Centre for Applied Geology
Ph.D Course Work

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>17GEOR0101</td>
<td>Advanced Mineralogy and Petrology</td>
<td>4</td>
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<tr>
<td></td>
<td>17GEOR0102</td>
<td>Structural Geology and Field Mapping</td>
<td>4</td>
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<td></td>
<td>17GEOR0103</td>
<td>Applied Geomorphology</td>
<td>4</td>
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<td></td>
<td>17GEOR0104</td>
<td>Research Methodology in Geological Studies</td>
<td>4</td>
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<tr>
<td>II</td>
<td>17GEOR0205</td>
<td>Instrumentation, Analytical Methods and Quantitative Techniques</td>
<td>4</td>
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<td></td>
<td>17GEOR02SX</td>
<td>Specific course to be prescribed by the Doctoral committee</td>
<td>4</td>
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<td>Seminar (3)</td>
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<td>Term paper/Topical Research</td>
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<tr>
<td>III</td>
<td></td>
<td>Research Credits</td>
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<td></td>
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<td>a) Project planning including literature collection, finalization of objectives and methodology</td>
<td>4</td>
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<td></td>
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<td>b) Field/ Lab Studies, Data collection, compilation of results, statistical analysis, results and final conclusion.</td>
<td>32</td>
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<td>End of Program</td>
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<td></td>
<td></td>
<td>Synopsis and Thesis submission, final viva</td>
<td>6</td>
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List of courses that are candidate centric (17GEOR02SX)

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>17GEOR02S1</td>
<td>GEO EXPLORATION</td>
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<tr>
<td>17GEOR02S2</td>
<td>APPLIED HYDROGEOLOGY</td>
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<td>17GEOR02S3</td>
<td>ENVIRONMENTAL GEOLOGY AND GEOLOGICAL HAZARDS</td>
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<td>17GEOR02S4</td>
<td>SEDIMENTOLOGY AND MARINE GEOLOGY</td>
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<tr>
<td>17GEOR02S5</td>
<td>MICROPALAEONTOLOGY AND PETROLEUM GEOLOGY</td>
</tr>
</tbody>
</table>
Learning Objectives: To understand the methods of interpretation of minerals and rocks in the field. To apply recent techniques for mapping the minerals and rocks.
Learning Outcomes: The scholar will be exposed to the field identification to distinguish properties of various mineral groups that formed as rocks in the field. The scholar also will be exposed the method of interpretation of minerals/rocks in terms of physical, optical and chemical properties.


Unit III: Igneous Petrology: Structure, texture, mineral and chemical composition, Classification, Mode of Occurrence and Origin of Igneous Rocks; Granites, Syenites, Gabbro, Dolerites, Basalts, Anorthosites, Dunite, Peridotite and Carbonatites. Field observation of Igneous Rocks


Reference Books:


Methods of Teaching: Class room teaching and Field Studies
Learning Objectives: To understand the various techniques for assessing the structure, tectonics and its importance. To understand the detailed Geological Field mapping techniques.
Learning Outcomes: The scholar will be exposed to the structure and tectonics and its interpretation principles in the field. This paper also highlights the field mapping techniques of geological studies.


Reference Books:


Methods of Teaching: Class room teaching and Field Studies
**Learning Objectives:** To understand the process of the geological ecosystems like Aeolian, Riverine, Coastal and Glacial geomorphic process, products and its exposure on the earth.  

**Learning Outcomes:** The scholar will be exposed to the development of Earth landforms due to the various geological agents. This paper also highlights the Remote sensing applications to the geomorphic studies.

**Unit I: Fluvial Landforms:** Stages of Stream Development, Specific landform features (Oxbows, levees, cut offs, floodplains, and meanders). Erosional, Transportation and Depositional Features.  

**Arid Landforms:** Stages of Arid Landform Development; Landform features; Stream gradients indicated by contours.  

**Karst Landforms:** Stages of Karstic Landform Development, Hydrogeologic gradients; Artesian aquifer systems. Structural Landforms; Landforms due to subsidence and upliftment, Block faulting, Fault offset recognition

**Unit II: Glacial Landforms:** Erosional, Transportation and Depositional Features. Continental glacial cycles; Causes of continental glaciation, Continental glacial landform features.  

**Aeolian (Wind) Landforms:** Erosional, Transportation and Depositional Features. Desert climate zones; Dune formation; Rain-shadow zones, Dune landforms and migration; Loess deposits. Tectonic Interactions with Landscapes and Climate Earth’s Climate Zones; Rain-shadow effects; Carbon geochemical cycle and global climate effects.

