BANGALORE UNIVERSITY
DEPARTMENT OF GEOLOGY
Jnanabharathi, Bangalore – 560 056

CBCS REGULATIONS
AND
PROPOSED SYLLABUS

MSc, APPLIED GEOLOGY
(Semester Scheme)
(Effective from the Academic Year 2014-15)
REGULATIONS

DURATION OF THE COURSE: Four Semesters (Two Academic Years)

ELIGIBILITY FOR ADMISSION

For admission to MSc Applied Geology course there shall be two modes of admission:

Mode I: 50% of the seats are reserved for those who have studied Geology at BSc degree and should have secured 50% of marks in Geology and an aggregate of 50% in the optional subjects.

Mode II: 50% of the remaining seats are reserved for those who have studied BSc with any other optional subjects and should have secured 50% marks in aggregate. In case of SC/ST students, relaxation is allowed as per the university regulations. If vacancy arises in either of the modes, inter mode filling up of seats may be allowed.

ATTENDANCE, LEAVE, PROGRESS AND CONDUCT

As existing in the regulations of Bangalore University applicable to P.G. courses in Science.

SCHEME OF EXAMINATION

I SEMESTER (THEORY)

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Paper Title</th>
<th>Instruction (hrs)/Week</th>
<th>Duration of Exams (hrs)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IA+Exam</td>
<td>Total</td>
</tr>
<tr>
<td>HAGT 101</td>
<td>Crystallography and Mineralogy</td>
<td>4</td>
<td>30+70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGT 102</td>
<td>Geodynamics and Geomorphology</td>
<td>4</td>
<td>30+70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGT 103</td>
<td>Structural Geology</td>
<td>4</td>
<td>30+70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGT 104</td>
<td>Palaeontology and Stratigraphy</td>
<td>4</td>
<td>30+70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>SAGT 105</td>
<td>Environmental Geology</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
<td>2</td>
</tr>
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</table>

PRACTICALS

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Paper Title</th>
<th>Instruction (hrs)/Week</th>
<th>Duration of Exams (hrs)</th>
<th>Practicals</th>
<th>Records &amp; Viva-voce</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAGP 106</td>
<td>Crystallography, Mineralogy and Geomorphology</td>
<td>8</td>
<td>4</td>
<td>70</td>
<td>30(20+10)</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGP 107</td>
<td>Structural Geology and Palaeontology</td>
<td>8</td>
<td>4</td>
<td>70</td>
<td>30(20+10)</td>
<td>100</td>
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Total 700 26
### II SEMESTER (THEORY)

<table>
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<tr>
<th>Paper Code</th>
<th>Paper Title</th>
<th>Instruction (hrs)/Week</th>
<th>Duration of Exams (hrs)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAGT 201</td>
<td>Igneous Petrology and Geochemistry</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
</tr>
<tr>
<td>HAGT 202</td>
<td>Fuel Geology</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
</tr>
<tr>
<td>HAGT 203</td>
<td>Exploration Geology</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
</tr>
<tr>
<td>HAGT 204</td>
<td>Remote Sensing and GIS</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
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<tr>
<td>SAGT 205</td>
<td>Sequence Stratigraphy and Engineering Geology</td>
<td>3</td>
<td>3</td>
<td>30+70</td>
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### PRACTICALS

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<th>Records &amp; Viva-voce</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAGP 206</td>
<td>Igneous Petrology, Petrochemical Calculation and Geochemical Exploration</td>
<td>8</td>
<td>4</td>
<td>70</td>
<td>30(20+10)</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGP 207</td>
<td>Geophysical Exploration, Remote Sensing and GIS</td>
<td>8</td>
<td>4</td>
<td>70</td>
<td>30(20+10)</td>
<td>100</td>
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Total: 700  26

