KANNUR UNIVERSITY

(Abstract)

B.Sc. Geology Programme-Scheme, Syllabus and Pattern of Question Papers of Core, Complementary Elective and Generic Elective Course under Choice Based Credit and Semester System (Outcome Based Education System-OBE) in Affiliated colleges with effect from 2019 Admission-Implemented-Orders issued.

Academic Branch

No.Acad.C/12502/2019 Civil Station P.O, Dated 21/06/2019

Read:- 1. U.O.No.Acad.C2/429/2017 dated 10-10-2017
2. The Minutes of the Meeting of the Curriculum Restructuring Committee held on 28-12-2018.
3. U.O No. Acad.C2/429/2017 Vol.II dated 03-06-2019
4. The Minutes of the Meeting of the Board of Studies in Geology (Cd) held on 11/06/2019
5. Syllabus of Geology Submitted by the Chairperson, Board of Studies in Geology (Cd) dated 14/06/2019

ORDER

1. A Curriculum Restructuring Committee was constituted in the University vide the paper read (1) above to co-ordinate the activities of the Syllabus Revision of UG programmes in Affiliated colleges of the University.

2. The meeting of the Members of the Curriculum Restructuring Committee and the Chairpersons of different Boards of Studies held, vide the paper read (2) above, proposed the different phases of Syllabus Revision processes, such as conducting the meeting of various Boards of Studies, Workshops, discussion etc.

3. The Revised Regulation for UG programmes in Affiliated colleges under Choice Based Credit and Semester System (in OBE-Outcome Based Education System) was implemented with effect from 2019 Admission as per paper read (3) above.

4. Subsequently, as per paper read (4) above, the Board of Studies in Geology (Cd) finalized the Scheme, Syllabus & Pattern of Question Paper for Core, Complementary Elective & Generic Elective Course of Geology Programme to be implemented with effect from 2019 Admission.

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5. As per paper read (5) above, the Chairperson, Board of Studies in Geology (Cd) has submitted the finalized copy of the Scheme, Syllabus & Pattern of Question Papers of Geology Programme for implementation with effect from 2019 Admission.

6. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under Section 11(i) of Kannur University Act 1996 and all other enabling provisions read together with accorded sanction to implement the Scheme, Syllabus & Pattern of Question Paper(Core/Complementary Elective/Generic Elective Course) of the B.Sc.Geology programme under Choice Based Credit and Semester System(in OBE-Outcome Based Education System) in the Affiliated colleges under the University with effect from 2019 Admission, subject to reporting to the Academic Council.

7. The Scheme, Syllabus & Pattern of Question Paper of the B.Sc. Geology Programme are uploaded in the University website (www.kannuruniversity.ac.in)

Orders are issued accordingly.

Sd/-
DEPUTY REGISTRAR (ACADEMIC)
For REGISTRAR

To

The Principals of Colleges offering B.Sc. Geology programme

Copy to:-

1. The Examination Branch (through PA to CE)
2. The Chairperson, Board of Studies in Geology (Cd)
3. PS to VC/PA to PVC/PA to Registrar
4. DR/AR-I, Academic
5. The Computer Programmer(for uploading in the website)
6. SF/DF/FC

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

Forwarded/By Order

SECTION OFFICER

KANNUR UNIVERSITY

BOARD OF STUDIES, GEOLOGY (Cd)

SYLLABUS FOR GEOLOGY CORE,
COMPLEMENTARY ELECTIVE COURSE
FOR B.Sc. PROGRAMME AND GENERIC ELECTIVE COURSES

CHOICE BASED CREDIT SEMESTER SYSTEM

(2019 ADMISSION ONWARDS)

Kannur University

Vision and Mission Statement

Vision: To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasaragod and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

Mission:

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher education and to cater to the modern notions of equity, social justice and merit in all educational endeavours.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as non-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

PROGRAMME OUTCOMES (PO)

PO 1.Critical Thinking:

1.1. Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.

1.2. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.

1.3 Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.

PO 2.Effective Citizenship:

2.1. Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.

2.2. Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalisation and the ability to understand and resist various kinds of discriminations.

2.3. Internalise certain highlights of the nation's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernisation of the post-colonial society.

PO 3.Effective Communication:

3.1. Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language

3.2. Learn to articulate, analyse, synthesise, and evaluate ideas and situations in a well-informed manner.

3.3. Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking.

PO 4.Interdisciplinarity:

4.1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.

4.2. Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.

4.3. Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.

PREFACE

1. Geology and its uses:

Geology is the study of the Earth. It includes study of land forms, surface and sub-surface processes, rocks, minerals, groundwater resources, Interior of the earth, fossils etc. An important aspect of Geology is the study of how Earth's materials, structures, processes and life have changed over time. Undergraduate programme in Geology is the foundation for the advanced studies on Geology. Geologist's work has helped us to understand the history of our planet. The more we understand Earth's history the better we can foresee how events and processes of the present might influence the future. Many events such as landslides, earthquakes, floods and volcanic eruptions can be hazardous to people. Geologists can prepare maps of areas that have flooded in the past; they can prepare maps of the areas that might be flooded in the future. These maps can be used to guide the development of communities and determine where flood protection or flood insurance is needed. Today we are concerned about climate change. Many geologists are working to learn about the past climates of earth and how they have changed with time. This information is valuable to understand how our current climate is changing and what the results might be.

2. Geology as a Career:

Geology gives a very interesting and rewarding career. The minimum training required is a B.Sc. degree in Geology, though it is M.Sc (Geology) degree holders who will be usually engaged by Governmental / non-governmental agencies as geologists. Geologists work in a variety of settings. These include: natural resource companies, environmental consulting companies, government agencies, non-profit organizations, colleges and universities etc. Many geologists do field work at least part of the time. Others spend their time in laboratories, classrooms or offices. All geologists prepare reports, do calculations and use computers. Advanced degrees will often qualify the geologist for supervisory positions, research assignments or teaching positions at the university level. Most geology post graduates with a strong academic background and good grades have no trouble finding employment if they are willing to move to a location where work is available. Geological Survey of India, Oil and Natural Gas Corporation, Indian Space Research Organization, National Centre for Earth Science Studies, Central Ground Water Board, Various Universities and Colleges, Centre for Water Resources Development and Management, National Institute of Hydrology, Remote Sensing Utilization Centers, Land Management Departments, Mud Logging companies, Groundwater Department, Mining and Geology Department etc. are a few career locations.

3. What next after B.Sc. Geology?

The graduates in Geology are employable as Geological Assistant/Technical Assistant in various Geological organizations like Mining & Geology and Ground Water

Department. Graduates with B.Ed. degree can teach courses at school level in Earth and Environment related subjects. . They can join to Postgraduate programmes in Geology/Marine Geology/Applied Geology/Geoinfomatcis/Hydrogeology/MTech geology, MScTech in geology etc. Geology is an interdisciplinary science which offers employment opportunities in scientific studies, exploration of natural resources, mining and Civil engineering filed.

4. Programme outcomes of B.Sc. Geology

The graduate of this programme will be able to

1. Megascopically identify rocks, minerals and fossils in the field as well as laboratory
2. Read and interpret geological maps with particular reference to structure and lithology
3. Design and develop geological map, geological cross section and panel diagrams to understand subsurface geology
4. Interpret topographical maps.
5. Identify landforms, soil types and their interrelationships.
6. Carryout microscopic identification of rocks and minerals.
7. Assist in site selections for civil constructions.
8. Plan and execute geological field work.
9. Understand natural hazard and its impact on the society.
10. Assess the environment impact in a geologic perspective.
11. Develop geological knowledge so as to evolve sustainable living practices

5. Geology as a complementary subject:

Geology as a complementary subject to other subjects facilitates understanding of the earth and its processes. Currently it is a complementary subject to B.Sc Geography.

6. Geology as generic electives / open courses:

The purpose of these courses is to provide a general understanding of the earth system for students of other streams.

Chairman

Board of Studies, B.Sc. Geology

Kannur University

Kannur University

Programme Specific Outcome of B.Sc. Geology Programme

PSO 1:

Understanding the nature and basic concept of physical geology, geomorphology, historical geology and structures in geological formations.

PSO 2:

Understanding the various crystal forms, their symmetry aspects, properties & identification of different minerals (megascopically and microscopically), their economic significance and distribution.

PSO 3:

Understanding the various types of igneous, sedimentary and metamorphic rocks analyzing their mineral content and textures megascopically and microscopically.

PSO 4:

Understanding stratigraphy, paleontology, economic geology, geology of India, environmental geology, Hazards and disaster management, Geoinformatics with application to Geographic Information System (GIS), gemology / mining processes/exploration methods/geotechnical engineering/ hydrogeology.

INDEX

KANNUR UNIVERSITY
B.Sc. GEOLOGY PROGRAMME

WORK AND CREDIT DISTRIBUTION STATEMENT

(B.Sc: Common English : 22, Additional Common:16, Core:56, First Complementary Elective : 12, Second Complementary Elective:12, Generic Elective: 2)

Semester	Course Title	Credits	Hours/week	Marks			Total Credits	Total Hours
				Internal	External	Total		
I	Common course (English) I	4	5	10	40	50	18	25
	Common course (English) II	3	4	10	40	50		
	Common course (Addl. Language) VII	4	4	10	40	50		
	Physical Geology and Global tectonics*	3	4	10	40	50		
	First complementary elective I	2	2	8	32	40		
	First complementary elective practical I	0	2	-	-	--		
	Second complementary elective I	2	2	8	32	40		
	Second complementary elective practical I	0	2	-	-	-		
II	Common course (English) III	4	5	10	40	50	18	25
	Common course (English) IV	3	4	10	40	50		
	Common course (Addl. Language) VIII	4	4	10	40	50		
	Structural Geology	3	2	10	40	50		
	Structural Geology practical	0	2	-	-	-		
	First complementary elective II	2	2	8	32	40		
	First complementary elective practical I	0	2	-	-	-		
	Second complementary elective II	2	2	8	32	40		
	Second complementary elective practical I	0	2	-	-	-		
III	Common course (English) V	4	5	10	40	50	15	25
	Common course (Addl. Language) IX	4	5	10	40	50		
	Crystallography	3	3	10	40	50		
	Crystallography practical	0	2	-	-	-		
	First complementary elective III	2	3	8	32	40		
	First complementary elective practical I	0	2	-	-	-		
	Second complementary elective III	2	3	8	32	40		
	Second complementary elective practical I	0	2	-	-	-		
IV	Common course (English) VI	4	5	10	40	50	27	25

	Common course (Addl. Language) X	4	5	10	40	50		
	Mineralogy	3	3	10	40	50		
	Practical I- (Structural Geology, Crystallography and Mineralogy)	4	2	10	40	50		
	First complementary elective IV	2	3	8	32	40		
	Second complementary elective IV	2	3	8	32	40		
	First complementary elective Practical I	4	2	8	32	40		
	Second complementary elective Practical I	4	2	8	32	40		
V	Igneous Petrology	3	3	10	40	50	16	25
	Sedimentary and Metamorphic Petrology	4	5	10	40	50		
	Stratigraphy and Palaeontology	4	5	10	40	50		
	Economic Geology	3	4	10	40	50		
	Petrology practical	0	3	-	-	-		
	Paleontology practical	0	2	-	-	-		
	Economic Geology Practical	0	1	-	-	-		
	Generic elective course	2	2	5	20	25		
VI	Environmental Geology	3	3	10	40	50	26	25
	Disaster Management	3	3	10	40	50		
	Geoinformatics	3	3	10	40	50		
	Geology of India	3	3	10	40	50		
	Discipline Specific Elective#	2	2	10	40	50		
	Practical II(Igneous, Sedimentary and Metamorphic Petrology).	4	3	10	40	50		
	Practical III (Palaeontology, Economic Geology and Geoinformatics)	4	4	10	40	50		
	Field work/Study tour	2	2	10	40	50		
	Project	2	2	5	20	25		
Total		120	150	360	1440	1800	120	150

*(Includes field work)

Among the given five discipline specific elective courses, College/Department may offer two courses at a time in the semester.

First Complementary Elective: **CHEMISTRY**

Second Complementary Elective: **PHYSICS**

Generic elective in Geology w.e.f. 2019 admission

Semester	Course Code	Course Title	Hours per week	Total Credits	Marks		
					Internal	External	Total
V	5D01GEO	Understanding Planet Earth	2	2	5	20	25
V	5D02GEO	Earth Resources Management	2	2	5	20	25
V	5D03GEO	Environmental Management and Sustainable Development	2	2	5	20	25
V	5D04GEO	Community Preparedness for Disaster Management	2	2	5	20	25
V	5D05GEO	Water Resources	2	2	5	20	25

Discipline specific elective course in Geology w.e.f 2019 admission

Semester	Course Code	Course Title	Hours per week	Total Credits	Marks		
					Internal	External	Total
VI	6B14AGEO	Gemology	2	2	10	40	50
VI	6B14BGEO	Mining Geology	2	2	10	40	50
VI	6B14CGEO	Exploration Geology	2	2	10	40	50
VI	6B14DGEO	Geotechnical Engineering	2	2	10	40	50
VI	6B14EGEO	Hydrogeology	2	2	10	40	50

PART A:

GEOLOGY CORE COURSES
WORK AND CREDIT DISTRIBUTION
(2019 ADMISSION ONWARDS)

Course code	Course title	Semester	Hours / Week	Credit	Exam hrs.	Marks		
						Internal	External	Total
1B01 GEO	Physical Geology and Global tectonics	I	4	3	3	10	40	50
2B02 GEO	Structural Geology	II	2	3	3	10	40	50
	Structural Geology practical	II	2	-	-	-	-	-
3B03 GEO	Crystallography	III	3	3	3	10	40	50
	Crystallography practical	III	2	-	-	-	-	-
4B04 GEO	Mineralogy	IV	3	3	3	10	40	50
4B05 GEO	Practical – I (structural geology, crystallography and mineralogy)	IV	2	4	3	10	40	50
5B06 GEO	Igneous Petrology	V	3	3	3	10	40	50
5B07GEO	Sedimentary and Metamorphic Petrology	V	5	4	3	10	40	50
5B08GEO	Stratigraphy and Palaeontology	V	5	4	3	10	40	50
5B09GEO	Economic Geology	V	4	3	3	10	40	50
	Petrology practical	V	3	-	-	-	-	-
	Paleontology practical	V	2	-	-	-	-	-
	Economic Geology practical	V	1	-	-	-	-	-
	Generic elective course	V	2	2	2	5	20	25
6B10GEO	Environmental Geology	VI	3	3	3	10	40	50
6B11GEO	Disaster Management	VI	3	3	3	10	40	50
6B12GEO	Geoinformatics.	VI	3	3	3	10	40	50
6B13GEO	Geology of India.	VI	3	3	3	10	40	50
6B14GEO	Discipline Specific Elective#	VI	2	2	3	10	40	50
6B15GEO	Practical -II(Igneous, Sedimentary and Metamorphic Petrology)	VI	3	4	3	10	40	50
6B16GEO	Practical - III (Palaeontology, Economic Geology and Geoinformatics)	VI	4	4	3	10	40	50
6B17GEO	Field work/Study tour*	VI	2	2	-	10	40	50
6B18GEO	Project	VI	2	2	-	5	20	25
Total				58		180	720	900

*Students will be on deputation for field work/study tour continuously for 7 working days (36 hours) during VIth semester.

Scheme of Evaluation

The scheme of evaluation in B.Sc. Geology programme under choice based Credit & Semester System shall contain 2 parts,

1) Continuous Evaluation (CE))
2) End-Semester Evaluation (ESE)

20 % weightage shall be given to the Continuous evaluation (CE) and 80% weightage shall be for End semester Evaluation (ESE).

Continuous Evaluation (Theory)

COMPONENT	WEIGHTAGE	REMARKS
Component 1 Test Paper	50%	Best of the two to be awarded for more than one test paper /assignment conducted.
Component 2 Assignment	50%	

Consolidation of marks for Continuous Evaluation of theory is as follows

Theory		
Component I Test paper Max. marks 5	**Component II Assignment Max. marks 5**	**Total Max. marks 10**

Continuous Evaluation (Practical)

Lab involvement & Records: Lab involvement is to be assessed during the practical classes by the teacher in charge. Quality of Lab Records is to be assessed by the teacher concerned on the basis of quality of observation books and lab records. Records must be properly certified by the teacher(s) and Head of the Department.

