

**MINUTES OF THE MEETING OF THE BOARD OF STUDIES IN GEOLOGY  
HELD ON MARCH 27, 2021 AT 3:15p.m.**

Vide Chowgule College notice F.133F/1276 dated 13 March 2021 a meeting of this Board of Studies (BoS) was convened on March 27, 2021 at 3:15p.m. in the Geology Lab, Block A, Parvatibai Chowgule College of Arts and Science (Autonomous), Margao-Goa. While faculty of the department were present in person the nominated members participated on Google meet. Since the number of members present represented the Quorum, the BoS began its proceedings.

Minutes are presented in the format.

**Members present in person:**

1. Shri Harish S Nadkarni – Chairman
2. Dr Meghana S Devli – Member
3. Mrs Swati S Ghadi – Member
4. Shri. Malcolm Afonso – Member
5. Mrs Magnolia Miranda – Member

**The following members of the Board of Studies attended the meeting online via Google meet.**  
**<https://meet.google.com/stv-vzcx-bev?hs=224>**

1. Dr Hrishikesh Samant – Nominee of the Vice Chancellor of Goa University

**Members absent with intimation:**

1. Dr Raymond Duraiswami – Academic Council Nominee

**Members absent without intimation:**

1. Dr. I A Khan – Academic Council Nominee
2. Ms Delia Cardozo – Postgraduate Meritorious Alumnus
3. Shri Kiran Sawant Dessai – Representative from the Industry/Corporate Sector

**Proceedings**

The Chairman welcomed the members of the Board of Studies (BoS). The minutes of the previous meeting in Geology held on May27, 2020 were read out by the Chairman and approved by the members of the board. The Chairman introduced and explained the agenda for this meeting and the Board transacted the following business:

**Agenda Items:**

1. Revision of Course Outcomes.
2. Revision of Syllabus
3. Any other business ( A.O.B)

### **AGENDA 1**

**1. To approve the revisions proposed in the course outcomes of the courses in Geology.**

The proposed changes in the course outcomes in all the courses offered were presented and discussed at the meeting. The BoS approved the changes that were proposed.

**2. To approve the revisions proposed in the syllabi of the courses in Geology at Semester VI**

- The proposed changes in the practical component in the course titled "GEL-IV. C-6: Structural Geology" offered as a Core Course at Semester IV was presented and discussed at the meeting. The practical 'Completion of Outcrops' was shifted from "GEL-IV. C-6: Structural Geology" to "GEL-VI.E-13B: Phanerozoic Stratigraphy of India". The BoS approved the changes that were proposed.
- The proposed changes in the shuffling of few topics from Module I to Module III in the course titled "GEL-V.E-11A: Metamorphic Petrology" offered as an Elective course at Semester V was presented and discussed at the meeting. The BoS approved the changes that were proposed.
- The proposed changes in the interchange between Module I and Module III in the course titled "GEL-VI.E-16A: Principles of Geophysical Exploration and Mining" offered as an Elective course at Semester VI was presented and discussed at the meeting. The BoS approved the changes that were proposed.

**AGENDA 2: Any other Business (A.O.B) with the permission of the Chair.**

Nil

**PART A: Resolutions**

- i. The Proposed course outcomes for all the courses offered in the subject of Geology were presented and discussed at the meeting. The BoS approved the revised course outcomes for all the courses and passed a resolution for their addition. The revised course outcomes for the undergraduate program in Geology for all the courses is presented below.



