



गोंय विद्यापीठ

ताळगांव पठार

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(Accredited by NAAC)

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GU/Acad –PG/BoS -NEP/2023/102/32

Date:16.06.2023

CIRCULAR

The University has decided to implement the UGC Curriculum and Credit Framework for the Undergraduate Programme (CCFUP) of **Bachelor of Science in Earth Science (Geology)/Bachelor of Science in Earth Science (Geology) (Honours)** under the National Education Policy (NEP) 2020 from the Academic Year 2023-2024 onwards.

The approved Syllabus of Semesters I and II of the **Bachelor of Science in Earth Science (Geology) /Bachelor of Science in Earth Science (Geology) (Honours)** Programme is attached.

Principals of Affiliated Colleges offering the **Bachelor of Science in Earth Science (Geology)/Bachelor of Science in Earth Science (Geology) (Honours)** Programme are requested to take note of the above and bring the contents of this Circular to the notice of all concerned.

(Ashwin Lawande)

Assistant Registrar – Academic-PG

To,

1. The Principals of Affiliated Colleges offering the Bachelor of Science in Earth Science (Geology)/Bachelor of Science in Earth Science (Geology) (Honours)

Copy to:

1. The Director, Directorate of Higher Education, Govt. of Goa.
2. The Dean, School of Earth, Ocean and Atmospheric Sciences, Goa University.
3. The Vice-Deans, School of Earth, Ocean and Atmospheric Sciences, Goa University.
4. The Chairperson, BoS in Earth Science.
5. The Controller of Examinations, Goa University.
6. The Assistant Registrar, UG Examinations, Goa University.
7. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

Goa University
Programme Structure for Semester I to VIII Under Graduate Programme - Earth Science

Semester	Major -Core	Minor	MC	AEC	SEC	I	D	VAC	Total Credits	Exit
I	Major- 1 GEO-100 Introduction to Mineralogy and Petrology (4)3T + 1P	Minor -1 GEO-111 Introduction to Geology (4)	MC-1 GEO-131 The Dynamic Earth (3)		SEC-1 GEO-141 Introduction to Remote sensing and Drone Photography 3 (1T + 2P)					
II			MC-2 GEO-132 Physical Geology (3)		SEC-2 GEO-142 Water Quality Assessment 3(1T + 2P)					*
III	Major- 2 GEO-200 Structural Geology and Physical Geology (4) Major- 3 GEO-201 Principles of Stratigraphy and Palaeontology (4)	Minor -2 GEO-211 Principles of Stratigraphy, Structural and Physical Geology (4)	MC-3 GEO-231 Natural Hazards (3) or MC-3 GEO-232 Environment of Goa (3)		SEC-3 GEO-241 Quality, Health, Safety and Environment (3) (1T + 2P)					

IV	<p>Major-4 GEO-202 Descriptive Mineralogy (4)</p> <p>Major-5 GEO-203 Mining Geology (4)</p> <p>Major-6 GEO-204 Geotectonics and associated Rocks (4)</p> <p>Major-7 GEO-205 Geology of Goa (2)</p>	<p>Minor-3 VET GEO-221 Engineering Geology (4)</p> <p>or</p> <p>Minor-3 VET GEO-222 Geophysical Exploration (4)</p>								
V	<p>Major-8 GEO-300 Ore Genesis / Formation (4)</p> <p>Major- 9 GEO-301 Structural Geology (4)</p> <p>Major- 10 GEO-302 Igneous Petrology (4)</p> <p>Major- 11 GEO-303 Optical Mineralogy (2)</p>	<p>Minor-4 VET GEO-321 Hydrogeology (4)</p> <p>or</p> <p>Minor-4 VET GEO-322 Gemmology (4)</p>								