Practical Test papers: shall be conducted by teachers-in-charge and marks shall be given based on the student's performance.

Practical		
Lab involvement & Record Max. marks 5	**Practical test paper Max. marks5**	**Total Max. marks 10**

Continuous Evaluation – Field work / study tour.

Study tour must be conducted under the supervision of teachers for understanding rocks/minerals/fossils/structures in the field. During this, the students must visit at least one mine or quarry and the studies conducted must be documented in a comprehensive tour report under the supervision and guidance of the teacher in charge. Necessary sketches, maps, photographs etc. have to be incorporated in the report.

Field work / study tour		
Sample collection Max. marks 5	**Report Max. marks 5**	**Total Max. marks 10**

Continuous Evaluation- Project

Supervising teachers will assess the project and award internal marks.

Components of Continuous Evaluation of Project

Continuous Evaluation (20% of total)	
Components	**Percentage**
Punctuality	20
Use of Data	20
Scheme/Organization of Report	30
Viva Voce	30

Consolidation of marks for Continuous Evaluation of Project is as follows

Reg. No.	**Punctuality Max. mark:1**	**Use of Data Max. marks :1**	**Scheme/Organization Max. marks :1.5**	**viva voce Max. marks :1.5**	**Total 5 marks**

End Semester Evaluation-Theory

The ESE in theory course is to be conducted with Question Papers set by external experts. External evaluation carries 80 % of the total marks. The evaluation of the answer scripts shall be done by examiner based on a well-defined scheme of valuation and answer keys. The duration of theory examination shall be 3 hours with a total mark of 40. (See model Question Paper).

End Semester Evaluation - Practical I, II & III

The ESE in practical course I shall be conducted at the end of fourth semester and that of practical course II and III shall be conducted at the end of sixth semester. The evaluation should be conducted jointly by 2 examiners appointed by the University- one external and the other internal. The duration of each practical exam shall be three hours. The candidate shall be permitted to attend the practical exam only if he/she submits certified bonafide Laboratory records of Practical work done. The total mark for ESE of each practical is 40.

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End Semester Evaluation - fieldwork/study tour

Field work /Study tour report must be submitted before the external examiners for evaluation. A display of samples collected by each student should be arranged so that the external examiners can view and examine the samples displayed and award marks. Viva-voce will be conducted by a board consisting of at least 2 examiners appointed by the University. The board will ask questions to the candidates related to field work/study tour they have conducted and assess the students

Reg.No.	**Display of samples Max. marks : 10**	**Field Report Max. marks : 10**	**Viva-voce Max. marks : 20**	**Total Max. marks : 40**

End semester evaluation- Project

End Semester Evaluation of project shall be done by the external examiners appointed by the University.

Components of End Semester Evaluation of Project

End Semester Evaluation (80% of Total)	
Components	**Percentage**
Relevance of the Topic, Statement of Objectives, Methodology (Reference/ Bibliography)	20
Presentation, Quality of Analysis/Use of Statistical tools, Findings and recommendations	30
Viva-Voce	50

Distributions of marks for project in End Semester Evaluation are as follows:

Reg. No.	**Relevance of the Topic, Statement of Objectives, Methodology (Reference/ Bibliography) Max. marks :4**	**Presentation, Quality of Analysis/Use of Statistical tools, Findings and recommendations Max. marks :6**	**Viva-Voce Max. marks :10**	**Total Max.marks :20**

Scheme for conducting Practical Examinations (ESE)

The university examinations in practical courses will be conducted by examiners appointed by the university. The scheme suggests the following within the purview of the B.Sc. Geology syllabus.

Practical I (Total marks -40)

Structural geology: Interpretation of one geological map and a structural problem.

Crystallography: Identifying and describing crystal models of typical minerals based on symmetry elements and forms present.

Mineralogy: Megascopic characterization and identification of minerals in hand specimen, Microscopic characterization and identification of minerals in thin sections.

Practical II (Total marks - 40)

Igneous, sedimentary and metamorphic petrology: Megascopic characterization and identification of igneous, sedimentary and metamorphic rocks in hand specimen.

Microscopic characterization and identification of igneous, sedimentary and metamorphic rocks in thin sections.

Practical III (Total marks - 40)

Palaeontology: Morphological characterization and identification of mega fossils.

Economic geology: Megascopic identification of economic minerals based on characterization. Use and Indian occurrence of economic minerals.

Geoinformatics: Procedure of operation of Gt.Aide package. Coordinate data conversion and data entry, preparation of thematic layers, creation of Digital Elevation Model, preparation of slope and aspect map.

Core course I: PHYSICAL GEOLOGY AND GLOBAL TECTONICS

Semester	Course code	Hours per week	Credit	Exam hours
1	1B01 GEO	4	3	3

COURSE OUTCOME

CO 1:
Understand various branches of geology, solar system, Physical parameters of earth and internal structure of earth, Exogenic and endogenic processes, concept of rock cycle.

CO2:
Understand the geological work and land forms developed by rivers, wind and glaciers

CO3:
Understand the geological work and land forms developed by oceans and seas, groundwater, origin and classification of lakes, backwaters of Kerala.

CO4:
Understand mechanism and causes of volcanoes and earthquakes, seismic waves and distribution earthquakes and volcanoes.

CO5
Understand the continental drift hypothesis and concepts of plate tectonics, types and characteristics of plate margins, and causes of plate motion

CO6:
Understand the mountain building process in relation to plate tectonics, classification of mountains, concept of isostasy, and Himalayan orogeny

Unit I
Earth Sciences - Definitions, brief introduction to the various branches of earth sciences; relationship of geology with other branches of science. Solar system with special emphasis on terrestrial planets and meteorites. Earth in solar system: size, shape, volume, mass, rotation and revolution. Modern theories of origin of earth, age of the earth. Internal structure of the earth

Geospheres: Lithosphere, hydrosphere and atmosphere. Exogenic and endogenic processes and geological agents. The concept of rock cycle.
Weathering: agents, types and products of weathering. factors controlling weathering. Soils: Origin and types. Mass wasting: Types, Landslides-causes and mitigation. (16 hours)

Unit II

Streams: Types, Drainage basins, geological activity of stream, erosion, transportation and deposition; erosional and depositional landforms. Davisian cycle and concept of peneplain.
Wind: origin of air currents, Corioilis force, Trade winds, cyclones and classification Formation of deserts, geological action of wind, landforms of aeolian origin.
Glaciers: formation and morphology, types, erosion and transportation by glaciers, glacial landforms, Ice age. (12 Hours).

Unit III

Oceans and Seas: Ocean water: extent, composition, waves, currents,
tides; Marine erosion, transportation and deposition and associated land forms. Ocean floor topography. Coral reefs: origin, types and distribution.
Lakes: Origin, classification and geological importance, Backwaters of Kerala.
Ground water: Source, nature, storage, porosity, permeability, aquifer, aquiclude, aquitard, water table, seepage and springs, geysers, wells, artesian wells, Geological action of groundwater and Karst topography.(12 Hours.)

Unit IV

Volcanoes: mechanism and causes of volcanic eruption, types, products, effects and prediction. 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, seismic belts of the world. (12 hours)

Unit V

Continental drift hypothesis, Sea floor spreading, polar wandering, paleomagnetism. Concept of plate tectonics: Types of plate margins- divergent, convergent, transform and diffuse plate margins. Important characteristics of plate margins - Triple junctions, Benioff zones, mid oceanic ridges, island arcs and rift valleys, oceanic trenches, transform and transcurrent faults. Passive and active continental margins. Causes of plate motion - mantle convection, mantle plumes & hotspots, Ridge push, Slab pull, mantle drag and Wilson's cycle. (14 Hours.)

Unit VI

Mountains: origin and classification; Concept of isostasy and various hypotheses. Orogeny in relation to plate tectonics. Origin of Himalayas. (6 Hours.)

Books for Reference:

1. Thompson, G. R. and Turk, J. (1997) Introduction to Physical Geology. 2nd Edn.
Thompson Brooks Publishers.

2. Carlson, D. and Plummer, C. (2010) Physical Geomorphology: Earth Revealed. 9th Edn., Mc-Graw Hill Co.
3. Parbin singh (2012). General and Engineering Geology. S. K. Kataria and Sons
4. Bloom, A.L. (1992) Geomorphology, Second Edition, Prentice Hall India Pvt. Ltd., New Delhi.
5. Holmes, A. (1981) Principles of Physical Geology. ELBS, Third Edition. Thomas Nelson.
6. Gilluly, J., Waters A.C. and A.O. Woodford (1975) Principles of Geology. 4th Edition, W.H. Freeman and Co.
7. Judson, S. and Kauffman, M.E. (1990) Physical Geology. Eighth Edition, Prentice Hall, New Jersey.
8. Mcalister, A.L. and Hay, E.A. (1975) Physical Geology, Principles and Perspectives. Prentice Hall Inc. London.
9. Montgomery C.W. (1993) Physical Geology. Wn. C. Brown Publishers, IOWA.
10. Skinner B.J. and Porter S.C. (1987) Physical Geology. John Wiley and Sons, New York.
11. Strahler, A.N. (1971) Earth Sciences. 2nd Edition, Harper and Row.
12. Ahamed, E. (1972) Coastal Geomorphology of India. Orient Longman, New Delhi.
13. King, C.A.M. (1972) Beaches and Coasts. Arnold, London.
14. Thornbury, W.D. (1968) Principles of Geomorphology, Wiley.

Marks including choice:

Unit	Marks
I	14
II	10
III	10
IV	08
V	12
VI	6

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1each = 6)
- **Answer all questions** (*6 questions x Mark 1each = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)
- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - Essay (6 questions x Marks 3 each =18)
- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)
- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core course II: **STRUCTURAL GEOLOGY**

Semester	Course Code	Hours per Week	Credit	Exam Hours
II	**2B02 GEO**	**2**	**3**	**3**

(Structural Geology practical 2 hours / week. External examination of structural geology practical as a component in Practical I in IVth semester)

COURSE OUTCOME

CO 1:

Understand the attitude of beds/geological structures, outcrop patterns, Rule of V's, measuring strike and dip of rock layers using Brunton compass and Clinometer, representation of relief & structural features in geological maps and factors of rock deformation

CO2:

Understand the geometry and classification, terminology, mechanism of formation of folds and criteria for their recognition in the field and map

To study the geometry, classification, terminology, mechanism of faulting, and criteria for the recognition of fault in the field and map

CO3:

Understand the mechanism of formation, and types of foliation and lineation

CO4:

Understand joints in rocks and their origin, classification and geological significance, the unconformities, their types and identification in the field and map.

Unit I

Introduction to Structural geology. Stratification, dip and strike, outcrops: pattern and width; outlier and inlier. Rule of V's. Clinometer and Brunton compass. Methods for representing relief features: contours; topographic and geologic maps; map symbols and rock symbols; interpretation of geological maps. Stages of rock deformation - stress & strain, and factors controlling rock deformation. (8 Hours)

Unit II

Folds: Definition, terminology, geometry and elements of folded surfaces, mechanism of folding, geometric and genetic classification of folds, criteria for recognition of folds in the field and on maps.

Faults: Definition, terminology and classification. Mechanism of faulting. Criteria for recognition of fault in the field and on the map (16 Hours).

Unit III

Foliations and lineations: mechanism of formation and their types. (6 Hours).

Unit IV

Joints: nature, origin, classification, geological significance and recognition in the field and map. Unconformities: origin, types and their recognition in the field and on the map. (6 Hours).

Books for Reference:

1. Billings M.P. (1972) Structural Geology. Third Edition. Prentice Hall, New Delhi.
2. De Sitter (1964) Structural Geology. Second Edition, McGraw Hill Co.
3. Hill, S. (1961) Elements of Structural Geology, Asia Publishing House.
4. Lahee (1987) Field Geology. Sixth Edition, McGraw Hill Co.
5. Ben A. Van Der Pluijm, Marshak, S. (2004) Earth Structure- An introduction to
6. Structural Geology and Tectonics. 2nd Edition.
7. Davis, H.D. and Reynolds, S.J. (1984) Structural Geology of rocks and regions.John Wiley and Sons, Inc.
8. Thompson, G. R. and Turk, J. (1997) Introduction to Physical Geology. 2nd Edn., Thompson Brooks Publishers.
9. Carlson, D. and Plummer, C. (2010) Physical Geomorphology: Earth Revealed. 9th Edn., Mc-Graw Hill Co.
10. Park R G (1997)Foundations of Structural Geology 3rd , Chapman & Hall
11. Hobbs, Means and Williams (1976) An Outline of Structural Geology. John Wiley.
12. John Robberts - Introduction to Geological Maps and Structures, Pergamon Press.
13. R J Twiss & E M Moore (2007) Structural Geology 2nd edition. Freeman & Company

Marks including choice:

Unit	Marks
I	14
II	18
III	14
IV	14

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1each = 6)

- **Answer all questions** (*6 questions x Mark 1each = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course III: CRYSTALLOGRAPHY

Semester	Course Code	Hours per Week	Credit	Exam Hours
III	3B03 GEO	3	3	3

(Crystallography practical 2 hours / week. External examination of crystallography practical as a component in Practical I in IVth semester)

Course Outcome

CO 1:

Understand morphology of crystals, crystal symmetry, various crystal angles and instrument to measure crystal angles.

CO2:

Understand crystallographic axes and six crystal systems by comparison, crystal parameters and notations and evaluates various crystal forms.

CO3:

Understand simple and combination forms of isometric and tetragonal crystal systems.

CO4:

Understand simple and combination forms of hexagonal, orthorhombic, monoclinic and triclinic crystal systems.

CO5

Differentiate twin crystals with elements of twinning, twin axis, twin plane and compositional plane giving examples, imperfections in crystals and basic aspects of crystal projection with special reference to stereographic projection.

Unit I

Elements of crystallography: crystalline state and crystals; Morphology of crystals, faces, edges, vertex, forms and zones. Crystal angles: plane angles, interfacial angles and solid angles. Contact Goniometer, law of constancy of interfacial angles. External symmetry. (6 hours)

Unit II

Crystallographic axes: choice of axes, labelling and orientation, classification of crystals into Systems and Classes, nomenclature of crystal faces, intercepts, parameters, unit face, Weiss notation, Miller indices, law of crystal indices, axial ratio. Brief study of the following: holohedral, hemihedral, hemimorphic, enantiomorphic and tetartohedral forms. (8 hours)

Unit III

Systematic crystallography: The study of symmetry, simple forms and combinations of the following crystal classes: Isometric system - normal, tetrahedral, pyritohedral and plagiohedral. Tetragonal system - Normal, tripyramidal, pyrimadal hemimorphic and sphenoidal. (15 hours)

Unit IV

Hexagonal system: Hexagonal Division - Normal class, tripyramidal, trapezohedral. Rhombohedral Division - Rhombohedral, trirhombohedral, pyramidal hemimorphic, trapezohedral. Orthorhombic system - Normal class. Monoclinic system - Normal class. Triclinic system - Normal class. (15 hours).

Unit V

Twin crystals: elements of twinning, twin axis, twin plane and compositional plane; important types and examples of twinning. Brief study of morphological imperfections in crystals. Basic concepts in crystallographic projections. (10 hours).

Books for Reference:

1. Dana, E.S. (1962) A text book of Mineralogy (Revised by Ford). Asia Publishing House,Wiley.
2. Philips F.C. (1956) An Introduction to Crystallography. Longmans Green 20
3. Read, H.H. (1984) Rutley's Elements of mineralogy. CBS Publishers, Delhi.
4. Hota R.N. (2011).Practical approach to crystallography and mineralogy, Geological Socety of India 202p.
5. Sharma, Ram & Sharma, Anurag & Editors AKJain, Series & Singh, Sandeep. (2013). Text-book Series in Geological Sciences for Graduate Students - Crystallography and Mineralogy.

Marks including choice:

Unit	Marks
I	10
II	10
III	14
IV	14
V	12

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course IV: MINERALOGY

Semester	Course Code	Hours Per Week	Credit	Exam Hours
IV	4B04 GEO	3	3	3

Course Outcome

CO 1:
Understand minerals and mineraloids, physical properties of minerals, types of bonding in atoms , arrangement of atoms in minerals and related changes in internal arrangement and external forms.

CO2:
Understand properties of light and related optical properties of minerals, petrological microscope and accessories.