**ODD SEMESTER**

<b>SEMESTER</b>	<b>COURSE CODE &amp; COURSE TITLE</b>	<b>REVISED COURSE OUTCOMES</b>
<b>I</b>	<b>GEL-I. C-1: FUNDAMENTAL OF MINERALOGY</b>	<p><b>CO1</b> Explain what is a mineral and its formation and describe the physical properties of minerals.</p> <p><b>CO2</b> Compare and contrast the elemental and major oxide composition of the crust with the entire earth and relate crystal chemistry and chemical bonding to the formation of minerals.</p> <p><b>CO3</b> Link how the internal atomic structure of minerals affects the external development of a crystal in terms of crystal symmetry, crystal system and crystal forms.</p> <p><b>CO4</b> Identify rock- forming minerals in hand specimen using their physical properties.</p> <p><b>CO5</b> Classify minerals into crystal systems based on crystal symmetry.</p>
	<b>GEL-II. C-2A: EARTH'S DYNAMICS AND TECTONICS</b>	<p><b>CO1</b> Explain the origin and nature of the earth, the internal layering, the earth's Gravity and magnetic field.</p> <p><b>CO2</b> Differentiate between the different types of forces operating in the lithosphere, responses to these forces and relate them to geological hazards.</p> <p><b>CO3</b> Explain the formation of structural features likes fold, faults, joints and unconformities.</p> <p><b>CO4</b> Read and interpret geological maps and draw geological cross – sections.</p> <p><b>CO5</b> Derive graphical solution to structural problems</p>
<b>III</b>	<b>GEL-III.C-5A: ADVANCED MINERALOGY AND GEOCHEMISTRY</b>	<p><b>CO1</b> Explain the concept of Gibbs Phase Rule, Collate structure, chemical composition with physical and optical properties of minerals of major silicate group of minerals, interpret stability relations of minerals using Phase diagrams of Olivine, Pyroxene and Feldspar Group of minerals. Explain how minerals originate and associate with each other in a rock.</p> <p><b>CO2</b> Collate structure, chemical composition with physical and optical properties of</p>



		<p>minerals of major silicate group of minerals and interpret stability relations of minerals of Feldspathoid, Silica, Amphibole and Mica Group of minerals. Explain how minerals originate and associate with each other in a rock</p> <p><b>CO3</b> Describe the geochemical composition of the earth and describe how compatible and incompatible elements are involved in the various geochemical processes.</p> <p><b>CO4</b> Calculate end-members for olivine, pyroxene and feldspar group of minerals and determine the structural Formula for the various silicate group of minerals.</p> <p><b>CO5</b> Plot major oxides and trace elements on tectonic discriminant diagrams.</p>
	<b>GEL-III.E-1: PHYSICAL GEOLOGY</b>	<p><b>CO1</b> Explain the processes of weathering, erosion, transportation, deposition by wind and how these geological processes create desert landforms.</p> <p><b>CO2</b> Identify and explain formation of various landforms created by geological action of streams and underground water .</p> <p><b>CO3</b> Identify and explain formation of various landforms created by geological action of glaciers and the sea.</p> <p><b>CO4</b> Assign stream order as per Strahler's Method and analyze various attributes of basin morphometry and drainage.</p> <p><b>CO5</b> Prepare and analyze long and cross sections of river profiles from SOI Toposheet</p>
	<b>GEL-III.E-2 : GROUNDWATER AND HYDROGEOLOGY</b>	<p><b>CO1</b> Explain the concept of Groundwater, its sub- surface distribution and sources, describe the rock properties of porosity and permeability affecting the movement of groundwater and differentiate between the various types of aquifers.</p> <p><b>CO2</b> Carry out groundwater exploration by resistivity method.</p> <p><b>CO3</b> Explain the effects of over withdrawal of groundwater and waterlogging, and suggest mitigation measures.</p> <p><b>CO4</b> Draw flow-nets from groundwater levels.</p> <p><b>CO5</b> Determine water quality based on various parameters.</p>