**Unit III: Coastal Landforms:** Coastal process: Erosional and depositional landforms, Types of Coast, Shoreline Change and its impacts, Sea level rise, Coastal zone management, Coastal regulation zone, Coastal protection structures, Sea water intrusion.

**Unit IV: Topographic Maps and Interpretation:** Map scales; Map Projections; Map Coordinates; Magnetic Declination. Topographic Maps; Digital Maps. Construction of Contours from Elevation Data; Computer Contouring Methods, Topographic Profiles with Geologic Cross Sections. Computer contouring methods using Surfer and Excel. GPS Surveying and Mapping, Total Station Survey Techniques for Topographic Mapping.
**Unit V: Remote Sensing Applications in Geomorphic Studies:** Manifestations of Fluvial, Arid, Aeolian, Coastal, Denudational and Karst Topography through Aerial and Satellite remote sensing data. Applied Geomorphology in Natural Resource Mapping, Regional Planning and Watershed Management.

**Reference Books:**

8. https://www.intechopen.com/books/studies-on-environmental-and-applied-geomorphology

**Methods of Teaching:** Class room teaching and Field Studies
Learning Objectives: To understand the research methods of Geoscientific Writing for the journals and thesis.

Learning Outcomes: The scholar will be exposed on Geological writing for the journal publications and thesis writing.

Unit I: Concept and Definition of Research; Academic Research, Basic and Fundamental Research, Applied Research, Theoretical, Conventional and Experimental Research. Concepts and needs of research hypothesis. Objective processes and steps in research methodology; Research proposal and concepts. Developing research proposal in the field of Geosciences.

Unit II: Literature Survey and Review, Research Literatures and Electronic Media including Internet, Use of Digital Library, Online Resources; Necessity of Review of Literatures. Research approach and identifying Gap areas from literature review; problem formulation and statement of research objectives; Developing of bibliography.

Unit III: Pre-field preparations: preparation of maps, survey of the study area through satellite imageries, google earth. Field mapping and documentation. Types and Procedure of sampling- grab sampling, random sampling, stratified random sampling, stratified profile sampling, lateral sampling, sampling documentation. Introduction to field mapping and section measurement. Introduction on laboratory techniques of data analysis and their limitations.

Types of data: primary and secondary data. Source and authenticity of secondary data.

Unit IV: Research Methodology and techniques used in the field and laboratory for geological samples, Field and Lab, developing hypothesis, Collection of primary data from the field, Execution of project, Data analysis, Interpretations of field and lab data, Dissemination of research results through conferences, workshops, synthesis of data, report writing and publication of research paper.

Unit V: Research Methodology is an art of scientific investigations, Geological questions and new insights of a geological event or phenomenon. Planning, Selection, Formulation and Execution of research project, Thrust area of the project, Objectives of
the project and the Course of action (work plan), Methods of sampling, and analytical techniques: Collection of air, water, soil and rock samples, Preparation of samples for microscopic examination and chemical analysis, Analytical Techniques.

References Books:


Methods of Teaching: Class room teaching and Field Studies
In this course, we will explore the different geological instruments and their operation principles, as well as various analytical and quantitative techniques used in geological studies.

**Learning Objectives:**
To understand the different geological instruments, geological statistics, and their operation principles.

**Learning Outcomes:**
The scholar will be exposed to various geological equipment's working principles, applications, and data interpretation for geological research.

**Unit I: Laboratory Techniques of Data Analysis:**

**Unit II: Introduction to Advanced Laboratory Techniques:**

**Unit III: Geospatial Technology Tools:**
Visual Interpretation Instruments, Stereoscopes, Parallax Bar, GPS & DGPS, LiDAR instruments, UAV, Thermal Scanners. Mapping basics (Types, Scale of maps, Legends, Source representation, map layout), Survey of India Toposheets, Geological Survey of India, Soil Survey of India (Source, Procedure for obtaining and representing the map output, Scale Types, Legends in the said maps).

**Unit IV: Geostatistics I: Making Predictions:**
Spatial interpolation - Elements and types: Global versus Local, Exact versus Inexact. Stochastic versus Deterministic, Abrupt versus Smooth. **Global Interpolation** - Trend, Order of polynomial, logistic option. **Local Interpolation** – Thiessen polygon (Voronoï plots), Inverse Distance...

Unit V: Geostatistics II: Practical Exposure on Exploratory spatial data analysis:

Reference Books: