M.Sc. Applied Geology and Geoinformatics
(Choice based credit system)
Syllabus – Revised, June 2016
M.Sc. Applied Geology and Geoinformatics

Annexure : I : A

CENTRAL UNIVERSITY OF KARNATAKA
Department of Geology
School of Earth Sciences

M.Sc. Applied Geology and Geoinformatics
Syllabus - 2016

I: PREAMBLE

A: Context
Geology is the study of the Earth, the materials of which it is made, the structure of those materials, and the processes acting upon them. It includes the study of organisms that have inhabited our planet. An important part of geology is the study of how Earth’s materials, structures, processes and organisms have changed over time. Geology can also refer generally to the study of the solid features of any celestial body (such as the geology of the Moon or Mars).

In this context the Central University of Karnataka introduce integrated BSc-MSc course in Geology to reduce the disparity between the need and availability of competent professionals to cater the requirements of our nation. This programme is basically an academic programme which focuses on preparing the students for research, as well as, for application of Geological knowledge in various field settings.

B: Objectives

The Central University aims to create qualified professionals to meet the increasing social needs of the hour. Hence, this curriculum is instituted with the following objectives:

- To shape skilled and qualified geologists to serve the industrial, management, educational and developmental sectors of the society and the country.
- To contribute to the existing knowledge bank in geological sciences with an integrated and interdisciplinary approach.
- To bring subjects like environmental geology, disaster management, water security, resource management, application of remote sensing and GIS in the field of Geology etc., as academic subjects into the mainstream.
- To develop in-depth knowledge and skills in qualitative and quantitative research methods through laboratory, field and web modes of learning.

C: Course orientation

A two-year master’s degree course in Geology is offered under the School of Earth Sciences following the ‘choice-based credit system’ with an integrated-interdisciplinary approach. The curriculum comprises inputs drawn from all basic geology streams and its application based study with the implication of Remote sensing techniques and GIS. The curriculum also focuses on the application of geo-informatics as a solution to major geological problems.
D: Unique features
The unique feature of this curriculum is that each core paper is integrated with theoretical knowledge and practical approach. The learning is mediated through classroom facilitations, virtual classroom learning modalities, laboratory experiments, internship, supervised dissertations, field works, field tour, etc. Knowledge acquisition procedures are monitored through lecture, participatory and cooperative learning. The learning processes are facilitated by experienced faculty and experts drawn from various academic institutions of repute.

F: Career development
In addition to the prescribed curriculum, students will be given ample opportunities to enhance their personal and professional competencies holistically through active participation in seminars, workshops, conferences, and contributions through the journal, book, and media clubs periodically. Facilities will be provided to students to undergo personal counselling, career guidance and employment opportunity.

II: REGULATIONS

1. Name of the Course: M.Sc. Geology (Department of Geology; under School of Earth Sciences)
2. Duration of the Course: Two years (Four semesters)
3. Eligibility and Attendance: As per University rules.
4. Intake: 30 (Thirty only)
5. Medium of Instruction and examination: English
6. Miscellaneous: All other matters not referred to specifically in these regulations shall be governed as per the Ordinances of the University as revised from time to time.
7. Course structure and credit allocation: Each credit denotes 1 hour for theory and two-hours for practicum. Total credits of the programme: 86 (24+22+20+20).
8. Specialization: Application of Earth science in various related fields with the support of Geo-informatics.
III: SCHEME OF STUDY AND EXAMINATIONS

(L= Lecture, T = Tutorial, P = Practical) Interested students can opt additional single credit papers not exceeding four credits in every semester.

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Papers</th>
<th>Code</th>
<th>Subject Title</th>
<th>Credits</th>
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<th>T</th>
<th>P</th>
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<tr>
<td>1</td>
<td>Core Course Paper 1</td>
<td>CC1</td>
<td>Mineralogy and Geochemistry</td>
<td>4</td>
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<td>CC2</td>
<td>Stratigraphy and Paleontology</td>
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<td>CCP1</td>
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<td>Practical: Structural Geology &amp; Geomorphology</td>
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<td>6</td>
<td>Skill Enhancement Course 1 (Foundation Course-Manmaking)</td>
<td>SEC 1</td>
<td>Field work</td>
<td>2</td>
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<td>2</td>
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<td>7</td>
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<td>AECC 1</td>
<td>Fundamentals of Geoinformatics</td>
<td>3</td>
<td>2</td>
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<td>8</td>
<td>Generic Elective Paper 1</td>
<td>GE1</td>
<td>Earth Resources / Fossils and Their Applications</td>
<td>3</td>
<td>2</td>
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<p>| Semester 2 |
|------------|--------|------|---------------|---------|---|---|---|
| 9          | Core Course Paper 4 | CC4   | Igneous, Sedimentary and Metamorphic Petrology | 4       | 4 | 0 | 0 |
| 10         | Core Course Paper 5 | CC5   | Ocean, Atmosphere and Climate Science | 3       | 2 | 1 | 0 |
| 11         | Core Course Paper 6 | CC6   | Hydrogeology and Environmental Geology | 3       | 3 | 0 | 0 |
| 12         | Core Course Practical Paper 3 | CCP3 | Practical: Petrology | 2       | 0 | 0 | 2 |
| 13         | Core Course Practical Paper 4 | CCP4 | Practical: Hydrogeology, Environmental Geology, and DIP | 2       | 0 | 0 | 2 |
| 14         | Ability Enhancement Compulsory Course 2 (Foundation-Ccompulsory) | AECC2 | Digital Image Processing (DIP) | 3       | 3 | 0 | 0 |
| 15         | Skill Enhancement Course 2 (Foundation Course-Manmaking) | SEC 2 | Social Orientation Course | 2       | 1 | 1 | 0 |
| 16         | Generic Elective Paper 2 | GE2   | Hazards, Disaster Mitigation and Management/Introduction to Earth Surface Processes | 3       | 2 | 1 | 0 |
|            | Total   |      |               |         |   | 22 | |</p>
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<td>Core Course Paper 7</td>
<td>CC7</td>
<td>Ore Geology and Mining Geology</td>
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<td>Core Course Paper 8</td>
<td>CC8</td>
<td>Exploration Geology</td>
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<td>Core Course Paper 9</td>
<td>CC9</td>
<td>GIS data analysis and Modelling</td>
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<td>CCP5</td>
<td>Practical: Exploration, Engineering Geology, and Ore Petrology</td>
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<td>Practical: GIS, Cartography and Surveying</td>
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<td>25</td>
<td>Discipline Specific Elective 2</td>
<td>DSE2</td>
<td>Major Project and Dissertation</td>
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Grand Total 86
IV: SYLLABUS

SEMESTER I

CC1: Mineralogy and Geochemistry:


Unit 2: Introduction to analytical techniques: X-ray diffraction (powder diffraction) method, EPMA, Inductively Coupled Plasma, Mossbauer Spectroscopy, Gas source Mass spectrometry, Scanning electron Microscopy, Back scattered electron detectors. IR spectroscopic method etc.


Books Recommended
23. Francis AlbarèdeGeochemistry: An Introduction, Cambridge, 2009

MSc Syllabus (Applied Geology and Geoinformatics) , Department of Geology, School of Earth Sciences, June, 2016
CC2: Stratigraphy and Paleontology:


Unit 2: Indian Stratigraphy: Archaeans with reference to Karnataka. Classification, lithology and correlation of Kaladgi, Badami, Bhimas, Cuddaphas and Vindyans. Paleozoic and Mesozoic stratigraphy, Gondwanas and Deccan traps.

Unit 3: Palaeoecology – principles and methods; application of fossils in the study of palaeoecology, palaeobiogeography and palaeoclimate. Ichnology-classification of trace fossils and their utility in palaeoenvironmental reconstructions.