### III SEMESTER (THEORY)

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<thead>
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<th>Paper Title</th>
<th>Instruction (hrs)/Week</th>
<th>Duration of Exams (hrs)</th>
<th>Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAGT 301</td>
<td>Sedimentary and Metamorphic Petrology</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
</tr>
<tr>
<td>HAGT 302</td>
<td>Stratigraphy of India and Mineral Economics</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
</tr>
<tr>
<td>HAGT 303</td>
<td>Mining Geology and Mineral Processing</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
</tr>
<tr>
<td>OE 304</td>
<td>The World of Rocks and Minerals OR Water Resources</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
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</tbody>
</table>

Total: 700  26
# PRACTICALS

<table>
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<tr>
<th>Paper Code</th>
<th>Paper Title</th>
<th>Instruction (hrs)/Week</th>
<th>Duration of Exams (hrs)</th>
<th>Practical</th>
<th>Records &amp; Viva-voce</th>
<th>Total</th>
<th>Credits</th>
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<tbody>
<tr>
<td>HAGP 305</td>
<td>Sedimentary and Metamorphic Petrology</td>
<td>8</td>
<td>4</td>
<td>70</td>
<td>30(20+10)</td>
<td>100</td>
<td>4</td>
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<tr>
<td>HAGP 306</td>
<td>Environmental Geology, Geostatistics and Surveying</td>
<td>8</td>
<td>4</td>
<td>70</td>
<td>30(20+10)</td>
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<td>4</td>
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<td></td>
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<td>600</td>
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# IV SEMESTER (THEORY)

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Paper Title</th>
<th>Instruction (hrs)/Week</th>
<th>Duration of Exams (hrs)</th>
<th>Marks IA+Exam</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAGT 401</td>
<td>Hydrogeology and Meteorology</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGT 402</td>
<td>Micropalaæontology and Marine Geology</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGT 403</td>
<td>Ore Geology and Analytical Techniques</td>
<td>4</td>
<td>3</td>
<td>30+70</td>
<td>100</td>
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<tr>
<td>HAGT 404</td>
<td>Dissertation (Evaluation and Viva-voce)</td>
<td>8</td>
<td>–</td>
<td>30 (viva)+70</td>
<td>100</td>
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</table>

# PRACTICALS

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Paper Title</th>
<th>Instruction (hrs)/Week</th>
<th>Duration of Exams (hrs)</th>
<th>Practical</th>
<th>Records &amp; Viva-voce</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAGP 405</td>
<td>Hydrogeology and Meteorology and Micropalaæontology</td>
<td>8</td>
<td>4</td>
<td>70</td>
<td>30(20+10)</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>HAGP 406</td>
<td>Ore Geology, Ore Reserve Estimation and Field Report Evaluation</td>
<td>8</td>
<td>4</td>
<td>65</td>
<td>10+5</td>
<td>100</td>
<td>4</td>
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<td></td>
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<td></td>
<td>20</td>
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<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
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<td></td>
<td>600</td>
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</table>

**Note:** Each theory paper shall be taught 4 hours/week. Each practical paper shall be conducted 4 times a week with 3 hours duration.

HAGP, Hard Core Applied Geology Practical; HAGT, Hard Core Applied Geology Theory; IA, Internal Assessment; OE, Open Elective; SAGT, Soft Core Applied Geology Theory.
DECLARATION OF RESULTS AND CLASSIFICATION OF SUCCESSFUL CANDIDATES

The results of successful candidates at the end of each semester shall be declared on the basis of percentage of aggregate marks and in terms of Grade Point Average (GPA) and alpha-sign grade. The results at the end of the fourth semester shall also be classified on the basis of percentage of aggregate marks and on the basis of the Cumulative Grade Point Average (CGPA) obtained in all the four semesters and corresponding overall alpha sign grade. An eight point grading system, alpha-sign grade as described below shall be adopted.