VI	<p>Major-12 GEO-304 Sedimentary Petrology (4)</p> <p>Major- 13 GEO-305 Metamorphic Petrology (4)</p> <p>Major- 14 GEO-306 Indian Stratigraphy (4)</p> <p>Major- 15 GEO-307 Project (4)</p>	<p>Minor- 5 VET GEO-323 Environment Geology (4)</p> <p>or</p> <p>Minor-5 VET GEO-324 Geoheritage (4)</p> <p>or</p> <p>Minor-5 VET GEO-325 Introduction to GIS (4)</p>								
VII	<p>Major-16 GEO-400 Principles of Mineralogy and Geochemistry (4)</p> <p>Major- 17 GEO-401 Structural Geology and Geotectonics (4)</p> <p>Major- 18 GEO-402 Igneous Petrology (4)</p> <p>Major- 19 GEO-403 Geological Field Mapping (Skilled Based Course) (1+3)</p>	<p>Minor -7 GEO-411 Groundwater Geology (Skilled Based Course) (4)</p>								

VIII	<p>Major-20 GEO-404 Sedimentology (4)</p> <p>Major-21 GEO-405 Metamorphic Petrology (N4)</p> <p>Major- 22 GEO-406 Principles of Stratigraphy and Indian Geology (4)</p> <p>Major- 23 GEO-407 Economic Geology (4)</p>	<p>Minor-8 GEO-412 Marine Geology (4)</p>								
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* List of Exit Courses along with the syllabus will be provided separately.

Name of the Programme: UG Degree Geology (Honors)

Course Code: GEO-100

Title of the Course: Introduction to Mineralogy and Petrology

Number of Credits: 4 (3 Theory + 1 Practical)

Effective from AY: 2023-24

Pre-requisites for the course:	Nil	
Course Objectives:	<ol style="list-style-type: none">1. To discuss the origin, shape, and size of the Earth.2. To explain the concepts of continental drift and plate tectonics.3. To demonstrate the symmetry in crystals4. To describe minerals and rocks using physical properties.	
Content:	Introduction to Geology; Applications and Career opportunities in Geosciences. Introduction to Planetary Geology, Origin of the earth: Nebular Hypothesis; Shape, Size, Structure of the earth, Introduction to Plate Tectonics	(20 Hours)
	Elementary Crystallography and Mineralogy: Scope and importance, states of matter, crystalline state, atomic arrangement in crystals. External characteristics of crystals, face, form, interfacial angles, law of constancy of interfacial angles.—Goniometers, crystal symmetry, classification of crystals, crystallographic axes and systems, parameters and indices, study of the normal symmetry classes. Applications of crystal properties. Physical properties of minerals, colour, streak, lustre, diaphaneity, cleavage, fracture, form, habit, hardness, specific gravity, electrical and magnetic properties. Introduction of common rock - forming minerals: quartz, feldspar, micas, pyroxenes, amphiboles and olivine.	
	Petrology: Scope and importance of Petrology, Rocks: their classification into three broad classes, igneous, sedimentary and metamorphic, Rock Cycle. Igneous Rocks: plutonic hypabyssal and volcanic types. Forms, structures and textures. Bowen's Reaction series. Classification based on grain size and mineral composition. Mineralization. Sedimentary Rocks: Structures, Textures and Classification of Sedimentary Rocks. Depositional Environments. Metamorphic Rocks: agents of metamorphism, types of metamorphism, fabric and Classification of Metamorphic Rocks.	(25 Hours)