Unit 4: Vertebrate Palaeontology: Mesozoic reptiles with special reference to origin diversity and extinction of dinosaurs. Evolution of horse and intercontinental migrations. Human evolution; vertebrate fossil record from India (Gondwana formations, Deccan volcanic Province, Palaeogene and Neogene sequences of India). Palaeobotany: Early plant life, colonization of land, important stages in plant evolution; Gondwana flora and role of climate in its evolution. Introduction to palynology. Introduction to micropalaeontology.

Books Recommended
2. Geology of India, D. N. Wadia ('78), Tata Mc. Graw Hill.
CC3: Geomorphology, Structural Geology and Tectonics:


**Books Recommended**

7. Lahee. Field Geology. RareBooksClub.com (May 19, 2012)
CCP1: Practical: Mineralogy & Paleontology:

Unit 1: Mineralogy: Crystallography (Study of 32 point groups, Representation of symmetry on stereograms, Stereographic projection, Axial ratios). Descriptive Mineralogy (Study of minerals belonging to major groups and their identification with the aid of megascopic characters).

Optical mineralogy (Relative refractive index by Becke method, Determination of vibration direction, pleochroism and optic sign for rock forming minerals. Identification of common rock forming minerals under microscope).


CCP2: Practical: Structural Geology & Geomorphology:


Unit 2: Geomorphology: Toposheet reading, Preparation of drainage map, Preparation Contour map, Morphometry, Preparation of drainage, Preparation of drainage density map, Preparation of drainage frequency map, Preparation of Relative Relief map. Drainage pattern analysis.
AECC1: Fundamentals of Geoinformatics:

Unit 1: Basic principles of Remote Sensing: Definition and components, Electro Magnetic Radiation; Wavelength regions of electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; Black body radiation; Reflectance; spectral reflectance of land covers.

Unit 2: Sensors and platforms: Types of sensors: Multispectral, Hyper-spectral, Microwave, scanners-along track and across track; Platform and their types-Geostationary and Polar orbiting, platforms based on altitudes. Satellite missions –MODIS, IRS, LANDSAT, SPOT, marine/ocean observation satellites.

Unit 3: Introduction to RADAR, LIDAR, SAR and Hyperspectral remote sensing. Integration of GIS with remote sensing.


Books Recommended
2. Photogeology - Miller, J.C.
6. Theory of pattern recognition and modern forecasting - V.Karpin and Wright Pattern.
7. Remote sensing in Geology - Parry S. Siegal& Alan. R.Gillespie

GE1 : Generic Elective
(Courses offered to students from other departments)
GE1 : Earth Resources
OR
GE1: Fossils and Their Applications

GE1 : Earth Resources

Unit 1: Earth Resources: Resource reserve definitions; mineral, energy and water resources. A brief overview of classification of mineral deposits with respect to processes of formation. Methods of mineral conservation.


Unit 3: Water resources and its role in the development. Hydrological cycle and processes.

Books Recommended

MSc Syllabus (Applied Geology and Geoinformatics), Department of Geology, School of Earth Sciences, June, 2016

**OR**

**GE1: Fossils and Their Applications**

**Unit 1:** Introduction to fossils. Definition of fossil, fossilization processes (taphonomy), taphonomic attributes and its implications, modes of fossil preservation, role of fossils in development of geological time scale and fossils sampling techniques.

**Unit 2:** Introduction to various fossils groups. Brief introduction of important fossils groups: invertebrate, vertebrate, microfossils, spore, pollens and plant fossils.

**Unit 3:** Application of fossils: Principles and methods of paleoecology, application of fossils in the study of paleoecology, paleobiogeography and paleoclimate. Societal importance of fossils in hydrocarbon exploration. Application of spore and pollens in correlation of coal seams. Fossils associated with mineral deposits, fossils as an indicator of pollution.

**Books Recommended**

**SEC1: Field work**
Compulsory field work on places of Geological importance.
Semester II

CC4: Igneous, Sedimentary and Metamorphic Petrology

Unit 1: Petrogenesis: Definition, Magma and its Origin, formation igneous rocks. Bowen’s reaction principle. Forms, Textures and structures of igneous rocks. Classification of igneous rocks.

Unit 2: Igneous Petrology: Composition, origin hand mode of occurrence of granite – Granodiorite - Diorite, syenite – Nephalinesyenite; Gabbro – Peridotite – Dunite; Anothosites, Lampropyres, Kimberlite, Carbonatites; Dolerites, Pegmatites; Rhyolites – Trachytes; Andesites&Dacites, Basalts.


Unit 4: Metamorphic petrology: Types and factors of metamorphism. Zones, grades and facies of metamorphism. Facies of Regional and contact metamorphism. Textures and structures of metamorphic rocks. Metamorphism of argillaceous, arenaceous, calcareous and acidic and basic igneous rocks. Metasomatism. Composition, origin and mode of occurrence of Gneisses, Amphibolites, Granulites, Schists and eclogites.

Books Recommended
CC5: Ocean, Atmosphere and Climate Science:


Books Recommended
4. Ahamed, E. Coastal geomorphology of India. Orient long man, New Delhi,
5. Meteorology by Eric W. Danielson, James Levin, Elliot Abrams
6. Essentials of Meteorology: An invitation to the Atmosphere by C. Donald Ahrens
7. Meteorology: Moran and Morgan
8. Meteorology by Eric W. Danielson, James Levin, Elliot Abrams
9. Essentials of Meteorology: An invitation to the Atmosphere by C. Donald Ahrens
10. Meteorology: Moran and Morgan
14. Ecology, environment and pollution – A Balasubramanian
15. Environmental Geology – K S Valdia
16. Environmental Geology – Flawn
17. All you wanted to know disasters – B K Khanna. 2005. New India Publishing Agency
CC6: Hydrogeology and Environmental Geology:

Unit 1: Origin of water; Hydrologic cycle; Classification of aquifers; hydrological properties of rocks; water table contour maps, Hydro-stratigraphic units, Theory of groundwater flow, Darcy’s Law and its applications, determination of permeability in laboratory and in field.

Unit 2: Groundwater quality, graphical presentation of water quality data; Coastal aquifers and salt water intrusions. Types of wells, drilling methods, construction, design, development and maintenance of wells. Pumps tests: methods, data analysis and interpretation; Surface and Subsurface geophysical methods of exploration.

Unit 3: Time scales of global changes in the ecosystems and climate. Impact of circulations in atmosphere and oceans on climate, rainfall and agriculture. Waterlogging problems due to indiscreet construction of canals, reservoirs and dams.


Books Recommended
1. Todd, D.K. Groundwater Hydrology
4. V. Chow Handbook of Applied Hydrology
5. E.E. Johnson 1982 Ground Water and Wells. Johnson Division, UOP Inc
12. Harinarayan Exploration Techniques for Groundwater. COSTED
MSc Syllabus (Applied Geology and Geoinformatics), Department of Geology, School of Earth Sciences, June, 2016

CCP3: Practical: Petrology and Ore Petrology:

Unit 1: Petrology: Study of mega structures, textures and mineralogy of igneous, sedimentary and metamorphic rocks. Microscopic study of Igneous, sedimentary and metamorphic rocks. Interpretation of Geochemical data

Unit 2: Ore petrology: Megascopic study of common metallic minerals, industrial minerals and rocks. Reflected-Microscope and its application. Study of the Metallic mineral under reflected light microscope

CCP4: Practical: Hydrogeology, Environmental Geology, DIP:

Unit 1: Hydrogeology: Preparation of water level contour maps and their interpretation; Calculation of Porosity, permeability, groundwater storage; Groundwater Exploration by Resistivity methods (Schumberger and Wenner methods); Pumping Test Data analysis; Water Quality data analysis

Unit 2: DIP: Interpretation of Images; Registration: Transfer of Information from Imagery to Base Map; Classification; Exposure to various Image Processing Techniques and Generation of digitally processed outputs.

Unit 3: Environmental Geology: Study of seismic and flood prone areas of India. Classification of ground water for use of drinking, irrigation and industrial purposes. Evaluation of Environmental impact of air pollution, ground water, landslides, deforestation, cultivation and building construction in specified areas.

AECC2: Digital Image Processing:

Unit 1: Data collection, data analysis, data collection errors, Remote sensing data requirements, image processing functions, image data formats. Image quality assessment: Image enhancement: Image reduction and magnification, contrast enhancement- linear and nonlinear enhancements, Band ratioing, spatial filtering- spatial convolution filtering, Fourier transformation, principal component analysis.

Unit 2: Image Rectification and Restoration: Geometric correction, geometric errors, types of geometric corrections: Image to map, Image to Image, hybrid approach, rectification logic, Mosaicking.


Unit 4: Thematic map accuracy: Landuse/Landcover map accuracy assessment, sources of errors in remote sensing derived thematic products, error matrix, analysis to assess the accuracy of remote sensing derived information.

Books Recommended
SEC2: Social Orientation Course

Unit 1: Social Problems: Importance of the Study of Social Problems; Problems of Aged. Awareness on anticorruption: Ethics, Anti-corruption, Vigilance, Details of the organization/agencies associated with anticorruption, Corruption free Society, Youth in nation building

Unit 2: Yoga: Concept and Practice, International day of Yoga. Mental and physical health through Yoga.

Unit 3: Smart cities program of Government of India. Its Mission and Objectives: Urban development. Role of various stakeholders associated with Smart city programs in India. Swachh Bharat Abhiyan' (Clean India Mission): Mission, objective and citizen responsibilities

Unit 4: Indian Constitution; Public Administration;

Books Recommended

GE2: Generic Elective
(Courses offered to students from other departments)

GE2: Hazards, Disaster Mitigation and Management
OR
GE2: Introduction to Earth Surface Processes

GE2: Hazards, Disaster Mitigation and Management:

Unit 1: Concepts of disaster; Types of disaster: natural and manmade - cyclone, flood, land slide, land subsidence, fire and earthquake, tsunami and volcanic eruption. Issues and concern for various causes of disasters. Disaster management, mitigation, and preparedness. Techniques of monitoring and design against the disasters. Management issues related to disaster.

Unit 2: Disaster Management in India: Risk, Vulnerability and Hazard Mitigation through capacity building. Legislative responsibilities of disaster management; disaster mapping, assessment. Pre-disaster risk & vulnerability reduction. Post disaster recovery & rehabilitation. Disaster related infrastructure development.

Unit 3: Hazard Zonation Mapping, Remote-sensing and GIS applications in real time disaster monitoring. Prevention and rehabilitation.

Books Recommended
OR

GE2: Introduction to Earth Surface Processes:

Unit 1: Historical development in the concept of earth surface processes, terrestrial relief, scales in geomorphology. Weathering and formation of soils.

Unit 2: Karst and speleology, slope and catchment erosion processes. Fluvial, aeolian, glacial, peri-glacial and coastal processes and resultant landforms.

Unit 3: Controlling factors (tectonics, climate, sea level changes and anthropogenic) and surface Processes. Climate change and geomorphic response. Geomorphic response to tectonics, sea level/base level change, anthropogenic affects. Surface processes and natural hazards. Applied aspects of geomorphology.

Books Recommended
Semester III

CC7: Ore Geology and Mining Geology:


Unit 3: Indian Mineral Deposits: Mineralogy, Origin, Occurrence and Distribution of the following mineral deposits; Metallic – Au, Cu, Fe, Mn and Al. Non Metallic- abrasives, ceramics, refractories, insulators, fossil fuels.