CO3:
Understand classification and major physical and optical properties of common non – silicate minerals.

CO4:
Understand structure and classification of silicate minerals with detailed physical, chemical and optical properties.

Unit I

Mineral: Definition of Mineral and Mineraloid; Scope and aim of Mineralogy.

Physical mineralogy: Physical properties of minerals-form, habit, cleavage, fracture, colour, luster, streak, hardness, specific gravity, piezoelectricity and pyroelectricity.

Bonding of atoms: Metallic, covalent, ionic and Van der Walls bonding in minerals, solid solution, exsolution, isomorphism, polymorphism and pseudomorphism in minerals. (14 hours).

Unit II

Optical mineralogy: Ordinary and polarized light, polarization of light,
refractive index, critical angle and total internal reflection. Polarization by reflection, absorption, refraction, double refraction. Construction of Nicol prisms. Petrological microscope: parts and functions. Optical accessories: Mica plate, gypsum plate and quartz wedge. Optical properties of minerals: Colour, Pleochroism, pleochroic haloes, relief, birefringence, interference colour, extinction, twinning, alteration and zoning. Isotropic and anisotropic substances, uniaxial and biaxial minerals, sign of elongation. (12 hours)

Unit III

Descriptive Mineralogy: a) classification of minerals. b) systematic study of the important non-silicate minerals: Diamond, Graphite, Sulphur, Gold, Silver, Copper, Realgar, Orpiment, Stibnite, Molybdenite, Cinnabar, Sphalerite, Galena, Chalcocite, Bornite,Chalcopyrite, Pyrite, Magnetite, Hematite, Marcasite, Barite, Gypsum, Halite, Fluorite, Corundum, Cryolite, Cuprite, Spinel, Chromite, Rutile, Cassiterite, Ilmenite, Monazite, Psilomelane, Pyrolusite, Goethite, Limonite, Bauxite, Calcite, Dolomite, Aragonite,Magnesite, Siderite, Malachite, Azurite. (12 hours).

Unit IV

Structure and classification of silicate minerals with detailed physical, chemical and optical properties of the following mineral families: Olivine, Garnet, Alumino silicate, Epidote, Pyroxene, Amphibole, Mica, Feldspars, Feldspathoids, Quartz, Zeolite group, Beryl, Cordierite and Tourmaline. Clay minerals: Kaolinite,Montmorillonite,illite.

(16 hours).

Books for Reference:

1. Dana, E.S. (1955). A text book of mineralogy – Asia publishing House, Wiley.
2. Read, H.H. (1984) Rutley's elements of Mineralogy. CBS Publishers, Delhi.
3. Mason, B. and Berry, L.G- Elements of Mineralogy – W.H. Freeman & Co.
4 Deer. W.A., Howie. R.A and Zuessman, J. (1966) An introduction of the Rock forming minerals. Longman.
5 Berry, Mason, Dietrich, (2000) Mineralogy, CBS Publication.
6 Cornelis Klein and Cornelius S. Hurlbut (1985) Manual of Mineralogy, John Wiley & Sons.
7 Nesse Williams, D. (2008) Introduction to Mineralogy. Oxford University Press.
8 Nesse Williams, D. (2003) Introduction to Optical Mineralogy. Oxford University Press.
9 Perkins Dexter (2006) Mineralogy. Pearson Prentice Hall.
10 Kerr P.F. (1977) Optical Mineralogy. Mcgraw-Hill
11 Perkins Dexter and Henke Kevin, R. (2007) Minerals in thin section. Pearson Education.

Marks including choice:

Unit	Marks
I	14
II	16
III	16
IV	14

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course V Practical–I- STRUCTURAL GEOLOGY, CRYSTALLOGRAPHY AND MINERALOGY

Semester	Course Code	Hours per week	Credit	Exam hours
IV	4B05 GEO	2*	4	3

*These two hours are meant for practical work related to mineralogy.

Course Outcome

CO 1:

Solve problems related to dip and strike, thickness and width of outcrops. Analyzing and interpreting different geological maps.

CO2:

Identification of various crystal models on the basis of symmetry and morphology

CO3

Identification of minerals by their megascopic and microscopic properties.

Unit I

Practical in Structural Geology (Hours per week: 2, Total hour: 36; Sem II)

Illustration with the help of neat diagrams of the following: Attitude of beds, apparent dip, strike and dip symbols, types of folds, faults and unconformities.

Problems in structural geology. Problems involving true and apparent dip, thickness and width of outcrops, three point problems.

Interpretation of geological maps and preparation of sections.

- Simple horizontal beds (2 maps)
- Study of effect of relief on 'V' of outcrops (2 maps)
- Simple dipping beds (2 maps)
- Simple dipping beds with intrusions (2 Maps)
- Tracing the out crops (2 maps)
- Folded beds (3 maps)
- Maps with different types of faults (4 maps)
- Simple dipping beds with unconformity (3 maps)
- Combination of intrusions, unconformity, folds and faults (5 maps)

Unit II

Practicals in Crystallography (Hours per week: 2, Total hour: 36; Sem III)

Drawing of symmetry elements of Normal classes of all systems.

Identification and description of the following crystal models.

Isometric system: Galena, Garnet, Spinel, Magnetite, Fluorite, Sphalerite, Tetrahedrite,

Pyrite and Cuprite.
Tetragonal system: Zircon, Cassiterite, Rutile, Apophyllite, Wulfenite, Chalcopyrite.
Hexagonal system: Beryl, Beta Quartz, Calcite, Tourmaline, Alpha Quartz.
Orthorhombic System: Barite, Olivine, Topaz, Sulphur, Staurolite.
Monoclinic system: Gypsum, Orthoclase, Augite, Hornblende.
Triclinic: Axinite, Albite, Kyanite.
Twin crystals: Spinel, Fluorite, Rutile, Calcite, Quartz, Staurolite, Aragonite, Gypsum, Augite, Orthoclase, Albite.

Unit III

Practicals in Mineralogy (Hours per week:2, Total hour:36; Sem IV)

Megascopic study and identification of the following minerals:

Quartz, Smoky Quartz, Milky Quartz, Rosy Quartz, Amethyst, Chalcedony, Agate, Flint,Jasper, Chert, Opal, Orthoclase, Microcline, Plagioclase, Nephelene, Leucite,Sodalite, Enstatite, Bronzite, Hypersthene, Diopside, Augite, Spodumene, Acmite, Rhodonite, Wollastonite, Anthophyllite, Tremolite, Actinolite, Hornblende, Olivine,Serpentine, Muscovite, Biotite, Vermiculite, Phlogopite, Chlorite, Epidote, Garnet,Natrolite, Stilbite, Apophyllite, Talc, Steatite, Andalusite, Kyanite, Sillimanite, Staourolite, Cordierite, Apatite, Beryl, Topaz, Calcite, Dolomite, Tourmaline,Zircon,Fluorite, Magnasite, Gypsum, Corrundum

.

Microscopic study of the following minerals:

Quartz, Microcline, Orthoclase, Albite, Oligoclase, Labradorite, Nephelene, Leucite, Enstatite, Hypersthene, Augite, Diopside, Hornblende, Tremolite, Actinolite, Anthophyllite, Biotite, Muscovite, Olivine, Epidote, Garnet, Chlorite, Cordierite, Andalusite, Sillimanite, Kyanite, Staurolite, Calcite, Sphene, Apatite, Zircon.

Core Course VI: IGNEOUS PETROLOGY

Semester	Course code	Hours per week	Credit	Exam hours
V	5B06 GEO	3	3	3

Course Outcome

CO 1:
Understand lava flows, types and structure of igneous rocks and rock cycle.

CO2:
Understand texture and its type present in igneous rocks.

CO3:
Understand melting of rocks and magma generation, cooling process, Bowen's reaction series ,eutectic, solid solution and incongruent relationship.

CO4:
Understand magmatic differentiation, fractional crystallisation, liquid immiscibility, assimilation. Tyrrell's tabular, CIPW ,IUGS- QAPF norm classification and nomenclature of igneous rocks based on depth of occurrence, silica percentage and colour index.

CO5
Understand petrography, petrogenesis and association of the common igneous rocks.

Unit I

Igneous Rock: definition, types- Plutonic, hypabyssal and volcanic. Rock cycle;Forms of igneous rocks: lava flows, pyroclastic deposits, volcanic ash, sill, laccolith, lopolith, phacolith, dyke, cone sheets, batholiths, stocks, bosses, bysmalith, ring dykes and dyke swarms. Structures of igneous rocks: Definition, vesicular, amygdaloidal, blocky lava, ropy lava, pillow structure, flow structure, sheeted joints, mural jointing, columnar jointing, rift and grain. (10 hours).

Unit II

Textures of igneous rocks: definition, crystal and glass, crystallites and microlites. Granularity and shapes of crystals; Equigranular textures- allotriomorphic, hypidiomorphic and panidiomorphic; Inequigranular textures- porphyritic and poikilitic, intergrowth textures, directive textures, devitrification, perilitic fractures, spherulitic structures, reaction structure. (10 hours)

Unit III

Cooling history of igneous rocks, melting and crystallization. Bowen's Reaction Series. Study of the following Binary systems: Diopside-Anorthite (Eutectic), Albite-anorthite (solid solution), Forsterite-silica (Incongruent). Partial melting and magma generation. (12 hours)

Unit IV

Diversity of igneous rocks: magmatic differentiation, fractional crystallisation, liquid immiscibility, assimilation. Classification and nomenclature of igneous rocks based on depth of occurrence, silica percentage and colour index. Tyrrell's tabular classification, CIPW norm, IUGS- QAPF classification of plutonic and volcanic rocks. (10 hours).

Unit V

Petrography, petrogenesis and association of the following rocks/classes:

Granite, pegmatite, aplite, syenite, diorite, gabbro, basalt, dolerite, anorthosite, dunite and peridotite. (12 hours)

Books for Reference:

1. Tyrrell, G.W. (1978) The principles of petrology – Chapman and Hall Ltd. London.
2. Bowen, N.L.M The Evolution of the Igneous Rocks – Dover publication, Inc, New York
3. Barth, FW. (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. Wells, A.K. (1949) Petrology of Igneous Rocks, Thomas Murby & Wells,
7. Johannsen, A – (1962) Descriptive petrography of Igneous Rocks, Vols. I to IV – AlliedPacific.
8. Mackenzie, W.S., Donaldson, C.H. and Guilford, C. (1988) Atlas of Igneous rocks and their textures, ELBS/Longman. 23
9. Winter J.D. (2001) An introduction to Igneous and Metamorphic Petrology. Prentice Hall, New Jersey.
10. Middlemost E.A.K. (1985) Magmas and Magmatic rocks. Longman, New York.
11. Ehler G.E. and Blatt H. (1999) Petrology- Igneous, Sedimentary and Metamorphic. CBS Publishers and Distributors, New Delhi.
12. Hyndman, D.W. (1972) Petrology of igneous and Metamorphic Rocks. Mc-Graw Hill

Marks including choice:

Unit	Marks
I	10
II	12
III	14
IV	10
V	14

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course VII : SEDIMENTARY AND METAMORPHIC PETROLOGY

Semester	Course code	Hours per week	Credit	Exam hours
V	5B07 GEO	5	4	3

COURSE OUTCOME

CO 1:
Understand origin and classification of sedimentary rocks.

CO2:
Understand sedimentary deposits, texture and structure and descriptive aspects of major sedimentary rocks

CO3:
Understands types and factors of metamorphism, concept of depth zones, Barrowian zones, mineral paragenesis, Facies and grade.

CO4:
Understand metamorphic textures and structures, effects of metamorphism on different types of rocks, petrography and petrogenetic aspects of common metamorphic rocks.

Unit I

Origin of Sedimentary rocks – disintegration & decomposition of rocks. Transportation – Deposition –diagenesis. Classification of sedimentary rocks into residual, mechanical, chemical and organic groups. Residual deposits – terra rossa, clay, laterite, bauxite and soils. Mechanical deposits – rudaceous, arenaceous and argillaceous groups. (20 hours)

Unit II

Chemical deposits: siliceous, carbonaceous, ferruginous and saline deposits. Organic deposits: calcareous, siliceous, phosphatic, ferruginous and carbonaceous deposits. Sedimentary textures and structures (clastic and non- clastic). Descriptive study of conglomerate, breccia, sandstones, limestone and shales. Introduction to placer deposits. Sedimentary facies. Formation and evolution of sedimentary basins. (25 hours)

Unit III

Metamorphism: definition, types, factors, Pressure-Temperature limits, Prograde and retrograde metamorphism. Concept of depth zones. Barrowian zones and mineral paragenesis. Facies concept: Greenschist , Amphibolite, Granulite, Eclogite and Blueschist facies, Contact metamorphic facies; Metamorphic Grade. (20 hours)

Unit IV:

Metamorphic textures and structures. Effects of metamorphism on different types of rocks: argillaceous rocks, calcareous rocks, arenaceous rock and basic igneous rocks. Petrography and petrogenetic aspects of the following rock types: Slate, phyllite, schist, gneiss, amphibolite, marble, granulite (charnockite and khondalite), mylonite, and Banded Magnetite Quartzite/Banded Hematite Quartzite. (25 hours)

Books for Reference:

1. Tyrrell, G.W. (2013) Principles of Petrology, Asia Publishing House.
2. Huang, W.T. (1962) Petrology. Mc-Graw Hill.
3. Pettijohn, F.J. (1983) Sedimentary Rocks. Harper & Bros.
4. Harker, A. (1964) Petrology for Students, Cambridge Press.
5. Harker, A. (1952) Metamorphism. Mc-Graw Hill Co.
6. Hyndman, D.W. (1972) Petrology of igneous and Metamorphic Rocks. Mc-Graw Hill.
7. Moorehouse, W.W. (1959) The study of rocks in thin sections. Harper and Row, New York.
8. Rao, B.B. (1986) Metamorphic Petrology. Oxford-IBH Publ. Co.
9. Williams, H., Turner, J.F. and Gilbert, C.M. (1985) Petrography-An Introduction to the study rocks in thin sections. Second Edn. CBS Publishers, Delhi.
10. Winter, J.D. (2001) An introduction to Igneous and Metamorphic Petrology. Prentice Hall, New Jersey.
11. Turner.F.J and Verhoogen.J (1960) Igneous and Metamorphic Petrology – McGraw Hill

12.Ehler G.E. and Blatt H. (1999) Petrology- Igneous, Sedimentary and Metamorphic. CBS Publishers and Distributors, New Delhi.

Marks including choice:

Unit	Marks
I	12
II	18
III	12
IV	18

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course VIII: STRATIGRAPHY AND PALAEONTOLOGY

Semester	Course Code	Hours per week	Credit	Exam Hours
V	5B08 GEO	5	4	3

Course Outcome

CO 1:
Understand the concept of strata, principles of Stratigraphy concept of facies, successions, type area and type Sections and breaks in stratigraphic successions.

CO2:
Understand the concept of geological column and Geological Time Scale, elements of lithostratigraphic, chronostratigraphic and biostratigraphic classifications , dating of strata and concepts of correlation.

CO3:
Understand sub divisions and scope of palaeontology, fossilization, types and uses of fossils, type specimen and marine environments.

CO4:

Understands Pre-Cambrian fossils, Siwalik fossils, Morphology, classification, stratigraphic distribution and importance of Trilobites, Brachiopoda, Pelecypoda, Gastropoda, Cephalopoda, Echinoidea, Crinoidea, Blastoidea, Anthozoa, Foraminifera, Hemichordata.

CO5:
Understand fossil flora from India and paleoecology of plant fossils.

Unit I

Definition and scope. Concept of stratum and delineation of strata. A brief study of the guiding principles of Stratigraphy (Principle of Uniformitarianism; principle of order of superposition; principle of cross-cutting relationships, principle of truncation; principle of original horizontality, principle of included fragments and principle of faunal succession). Concept of facies, Local and regional successions. Type area and Type Sections. Breaks in stratigraphic successions: Unconformities and Diastems (18 hours).