	<p>PRACTICAL Crystallography, Mineralogy and Petrology</p> <ol style="list-style-type: none"> 1. Study of 15 crystal models. 2. Identification and description of the physical properties, compositions, occurrence and uses of 20 common minerals. 3. Systematic description and Identification of 20 common rocks. 4. Field Work: All the students shall undertake geological field work to study the local geology under the guidance of a teacher. Each student shall maintain a field diary and write a geological report. The minimum time spent in the field should be 15 hours. 	<p>(30 hours)</p>
<p>Pedagogy:</p>	<ul style="list-style-type: none"> ● Chalk and Board ● PPT and Practical demonstration of Mineral and Rock Specimens ● Class Quiz 	<ul style="list-style-type: none"> ● Videos ● Group Discussion ● Field Visits ● Flipped Classroom ● Assignments
<p>References/Readings:</p>	<ol style="list-style-type: none"> 1. Singh, P. (1978). A textbook of engineering and general geology (3rd ed.). S. Chand & Company Ltd. 2. Grotzinger, J. P., & Jordan, T. H. (2020). Understanding Earth. Macmillan Learning. 3. Monroe, J. S., & Wicander, R. (2015). The changing earth: Exploring Geology and Evolution. Cengage Learning. 4. Mukherjee, P. K., (2013). A Textbook of Geology. World Press. 5. Holmes, A. (2013). Principles of Physical Geology. Routledge. 6. Rutley, F. (2019). Rutley's Mineralogy. Routledge. 7. Klein, C., & Hurlbut, C. S. Jr. (2021). Dana manual of mineralogy. Wiley. 8. Lutgens, F. K., Tarbuck, E. J., & Tasa, D. G. (2021). Essentials of geology (13th ed.). Pearson. 9. Marshak, S. (2015). Earth science (14th ed.). John Wiley & Sons. 10. Blyth, F. G. H., & de Freitas, M. H. (2018). Geology for engineers (3rd ed.). CRC Press. 	
<p>Course Outcome:</p>	<p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Differentiate the layers of the Earth based on their structure and composition. (CL2) 2. Identify minerals based on their physical properties. (CL3) 3. Deduce the symmetry of crystals. (CL4) 4. Categorize rocks based on their properties. (CL4) 	

Name of the Programme: UG Degree Geology (Honors)

Course Code: GEO-111

Title of the Course: Introduction to Geology

Number of Credits: 4 (Theory)

Effective from AY: 2023-24

Pre-requisites for the course:	Nil	
Course Objectives:	1. To discuss the origin and various components of earth system. 2. To describe minerals and rocks using physical properties.	
Content:	Introduction to Geology; Applications and Career opportunities in Geosciences. Origin, Shape, Size and internal structure of the earth. Introduction to Plate Tectonics. The Earth System: Atmosphere: Structure and Composition, Hydrosphere: Occurrence and distribution of water, Hydrological Cycle, Biosphere: Evolution of life through geologic time, Cryosphere, Geosphere: Minerals and Rocks	(15 Hours)
	Introduction to Minerals and Rocks: Physical and crystallographic properties of minerals, colour, streak, lustre, diaphaneity, cleavage, fracture, form, habit, hardness, specific gravity and crystal system. Uses of Minerals. Introduction of common rock – forming minerals: quartz, feldspar, micas, pyroxenes, amphiboles and olivine	(15 hours)
	Scope and importance of Petrology, Rocks: their classification into three broad classes, igneous, sedimentary and metamorphic, Rock Cycle. Igneous Rocks: Mode of occurrence, Forms, structures and textures. Bowen's Reaction series. Classification based on grain size and mineral composition. Sedimentary Rocks: Structures, textures and classification Metamorphic Rocks: Agents of metamorphism, types of metamorphism, fabric and classification	(30 hours)
Pedagogy:	<ul style="list-style-type: none">● Chalk and Board● PPT and Practical demonstration of Mineral and Rock Specimens● Class Quiz	<ul style="list-style-type: none">● Videos● Group Discussion● Field Visits● Assignments
References/ Readings:	<ol style="list-style-type: none">1. Singh, P. (1978). A textbook of engineering and general geology (3rd ed.). S. Chand & Company Ltd.2. Grotzinger, J. P., & Jordan, T. H. (2020). Understanding Earth. Macmillan Learning.3. Monroe, J. S., & Wicander, R. (2015). The Changing Earth: exploring geology and evolution. Cengage Learning.4. Mukherjee. P. K. (2013). A Textbook of Geology.5. Holmes, A. (2013). Principles of Physical Geology. Routledge.6. Rutley, F. (2019). Rutley's Mineralogy. Routledge.7. Klein, C., & Hurlbut, C. S. Jr. (2021). Dana manual of mineralogy. Wiley.8. Lutgens, F. K., Tarbuck, E. J., & Tasa, D. G. (2021). Essentials of Geology (13th ed.). Pearson.9. Marshak, S. (2015). Earth science (14th ed.). John Wiley & Sons.	

	10. Blyth, F. G. H., & de Freitas, M. H. (2018). Geology for engineers (3rd ed.). CRC Press.
Course Outcome:	At the end of the course the student will be able to: <ol style="list-style-type: none">1. Distinguish between the layers of the earth based on the structure and composition (CL2)2. Explain the Earth System (CL2)3. Identify the minerals based on their physical properties (CL3)4. Categorize different rock types (CL4)

Name of the Programme: UG Degree Geology (Honors)

Course Code: GEO-131

Title of the Course: The Dynamic Earth

Number of Credits: 3 (Theory)

Effective from AY: 2023-24

Pre-requisites for the course:	Nil	
Course Objectives:	1. To discuss the origin and various components of earth system. 2. To explain geologic time. 3. To describe minerals and rocks using physical properties.	
Content	Introduction to Geology; Applications and Career opportunities in Geosciences. Introduction to the Dynamic Earth System. Overview of Earth's systems: Atmosphere, Biosphere, Hydrosphere, Geosphere. Origin, shape, size, Internal Structure and composition of the Earth. Earth's Magnetism.	15 hours
	Plate Tectonics and Continental Drift, Evolution of Himalayas. Volcanoes and Earthquakes. Geologic Time and Evolution of Life. Relative and absolute dating.	15 hours
	Introduction to minerals and their uses. Introduction to Igneous, Sedimentary and Metamorphic Rocks and their uses. Minerals and Rocks of Goa.	15 hours
Pedagogy:	<ul style="list-style-type: none">● Chalk and Board● PPT and Practical demonstration of Mineral and Rock Specimens	<ul style="list-style-type: none">● Class Quiz● Videos● Group Discussion● Assignments
References/Readings:	1. Singh, P. (1978). A textbook of engineering and general geology (3rd ed.). S. Chand & Company Ltd. 2. Lutgens, F. K., Tarbuck, E. J., & Tasa, D. (2021). Essentials of geology. Pearson. 3. Marshak, S. (2015). Earth: Portrait of a planet (5th ed.). W. W. Norton & Company. 4. Marshak, S., & Rauber, R. (2017). Earth Science. W.W. Norton & Company. 5. Plummer, C. C., Carlson, D. H., & Hammersley, L. (2015). Physical geology. New York: McGraw-Hill Education. 6. Carlson, D. H., Plummer, C. C., & McGeary, D. (2016). Earth revealed. McGraw-Hill Education. 7. Thompson, J. R., & Turk, J. (2017). Introduction to Physical Geology. Pearson. 8. Dessai, A. G. (2018). Geology and Mineral Resources of Goa. New Delhi Publishers.	
Course Outcome:	At the end of the course the students will be able to: 1. Differentiate between the layers of the earth based on the structure and composition (CL2) 2. Relate the occurrence of earthquakes and volcanoes with plate tectonics. (CL3) 3. Identify various minerals (CL3) 4. Identify different types of rocks (CL3)	

Name of the Programme: UG Degree Geology (Honors)

Course Code: GEO-132

Title of the Course: Physical Geology

Number of Credits: 3 (Theory)

Effective from AY: 2023-24

Pre-requisites for the course:	Nil	
Course Objectives:	1. To describe the major relief features of the Earth. 2. To discuss the various geological processes that operate on and near the surface of the Earth. 3. To explain the formation of different landforms.	
Content	Scope and importance, Major relief features of the Earth, Characteristic features of mountain, plateaus and plains, general relief features of the ocean floor. Hypsographic curve, Isostasy. Present is key to the past – Principle of Uniformitarianism	15 hours
	Weathering and Erosion - physical, chemical and biological. Rivers: development of a typical river system, source and surface flow, erosion, transport, deposition and associated landforms. Geological work of groundwater and Karst topography	15 hours
	Glaciers: types and movements, formation and morphology, erosion, transport, deposition and resulting landforms. Wind: erosion, transport and deposition and resulting landforms, types of deserts and dunes, loess. Oceans and seas: Waves and currents, erosion, transport, deposition and resulting landforms.	15 hours
Pedagogy:	<ul style="list-style-type: none">● Chalk and Board● PPT and Practical demonstration	<ul style="list-style-type: none">● Class Quiz● Videos● Group Discussion
References/Readings:	<ol style="list-style-type: none">1. Singh, P. (2010). Engineering and general geology. S. K. Kataria & Sons.2. Holmes, A. (2017). Physical Geology. Wiley.3. Condie, K.C. (2015). Plate tectonics and crustal evolution. Oxford: Butterworth-Heinemann.4. Plummer, C. C., & McGeary, D. (2015). Physical Geology (15th ed.). McGraw-Hill.5. Tarbuck, E. J., & Lutgens, F. K. (2017). The Earth: An Introduction to Physical Geology (12th ed.). Pearson.6. Grotzinger, J. P., & Jordan, T. H. (2014). Understanding the Earth (7th ed.). W. H. Freeman.7. Monroe, J. S., & Wicander, R. (2017). The Changing Earth: Exploring Geology and Evolution (7th ed.). Cengage Learning.8. Carlson, D. H., Plummer, C. C., & Hammersley, L. (2019). Physical Geology (16th ed.). McGraw-Hill.9. Livard, D. A. (2016). Satellite Geology and Geomorphology (2nd ed.). Springer.10. Thompson, G. W., & Turk, J. T. (2017). Introduction to Physical Geology (2nd ed.). Pearson.11. Tucker, M. E. (2016). Field Geology (6th ed.). Wiley-Blackwell.12. Compton, R. R. (1985). Field Geology (2nd ed.). Wiley.	
Course Outcome:	At the end of the course the student will be able to:	

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| | <ol style="list-style-type: none">1. Recognize the major relief features of the earth based on their characteristics. (CL2)2. Describe the processes of weathering and erosion. (CL1)3. Describe the landforms produced by various geological processes. (CL1)4. Identify the landforms in the field. (CL3) |
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Name of the Programme: UG Degree Geology (Honors)

Course Code: GEO-141

Title of the Course: Remote Sensing and Drone Photography

Number of Credits: 3 (1 Theory + 2 Practical)

Effective from AY: 2023-24

Pre-requisites for the course:	Nil	
Course Objectives:	1. To describe the remote sensing process. 2. To explain the applications of remote sensing in various fields.	
Content	Remote Sensing: Definition, scope and limitations. Elements of Remote Sensing, active and passive sensing. Electromagnetic radiation (EMR), Interaction of EMR with atmosphere and earth surface. Remote Sensing Platforms, Satellites: geostationary, geosynchronous and sun-synchronous satellites, types of sensors. Resolutions: spatial, spectral, radiometric, temporal resolutions. Introduction to drone photography: History of drone photography, Applications of drone photography: Environmental monitoring, Geological studies, Agriculture; Types of drones and their features.	15 hours
	PRACTICAL: Image interpretation exercises: Using satellite or aerial images identify land cover types, features, and other relevant information based on interpretation of the image. Time-series analysis: Using time-series of satellite images analyze and interpret changes in land cover, vegetation and other relevant parameters over time. Remote sensing applications: Research and present on real-world applications of remote sensing technology, such as landslide monitoring or natural disaster response. Drone technology and equipment: Drone components and operation, Camera and gimbal systems, Remote control and mobile app. Hands-on training on Drone Photography Legal and ethical considerations: Research and present on the legal and ethical considerations of drone photography, such as privacy, safety, and airspace regulations. Create a short film or photo essay using drone footage.	60 hours
Pedagogy:	<ul style="list-style-type: none">● Chalk and Board● PPT and Practical demonstration	<ul style="list-style-type: none">● Class Quiz● Videos● Group Discussion