First class with distinction 70% and above (A+,A++or O)
First class 60% and above but less than 70% (A)
High second class 55% and above but less than 60% (B+)
Second class 50% and above but less than 55% (B)
Pass class 40% and above but less than 50% (C)

EIGHT POINT ALPHA-SIGN GRADING SCALE

<table>
<thead>
<tr>
<th>Grade Avg.</th>
<th>Alpha-Sign Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4</td>
<td>D</td>
</tr>
<tr>
<td>4–&lt;5</td>
<td>C</td>
</tr>
<tr>
<td>5–&lt;5.5</td>
<td>B</td>
</tr>
<tr>
<td>5.5–&lt;6</td>
<td>B+</td>
</tr>
<tr>
<td>6–&lt;7</td>
<td>A</td>
</tr>
<tr>
<td>7–&lt;8</td>
<td>A+</td>
</tr>
<tr>
<td>8–&lt;9</td>
<td>A++</td>
</tr>
<tr>
<td>9–10</td>
<td>O</td>
</tr>
</tbody>
</table>

Note on Continuous Evaluation
1. The breakup of the continuous evaluation marks are as follows:
   - Theory tests 15
   - Assignment 10
   - Attendance 05
   - Total 30 marks

   a. Continuous tests

   One hour every week, is put aside in the timetable as a ‘test period’. These tests start after completion of the first month of course work. These tests go in a sequential order, such that in the first week, the students have a test in paper I, the second week in paper II, in the third week in paper III and in the fourth week in paper IV and V. The cycle keeps repeating such that every student appears for three tests in every theory paper. All tests are compulsory. Since it is in the timetable and the students know the schedule of tests before hand, they are prepared for the tests. If the ‘test day’ happens to be a holiday, the test is shifted to another period in the week itself, based on the convenience of the students and the teacher concerned. The test is generally for 15 marks and consists of objective type questions and / or short notes. These test marks are entered in
the register kept in the office by the teacher concerned. For the purpose of continuous evaluation, the total of the three tests are calculated and then converted taking into account that the maximum for continuous tests is only 15 marks. Previously, three tests were given and the best two were taken for calculation. This was to ensure that students who had missed one test for genuine reasons test if they had done the first two tests well, thus defeating the very purpose of continuous evaluation.

However, whether the best two or all three should be taken into consideration for calculation can be decided at the level of the departmental council. If need be, one “repeat test” can be given at the end of the semester to all those students who have missed any one test, so that the average of three tests can still be calculated. This can be held at the convenience of the department.

b. Assignment
Every student submits an assignment/makes a presentation to the class/conducts a seminar etc for every paper. The list of topics is given at the beginning of the semester and students choose their topic. This is evaluated by the subject teacher for 10 marks and these marks are entered in the Internal Marks Register.

c. Attendance
Minimum percentage of attendance to be able to write the exam is 75%. Marks for attendance are as follows:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 – 100%</td>
<td>05</td>
</tr>
<tr>
<td>90 – 94%</td>
<td>04</td>
</tr>
<tr>
<td>85 – 89%</td>
<td>03</td>
</tr>
<tr>
<td>80 – 84%</td>
<td>02</td>
</tr>
<tr>
<td>75 – 80%</td>
<td>01</td>
</tr>
</tbody>
</table>

Every month, the percentage of attendance for each student is read out in class, so that students who are on the borderline can make up.

2. Practicals

Record 20
Viva-voce 10
Total 30 marks

The format of giving marks for attendance is the same as for the theory papers.

At the end of the semester, the continuous evaluation marks are put up on the Notice Board and students are asked to verify the marks and bring any discrepancies to the notice of the chairperson. The Internal Marks Register can also be checked by the students to ensure that the marks entered are correct.
I SEMESTER

PAPER HAGT 101: CRYSTALLOGRAPHY AND MINERALOGY (1:3 or 4 hrs/wk)

CRYSTALLOGRAPHY

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1 hr</td>
</tr>
<tr>
<td>Space lattice</td>
<td>1 hr</td>
</tr>
<tr>
<td>Crystal elements, symmetry in crystals</td>
<td>1 hr</td>
</tr>
<tr>
<td>Hermann-Mauguin notation and indices</td>
<td>1 hr</td>
</tr>
<tr>
<td>Classification of crystals into 32 classes</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Crystal forms</td>
<td>2 hrs</td>
</tr>
<tr>
<td>Crystal projections</td>
<td>2 hrs</td>
</tr>
<tr>
<td>Twinning</td>
<td>1 hr</td>
</tr>
<tr>
<td>X-ray crystallography</td>
<td>1 hr</td>
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</tbody>
</table>

MINERALOGY

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical properties of minerals</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Structure of silicates</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Classification of minerals based on chemical composition</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Study of the following groups of minerals and their industrial applications:</td>
<td></td>
</tr>
<tr>
<td>Ortho and ring silicates: olivine, garnet.</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Chain silicates: pyroxene and amphiboles</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Ring silicates: epidote</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Sheet silicates: mica and clay minerals</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Frame work silicates: feldspars, feldspathoids and quartz</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Native elements, oxides, hydroxides and carbonates.</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Gemstones</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Principles of optics</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Optical instruments and accessories</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Pleochroism</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Birefergence</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Isotropism and anisotropism</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Extinction angle</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Optic axial angle, optic orientation</td>
<td>3 hrs</td>
</tr>
</tbody>
</table>
REFERENCES
Donald Bloss, 1999: Optical X-ray Crystallography, Mineralogical Society of America.
Dana, 2003: Text Book of Mineralogy, Wiley Bastern Ltd.

PAPER HAGT 102: GEODYNAMICS AND GEOMORPHOLOGY (2:2 or 4 hrs/wk)

GEODYNAMICS

The broad features of the Earth including layered structure. 2 hrs
The Continental Crust: Structure based on seismological data 2 hrs
Isostatic equilibrium and Gravity anomalies 2 hrs
The Oceanic Crust: structure based on seismic data, velocity - depth distribution. Ocean floor spreading, oceanic ridges and continental margins. 2 hrs
Dynamic evolution of continental and oceanic crust. 2 hrs
The Mantle: Seismological methods of investigating mantle structure. Temperature-depth distribution. Composition of mantle. 2 hrs
The Core: Its Structure, Physical state and composition. The earth’s magnetic field, main field and secular variation. 2 hrs
Plate Tectonics: Continental drift – Geological and palaeomagnetic lines of evidence, ocean floor spreading, subduction zone, collision of continents, mid-oceanic ridges and transform faults. 6 hrs
The Origin of Earth’s Surface Features: Contraction hypothesis. Expanding earth hypothesis. The convection hypothesis. 2 hrs
Orogeny and epirogeny processes, anatomy of orogenic belts. 1 hr
Tectonic elements of Indian subcontinent. 1 hr

GEOMORPHOLOGY

Introduction and concepts in Geomorphology. 2 hrs
Weathering – Mechanical, chemical, biological weathering. Factors controlling weathering. 2 hrs
Soil formation - soil profile, classification and geomorphic significance. 3 hrs
Slope: slope profiles, hill, slope development, slope stability. 2 hrs
Drainage Basin: Drainage network, basin morphology, basin denudation and evolution. 2 hrs
Fluvial Processes: River channels, sediment in channels, the Quasi - equilibrium condition, channel patterns, rivers, equilibrium and time. 2 hrs
Fluvial Land Forms: Flood plain, fluvial terrain, fans and pediments, deltas. 2 hrs
Eolian Processes and Landforms: Erosional and depositional landforms. 2 hrs
Glacial Processes and Landforms: Erosional and deposition features. 2 hrs
Karst Processes and Landforms: Process and controls, drainage characteristics, surficial landforms and limestone caves. 2 hrs
Coastal Processes and Landforms: Processes, beaches, coastal topography, shoreline changes. 1 hr
Geomorphology of Indian sub-continent. 2 hrs

REFERENCES
Alma Mater Fortag.
Naqvi, S.M. 2005, Geology and Evolution of the Indian Plate (From Headen to Holocene-4 Ga to 4Ka). Capital Publishing Company.
Derbyshire, E. Gregory, K.J. and J.R. Hills, 2000: Geomorphological process. Dawson & Sons Ltd.

PAPER HAGT 103: STRUCTURAL GEOLOGY (4 or 4 hrs/wk) 52 hrs
Introduction – Geological structures and their significance 3hrs
Concept of stress and strain, Strain ellipsoid and geological significance 5 hrs
Folds, types of folds, classification, geometry of folds, mechanism of folding, superimposed folds. Recognition of folds in field. 8 hrs
Faults, geometrical and genetic classification of faults, gravity faults, normal faults, thrust faults and strike – slip faults, recognition of faults in the field.  
Joints, types of joints, classification of joints.  
Cleavage, Schistosity, Foliation, lineation and their relation to major structures.  
Unconformities, types, recognition and significance.  
Shear zones, types of shear zones and geometry of shear zones.  
Dating of structural events.  

REFERENCES

PAPER HAGT 104: PALAEONTOLOGY AND STRATIGRAPHY (2:2 or 4 hrs/wk)

PALAEONTOLOGY  
Classification of fossils  
Habitats and marine environments  
Fossils – definition, types of fossils  
Fossilization: mode of preservation and their importance  
Origin and evolution of life  
Study of the following groups of invertebrate fossils: Corals, Graptolites, Brachiopods, Lamellibranches, Cephalopods, Echinoids and Trilobites  
A general review of Vertebrates through geologic time  
A general review of plant fossils through geologic time  

STRATIGRAPHY
Concepts in stratigraphy: Basic principles and definitions. Concept of time and resolution.  
Stratigraphic classification and code of nomenclature. Stratigraphic correlation.  
Stratification and stratigraphic column. Concept of facies including Walther's Law of facies succession.  
Graphical representation of stratigraphic data; Applications of stratigraphy: Techniques in stratigraphic correlation (local, regional and intercontinental).
Elements of magneto- seismic-, sequence-, isotope- and high resolution event stratigraphy. 5 hrs
World stratigraphy; Brief description of principal stratigraphic units
of the world in type areas only. 7 hrs

REFERENCES

PAPER SAGT 105: ENVIRONMENTAL GEOLOGY (3 or 4 hrs/wk) 52 hrs
Introduction, concept of ecosystem, impacts of circulation in atmosphere and oceans on climate. 4 hrs
Evolution of atmosphere, hydrosphere and biosphere and their mutual relationship with lithosphere. 5 hrs
Records of palaeo – temperature, global warming caused due to indiscrete use of fossil fuels; volcanic eruptions and deforestation. 4 hrs
Humans as center of biosphere, change in human–environment relationship. Impact of major human activities on the environment, impact assessment of degradation. 2 hrs
Contamination of surface water and groundwater due to industrialization, urbanization and agriculture. 4 hrs
Water logging – problems due to construction of canals, reservoirs and dams. 2 hrs
Soil profiles and soil quality degradation due to irrigation, use of fertilizers and pesticides. 2 hrs
Impact of exploration of natural earths resources on environment: Mineral resources and Energy resources. 4 hrs
Environmental pollution; causes, effects and control of soil, water, air and noise. 5 hrs
Wastes: Sources, types and waste disposal and management (domestic, municipal, agricultural, industrial, biomedical, nuclear waste, etc.) 7 hrs
Important environmental legislation 2 hrs

REFERENCES
PRACTICALS

PAPER HAGP 106: CRYSTALLOGRAPHY, MINERALOGY AND GEOMORPHOLOGY (1:2:1)

CRYSTALLOGRAPHY AND MINERALOGY


Study of minerals belonging to major groups and their identification based on megascopic characters and etch tests. Calculation of structural formula.

Determination of the following properties by classical methods: extinction angle, birefringence, pleochroism and optic sign of rock-forming minerals.

GEOMORPHOLOGY


PAPER HAGP 107: STRUCTURAL GEOLOGY AND PALAEONTOLOGY

STRUCTURAL GEOLOGY (2:2)


PALAEONTOLOGY

Mode of preservation – study of the following genera: Corals, Brachiopods, Cephalopods, Echinoderms, Trilobites and plant fossils.

FIELD WORK: During the I semester, the students have to participate compulsorily in a mapping programme for about 10 days and submit a detailed field report, which will be evaluated in IV semester.