Unit II

Concept of geological column and Geological Time Scale. Elements of lithostratigraphic, chronostratigraphic and biostratigraphic classifications and their units. Dating of strata (relative and absolute dating). Stratigraphic concepts of correlation, criteria and methods. (20 hours)

Unit III

Palaeontology - sub divisions and scope. Fossilization. Types of fossils: body fossils, trace fossils, index and zone fossils, transported fossils, leaked fossils and pseudo fossils. Taxonomic hierarchy. Type specimen: Holotype, genotype, paratype, syntype. Scientific value and uses of fossils. Types of marine environments. (14 hours)

Unit IV

Pre-Cambrian fossils-Blue green algae and Stromatolites. Morphology, classification, stratigraphic distribution and importance of Phylum Arthropoda – Class Trilobites, Phylum Brachiopoda, Phylum Mollusca- Pelecypoda, Gastropoda and Cephalopoda, Phylum Echinodermata – Echinoidea, Crinoidea, Blastoidea, Phylum Cidaria – Class Anthozoa, Phylum Protozoa – Order Foraminifera, Sub-Phylum hemichordata.. A short account of Siwalik fossils. (28 hours)

Unit V

Palaeobotany: A short account of the following fossil flora from India: Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepidodendron, Vertebraria and Sigillaria. Paleoecology of plant fossils. (10 hours)

Books for Reference:

1. Woods, H. (1961) Invertebrate Palaeontolgy. Cambridge University Press.
2. Romer, A.S. (1966) Vertebrate Palaeontology, 3rd edition. Chicago Univ. Press.
3. Arnold Ca. (1947) An introduction to Palaeobotany. Mc-Graw Hill.
4. Haq, B. U. and Boersma, A. (1978) Introduction to Marine Micropalaeontology. Elsevier, Netherlands.
5. Raup, D.M. and Stanley, M.S. (1978) Principles of Palaeontology. CBS Publishers.
6. Moore, R.C., Lalicker, C.G., and Fischer, A.G. (1952) Invertebrate Fossils. Mc-Graw Hill.
7. Shrock, R.R. AND Twenhofel, W.H. (1953). Principles of Invertebrate Palaeontology, 2nd edition. Mc-Graw Hill.
8. Palaeontolgy – An introduction (1985). Pergamon; First Edition.
9. Black A M. The elements of Palaeontology.
10. Ray A K. Fossils in earth science.
11. Dunbar, C.O and Rogers, J. (1961) Principles of Stratigraphy. Wiley Publications.
12. Krumbein W.C. and Sloss, L.D. (1963) Stratigraphy and Sedimentation. Freeman

Marks including choice:

Unit	Marks
I	10
II	12
III	20
IV	10
V	8

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course IX: ECONOMIC GEOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B09GEO	4	3	3

COURSE OUTCOME

CO 1:

Understand historical development of Economic Geology. Ore minerals and gangue minerals, tenor and grade of ores, Lindgren's and Bateman's classification. mineralizing solutions and controls of ore localization.

CO2:

Understand different processes and types of mineral deposits.

CO3:

Understand metallogenetic epochs and provinces, stratigraphic significance of Indian mineral deposits. mode of occurrence, distribution and important economic uses of the mineral deposits in India.

CO4:

Understand minerals used as abrasives, refractories, fertilizers, ceramics and gemstones, mineral deposits of Kerala, types of exploration of mineral deposits, fuel minerals sustainable development of mineral resources.

Unit I

Definition, scope and historical development of Economic Geology. Ore minerals and gangue minerals, tenor and grade of ores. Outline of Lindgren's and Bateman's classification of mineral deposits. Mineralizing solutions and its migration. Physical, chemical, structural and stratigraphic controls of ore localization. (16 hours)

Unit II

Magmatic, hydrothermal and surface processes of formation of mineral deposits- magmatic deposits, contact metasomatic deposits, hydrothermal deposits, pegmatitic mineral deposits, volcanic exhalative deposits, evaporites, sedimentary deposits, oxidation and supergene sulphide enrichment deposits, residual and mechanically concentrated deposits, placer deposits, metamorphic deposits. (24 hours)

Unit III

Brief study of metallogenetic epochs and provinces of Indian mineral deposits. Indian mineral deposits and its stratigraphic significance. Mode of occurrence, distribution and important economic uses of the following mineral deposits in India: Ores of Aluminium,

Chromium, Copper, Lead, Zinc, Gold, Manganese, Iron, Thorium, Uranium, Magnesium, Tin and Titanium. (16 hours)

Unit IV

Minerals used as abrasives, refractories, fertilizers, ceramics and gemstones. Economically significant mineral deposits of Kerala. Brief outline of the types of exploration of mineral deposits: geological, geophysical, geochemical and geobotanical exploration methods. Fuel minerals and its exploration. Sustainable development of mineral resources. (16 hours)

Books for Reference:

1. Gokhale and Rao (1978) Ore deposits of India. Thomson Press (India)
2. Jensen, m and Bateman, A.M. (1981) Economic Mineral Deposits. John Wiley & SonsInc
3. Krishnaswamy, S. (1988) Indian Mineral Resources. 3rd Edition. South Asia Books
4. Krauskopf (1994) Introduction to Geochemistry. 3rd Edition. McGraw-Hill Publications.
5. Park, C.F. and Mac Diarmid, R.A. (1964) Ore deposits. W. H. Freeman Publications.
6. Roy Chacko P.T. (ed.), (2005) Mineral resources of Kerala. Department of Mining and Geology.
7. Sinha, R.K (1982) Industrial minerals. Oxford and IBH Publishing Co.
8. Umeshwar Prasad (2000) Economic Geology- Economic Mineral Deposits. 2nd Edition. CBS Publishers and Distributors.
9. Mihir Deb and Sanjib Chandra Sarkar (2017) Minerals and Allied Natural Resources and their Sustainable Development: Principles, Perspectives with Emphasis on the Indian Scenario. Springer publications.

10.P K. Banerjee and S Ghosh (1997), Elements of prospecting for National Mineral Deposits. Allied publishers Ltd.

Marks including choice:

Unit	Marks
I	14
II	20
III	12
IV	14

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

(Petrology Practical 3 hours / week. ESE in Practical II in semester VI. Palaeontology Practical 2 hours / week. ESE in Practical III in semester VI. Economic Geology practical 1 hour / week. ESE in Pactical III in semester VI)

Core Course X: Environmental Geology

Semester	Course code	Hours per week	Credit	Exam Hours
VI	6B10GEO	3	3	3

COURSE OUTCOME

CO 1:
Understand earth systems to the student's scientific literacy

CO2:
Understand the tools necessary to interpret change in global environments with special emphasis to earth system.

CO3:
Understand effective problem-solving methodologies for sustainability in human-landscape interactions

CO4
Understand environmental planning and management:

CO5:
Understand the ecosystem services provided by the natural systems.

Unit I :
Environmental Geoscience: Environment--concept, definition, scope and importance; Ecosystem--the physical environment, atmosphere, hydrosphere and lithosphere; Anthropogenic environment. (10 hours)

Unit II :
Environment and Natural Processes:
Natural Resources: Renewable and Non-renewable resources and its utilization & Waste Generation, Concept of sustainable development. Issues affecting future development (population, urbanization, health, water scarcity, energy, climate change, toxic chemicals, finite resources etc.); Environmental units. (10 hours).

Unit III:
Environmental Pollution:
Water pollution--causes, effects, prevention and control. Water quality parameters and standards. Solid waste pollution- Domestic, industrial and urban wastes, Solid waste disposal and site identification, Nuclear wastes and safe disposal.

Air pollution--causes, effects, Air pollution and climate. Greenhouse Effect and Ozone Depletion. Air pollution preventive measures (14 hours)

Unit IV:

Environmental Planning and Management: Environmental Impact Assessment. Environmental Impact of urbanization. Geology and Urban planning. Role of Geologist in conservation of environment, Environmental protection legislations (10 hours)

Unit V:

Ecosystem services- River ecosystem, Natural flow regimes: The river ecosystem, Ecosystem functioning, River flood plain interaction, Interaction of flow with other ecosystem components, Impact of regulation of rivers, Environment flow concept and history, Environmental flow assessment. Wetlands and Ecosystem services, valuation of ecosystem services. (10 hours)

Books for Reference:

1. Valdiya, K.S. (1987) Environmental Geology—Indian Context, Tata McGraw Hills.
2. Strahler, A.N. and Strahler, A.H. (1973) Environmental Geosciences, Wiley Eastern.
3. Donald. R. Coates (1981) Environmental Geology, John Wiley & Sons.
4. Peter. T. Elawan (1970) Environmental Geology, Harper & Row.
5. Keller, E.A. (1978) Environmental Geology, Bell & Howell, USA.
6. Bryante (1985) Natural Hazards, Cambridge University Press.
7. Das, R.C. and Behera, D.K. (2008) Environment Science Principles and Practice, Prentice Hall of India.
8. Davis, et. al., (1976), Environmental Geoscience, Wiley Eastern.
9. Environmental flows- An introduction for Water resource Managers, Brij Gopal National Institute of Ecology, 2013

Marks including choice:

Unit	Marks
I	14
II	12
III	14
IV	10
V	10

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course XI: Disaster Management

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B11GEO	3	3	3

COURSE OUTCOME

CO 1:

Understand the different types of hazards, Risk, Vulnerability, concept of disaster management.

CO2:

Understand various geohazards, its causes, mitigation measures and preparation of hazard zonation maps

CO3:

Understand the three cycles of disaster management, warning systems, response and post disaster responsibility.

CO4:

Understand relationship between disasters and development and disaster management in India.

CO5

Understand disaster management plan and how to support the disaster management system in the State

Unit I

Understanding the Concepts and definitions - Disaster, Hazard, Vulnerability, Risk, Capacity building, Disaster and Development, Disaster management. Classification of disasters, Natural and Manmade, Hydro-meteorological, Geological, Accidental, chemical, Industrial, nuclear and Biological related. Global Disaster Trends – Emerging Risks of Disasters – Climate Change(10 hours).

Unit II

Geological Hazards - Earthquakes **–** Seismic zones classification and Seismic Zones in India, hazard Management, mitigation measures, warning system, Institutional mechanism in implementation.

Landslides**-** Morphology of landslides, causal factors for landslides, Classification of Conditions/Factors responsible for Landslides, landslide risk reduction measures. Tsunami **-** Causes, Vulnerability analysis, mitigation, early warning system and Tsunami Vulnerability

in India and preparedness. Volcanoes **–** causes, types, mitigation measures, warning system. Mine fire– causes, types, mitigation measures, warning system. Dam burst – causes, flood inundation mapping, mitigation measures, alert and warning systems. Geo-hazard mapping and preparation of zonation maps**.** (10 hours)

Unit III

Disaster Management- Risk reduction and Crisis Management, Disaster management cycle and its analysis, Pre-disaster phase, Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness, Community based disaster management, Understanding of warning and de-warning messages, Disaster Phase, Post disaster phase – Rehabilitation, Role of geologists in disaster management. (12 hours).

Unit IV

Disaster management and Development: Inter relationship between disasters and development; Geological factors contributing to Risk; Impacts of development projects such as dams, embankments, changes in land use.

Disaster Management in India- Hazards and vulnerability profiles of India, Institutional Mechanism, Role and Responsibility of various institutions- Panchayathi Raj Institutions, District, State and Central Governments and other stakeholders, Disaster Management Act and policy (16 hours)

Unit V

Disaster Management Plan -Preparation of District and State Disaster management plans – Framework -Coordinating and Monitoring Mechanism- Sections of the Framework-Suggested Outline-Disaster specific action plan (Flood, Landslide, Pesticide contamination, Road accident and Epidemics), Preparation of community level disaster management plans (6 hours).

Books for Reference:

1. David, A. (2000) Introduction in confronting catastrophe. Oxford Univ. Press.
2. Cuny, F. (1983) Development and disasters. Oxford University Press.
3. Govt. of India (2005) Disaster Management Act, New Delhi.
4. Govt. of India (2009) National Disaster Management Policy.
5. Gupta, A.K. and Nair, S.S. (2011) Environmental Knowledge for disaster Risk Management, NIDM, New Delhi.
6. Murthy, R.K. (2012) Disaster Management, Wisdom Press, New Delhi.
7. Tearfund (2006) Reducing risk of disaster in our communities, Disaster theory.
8. Vasudevan, V., Krishnan, K.R.S., Baba, M. and Kumar, P (eds.) Natural Hazards and

management strategies. XVIII Kerala Science Congress – 2006, KSCSTE.

9. Building PRI capacities for Disaster Preparedness and Management –UNDP

10. Humanitarian Charter and Minimum standards in Disaster response. The Sphere Project 2011.

11. Disaster management, Vinod K Sharma, Ed. Description: New Delhi: National Centre for Disaster Management, 2001 : 325p

12. All you wanted to know about Disasters, B K Khanna, New India publishing Agency, 2005

13. Disaster and Hazard management Namboodripad P., Oxford book house, 2008

14. Introduction to International Disaster Management, Elsevier Science (B/H), London Coppola D P, 2007

15. State of Environment Report Kerala 2007 Vol. 2 Natural Hazards, KSCSTE 2007

16. Management of Biological Disasters. NDMA 2008

17. Websites: www.http://nidm.gov.in

18. www.http://cwc.gov.in

19. www.http://ekdrm.net

Marks including choice:

Unit	Marks
I	10
II	12
III	14
IV	16
V	8

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*
- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

CORE COURSE XII : GEOINFORMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B12GEO	3	3	3

COURSE OUTCOME

CO 1:

Understand fundamentals and components of Geoinformatics.

CO2:

Understand history and development, components of and data types of GIS, GIS workflow,. Data entry into GIS. Basic digital map generation and introduction to GIS packages.

CO3:

Understand basic idea of GPS, GPS satellites, GPS receivers and uses of GPS.

CO4:

Understand basic aspects of satellite remote sensing, various data products of Indian Remote sensing missions, Google Earth and Bhuvan Geoportals.

CO5

Understand various sources of data for geoinformatics and its applications in geological studies.

Unit I

Geoinformatics: definition; Scope, development and importance of Geoinformatics. Allied disciplines and their interrelationships. GIS, Remote Sensing, GPS, Cartography, CAD, Aerial Photography, Photogrammetry. Web GIS and Mobile GIS. (8 hours)

Unit II

GIS: definition. History and development of GIS. Components of GIS. Data types: Spatial and attribute data; Raster and vector data; meta data. Thematic layers. GIS workflow: georeferencing, projection, transformation and topology creation. Data entry into GIS. Editing of layers, creating attribute data. Basic digital map generation.

Introduction to GIS packages: Free GIS: GRASS and QGIS; Commercial GIS: ArcGIS.

Toposheet, coordinates; Introduction to Gt Aide. (12 hours)

Unit III

Introduction to Satellite based navigation system. Basic idea of GPS, GPS satellites, space segment, ground and control segment, GPS receivers; uses of GPS, worldwide digital network of GPS. Basic idea of IRNNS and GAGAN. (12 hours)

Unit IV

Satellite remote sensing. Electromgnetic spectrum. Basics of optical, thermal and microwave remote sensing. Resolution concepts – spatial, spectral, temporal and radiometric resolution. Various data products of Indian Remote sensing missions: IRS, Cartosat and Resourcesat. Introduction to Google Earth and Bhuvan Geoportals. (12 hours).

Unit V

Sources of data for geoinformatics applications: Various maps, aerial photos, satellite imageries, ground survey with GPS, reports and publications, socioeconomic data and census data.

Geoinformatics applications in Geological Studies –Geological mapping, Groundwater management, Environmental geology and disaster management (10 hours)

Books for Reference:

1. Godchild M.F. and Kemp K. (1990) Developing a curriculum in GIS: The NCGIA Core curriculum project, University of California, Santa, Barbara.
2. Ian Haywood, Sarah Cornelius and Steve Carver (2000). An introduction to Geographical Information System, AddisionWesley Longman Ltd., New York
3. Misra H.C. (1995) A Handbook on GIS. GIS India, Hyderabad.
4. Smith T.R. and Piquet (1985) GIS. London Press, London.
5. Taylor D.R.F. (1991) GIS: The Microcomputer and Modern Cartography. Pergamon Press, Oxford.
6. Lo C.P. and Young A.K.W. (2003) Concepts & Techniques of Geographical Information System. Prentice Hall of India, New Delhi.
7. Craig D Knuckles (2000) Introduction to Interactive Programming on the Internet. John Wiley & Sons Inc.
8. Zhong-Ren Peng and Ming-Hsiang Tsou (2003) Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks.
9. Korte, G. B., (2001) The GIS book: 5th Edition, Onward press, Australia.
10. Kang-Stung-Chang (2002) Introduction to Geographical Information Systems. Tata McGraw Hill Publishing Co.
11. StephenWise (2002) GIS Basics. CRC Press.
12. Ahmed El-Rabbany (2002) Introduction to GPS: The Global Positioning System. Artech House, Boston.
13. HofmannW. (2001) GPS Theory and Practice. H. Lichtenegger & J. Collins, Springer- Wien, New York.
14. Brijesh,V.K.,(2017).Pictorial Kit for beginners-GIS,ARC-GIS,Q-Field. Notion press.com, India, ISBN:978-1-947851-94-8.
15. Dinesh, A.C.,Sajesh, P.V. and Nisha, N.V (2019). Gt Aide (Academi)- An idea for interactive learning.