References/ Readings:	<ol style="list-style-type: none"> 1. Reed, B. (2019). Physical principles of remote sensing. Cambridge University Press 2. Lillesand, T. M., & Kiefer, R. W. (2018). Remote sensing and image interpretation. John Wiley & Sons. 3. Gupta, R. P. (2013). Remote sensing geology. Springer. 4. Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2020). Remote sensing and image interpretation. John Wiley & Sons. 5. Pande, P. C. (1987). Principles and applications of photogeology. IBH. 6. Miller, M. M., & Miller, J. D. (2014). Photogeology. Springer Science & Business Media. 7. Moffitt, F. H., & Mikhail, E. M. (2010). Photogrammetry. Wiley. 8. Carroll, M. (2019). Drone photography basics: Your guide to the sky. Skyhorse Publishing. 9. Hall, C. (2018). The drone photography handbook: Capture stunning aerial photos and videos with your drone. Ilex Press. 10. Hall, M. (2018). Aerial photography and videography using drones. CRC Press. 11. LaRue, M. A. (2018). Introduction to drone photography: Learn how to take stunning aerial photos and videos. Skyhorse Publishing.
Course Outcome:	<p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Demonstrate EMR interactions. (CL2) 2. Analyse the applications of satellites and sensors. (CL4) 3. Identify ground features using aerial photos and satellite images. (CL3) 4. Operate a drone according to proper procedures and safety measures. (CL3)

Name of the Programme: UG Degree Geology (Honors)

Course Code: GEO-142

Title of the Course: Water Quality Assessment

Number of Credits: 3 (1 Theory + 2 Practical)

Effective from AY: 2023-24

Pre-requisites for the course:	Nil	
Course Objectives:	1. To explain the occurrence and distribution of water on Earth. 2. To discuss the water quality parameters and standards. 3. To recognize the sources of water pollution, types of pollutants and their effects on human health and ecosystems.	
Content	Introduction, hydrologic cycle Precipitation, runoff, evapotranspiration, infiltration, groundwater recharge: measuring instruments and methods Occurrence of water: surface and groundwater. Water quality parameters and WHO and BIS standards. Water pollution: Point and non-point source, major water pollutants and toxic pollutants, their properties, Arsenic and Fluoride pollution in India, microbiological pollution.	15 hours
	PRACTICAL: Water sampling and sampling techniques. Creation of geotagged inventory of available surface water bodies around the institution. Estimation of Water Quality Parameters: pH, Temperature, Electrical Conductivity, Ca Hardness, Mg Hardness, Biological Oxygen Demand (BOD), Turbidity. Rapid Test for E. coli Graphical Representation of water quality parameters: Collin's Bar Graph, Stiff's Polygon, Piper's Trilinear Diagram, Schoeller's Diagram. Calculation of Water quality parameters: Total Hardness, Total Dissolved Solids (TDS), Sodium Absorption Ratio, % Na, Residual Carbonate. Flow Net Analysis. Visit to a water purification plant or laboratory facility where water is tested.	60 hours
Pedagogy:	<ul style="list-style-type: none">● Chalk and Board● PPT and Practical demonstration	<ul style="list-style-type: none">● Class Quiz● Videos● Group Discussion
References/ Readings:	<ol style="list-style-type: none">1. Hiscock, K. M., & Bense, V. F. (2014). Hydrogeology: Principles and Practice. John Wiley & Sons.2. David, T. (2008). Fundamentals of Hydrology. In Routledge eBooks. Informa. https://doi.org/10.4324/97802039336643. WHO (1993b). Guidelines for Drinking-water Quality. World Health Organization.4. BIS (2001). Bureau of Indian Standards Catalogue, 2001.5. Raghunath, H. M. (2007). Ground Water. New Age International.6. Fetter, CW., Bowing, T & Kreamer, D (2018): Contaminant Hydrogeology, Waveland.	

	7. Dessai, A. G. (2023). Environment, Resources and Sustainable Tourism: Goa as a Case Study (Advances in Geographical and Environmental Sciences). (1st Ed). Springer Verlag.
Course Outcome:	At the end of the course the student will be able to: <ol style="list-style-type: none">1. Describe the hydrologic cycle and its components. (CL2)2. Identify point and non-point sources of pollution. (CL 3)3. Test important water quality parameters in field and in laboratory. (CL4)4. Illustrate water quality data graphically. (CL3)