / Dissertation work with credit of 2 in the VI semester examinations will have both internal and external assessment components of 20 marks and 80 marks respectively.

SOCIAL SERVICE AND EXTENSION ACTIVITIES

(1 Credit)

A minimum credit of 1 is allotted for Social Service / Extension Activities in the Sixth Semester.

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