Marks including choice:

Unit	Marks
I	10
II	14
III	14
IV	12
V	10

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course XIII : GEOLOGY OF INDIA

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B13GEO	3	3	3

COURSE OUTCOME

CO 1:

Understand the physiographic and major geological divisions of India. Geological time scale and its representative in Indian stratigraphy, early Precambrian terrains of India and the concept of cratons and mobile belts

CO2:

Understand Archaean succession of India with special reference to stratigraphy, lithology and structure, Dharwar , Aravalli, Delhi, Cuddapah Vindhyan and Kurnool Supergroup
Brief study of Precambrian Geology of Kerala.

CO3:

Understand Palaeozoic stratigraphic succession and associated fossils of Spiti region, marine Mesozoic succession in India, Triassic succession of Spiti, Jurassic succession of Spiti and Kutch, Cretaceaous succession of Trichy and Narmada Valley and Bagh Beds.

CO4:

Understand Gondwana Supergroup and age probems of Deccan traps.

CO5

Understand Cenozoic succession of India, Cenozoic succession of Assam, Siwalik Supergroup. Cuddalore sandstone, Quilon and Warkalli formations. Karewa Group and Indo-Gangetic Alluvium.

Unit I

Brief study of the physiographic divisions of India. Major geological divisions of India. Geological time scale and its representative in Indian stratigraphy. General study of Early Precambrian terrains of India and the concept of cratons and mobile belts. (6 hours).

Unit II

Archaean succession of India. Sargur Supergroup: distribution, lithology, structure, associated intrusives and economic resources. Proterozoic succession of India: General distribution and major lithounits. Geographic distribution, lithological features, classification, structural features, associated magmatism, organic remains, age and economic importance of the following lithostratigraphic units:

a. Dharwar Supergroup b. Aravalli Supergroup

c. Delhi Supergroup d. Cuddapah Supergroup
e. Vindhyan Supergroup f. Kurnool Supergroup (18 hours)

Unit III

Palaeozoic stratigraphic succession and associated fossils of Spiti region and its Precambrian foundation in India. Distribution of marine Mesozoic succession in India and detailed study of the following:

a. Triassic succession of Spiti. b. Jurassic succession of Spiti and Kutch.
c. Cretaceaous succession of Trichy and Narmada Valley. d. Bagh Beds. (10 hours).

Unit IV

Gondwana Supergroup: geographic distribution, nature of Gondwana basins, environment of deposition, lithology, organic remains, age and economic resources. Deccan traps: extent, distribution, classification, lithology, inter trappeans and infra trappeans. Age of Deccan Traps. (8 hours).

Unit V

Cenozoic succession of India: A brief study of Palaeogene and Neogene lithounits and their distribution in India. Detailed study of the following:

a. Cenozoic succession of Assam. b. Siwalik Supergroup. c. Cuddalore sandstone
d. Karewa Group. e. Indo-Gangetic Alluvium.

Geology of Kerala – Pre-Cambrian, Tertiary and Quarternary formations of Kerala. Brief study of Quilon and Warkalli formation. (12 hours).

Books for Reference:

1. Krishnan, M.S. (1982) Geology of India and Burma, 6th edition.
2. Ravindra Kumar (1985) Fundamentals of Historical Geology and Stratigraphy of India.
3. Soman,K (2002) Geology of Kerala, Geological Society of India, 2 revised edition,1-331
4. Wadia D. N. (1944) Geology of India. MacMillan and Co. Limited.
5. Vaidyanadhan, R. and M. Ramakrishnan (2008) Geology of India (Volume I and II). Geological Society of India, Bangalore.

6.Geological survey of India (2015). Miscellaneous publication no. 30. Geology and mineral resources of the states of India, Part IX – Kerala

Marks including choice:

Unit	Marks
I	8
II	18
III	12
IV	10
V	12

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Discipline Specific Elective Course I: GEMOLOGY

Semester	Course Code	Hours per week	Credit	Exam Hours
VI	6B14AGEO	2	2	3

COURSE OUTCOME

CO 1:

Understand basic properties gem stones and crystals, qualities and classification of gem stones.

CO2:

Understand physical properties of Gemstones and the instruments used to measure.

CO3:

Understand optical properties of Gemstones and the instruments used to measure.

CO4:

Understand methods of enhancement and treatments of gem stones.

CO5:.

Understand industrial aspects of gem stones, Gem industrial centers of India and world and Gem stones of India.

Unit I

Introduction to Gems - Basic properties of gems. Origin of gem stones. Nature of gem material: quality essential in gems-beauty, durability, rarity. Crystal form and habit: crystalline, amorphous and metamict minerals. Gem stones -classification and uses. Observations with hand lens. Units of measurement: metric scale, carat, pearl and grain.(6 Hours)

Unit II

Physical properties: hardness - its applications and limitations in gemmology. Cleavage, Fracture, parting, and their significance in gemology and lapidary work. Specific gravity-utility and determination by hydrostatic weighing, heavy liquids, floation and pycnometer. Inclusions and other features of gemstones. Identification of rough stones. (6 Hours)

Unit III

Optical properties: The electromagnetic spectrum, reflection and its importance in gemology-lustre, aventurescence, sheen, chatoyancy, asterism, luminescence, play of colours, labradorescence, inclusions etc. Laws of refraction, refractive index (R.I), total reflection- in design of refractometer. Construction and use of refractometer. Polariscope-

construction and use in gemmology. Dichroscope construction, use of Chelsea colour filter, Infra-red ultraviolet and x-rays in gem identification. (8 Hours)

Unit IV

Enhancement and treatments- enhancement methods -coloured and colourless impregnation, dyeing, bleaching and its identification. Methods of treatment – laser drilling, irradiation, heat treatment, surface modifications, diffusion treatment and its identification. Composites - types, classification and identification.(8 Hours)

Unit V

Gem cutting instruments, Industrial applications of gem stones, Gem industrial centeres of India and world, Gem stones of India – Distribution, geological setting and genesis. Gem stones of Kerala. (8 Hours)

Books for Reference:

1. Karanth,R.V. (2000). Gem and gem industry in India, Memoir 45, Geological Society of India, Bangalore.
2. Babu,T.M. (1998). Diamond in India, Economic Geology Series 1, Geological Society of India, Bangalore.
3. Hall,C. (2005). Gemstones, Dorling Kindersley,London.
4. Sinkankas,J.J. (1964). Mineralogy: A first Course, Van Nostrand Reinhold, New York.
5. Krishnan,M.S. (1964). Mineral Resources of Madras, Memoir Vol 80, Geological Survey of India ,Kolkota
6. Prasad,U. (2003). Economic Mineral Deposits, CBS Publishers, New Delhi.
7. Read,P.G. (1984). Beginner's Guide to Gemmology, Heinemann Professional Publishing Ltd,London.
8. O'Donoghue,M. (2006). Gems. Elsevier, Singapore.
9. Keller,P.C. (1990). Gemstones and their origins, Van Nostrand Reinhold, New York.
10. Herbert Smith,G.F (1912). Gemstones. Metheun,London.
11. Read,P.G. (2005). Gemmology, 3rd ed. Elsevier,Singapore.
12. Walton,L. (2004). Exploration Criteria for Colored Gemstones, Canada.

Marks including choice:

Unit	Marks
I	12
II	12
III	12
IV	12
V	12

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Discipline specific elective course II: MINING GEOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14BGEO	2	2	3

COURSE OUTCOME

CO 1:

Understand geological sampling and geological logging.

CO2:

Understand explosives and breaking of rocks, surface mining methods, stoping and shaft sinking.

CO3:

Understand subsurface mining methods, coal mining and mining terms.

CO4:

Understand mineral economics, national mineral policy, forest policy and mineral concession rules.

Unit I

Sampling of ores and minerals: definition and types of samples. Outline of sampling methodology. Core samples and their preservation. Drilling – brief account of different types of drilling – Geological logging of borehole samples. (8 Hours).

Unit II

Methods of breaking rocks – A short note on explosives. Definition of mining terms: Shaft, Level, Adit, Hanging wall, Footwall, Drive, Cross cut, Tunnel, Raise, Winze and Chute.

Surface mining: open cast mining - Machineries. Alluvial mining: Panning –Rocker-Sluicing – Hydraulicking – Dredging -–shaft sinking and its methods. (10 hours)

Unit III

Underground mining: Criteria to choose subsurface mining, Stoping – Open stopes – Supported stopes – pillar – Square set filled – Shrinkage stopes, Glory hole mining. Caving methods: Top slicing, Sub level caving, Block caving, Coal mining: Prospecting and Planning – Strip mining –Room and Pillar method – Long wall methods- Horizon mining. (10 Hours).

Unit IV

Introduction to Mineral Economics; Essential critical and strategic minerals Demand and Supply. National Mineral Policy – Problems and Prospects. Evolution of National Mineral policy – Ideal Scope of a mineral policy – Categories of minerals for grant of concessions – Minor minerals – Major minerals. Procedure for obtaining mineral concession. Kerala Minor Mineral Concession Rules 1967; Forest policy. (8 hours)

Books for Reference:

1. R.N.P. Arogyasamy, Courses in mining Geology, Oxford & IBH Publishing Co.
2. Mckinstry- Mining Geology.
3. K.K. Chatterjee -An Introduction to Mineral Economics.
4. R.K. Sinha & N.L. Sharma- Mineral Economics.
5.Thomas R.T. (1979) – An Introduction to Mining – Methun.

Marks including choice:

Unit	Marks
I	12
II	12
III	12
IV	12
V	12

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - Essay (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Discipline specific elective course III: EXPLORATION GEOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14CGEO	2	2	3

COURSE OUTCOME

CO 1:
Understand the various techniques used for mineral exploration, basic principles, instruments, data generation in the field and exploration.

CO2:
Understand gravity and magnetic methods of surveying.

CO3:
Understand electrical method of surveying.

CO4:
Understand seismic methods of surveying.

Unit I

Geochemical Exploration: definition and scope. Basic principles: Concepts of background, threshold, and anomalous values. Distribution of elements near ore bodies: primary, secondary, and leakage haloes. Lithogeochemical and hydrogeochemical methods. (6 Hours)

Unit II

Gravity Method: Gravity and Newton's Law of Gravitation. Gravity measurements: Absolute and relative. Gravimeters: Outline of Stable and Unstable gravimeters. Gravity Surveys. Applications and limitations.

Magnetic Methods: magnetic field of the Earth. Magnetic character of rocks and minerals. Units of measurement. Magnetometers: Types. Magnetic surveys. Applications and limitations of magnetic methods. (8 Hours).

Unit III

Electrical Methods: Definition – Ohm's Law – Resistivity and conductivity – Electrical properties of rocks and minerals - Units of measurement. Resistivity surveying equipment. Electrode configurations: Wenner – Schlumberger and dipole. Applications and limitations of resisitivity methods. Vertical Electrical Sounding in groundwater exploration. (10 Hours).

Unit IV

Seismic Methods: General principles. Methods for artificial seismic waves. Recording equipment. Geophones – types and their limitations. Seismic refraction Methods: Principle – Instruments and equipment – Field Methods: Fan, Arc, and Profile shooting. Seismic reflection Methods: Principle - Instruments and equipment – Field Operations: Shot point and Detector spreads. Applications and limitations. (12 Hours).

Books for Reference:

1. Banerjee,P.K. & S.Ghosh. (1997). Elements of Prospecting for Non Fuel Mineral Deposits. Allied. Chennai.
2.Arogyaswamy,R.N.P. (1980). Courses in Mining Geology.Oxford & IBH,New Delhi.
3.Hawkes,H.E. (1959). Principles of Geochemical Prospecting. Bulletin 1000F.USGS.
4.Moon,C.J et al.(2006). Introduction to Mineral Exploration. Wiley Blackwell. New Delhi.
5.Ramachandra Rao,M.B. (1993). Outlines of Geophysical Prospecting. EBD Publishers, Dhanbad.
6.Kearey,Pet al.(2002). An Introduction to Geophysical Exploration. Wiley. Delhi.
7.Mussett,A.E.& Khan,M.A.(2000). Looking into the Earth. Cambridge University Press, New Delhi.
8. Sharma,P.V. (2005). Environmental and Engineering Geophysics. Cambridge University Press. Delhi.
9. Prasad,U. (2003). Economic Mineral Deposits. CBS. Delhi.
10. Banerjee,D.K. (1998). Mineral Resources of India.World Press. Kolkata.
11. Deb,S.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.

Marks including choice:

Unit	Marks
I	14
II	14
III	16
IV	16

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Discipline specific elective course IV: GEOTECHNICAL ENGINEERING

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14DGEO	2	2	3

COURSE OUTCOME

CO 1:
Understand weathering and its significance in civil engineering. Soil and its field identification,engineering classification of soils and soil mechanics

CO2:
Understand physical and mechanical characters of soils and its determination, particle size and sieve analysis.

CO3:
Understand various engineering tests applicable to soil, soil stabilization, and engineering properties of laterite as an example.

CO4:
Understand geological materials for engineering works and constructions.

CO5:
Understand Geology for site investigations for dams and reservoirs,tunnels, roads and railways, bridges and buildings

Unit I
Weathering and its significance in civil engineering. Soil - genesis and profile and field identification. Engineering classification of soils. Soil mechanics. (4Hours)

Unit II
Water content in soils, specific gravity of soils, void ratio, porosity, water content determination, specific gravity determination, (open drying method for water content determination and density bottle method for specific gravity determination). Particle size of soils, sieve analysis. Particle size distribution curve and its uses, plasticity of soils, consistency limits, permeability of soils, coefficient of permeability, constant head permeability test. (8 Hours.)

Unit III
Effective stress and its importance, consolidation of soils, behavior of saturated soil under pressure, consolidation tests. Shear characteristics of soils and triaxial compression tests.

Compaction of soils and compaction tests (standard Procter test).Soil stabilization,. Standard penetration test, pile foundations. Engineering properties of laterites. (8 Hours.)

Unit IV

Geological materials used in construction. Building stones, roofing and facing materials, concrete aggregate, road aggregate, gravels and sands, Possolanic materials. (8Hours)

Unit V

Geology for site investigations for dams and reservoirs, tunnels, roads and railways, bridges and buildings. (8 Hours.)

Books for Reference:

1. Geology for engineers, (2006).,Blith FGH and Freitas M.H – Butterworth- Heinemann, Oxford;7th edition.

2.Principle of engineering geology and geotectonics (1957), Dimitri P Krynine, William F Judd, Mc Graw Hill, Newyork,.

3.Engineering geology, (2007).Bell.F.G., Butterworth- Heinman, Oxford, 2nd edition.

4. A text book of engineering and general geology. (1992).Parbin Singh,S K Katharia and sons, New Delhi.

5. A Text Book of Engineering Geology (1993) Kesavulu, N.C., Macmillan India Ltd., New Delhi.

Marks including choice:

Unit	Marks
I	10
II	14
III	12
IV	12
V	12

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - Essay (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Discipline specific elective course V: HYDROGEOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14EGEO	2	2	3

COURSE OUTCOME

CO 1:

Understand the origin of groundwater and its distribution, Springs and types, and aquifers and its types.

CO2:

Understand rock properties affecting movement of groundwater, Darcy's law and its determination.

CO3:

Understand Groundwater exploration by electrical resistivity method, well design, groundwater fluctuations and recharge methods.

CO4:

Understand sea water intrusion and control measures and groundwater quality parameters and standards of WHO and BIS.

CO5:

Understand groundwater recharge methods and rainwater harvesting.

Unit I

Definition of hydrogeology and groundwater – Types of groundwater based on origin - Hydrological cycle - Vertical distribution of ground water – Springs: types, geological conditions favoring development of springs - Definition of aquifers, aquitards, aquifuges and aquicludes - Types of Aquifers: unconfined, semi-confined, confined and perched – Artesian wells. (8 hours)

Unit II

Rock properties affecting groundwater: types of openings, porosity, specific yield, specific retention and permeability – Groundwater movement – Darcy's law and its applications – Determination of permeability in field and laboratory.(6 hours)

Unit III

Groundwater exploration by electrical resistivity method – Outline of dug wells, tube wells, jetted wells, infiltration galleries and collector wells – Well design and development – Fluctuations of groundwater – Groundwater recharge methods. (6 hours)

Unit IV

Sea water intrusion: causes, consequences and, preventive and control measures. Ground water quality– Parameters considered for assessing groundwater quality -suitability for

drinking and irrigation purposes – The latest drinking and irrigation water standards of World Health Organization and Beuro of Indian Standards – Waterborne diseases .(8 hours)

Unit V

Groundwater Recharge:- Recharge methods - Basin method, Stream channel method, Ditch or Furrow method, Flooding method, Irrigation method, Pit method, Recharge well method. Rainwater Harvesting systems. (8 hours).

Books for Reference:

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

Marks including choice:

Unit	Marks
I	10
II	10
III	15
IV	15
V	10

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 = 6)

- **Answer all questions** (*6 questions x Mark 1 = 6*)

Part B - **Short Essay** (8 questions x Marks 2 each =16)

- ***Answer any 6questions*** *(6questions x Marks 2 each=12)*

Part C - **Essay** (6 questions x Marks 3 each =18)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -60**
- ***Maximum marks of the course- 40***

Core Course: Practical II - IGNEOUS, SEDIMENTARY AND METAMORPHIC PETROLOGY

Semester	Course Code	Hours per Week	Credit	Exam Hours
VI	6B15GEO	3	4	3

Course Outcome

CO 1:

Identify igneous, sedimentary, metamorphic rocks specimens and thin sections with mineralogy and texture.

Igneous, Sedimentary and Metamorphic Petrology

Megascopic and microscopic identification of the following rocks:

Granite, Graphic granite, Pegmatite, Aplite, Granite Porphyry, Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite, Dolerite, Basalt, Vesicular Basalt, Amygdaloidal basalt, Rhyolite, felsites, Obsidian, Pumice, Lamprophyre.

Conglomerate, Breccia, Sandstone, Arkose, Shale, Limestone, Laterite, Chert, Grit. Fossiliferous limestone, Kankar limestone.

Slate, Phyllite, Schists, Gneisses, Quartzite, Marble, Amphibolite, Eclogite, Charnockite, Khondalite, Banded Magnetite quartzite, mafic granulite and Khondalite

Core course:PRACTICAL- III PALAEONTOLOGY, ECONOMIC GEOLOGY AND GEOINFORMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK*	CREDIT	EXAM HRS
VI	6B16GEO	4	4	3

*2 hours for Geoinformatics, 1 hour for Economic geology and 1 hour for Palaeontology

Course Outcome

CO 1:

Recognizing megafossils based on morphological features.

CO2:

Identify economic mineral specimens by observing characteristic features.

CO3:

Application GIS in the generation of digital elevation model, preparation of thematic layers and Gt. Aide

PALAEONTOLOGY

Morphological studies of the following fossils

Protozoa: Lagena, Nodosaria, Textularia, Nummulites, Globigerina.

Coelentrata: Calceola, Zaphrentis, Halysites, Favosites, Montlivaltia.

Arthropoda : Calymene, Phacops, Olenus, Olenellus and Paradoxides.

Brachiopoda: Spirifer, Productus, Terebratula, Rhynchonella, Athyris, Orthis, Lingula

Mollusca: Gasteropoda (Natica, Turbo, Trochus, Turritella, Cerethium, Conus, Murex, Cypraea, Physa

Cephalopoda: Nautilus, Goniatites, Orthoceras, Phylloceras, Baculites, Schloenbachia, Ceratites, Acanthoceras

Pelecypoda: Arca, Trigonia, Nucula, Spondylus, Pecten, Inoceramus, Ostrea, Gryphaea,Alectryonia.

Echinodermata: Pentacrinus, Cidaris, Hemicidaris, Echinus, Micraster, Holaster, Encrinus.

Plant fossils: Glossopteris, Gangamopteris, Ptilophyllum, Lepidodendron, Sigillaria, Calamites, Elatocladus.

ECONOMIC GEOLOGY

Megascopic identification of important ore minerals:

Ore minerals of Iron (Hematite, Magnetite, Siderite, Banded Hematite Quartizite and Banded Magnetite Quartizite)

Manganese (Pyrolusite, Psilomelane, Wad)

Aluminium (Bauxite)

Lead and Zinc (Galena, Sphalerite)

Copper (Chalcopyrite, Malachite, Azurite, Bornite and native copper)
Chromium minerals (Chromite)
Micas (Muscovite and Biotite), Talc
Refractories (Graphite, Kyanite, Sillimanite, Barite)
Asbestos minerals (Chrysotile and Serpentine)
Sulphur minerals (Sulphur, Pyrite, Orpiment, Realgar)
Abrasives (Quartz, Corundum, Garnet)
Gemstones (Tourmaline, Garnet, Topaz and Beryl)
Fertilizer minerals (Gypsum, Anhydrite, Calcite, Dolomite)
Coal (Peat, Lignite, Bituminous coal, Anthracite)
Petroleum (Crude oil)
Radioactive minerals (Monazite, Ilmenite, Rutile)
Clay minerals (Kaolinite, Ball clay)

GEOINFORMATICS

Basic operations of the GPS
Field spatial data collection.
Generation of thematic layers.
Demonstration of any GIS package.
Spatial and non spatial data base generation in Q -GIS
Generating a simple map with the GIS
Digital Elevation Models.
Gt. Aide package.

Core course : FIELD WORK/ STUDY TOUR

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B17GEO	2	2	-

Course Outcome

CO 1:

Understands the various features in the earth, different rock types, minerals, fossils and structures.

CO2:

Document and creates reports of the field study.

Field work/ study tour

Geology is a field science which requires study tour and field work. The study cannot be restricted to a small area for better understanding of the subject. The field trip includes visit to Ghat sections, Underground mines, Open cast mines, beaches, oceans, rivers, valleys plains, plateaus, deserts, glaciers, mountains, lakes, backwaters and so on. Resource mapping is an integral part of the study tour. Visit to institutions where geological investigations and research works are undertaken are important. Specimen collection, documentation and report writing is part of the work. As far as possible this shall be done in all the three years. Without filed work the study of geology will not be complete. The study tour to areas of geological importance is mandatory during VI Semester. The samples collected during the study tour / field work under the guidance of geology teachers are to be properly labeled and displayed before the examiners appointed by the university. The report, properly signed by teachers and Head of the Department, shall be submitted for End Semester Evaluation.

Books for Reference:

1.Lahee, F.H.,(1961). Field Geology, Mc Graw-Hill book company, 926p

2. Robert R. Compton (1962). Manual of field geology, Wiley Eastern private Limited, New Delhi, 378 p.

3.Gokhale, N.W.(2003).Theory of structural geology, CBS Publishers and distributors, New Delhi, India.

4.Mathur, S.M.,(2001). Guide to field geology,Pentice Hall of India Pvt. Ltd., New Delhi, 203p.

5. Gokhale, N.W (2012). A guid to field Geology. CBS Publishers and distributors, New Delhi, India.

Core course : PROJECT

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B18GEO	2	2	-

The purpose of doing project work and preparing project report is to understand scientific observation, experimentation and documentation to produce new data that can contribute new knowledge to the specific domain. At B.Sc.(Geology) level, a group project work consisting of 3 to 6 members, based on field visit followed by laboratory work and documentation is suggested. One/ two days field work carried out under the guidance of geology teachers with proper sampling, field photos, field observations/measurements etc. in the specific area / domain of interest that falls within the broad purview of syllabus is to be carried out and report produced and submitted. The project report must be properly authenticated by the student/s, guide/s and the head of the Department along with the certification as to the originality of the work. The project report will be evaluated as per the university guidelines.

Books for Reference:

1.Lahee, F.H.,(1961). Field Geology, Mc Graw-Hill book company,926p2. Robert R. Compton (1962). Manual of field geology, Wiley Eastern private Limited, New Delhi, 378 p.
2.Mathur, S.M.,(2001). Guide to field geology,Pentice Hall of India Pvt. Ltd., New Delhi, 203p.
3.Robert R. Compton (1962). Manual of field geology, Wiley Eastern private Limited, New Delhi, 378 p.

PART B:

GEOLOGY COMPLEMENTARY ELECTIVE COURSES

[FOR B.SC GEOGRAPHY PROGRAMME]

WORK AND CREDIT DISTRIBUTION

(2019 ADMISSION ONWARDS)

Course code	Course title	Semester	Hours / week	Credit	Exam hours	Marks		
						Internal	External	Total
1C 01GEO	Geology I	I	2	2	3	8	32	40
	Geology I practical		2	0				
2C 02GEO	Geology II	II	2	2	3	8	32	40
	Geology II practical		2	0				
	Geology III	III	3	2	3	8	32	40
3C 03GEO	Geology III practical		2	0				
4C 04GEO	Geology IV	IV	3	2	3	8	32	40
4C05 GEO(P)	Geology practical*		2	4	3	8	32	40

*End semester Examination includes practical done in all the 4 semesters.

EVALUATION

Assessment	Weightage
EXTERNAL	4
INTERNAL	1

Continuous Evaluation (Theory)

Component	Weightage	Remarks
Component 1 Test paper	50%	Best of the two to be awarded for more than one test paper /assignment conducted
Component 2 Assignment	50%	

Consolidation of marks for Continuous Evaluation of theory is as follows:

Theory		
Component I Test paper Max. marks 4	**Component II Assignment Max. marks 4**	**Total Max.marks 8**

End semester evaluation-Theory

The ESE in theory course is to be conducted with Question Papers set by external experts. External evaluation carries 80 % of the total marks. The evaluation of the answer scripts shall be done by examiner based on a well-defined scheme of valuation and answer keys. The duration of theory examination shall be 3 hours with a total mark of 32 . (See model Question Paper).

Continuous Evaluation (Geology Practical)

Lab involvement & Records: Lab involvement is to be assessed during the practical classes by the teacher in charge. Quality of Lab Records is to be assessed by the teacher concerned on the basis of quality of observation books and lab records. Records must be properly certified by the teacher(s) and Head of the Department.

Practical Test papers: shall be conducted by teachers-in-charge and marks shall be given based on the student's performance.

Practical		
Lab involvement & Record Max. marks 4	**Practical test paper Max. marks 4**	**Total Max. marks 8**

Scheme for conducting Practical Examinations (ESE)

The university examinations in practical courses will be conducted by examiners appointed by the university. The scheme suggests the following within the purview of the syllabus.

Practical I (Total marks -32)

. Exercises in identification of salient topographic and drainage features using topographic maps of Survey of India. Measurement of slope and distance in topographic maps. Megascopic identification of rock forming minerals and ore minerals listed in the theory part of the syllabus.

Megascopic identification of igneous, sedimentary and metamorphic rocks listed in the theory part of the syllabus. Determination of strike and dip of formations from maps. Interpretation of geological maps with simple structures (fold, fault, unconformity).

The candidate shall be permitted to attend the practical exam only if he/she submits certified bonafide Laboratory records of Practical work done.

.

COMPLEMENTARY ELECTIVE COURSE I: GEOLOGY I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	1C01 GEO	2	2	3

COURSE OUTCOME

CO 1:

Understands earth as a member of solar system, origin, age, size, internal structure of earth and rock cycle.

CO2:

Understands internal and external processes of earth, Rock weathering, Soil type and its profile, soil erosion, oil types of Kerala. Continental drift . Plate tectonics. Seafloor spreading and Palaeomagnetism.

CO3:

Understands Mass wasting , its types Causes and effects, Concept of isostasy. Orogeny and epirogeny and Mountains.

CO4:

Understands sources, occurrence and geological work of groundwater, Hydrologic cycle, hydrologic properties of water bearing rocks, types of aquifers, springs; Conservation of groundwater.

Unit I

Introduction to Earth Science, Earth and Solar System, Origin of the earth, Age of the earth. Relative age and absolute age . Size of the earth. Internal constitution of the earth –Crust , Mantle and Core. Interior of the earth .The rock cycle – Igneous, Sedimentary and Metamorphic Rocks. (10 hours).

Unit II

Internal and external processes. Rock weathering. Agents and causes of weathering, Physical and chemical weathering. Soil -Types and Classification of soil . Soil profile. Soil erosion, soil type of Kerala, Continental drift. Plate tectonics. Seafloor spreading . Palaeomagnetism.(10 hours).

Unit III

Mass wasting . Different types of mass wasting. Causes and effects of landslides.

Concept of isostacy. Orogeny and epeirogeny . Mountains,types and mountain building.Origin of Himalayas. (8 hours).

Unit IV

Groundwater. Sources. Hydrologic cycle. Occurrence of groundwater. Hydrologic properties of water bearing rocks – aquifers , aquicludes,aquitard aquifuge. Types of aquifers – confined, unconfined and artesian aquifers, springs . Geological work of underground water.Karst topography. Conservation of groundwater, artificial recharge of ground water. (8 hours).

Books for Reference:

1. Thompson, G. R. and Turk, J. (1997) Introduction to Physical Geology. 2nd Edn. Thompson Brooks Publishers.
2. Carlson, D. and Plummer, C. (2010) Physical Geomorphology: Earth Revealed. 9th Edn., Mc-Graw Hill Co.
3. Bloom, A.L. (1992) Geomorphology, Second Edition, Prentice Hall India Pvt. Ltd., New Delhi.
4. Holmes, A. (1981) Principles of Physical Geology. ELBS, Third Edition. Thomas Nelson.
5. Physical Geology: Exploring the Earth James Stewart Monroe, Reed Wicander 2005 Thomson Brooks/Cole 644 page
6. Cliffs Quick Review Physical Geology Mark J. Crawford 1998 Wiley 258 p
7. Earth: An Introduction to Physical Geology Edward J. Tarbuck, Frederick K. Lutgens, Dennis Tasa 2007 Pearson 720 p
8. Strahler, A.N. (1971) Earth Sciences. 2nd Edition, Harper and Row.
9. Thornbury, W.D. (1968) Principles of Geomorphology, Wiley.
10. Laboratory Manual for Physical Geology James H Zumberge, Robert H. Rutford, James L Carter 2006 McGraw-Hill Higher Education 289 p.

11. How Does Earth Work?: Physical Geology and the Process of Science Gary Allen Smith, Aurora Pun 2006 Pearson Prentice Hall 641 p.

Marks including choice:

Unit	Marks
I	14
II	14
III	14
IV	10

About the Pattern of Questions:

Part A - **Short answer** **(5questions x Mark 1 = 5)**

- **Answer all questions** **(*5 questions x Mark 1 = 5*)**

Part B - **Short Essay** **(6 questions x Marks 2 each =12)**

- ***Answer any 6questions*** ***(4questions x Marks 2 each=8)***

Part C - **Essay** **(5 questions x Marks 3 each =15)**

- ***Answer any 4 questions*** ***(3 questions x Marks 3 each=9)***

Part D - **Long Essay** **(4 questions x Marks 5 each =20)**

- ***Answer any 2 questions*** ***(2 questions x Marks 5 each=10)***

- **Total marks including choice -52**
- ***Maximum marks of the course- 32***

COMPLEMENTARY ELECTIVE COURSE II: GEOLOGY II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	2C 02 GEO	2	2	3

COURSE OUTCOME

CO 1:

Understands stream flows, types of streams, drainage basins, drainage patterns, geological work of streams and associated land forms.

CO2:

Understands geological work of glaciers, wind, oceans and seas and related land forms and deposits.

CO3:

Understands types, mechanism and distribution of volcanoes and earthquakes, seismic waves and seismic belts.

CO4:

Understands crystals, minerals and physical properties of minerals and differentiate Chemical composition and diagnostic properties of some specific minerals

Unit I :

Streams – overland flow, channel flow. Types of streams. Drainage basins, patterns. Geological work of streams – erosion, transportation, deposition – types of loads – long profile of stream – Graded stream. Concept of base level – Fluvial aggradational and degradational landforms. (8 hours).