	<b>GEL-III.E-3A ORE GENESIS</b>	<p><b>C01</b> Classify and differentiate the stages of ore-formation and ores, explain the igneous origin of ore minerals.</p> <p><b>C02</b> Explain the role of hydrothermal solutions and submarine volcanism forming ore-deposits. Also, describe sedimentation process in creating ore deposits.</p> <p><b>C03.</b> Describe various ore minerals and deposits found in India.</p> <p><b>C04</b> Identify various industrial minerals with the help of their physical properties.</p> <p><b>C05</b> Identify various ore minerals on determining their physical properties.</p>
	<b>GEL-III.E-4 MARINE GEOLOGY</b>	<p><b>C01</b> Describe ocean bathymetry and learn to identify features of the ocean floor such as mid ocean ridges, seamounts, guyots, hydrothermal vents, pillow basalts, trenches and Relate the ocean features to their tectonic origin.</p> <p><b>C02</b> Describe the various processes which give rise to ocean circulation.</p> <p><b>C03</b> Classify marine sediments into categories based on their origin and Identify the characteristics of important marine resources from marine sediments for the future.</p> <p><b>C04</b> Recognise how near shore geological processes shape coastlines over time.</p>
	<b>GEL-III.SEC-1 OPERATIONAL GEOLOGY AND GEMMOLOGY</b>	<p><b>C01</b> Manage any data in a systematic manner in Excel spreadsheet and perform basic data analysis using Excel tools.</p> <p><b>C02</b> Explain the processes involved in drilling project, the type of data generated and create a drill hole database in Excel.</p> <p><b>C03</b> Decide on the factors controlling cost of a gemstone, explain the causes of colours in gemstones.</p> <p><b>C04</b> Explain how gemstones are synthesized, explain how gemstones are enhanced from low-grade to saleable quality, and explain the styles of cuts preferred for different gemstones.</p>



<b>V</b>	<b>GEL-V. C-7A : SEDIMENTARY PETROLOGY</b>	<p><b>C01</b> Explain the origin of sedimentary rocks and relate it to the associated textures and environments of deposition.</p> <p><b>C02</b> Gain insight into the process of formation of sedimentary rocks by studying the various sedimentary structures.</p> <p><b>C03</b> Explain the various classes of sedimentary rocks.</p> <p><b>C04</b> To identify, describe and classify rocks using hand specimens and rock thin sections.</p> <p><b>C05</b> To calculate various textural parameters of sedimentary rocks.</p>
	<b>GEL-V.E-9B : PRECAMBRIAN STRATIGRAPHY OF INDIA</b>	<p><b>C01</b> Subdivide India physiographically on the basis of their characters, and explain the tectonics and evolution of cratons and mobile belts of Indian shield.</p> <p><b>C02</b> Enact the stratigraphic history and lithologic sequences of Dharwar craton.</p> <p><b>C03</b> Describe the Proterozoic geology of Peninsular India.</p> <p><b>C04</b> Classify the various kinds of rocks of Goa.</p> <p><b>C05</b> Assign various rock Formations of Peninsular India to their respective geologic age on their characters.</p>
	<b>GEL-V.E-10: PETROLEUM GEOLOGY</b>	<p><b>C01</b> Describe the properties and the mode of formation of Hydrocarbons</p> <p><b>C02</b> Compare various exploration techniques involved in hydrocarbon detection.</p> <p><b>C03</b> Explain the process of drilling &amp; completion of a Petroleum well; and Determine distribution of major oil deposits in India and in the world.</p> <p><b>C04</b> Prepare isopach maps and analyze well logs.</p> <p><b>C05</b> Delineate and describe the petroliferous domains in India.</p>
	<b>GEL-V. E-11A: METAMORPHIC PETROLOGY</b>	<p><b>C01</b> Explain metamorphism, factors responsible and relate them to types of metamorphism with the products, represent metamorphic rocks graphically using Phase Diagrams and explain metamorphism wrt tectonics.</p> <p><b>C02</b> Apply fundamental principles of metamorphism to development of textures, classify metamorphic rocks</p>

		<p>based on mineral assemblage and fabric, interpret tectonic setting of Metamorphic Belts based on field characters and kinematic stress indicators.</p> <p><b>CO3</b> Explain types of metamorphism. Also, differentiate between Barrovian and Buchan Zones, Apply the facies concept to progressive contact and regional including burial metamorphism.</p> <p><b>CO4</b> Identification of metamorphic rocks w.r.t mineralogy, texture, type of metamorphism, facies, protolith megascopically and microscopically.</p>
	<b>GEL-V.E-12: REMOTE SENSING AND DIGITAL IMAGE PROCESSING</b>	<p><b>CO1</b> Explain remote sensing fundamental principles, purposes, advantages and limitations.</p> <p><b>CO2</b> Describe the basic characteristics of optical remote sensing imagery.</p> <p><b>CO3</b> Perform visual image interpretation of satellite imagery.</p> <p><b>CO4</b> Apply basic procedures of Digital Image processing for Remote sensing image enhancements analysis.</p> <p><b>CO5</b> Perform image classification and create a map.</p>

#### EVEN SEMESTER

SEMESTER	COURSE CODE & COURSE TITLE	REVISED COURSE OUTCOMES
<b>II</b>	<b>GEL-II.C-3A: ELEMENTARY PETROLOGY</b>	<p><b>CO1</b> Explain the processes involved in the formation of Igneous rocks, identify their forms, textures, structures and classify them.</p> <p><b>CO2</b> Explain the processes involved in the formation of Sedimentary rocks, identify their textures, structures and classify them.</p> <p><b>CO3</b> Explain the processes involved in the formation of Metamorphic rocks, identify their agents, textures, structures and classify them.</p> <p><b>CO4</b> Identify the different textures and structures of igneous, sedimentary and metamorphic rocks in hand specimen.</p>



		<b>CO5</b> Describe the mineralogy observed in hand specimens of igneous, sedimentary and metamorphic rocks and identify them.
	<b>GEL-II. C-4: PRINCIPLES OF STRATIGRAPHY AND PALEONTOLOGY</b>	<b>CO1</b> Explain principles of Stratigraphy, concepts of Facies, correlation and measurements of geologic time. <b>CO2</b> Describe types of fossils, conditions and modes for fossilisation, explain how fossils can be used to locate economic deposits. <b>CO3</b> Describe and explain morphology of the hard parts of body fossils belonging to the different phylums and mention their geological time <b>CO4</b> Analyse geologic maps, solve problems on bearings and handle clinometer compass. <b>CO5</b> Describe and identify fossils/casts/shells w.r.t their morphology and geological age.
<b>IV</b>	<b>GEL-IV.C-6: STRUCTURAL GEOLOGY</b>	<b>CO1</b> Apply knowledge on primary and secondary structures in rocks to stratigraphic problems; also, relate stress and strain in explaining the geometry in rocks <b>CO2</b> Explain the mechanisms involved in the creation of different geologic features. <b>CO3</b> Classify different kinds of rock structures and describe the mechanisms of their generation. <b>CO4</b> Draw cross-sections across geologic maps, and also, create geologic maps from data provided.
	<b>GEL-IV.E-5A: ENGINEERING GEOLOGY</b>	<b>CO1</b> Explain the engineering properties of rocks and soil to determinetheir suitability for engineering works. <b>CO2</b> Explain the role of a geologist and the methods involved in geotechnical investigations needed for selection of site for engineering works. <b>CO3</b> Explain geological aspects that needs to be considered during the planning and construction of major civil structures like dams, bridges and tunnels. <b>CO4</b> Solve numerical problems on ultimate strength of rocks, RQD and describe



		<p>physical properties of core samples.</p> <p><b>C05</b> Compute reservoir area, catchment area, reservoir capacity and assess site feasibility based on geological maps.</p>
	<b>GEL-IV.E-6A: OPTICAL MINERALOGY</b>	<p><b>C01</b> Explain basic concepts in optical mineralogy and relate them to study of minerals in Plane Polarised Light (PPL).</p> <p><b>C02</b> Explain basic concepts in optical mineralogy and relate them to study of minerals Between Crossed Polars (BXP).</p> <p><b>C03</b> Distinguish Uniaxial and Biaxial Indicatrix and study behaviour of minerals under convergent light.</p> <p><b>C04</b> Identify major rock-forming minerals in microsections.</p> <p><b>C05</b> Detect Optic Sign for Uniaxial and Biaxial Minerals using Interference Figures, Determine Anorthite content of Plagioclase and calculate Optic Axial Angle.</p>
	<b>GEL-IV.E-7: NATURAL HAZARDS AND MANAGEMENT</b>	<p><b>C01</b> Describe the influence of mitigation, preparation, response and recovery on natural hazards such as droughts, floods, cyclones, volcanic eruptions, tsunami, landslides &amp; subsidence, salinity hazards and coastal erosion.</p> <p><b>C02</b> Compare and critically analyze recent disasters caused by natural events.</p> <p><b>C03</b> Analyze how geologic hazards impact our everyday lives and understand the science behind occurrence of geologic events that are reported.</p>
	<b>GEL-IV.E-8: GEOTECTONICS</b>	<p><b>C01</b> Gain an insight into the earth's interior and generation of its magnetic field.</p> <p><b>C02</b> Understand the theory of Continental Drift along with supporting evidences.</p> <p><b>C03</b> Explain mountain building (orogenesis) and its relation to plate tectonics.</p> <p><b>C04</b> Identify and plot various tectonic features on the earth's surface.</p> <p><b>C05</b> Apply the concept of plate tectonics to gain insight into earthquakes and hotspots.</p>