Books Recommended
4. Ore Microscopy - Cameron E N.1961. Wiley,
CC8: Exploration Geology:


Books recommended
14. Mining Geology-R.N.P.ArogyaSwamy
CC9: GIS data analysis and Modelling

Unit 1: Introduction to Geographic Data: Representing geographic space, representing spatio-temporal relationships, File formats for spatial data. Introduction to Database: Database-definition and advantage, computer file structures – simple lists, ordered sequential files, indexed files. Query

Unit 2: Database management system: Essentials of DBMS, levels of data abstraction and data models, characteristics and functionality of DBMS. Types of DBMS structures: Hierarchical, Network system, relational and object oriented. Hybrid database models. Database Design and storage: Conceptual database design, logical database design, and physical database design. Data Storage: Raster and vector data storage and Compression techniques

Unit 3: Spatial analysis meaning and scope: Spatial Decision support system, spatial statistics, Geo-computation, Typology of spatial analysis technologies. Geo-statistical measurements, Boolean operations - overlay, buffering, density analysis, Trend surface analysis. Advanced spatial analysis: Network and raster connectivity operations, Spatial interpolation and proximity operations, Fuzzy analysis. Integration and modeling of spatial data: Suitability modeling, hydrographic modeling, network modeling, Distance modeling, surface modeling.

Books Recommended
DSE1: Advanced Remote sensing in Geosciences:

Unit 1: Spectral characteristics of vegetation, temporal (phenological) characteristics of vegetation, vegetation index. Crop type classification concepts, spectral response of different crops. Crop diseases and assessment, advances in crop monitoring, forest change detection, forest damage assessment and forest monitoring


Unit 3: Remote sensing in urban and infrastructure planning: Urban/suburban resolution considerations, urban land use/land cover classification system, Residential Land use, Commercial Land use, Industrial land use, Transportation infrastructure, Communication and Utilities, transport infrastructure facilities, methods of surveys in town planning, preparation of development plans.


Books Recommended

AECC3: Engineering Geology, Geodesy and Surveying:


Unit 2: Mass movements with special emphasis on landslides and causes of hill slope instability. Earthquakes and seismicity, seismic zones of India. Seismic design of building. Influence of geological conditions on foundation and design of buildings. Introduction to geotechnical engineering.


Books Recommended
Elementary surveying, Major basil Jackson

CCP5: Practical: Exploration, Engineering Geology, and Ore Petrology:

Unit 1: Exploration: Mineral resources evaluation, Estimation of tonnage, averaging assay, economic analysis and resource estimation. Estimation of subsurface resources by borehole log data.

Unit 2: Engineering Geology: Engineering properties of rocks. Study of map, models of important engineering structures as dam sites and tunnels. Interpretation geological maps for landslide problems.

Unit 3: Ore Petrology: Megascopic study of common metallic minerals, industrial minerals and rocks. Reflected-Microscope and its application. Study of the Metallic mineral under reflected light microscope

CCP6: Practical: GIS, Cartography and Surveying:

Unit 1: GIS & Cartography: Map appreciation and conventional signs, Relief and slope Maps; Representation Dot maps, Density maps-colour and gray scale patterns, index of concentration and diversification, transport networking analysis, flow maps. Quantitative symbolization and location maps: point and line pattern analysis, cartograms and 3D maps. Map registration and feature extraction.

Unit 2: Surveying: Plane table chain survey, Dumpy level/auto leveling
Semester IV

CC10: Internship:
Internship in GIS/RS/Geological organizations/institutions based on student’s choice to be finalized in consultation with concerned faculty.

DSE2: Project report and viva:
Students will have to produce a Project Report and submit to the department by the end of the semester which will be evaluated and graded by the University for award of marks.
There is no financial commitment on the part of the University for the internship/project. However the University may assist the candidate in locating him / herself and issue letters to concern besides supplying any other documents / references etc.
The project will be of 4 – 5 months.