Unit II :

Glaciers – types, distribution, geological work – glacial landforms, moraines. Wind – geological action of wind – aeolian landforms .Oceans and seas – geological activity of ocean and sea waves. Sea level changes and their causes. Submarine topography, coral reefs, coastal landforms – marine sediments. (8 hours)

Unit III:

Volcanoes – mechanism, types, products. Distribution of volcanoes, volcanic landforms. Earthquakes – causes, types, seismic waves, epicentre, focus, isoseismal lines, intensity and magnitude, Seismic belts. (8 hours).

Unit IV:

Minerals and crystals – study of crystals and its significance in mineral identification. Physical properties of minerals – colour, streak, lustre, transparency, fracture, cleavage, hardness, specific gravity, magnetism. Chemical composition and diagnostic properties of the following minerals:-Quartz, feldspar, biotite, muscovite, hornblende, calcite, garnet,

hematite, gypsum, kyanite, sillimanite, magnetite, chromite, pyrite, chalcopyrite, beryl, magnesite, fluorite, talc, pyrolusite, galena, dolomite, corundum, graphite, sphalerite, diamond, coal, asbestos, monazite, bauxite. (12 hours)

Books for Reference:

1. Thompson, G. R. and Turk, J. (1997) Introduction to Physical Geology. 2nd Edn. Thompson Brooks Publishers.
2. Carlson, D. and Plummer, C. (2010) Physical Geomorphology: Earth Revealed. 9th Edn., Mc-Graw Hill Co.
3. Bloom, A.L. (1992) Geomorphology, Second Edition, Prentice Hall India Pvt. Ltd., New Delhi.
4. Holmes, A. (1981) Principles of Physical Geology. ELBS, Third Edition. Thomas Nelson.
5. Mcalister, A.L. and Hay, E.A. (1975) Physical Geology, Principles and Perspectives. Prentice Hall Inc. London.
6. Strahler, A.N. (1971) Earth Sciences. 2nd Edition, Harper and Row.
7. Thornbury, W.D. (1968) Principles of Geomorphology, Wiley.
8. Dana, E.S. (1962) A text book of Mineralogy (Revised by Ford). Asia Publishing House, Wiley.
9. Philips F.C. (1956) An Introduction to Crystallography. Longmans Green 20
10.Read, H.H. (1984) Rutley's Elements of mineralogy. CBS Publishers, Delhi

Marks including choice:

Unit	Marks
I	10
II	14
III	12
IV	16

About the Pattern of Questions:

Part A - Short answer (5questions x Mark 1 = 5)
- **Answer all questions (*5 questions x Mark 1 = 5*)**

Part B - Short Essay (6 questions x Marks 2 each =12)
- ***Answer any 6questions (4questions x Marks 2 each=8)***

Part C - Essay (5 questions x Marks 3 each =15)
- ***Answer any 4 questions (3 questions x Marks 3 each=9)***

Part D - Long Essay (4 questions x Marks 5 each =20)
- ***Answer any 2 questions (2 questions x Marks 5 each=10)***
- **Total marks including choice -52**
- ***Maximum marks of the course- 32***

COMPLEMENTARY ELECTIVE COURSE III: GEOLOGY III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3 C 03 GEO	3	2	3

COURSE OUTCOME

CO 1:

Understands properties of magma, types of lava, texture, occurrence and classification of igneous rocks

CO2:

Understands sediments, texture and structure and classification sedimentary rocks.

CO3:

Understands types, factors and textures of metamorphic rocks and megscopic study of specific rocks.

CO4:

Understands topographical and geological maps, attitude of geological surface, types of geological structures, fold, unconformity, fault, foliation and lineation

Unit I :

Magma – physical and chemical properties, lava and its types. Igneous rocks – texture, mode of occurrence – dykes, sills, laccolith, lopolith, stock, batholith, phacolith. Classification of igneous rocks – megascopic study of igneous rock types – granite, pegmatite,dolerite, basalt, dunite, syenite and gabbro (10 hours)

Unit II :

Brief study of sediments and sedimentary rocks. Structural and textural features, Classification of sediments and sedimentary rocks. Megascopic study of the following sedimentary rocks – sandstone, shale, limestone, conglomerate, laterite. (10 hours)

Unit III:

Metamorphism – types and factors. Textures of metamorphic rocks. Megascopic study of the following metamorphic rocks – slate, schist, gneiss, marble, charnockite, khondalite. (10 hours)

Unit IV:

Topographical maps and geological maps – their preparation, conventional symbols. Outcrops, strike and dip of surfaces,primary and secondary structures, unconformities and their geological significance. Folds and its geometrical elements,Brief study of the following – antiform, synform, anticline, syncline, isoclinal fold, recumbent fold, overturned fold, geanticline, geosyncline, anti and synclinoriums.

Faults – terminologies, types, study of the following – normal, reverse, strike slip and dip slip faults, horst, graben, rift valley. Joints – types and geological significance. Foliation and lineation. (24 hours)

Books for Reference:

1. Tyrrell, G.W. (1978) The principles of petrology – Chapman and Hall Ltd. London.
2. Bowen, N.L.M The Evolution of the Igneous Rocks – Dover publication, Inc, New York
3. Barth, FW. (1962) Theoretical Petrology -Wiley.
4. Turner.F.J and Verhoogen.J (1960) Igneous and Metamorphic Petrology – McGraw Hill.
5. Johannesen, A – (1962) Descriptive petrography of Igneous Rocks, Vols. I to IV – Allied Pacific.
6. Hyndman, D.W. (1972) Petrology of igneous and Metamorphic Rocks. Mc-Graw Hill.
7. Billings M.P. (1972) Structural Geology. Third Edition. Prentice Hall, New Delhi.
8. De Sitter (1964) Structural Geology. Second Edition, McGraw Hill Co.
9. Lahee (1987) Field Geology. Sixth Edition, McGraw Hill Co.

Marks including choice:

Unit	Marks
I	12
II	10
III	10
IV	20

About the Pattern of Questions:

Part A - **Short answer** **(5questions x Mark 1 = 5)**

- **Answer all questions** **(*5 questions x Mark 1 = 5*)**

Part B - **Short Essay** **(6 questions x Marks 2 each =12)**

- ***Answer any 6questions*** ***(4questions x Marks 2 each=8)***

Part C - **Essay** **(5 questions x Marks 3 each =15)**

- ***Answer any 4 questions*** ***(3 questions x Marks 3 each=9)***

Part D - **Long Essay** **(4 questions x Marks 5 each =20)**

- ***Answer any 2 questions*** ***(2 questions x Marks 5 each=10)***

- **Total marks including choice -52**
- ***Maximum marks of the course- 32***

COMPLEMENTARY ELECTIVE COURSE IV: GEOLOGY IV

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4 C 04 GEO	3	2	3

COURSE OUTCOME

CO 1:

Understands principles of stratigraphy, Geological time scale and basic time units

CO2: Understands major geological divisions of India and basics of Precambrian, Tertiary and Quaternary formations of Kerala, Palaeontology and its branches, fossils, types of fossilization, and uses of fossils.

CO3:

Understands economic minerals and important processes of ore mineral formation

CO4:

Understands mode of occurrence, geographic locations and geology of the major mineral deposits of India.

Unit I

Stratigraphy –basic principles, uniformitarianism, order of superposition, lateral continuity, original horizontality, faunal succession, faunal assemblages.Divisions of stratigraphy.Geological time scale and basic time units – eon, era, period, epoch. (8 hours)

Unit II

Brief introduction to major geological divisions of India .Brief study of the stratigraphy of Kerala – Precambrian, Tertiary and Quaternary formations.

Palaeontology – its branches, fossils, types of fossilzation, and uses of fossils.Carbon dating (22 hours)

Unit III

Economic geology – ore, gangue and industrial minerals. Brief study of important processes of ore mineral formation. Magmatism, hydrothermal process, volcanism, contact metasomatism, metamorphism, evaporites, residual and mechanical concentration, supergene sulphide enrichment.Megascopic identification of following ore minerals : Hematite, magnetie, chalcopyrite, malachite, chromite, bauxite, galena, sphalerite, pyrolusite and psilomelane (12 hours)

Unit IV

Mode of occurrence, geographic location in India, and geology of the following

mineral deposits. Iron – Kudremukh, Karnataka. Lead and Zinc – Zawar, Rajasthan. Gold – Hutti, Karnataka. Mica – Nellore, Andhra Pradesh. Manganese – Chindwara, Madhya Pradesh. Copper –Khetri, Rajasthan. Aluminium – Koraput, Orissa. Lignite – Neyveli, Tamil Nadu. Coal – Bokaro,Bihar. Petroleum – Naharkotiya, Assam and Bombay High.Mineral resourses of Kerala. (12 hours)

Books for Reference:

1. Krishnan, M.S. (1982) Geology of India and Burma, 6th edition.
2. Ravindra Kumar (1985) Fundamentals of Historical Geology and Stratigraphy of India.
3. Wadia D. N. (1944) Geology of India. MacMillan and Co. Limited.
4. Dunbar, C.O and Rogers, J. (1961) Principles of Stratigraphy. Wiley Publications.
5. Gokhale and Rao (1978) Ore deposits of India. Thomson Press (India)
6. Jensen, m and Bateman, A.M. (1981) Economic Mineral Deposits. John Wiley & Sons Inc
7.. Krishnaswamy, S. (1988) Indian Mineral Resources. 3rd Edition. South Asia Books.
8. Sinha, R.K (1982) Industrial minerals. Oxford and IBH Publishing Co.
9. Woods, H. (1961) Invertebrate Palaeontolgy. Cambridge University Press.

Marks including choice:

Unit	Marks
I	8
II	18
II	14
IV	12

About the Pattern of Questions:

Part A - **Short answer** (5questions x Mark 1 = 5)

- **Answer all questions** (*5 questions x Mark 1 = 5*)

Part B - **Short Essay** (6 questions x Marks 2 each =12)

- ***Answer any 6questions*** *(4questions x Marks 2 each=8)*

Part C - Essay (5 questions x Marks 3 each =15)

- ***Answer any 4 questions*** *(3 questions x Marks 3 each=9)*

Part D - **Long Essay** (4 questions x Marks 5 each =20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10)*

- **Total marks including choice -52**
- ***Maximum marks of the course- 32***

COMPLEMENTARY ELECTIVE COURSE V: GEOLOGY PRACTICAL

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4C 05GEO(P)	2	4	3

COURSE OUTCOME

CO 1:

Understands principles of stratigraphy, Geological time scale and basic time units

CO2:

Understands major geological divisions of India and basics of Precambrian, Tertiary and Quaternary formations of Kerala.

CO3:

Understands palaeontology and its branches, fossils, types of fossilzation, and uses of fossils.

CO4:

Understands economic minerals and important processes of ore mineral formation

CO5

Understands mode of occurrence, geographic locations and geology of the major mineral deposits of India.

Geology practical in first semester (hours per week: 2; total hours: 36;)

1. Preparation of diagrams of the following – rock cycle, hydrological cycle, subsurface groundwater occurrence, confined, unconfined and artesian aquifers.
2. Preparation of diagram of typical soil profile.

Geology practical in second semester (hours per week: 2; total hours: 36;)

1. Exercises in identification of salient topographic and drainage features using topographic maps. 1 : 50,000 or 1 : 25,000 Survey of India of toposheets.
2. Megascopic identification of rock forming minerals and ore minerals listed in the theory part of the syllabus. Also revision of practicals done during I Semester .

Geology practical in third semester (hours per week :2; total hours : 36;)

1. Preparation of chart showing classification of igneous, metamorphic and sedimentary rocks.
2. Megascopic identification of igneous, sedimentary and metamorphic rocks listed in the theory part of the syllabus.
3. Block diagrams of the following: fold - anticline, syncline, recumbent fold, isoclinal fold. Fault– normal, reverse, dipslip, strike slip, graben, horst. Unconformity – angular, disconformity, non-conformity. Joints, dykes, sills, laccolith, lopolith, batholith, phaccolith.
4. Measurement of slope and distance in topographic maps. Completion of outcrops in contour maps. Determination of strike and dip of formations from maps. Interpretation of geological maps with simple structures (fold, fault, unconformity).

Geology practical in fourth semester (hours per week :2; total hours : 36;)

1. Preparation of chart of geological time scale, mineral map of Kerala, map of India showing locations of important mineral deposits mentioned in the theory syllabus.
2. Geological map of Kerala showing distribution of major stratigraphic units.

PART C

GEOLOGY GENERIC ELECTIVE COURSES
WORK AND CREDIT DISTRIBUTION
(2019 ADMISSION ONWARDS)

The course in generic elective is conducted during Vth semester. Students of other departments can choose **any one of the generic elective course from the pool of five courses offered.**

Course code	Course title	Semester	Hours/ week	Credit	Exam hours	Marks		
						Internal	External	Total
5 D 01 GEO	Understanding planet earth	V	2	2	2	5	20	25
5 D 02 GEO	Earth resources management	V	2	2	2	5	20	25
5 D 03 GEO	Environmental management and sustainable development	V	2	2	2	5	20	25
5 D 04 GEO	Community preparedness for disaster management	V	2	2	2	5	20	25
5 D 05 GEO	Water resources	V	2	2	2	5	20	25

EVALUATION

Assessment	Weightage
External	4
Internal	1

Continuous evaluation - Theory

Component	Weightage	Remarks
Component 1 Test paper	50%	Best of the two to be awarded for more than one test paper /assignment conducted
Component 2 Assignment	50%	

Consolidation of marks for Continuous Evaluation of theory is as follows

Theory		
Component I Test paper Max. marks 2.5	**Component II Assignment Max. marks 2.5**	**Total Max.marks 5**

End semester evaluation-Theory

The ESE in theory course is to be conducted with Question Papers set by external experts. External evaluation carries 80 % of the total marks. The evaluation of the answer scripts shall be done by examiner based on a well-defined scheme of valuation and answer keys. Theduration of theory examination shall be 2 hours with a total mark of 20. (See model Question Paper)..

GENERIC ELECTIVE COURSE I: UNDERSTANDING PLANET EARTH

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5 D 01 GEO	2	2	2

COURSE OUTCOME

CO 1:

Understands earth as a member of solar system, origin, age, size, internal structure of earth and rock cycle.

CO2:

Undestand Internal and external processes of earth, Rock weathering, soil type and its profile, Continental drift. Plate tectonics. Seafloor spreading and Palaeomagnetism.

CO3:

Understand Mass wasting, Causes and effects of landslides, types of mountains and mountain building.

CO4:

Understand sources and occurrence of groundwater, hydrologic cycle, hydrologic properties of water bearing rocks, types of aquifers, Springs, conservation of groundwater.

Unit I

Introduction to Earth Science. Earth and Solar System. Origin of the earth. Age of the earth . Size of the earth. Internal constitution of the earth –Crust , Mantle and Core. The rock cycle – Igneous , Sedimentary and Metamorphic Rocks. (8 Hours).

Unit II

Internal and external processes. Rock weathering. Agents and causes ;Soil -Types and Classification. Soil profile. Continental drift . Plate tectonics. Seafloor spreading. Palaeomagnetism. (10Hours)

Unit III

Introduction to mass wasting . Causes and effects of landslides.-Mountains - types, process of mountain building. (8 Hours).

Unit IV

Groundwater. Sources. Hydrologic cycle. Occurrence of groundwater. Hydrologic properties of water bearing rocks – aquifers , aquicludes, aquitard, aquifuge. Types of aquifers –confined, unconfined and artesian aquifers, springs. Conservation of groundwater, artificial recharge of ground water. (10 Hours)

Books for Reference:

1. Thompson, G. R. and Turk, J. (1997) Introduction to Physical Geology. 2nd Edn. Thompson Brooks Publishers.
2. Carlson, D. and Plummer, C. (2010) Physical Geomorphology: Earth Revealed. 9th Edn.,Mc-Graw Hill Co.
3. Holmes, A. (1981) Principles of Physical Geology. ELBS, Third Edition. Thomas Nelson.
4. Physical Geology: Exploring the Earth James Stewart Monroe, Reed Wicander 2005 Thomson Brooks/Cole 644 page
5 . Earth: An Introduction to Physical Geology Edward J. Tarbuck, Frederick K. Lutgens, Dennis Tasa 2007 Pearson 720 p.