	<b>GEL-IV.SEC-2: GIS FOR BEGINNERS</b>	<p><b>CO1</b> Understand the fundamental concepts of GIS.</p> <p><b>CO2</b> Create/extract geospatial data from hardcopy maps, open-source GIS portals and field surveys.</p> <p><b>CO3</b> Visually identify various features such as landforms, geologic structures, manmade structures etc. on satellite imagery.</p> <p><b>CO4</b> Apply GIS techniques such as those used for analysing and presenting water quality data, Terrain data, geologic data etc to prepare aesthetically pleasing and informative maps.</p> <p><b>CO5</b> Prepare and execute a simple GIS project in their domain of study.</p>
<b>VI</b>	<b>GEL-VI.C-8A IGNEOUS PETROLOGY</b>	<p><b>CO1</b> Explain the composition of the Earth and relate it to magma generation.</p> <p><b>CO2</b> Gain insight into the crystallization of melts by studying the various textures and microstructures displayed in igneous rocks.</p> <p><b>CO3</b> Explain the diversity and differentiation of magmas to deduce the formation of various rock types and their associated characteristics.</p> <p><b>CO4</b> Identify, describe and classify igneous rocks in hand specimen and thin sections.</p> <p><b>CO5</b> Identify igneous rocks from their chemical analysis using normative minerals.</p>
	<b>GEL-VI.E-13B PHANEROZOIC STRATIGRAPHY OF INDIA</b>	<p><b>CO1</b> Explain the transitionary changes in the Indian regions from the Precambrian to the beginning and end of Paleozoic Era. Also, enact the history of evolution and lithologic sequences of Gondwana basins in India.</p> <p><b>CO2</b> Explain the origin of Ocean Flood Basalts; also, relate the paleogeography of Peninsular India to the occurrences of sedimentary sequences of rocks in the region.</p> <p><b>CO3</b> Describe the phases involved in the evolution of Himalayas and to enact the lithologic history of Assam and Siwalik hills.</p> <p><b>CO4</b> Prepare lithostratigraphic maps of India.</p>



		<b>CO5</b> Identify rocks and relate them to different rock systems of India based on their fossil content, if any; and state their geological age.
	<b>GEL-VI, E-14B: ROCK STRUCTURES AND DEFORMATION MICROSTRUCTURES</b>	<b>CO1</b> Explain deformation, its process and mechanisms of generation of rock structures and rock deformation microstructures. <b>CO2</b> Apply the significance of foliation and lineation observed in field as well as in microsections in understanding microstructures and rock deformation. Interpret Shear Sense Indicators in Mylonites. <b>CO3</b> Interpret the significance of microstructures in Igneous, Sedimentary and Metamorphic rocks. <b>CO4</b> Identify and Interpret the significance of rock and deformation microstructures in thin sections.
	<b>GEL-VI-E-15A: SURVEYING MAPPING AND FIELD GEOLOGY</b>	<b>CO1</b> Perform preliminary surveys such as those used in mining e.g. Plane table survey, Levelling survey, GPS survey etc. <b>CO2</b> Work independently in the field of geology performing tasks such as data collection, note keeping, mapping and geologic report preparation <b>CO3</b> Perform basic GIS tasks using open source software.
	<b>GEL-VI-E-16A: PRINCIPLES OF GEOPHYSICAL EXPLORATION AND MINING</b>	<b>CO1</b> Explain processes involved in Open-cast and Underground mining and the regulations that control these processes. <b>CO2</b> Explain the stages involved in mineral exploration and the process of estimation of reserves <b>CO3</b> Explain the principles behind, and methods of Geophysical, Geochemical and Geobotanical exploration <b>CO4</b> Draw cross - and longitudinal sections using bore-hole Data and estimate ore reserves using different methods. <b>CO5</b> Interpret bouguer gravity anomaly maps and magnetic data.