Marks including choice:

Unit	Marks
I	8
II	8
III	8
IV	6

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 each= 6)

- **Answer all questions** (*6 questions x Mark 1 each = 6*)

Part B - **Short Essay** (6 questions x Marks 2 each =12)

- ***Answer any 4 questions*** *(4questions x Marks 2 each=8)*

Part C - Essay (2 questions x Marks 6 each =12)

- ***Answer any 1 question*** *(1 question x Marks 6 each=6)*

- **Total marks including choice -30**
- ***Maximum marks of the course- 20***

GENERIC ELECTIVE COURSE II: EARTH RESOURCES MANAGEMENT

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5 D 02 GEO	2	2	2

COURSE OUTCOME

CO 1:
Understand resources and types including mineral, water and forest recourses and fuel resources.

CO2:
Understand mineral resources and their uses.

CO3:
Understand sources of water resources and human intervention on them.

CO4:
Understand water resource development and management and their sustainable development.

Unit I :
Resources- natural resources, earth resources, renewable resources, non-renewable resources. Important resources on earth – forest, mineral deposit, water resources, fossil fuels. Fossil fuel resources- Coal, lignite and petroleum- origin and uses (6 Hours)

Unit II :
Mineral resources- ore deposits of metals (copper, aluminium, iron lead and zinc), non-metallic mineral deposits (quartz, feldspar, mica, calcite, gypsum and dolomite), building stones (Crystalline rock, laterite, marble, slate and sandstone), precious and semi-precious stones (diamond, ruby, sapphire, emerald, amethyst and garnet), sands and soils. Uses of mineral resources. (10 Hours)

Unit III:
Water resources- fresh and saline. Fresh water resources- rain, glacial ice, groundwater, springs and surface water. Rivers and lakes. Hydrologic cycle. Uses of water and human

intervention in water resources for domestic, industrial and agricultural purposes. Man-made structures – dams, reservoirs, tanks, ponds, surangas, open wells, bore wells and tube wells (10 Hours).

Unit IV:

Resources and development, resource management and sustainable development. Depletion of non-renewable resources. conservation of resources. Alternative resources. Conservation of fossil fuels- solar energy as an alternative. Conservation of ore deposits and alternatives for metals, Conservation of natural construction materials and alternatives.

Protection and conservation of water resources-Recharge of groundwater, rain water harvesting. Water pollution and mitigation measures. (10 Hours)

Books for Reference:

1. Todd, D.K and L.W. Mays (2004). Groundwater Hydrology. John Wiley & Sons.
2. Karanath, K.R (1987). Groundwater Assessment, Development & Management, Tata Mc Graw Hill.
3. Donald. R. Coates (1981) Environmental Geology, John Wiley & Sons.
4. Peter. T. Elawan (1970) Environmental Geology, Harper & Row.
5. Keller, E.A. (1978) Environmental Geology, Bell & Howell, USA.
6. Valdiya, K.S. (1987) Environmental Geology—Indian Context, Tata McGraw Hills.
7. Gokhale and Rao (1978) Ore deposits of India. Thomson Press (India)
8. Jensen, m and Bateman, A.M. (1981) Economic Mineral Deposits. John Wiley & SonsInc
9. Krishnaswamy, S. (1988) Indian Mineral Resources. 3rd Edition. South Asia Books
10. Roy Chacko P.T. (ed.), (2005) Mineral resources of Kerala. Department of Mining and Geology.
11. Sinha, R.K (1982) Industrial minerals. Oxford and IBH Publishing Co.
12. Mihir Deb and Sanjib Chandra Sarkar (2017) Minerals and Allied Natural Resources and their Sustainable Development: Principles, Perspectives with Emphasis on the Indian Scenario. Springer publications.

Marks including choice:

Unit	Marks
I	6
II	8
III	8
IV	8

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 each= 6)

- **Answer all questions** (*6 questions x Mark 1 each = 6*)

Part B - **Short Essay** (6 questions x Marks 2 each =12)

- ***Answer any 4 questions*** *(4questions x Marks 2 each=8)*

Part C - **Essay** (2 questions x Marks 6 each =12)

- ***Answer any 1 question*** *(1 question x Marks 6 each=6)*

- **Total marks including choice -30**
- ***Maximum marks of the course- 20***

GENERIC ELECTIVE COURSE III: ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5 D 03 GEO	2	2	2

COURSE OUTCOME

CO 1:
Understand the concepts of sustainable development, development of the principles and definitions of terms.

CO2:
Understand the ecosystem and ecosystem services and climate challenges in various sectors and need of sustainable development.

CO3:
Understand the Sustainable Development goals, goal based planning and implementation

CO4:
Understand the policies for sustainable development in India.

.

Unit I

Principles of Sustainable Development: History and emergence of the concept of Sustainable Development, Definitions: Environmental issues and crisis, Resource degradation, greenhouse gases, desertification, social insecurity, Industrialisation, Globalisation and Environment. (10 Hours)

UNIT II

Ecosystems and Ecosystem services and resources, Climate change and challenges in Energy Water Resources and Agriculture. (8 Hours)

UNIT III

United Nations Sustainability Development Goals. Overview of 17 goals, benefits of goal based planning, challenges in implementation (8 Hours).

UNIT IV

Sustainable Resource Management Policies in India - Environment policy, water policy and mining policy. Basic objectives of the policies along with goals and visions. (10 Hours).

Books for Reference:

1. Martin J. Ossewaard(2018) Introduction to Sustainable Development: SAGE Publications Pvt. Ltd; First edition.

2.Brown,L(2009).PlanB4.0.NortonPublishers,NewYork.

(http://www.earthpolicy.org/images/uploads/book_files/pb4book.pdf).

3.Fulekar,M.H.,Bhavana Pathak and Kale, R.K (2013). Environment and Sustainable Development, Springer India.

4. Ghosh Roy, M.K.,(2011).Sustainable Development: Environment, Energy and Water Resources. Ane Books,384 p.

5. Mark Everard (2017) Ecosystem services - Key Issues, Google books.

Marks including choice:

Unit	Marks
I	8
II	6
III	8
IV	8

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 each= 6)

- **Answer all questions** (*6 questions x Mark 1 each = 6*)

Part B - **Short Essay** (6 questions x Marks 2 each =12)

- ***Answer any 4 questions*** *(4questions x Marks 2 each=8)*

Part C - **Essay** (2 questions x Marks 6 each =12)

- ***Answer any 1 question*** *(1 question x Marks 6 each=6)*

- **Total marks including choice -30**
- ***Maximum marks of the course- 20***

GENERIC ELECTIVE COURSE IV: COMMUNITY PREPAREDNESS FOR DISASTER MANAGEMENT

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5 D 04 GEO	2	2	2

COURSE OUTCOME

CO 1:
Understand the different types of hazards, risk, vulnerability, concept of disaster management.

CO2:
Understand risk reduction and crisis management, warning systems and phases of disaster.

CO3:
Understands inter relationship between disasters and development, geological factors contributing to risk and impacts of development projects.

CO4
Understands hazards and vulnerability profiles of india and resposibility of authorities

CO5:
.Understand disaster management plan and how to support the disaster management system in the State

Unit I
Disaster, Hazard, Vulnerability, Risk, Capacity building, Disaster and Development, Disaster management. Classification of disasters, Natural and Manmade, Hydro-meteorological, Geologically related, Accidental related, Chemical, Industrial and nuclear related, Biological related management, Global Disaster Trends – Emerging Risks of Disasters. Climate Change (8 hours)

Unit II :
Risk reduction and Crisis Management, Disaster management cycle and its analysis, Pre-disaster phase, Risk Assessment and Analysis, Risk Mapping, Zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness, Community based disaster management, Understanding of warning and de-warning messages, Disaster Phase, Post disaster phase –Rehabilitation, Role of geologists in disaster management.(8 hours)

Unit III:

Inter relationship between disasters and development; Geological factors contributing to Risk; Impacts of development projects such as dams, embankments, changes in land use.(8 hours).

Unit IV:

Hazards and vulnerability profiles of India, Institutional Mechanism, Role and Responsibility of various institutions- Panchayathi Raj Institutions, District, State and Central Governments and other stakeholders, Disaster Management Act and policy.(6 hours)

Unit V:

Preparation of District and State Disaster management plans – Framework -Coordinating and Monitoring Mechanism- Sections of the Framework- Suggested Outline-Disaster specific action plan (Flood, Landslide, Pesticide contamination, Road accident and Epidemics), Preparation of community level disaster management plans(6 hours)

Books for Reference:

1. David, A. (2000) Introduction in confronting catastrophe. Oxford Univ. Press.
2. Cuny, F. (1983) Development and disasters. Oxford University Press.
3. Govt. of India (2005) Disaster Management Act, New Delhi.
4. Govt. of India (2009) National Disaster Management Policy.
5. Gupta, A.K. and Nair, S.S. (2011) Environmental Knowledge for disaster Risk Management, NIDM, New Delhi.
6. Murthy, R.K. (2012) Disaster Management, Wisdom Press, New Delhi.
7. Tearfund (2006) Reducing risk of disaster in our communities, Disaster theory.
8. Disaster management, Vinod K Sharma, Ed. Description: New Delhi: National Centre for Disaster Management, 2001 : 325p
9. All you wanted to know about Disasters, B K Khanna, New India publishing Agency, 2005
10. Disaster and Hazard management. Namboodripad P., Oxford book house, 2008
11. State of Environment Report Kerala 2007 Vol. 2 Natural Hazards, KSCSTE 2007
12. Management of Biological Disasters. NDMA 2008
13. Websites: www.http://nidm.gov.in
14. www.http://cwc.gov.in
15. www.http://ekdrm.net

Marks including choice:

Unit	Marks
I	6
II	6
III	6
IV	6
V	6

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 each= 6)

- **Answer all questions** (*6 questions x Mark 1 each = 6*)

Part B - **Short Essay** (6 questions x Marks 2 each =12)

- ***Answer any 4 questions*** *(4questions x Marks 2 each=8)*

Part C - **Essay** (2 questions x Marks 6 each =12)

- ***Answer any 1 question*** *(1 question x Marks 6 each=6)*

- **Total marks including choice -30**
- ***Maximum marks of the course- 20***

GENERIC ELECTIVE COURSE V: WATER RESOURCES

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5 D 05 GEO	2	2	2

COURSE OUTCOME

CO 1:

Understand ground water and surface water, hydrologic cycle, drainage pattern andriver basins

CO2:

Understand hydrogeological properties of water bearing rocks, type of wells, groundwater provinces of India and groundwater development potential of Kerala.

CO3:

Understand water quality standards proposed by World Health Organization and Beuro of Indian Standards. Physical, chemical and biological parameters. Sea water intrusion, water pollution and its remedial measures.

CO4:

Understand water resource development and management practices to conserve water..

Unit I :

Water Resources: Ground water and surface water; Surface water: rivers ,lakes, ponds, wetlands, Hydrologic cycle; Drainage pattern, river basins. (8 hours)

Unit II : -

Ground water; hydrogeological properties of water bearing rocks- porosity and permeability; Types of aquifer. Type of wells - dug wells, tube wells bore wells and surangams; Groundwater provinces of India. Groundwater development potential of Kerala.(8 hours)

Unit III:

Water quality standards proposed by World Health Organisation and Beuro of Indian Standards. Physical, chemical and biological parameters; Sea water intrusion, Water pollution -its causes and mitigation, water borne diseases and remedial measures. (10 hours)

Unit IV:

Water resource development and management. Water conservation practices; Well design and well development;. Watershed management- rain water harvesting-artificial recharge.. Groundwater exploration. (10 hours)

Books for Reference:

1. Todd, D.K and L.W. Mays (2004). Groundwater Hydrology. John Wiley & Sons.
2. Davis, S.N. & Deweist., R.J.M (1966). Hydrogeology , John Wiley & Sons, New York
3. Ragunath, H.M (2007). Groundwater, New Age International Publishers, Delhi
4. Karanath, K.R (1987). Groundwater Assessment, Development & Management, Tata Mc Graw Hill.

Marks including choice:

Unit	Marks
I	6
II	8
III	8
IV	8

About the Pattern of Questions:

Part A - **Short answer** (6 questions x Mark 1 each= 6)

- **Answer all questions** (*6 questions x Mark 1 each = 6*)

Part B - **Short Essay** (6 questions x Marks 2 each =12)

- ***Answer any 4 questions*** *(4questions x Marks 2 each=8)*

Part C - Essay (2 questions x Marks 6 each =12)

- ***Answer any 1 question*** *(1 question x Marks 6 each=6)*

- **Total marks including choice -30**
- ***Maximum marks of the course- 20***

KANNUR UNIVERSITY
I SEMESTER B.Sc. PROGRAMME
CORE SUBJECT: GEOLOGY
1B01GEO – PHYSICAL GEOLOGY AND GLOBAL TECTONICS

Time: 3 Hours **Max. marks: 40**

Answers can be written only in English.
Draw neat sketches wherever necessary

I Write Short answer on all the questions .

1. Branch of earth science that deals with earthquakes.
2. Give an example for endogenic process.
3. Instrument that record the seismic waves.
4. What is MOR.
5. Arm chair shaped depression formed by glacial action.
6. Crescent shaped sand dune.

(6 X 1 = 6 Marks)

II Write short essay on any six of the following.

.

7. Differentiate focus and epicenter of an earthquake.
8. Types of mass wasting.
9. Internal structure of earth.
10. Types of seismic waves.
11. Interior of earth.
12. Volcanoes.
13. Chemical weathering
14. Hogback. **(6 X 2 = 12 Marks)**

III write essay on any four of the following.

15. Origin of the earth
16. Global distribution of volcanoes.
17. Rock cycle.
18. Concept of peneplain.
19. Karst topography.
20. Land slides **(4 X 3 =12Marks)**

IV Write long essay on any two of the following.

21. Causes and control measures of landslides.
22. Landforms of aeolian origin.
23. Prediction of volcanoes.
24. Modern theories of origin of earth. **(2 X 5 = 10Marks)**

KANNUR UNIVERSITY
V SEMESTER UG PROGRAMME
GENERIC ELECTIVE COURSE IN GEOLOGY
5D 05 GEO: Water Resources

Time: 2 hours **Max. Marks: 20**

Answers can be written only in English.
Draw neat sketches wherever necessary

Section A

Short answer type questions. Answer *all 6* questions.

1. The water originated by rainfall is called --------
2. The rock which is neither porous nor permeable is called --------
3. Which of the following rock has highest primary porosity?
(a) Granite (b) sandstone (c) Gneiss (d) Dolerite
4. The composition of stalagmites.
5. The alluvial deposits of roughly triangular shape that are deposited by major rivers at their mouths
6. A biological parameter of groundwater quality.
(a) TDS (b) pH (c) Hardness (d) E.Colli (6x1 = 6 marks)

Section B

Write short essay on any *four* of the following.

7. Hydrological cycle
8. Artificial recharge
9. Water quality
10. Borewells
11. Drainage pattern
12.Water table

(4x2=8 marks)

Section C

Write essays on any *one* of the following.

13. Ground water provinces of India
14. Sea water intrusion

(1x6=6 marks)

KANNUR UNIVERSITY
I SEMESTER UG PROGRAMME
GEOLOGY COMPLEMENTARY ELECTIVE
1C01GEO GEOLOGY I

Time: Three Hours Maximum marks: 32

Answer all questions
Write only in English
Draw neat sketches wherever necessary.

Short Answer Type -Answer all questions

1. The average radius of the earth
2. Age of the earth
3. The layer of the earth between the crust and the mantle.
4. The agent of weathering involved in arid regions
5. Who proposed the concept of Continental Drift?

(5x1 = 5 marks)

Short essay–Answer any 4 questions

6. Palaeomagnetism
7. What is crust?
8. Explain Talus
9. Orogeny
10. Watertable
11. Landslides **(4x2 = 8 marks)**

Essay type - Answer any 3 questions

12. Origin of earth.
13. Rock Cycle
14. Soil profile
15. Groundwater recharge
16. Lithosphere. **(3x3 = 9 marks)**

Long Essay type –Answer any 2 questions.

17. Give an account on the geological work of groundwater.
18. Describe the processes of weathering.
19. Explain types of mountains and mountain building process.
20. Describe the various methods followed in determining the age of the earth.

(2x5 = 10 marks)