**PART B:**

Important points/recommendations of BoS that require consideration/approval of Academic Council: (revised approved syllabus attached).

1. Revision of practical in the core course "GEL-IV.C-6: Structural Geology" to be offered at Semester IV of the undergraduate course of Geology.
2. Revision of theory in the Elective course GEL-V.E-11A: Metamorphic Petrology" to be offered at Semester V of the undergraduate course of Geology.
3. Revision of theory in the Elective course GEL-VI.E-16A: Principles of Geophysical Exploration and Mining" to be offered at Semester VI of the undergraduate course of Geology.
4. Flexibility to the Board of Studies in Geology in shuffling/modifying the core/elective courses between/of the semesters of the BSc programme.

The Chairman thanked the members of the Board of Studies in Geology for their valuable contribution and active participation in the meeting.

The meeting ended with a vote of thanks to the Chair.

The foregoing minutes of the meeting were circulated by the Chairman, Board of Studies in Geology after the conclusion of the BoS meeting.

The following members of the Board of Studies were present in person for the meeting:

1. Shri Harish S Nadkarni – Chairman
2. Dr Meghana S Devli – Member Secretary
3. Mrs Swati S Ghadi – Member
4. Shri. Malcolm Afonso – Member
5. Mrs Magnolia Miranda – Member

The following members of the Board of Studies attended the meeting online via video conferencing Link: <https://meet.google.com/stv-vzcx-bev?hs=224>


1. Dr Hrishikesh Samant – Nominee of the Vice Chancellor of Goa University

Members absent with intimation:

2. Dr Raymond Duraiswami – Academic Council Nominee

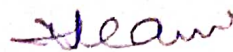
Members absent without intimation:

1. Dr. I A Khan – Academic Council Nominee
2. Shri Kiran Sawant Dessai – Representative from the Industry/Corporate Sector
3. Ms Delia Cardozo – Postgraduate Meritorious Alumnus



Dr. Meghana S. Devli  
(Member Secretary)

27 March 2021



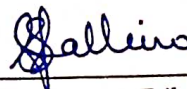
Harish S. Nadkarni  
(Chairman, Board of Studies, Geology)



PART C : The remarks of the Dean of the Faculty :

- a. The minutes are in order.
- b. The minutes may be placed before the Academic Council with remark, if any.
- c. Important points of the minutes which need clear policy decision of the Academic Council to be recorded.

Signature of the Dean of Physical and Earth Sciences: \_\_\_\_\_



Dr. Sameena Faleiro

Date: 31 March 2021.

### ANNEXURE A

(Summary of changes incorporated in the syllabus)

#### DEPARTMENT OF GEOLOGY

Semester	Course Title	Existing (Indicate only the unit where the change is proposed)	Changes Proposed	Specify the reason for the change
All Semesters	All Courses	Existing Course Outcomes (CO)	Revision of the Cos for all the courses	For mapping and Attainment of COs
IV& VI	GEL-IV. C-6: Structural Geology&  GEL-VI. E-13B: Phanerozoic Stratigraphy of India	Practical 'Completion of Outcrops' presently in GEL-IV. C-6: Structural Geology	Practical 'Completion of Outcrops' shifted to GEL-VI. E-13B: Phanerozoic Stratigraphy of India	Overloading of practical components in GEL-IV. C-6: Structural Geology
V	GEL-V. E-11A: Metamorphic Petrology	Module I to Module III	Few topics shifted from Module I to Module III	To maintain continuity in the topic
VI	GEL-VIE-16A: Principles of Geophysical Exploration and Mining	Module I and Module III	Interchange between Module I and Module III	Need to teach Geophysical Exploration methods before drilling and estimation of ore reserves.

- 1) Part B of the minutes of BOS meeting.
- 2) Programme Specific Outcomes and Course Outcomes
- 3) Course Structure
- 4) Revised Syllabus
- 5) Annexure A, which is the summary of the changes incorporated in the syllabus. (as per the format attached).