II SEMESTER

PAPER HAGT 201: IGNEOUS PETROLOGY AND GEOCHEMISTRY

(3:1 or 4 hrs/wk) 52 hrs

Introduction – Forms, structures and textures of igneous rocks 5 hrs

Classification of igneous rocks – CIPW and IUGS 3 hrs

Magma generation in the crust and mantle 2 hrs

Physical properties of magma – temperature, density and viscosity 2 hrs
Magma chamber processes: convection – fractional crystallization, assimilation, mixing of magmas 5 hrs
Phase equilibria in igneous systems – binary and ternary 3 hrs
Petrological aspects of the following groups:
Granite – granodiorite – diorite 2 hrs
Syenite – nepheline syenite 2 hr
Ultramafic rocks, layered complexes and anorthosite 3 hrs
Lamprophyre, carbonatite and kimberlite 3 hrs
Rhyolite – dacite – andesite 2 hrs
Trachyte and phonolite 2 hrs
Basalt and its types 4 hrs
Komatiites 1 hrs

GEOCHEMISTRY

Introduction – definition, role of geochemistry in geological studies. 1 hr
Abundance of elements in earth. 1 hr
Meteorites and their characteristics. 2 hrs
Geochemical classification of elements. 1 hr
Major, trace and REE and their petrogenetic significance in understanding the igneous, sedimentary and metamorphic processes. 5 hrs
Radiogenic stable isotopes and their petrogenetic significance. 3 hrs

REFERENCES

**PAPER HAGT 202: FUEL GEOLOGY (4 or 4 hrs/wk)**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Introduction, definition, types and importance.</td>
<td>2 hrs</td>
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<tr>
<td><strong>Petroleum Geology</strong></td>
<td></td>
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<tr>
<td>Introduction and occurrence of petroleum.</td>
<td>2 hrs</td>
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<tr>
<td><strong>Reservoir</strong></td>
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<tr>
<td>Traps – structural, stratigraphic and combination traps: salt domes.</td>
<td>5 hrs</td>
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<tr>
<td>The origin, composition and different fractions, migration and accumulation of oil and gas. Transformation of organic matter into kerogen, organic maturation, thermal cracking of kerogen.</td>
<td>5 hrs</td>
</tr>
<tr>
<td>Prospecting for oil and gas, drilling and logging procedures.</td>
<td>3 hrs</td>
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<tr>
<td>Petroliferous basins of India and world. Geology of the productive oil fields of India. Future prospects and the economic scenario.</td>
<td>5 hrs</td>
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<tr>
<td><strong>Coal Geology</strong></td>
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<tr>
<td>Introduction – historical review.</td>
<td>1 hrs</td>
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<tr>
<td>Origin, types and classification.</td>
<td></td>
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<tr>
<td>Geology of coal – coal as rock, sapropelic coal, coal, boghead coal, channel coal, humic coal, peat, lignite, (or brown coal), sub-bitminous coal (lignitous coal), bitminous coal, semi-anthracite, anthracite, unusual coal type, paper coal, coloured coal.</td>
<td>2 hrs</td>
</tr>
<tr>
<td><strong>Mode of Occurrence</strong></td>
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<tr>
<td>Structures in coal seams: banding, cleats, coal ball, eye coal, cone in cone structure, shark tooth and saw tooth structure.</td>
<td>1 hrs</td>
</tr>
<tr>
<td>Coal through ages: coal-forming epochs in the geological past (Carboniferous, Permian, Triassic, Jurassic, Cretaceous and Tertiary). Geological and geographical distribution of coal deposits in India. Detail geology for some important coal fields in India.</td>
<td>3 hrs</td>
</tr>
<tr>
<td><strong>Coal Properties</strong></td>
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<tr>
<td>Characteristic of coal: physical and chemical characteristics, proximate analysis, moisture, volatile matter, ash, fixed carbon, ultimate analysis, carbon and hydrogen, nitrogen, oxygen, sulphur, phosphorous and caloric value.</td>
<td>3 hrs</td>
</tr>
<tr>
<td><strong>Petrographic Characteristics</strong></td>
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<tr>
<td>Macroscopic ingredients and microscopic constituents, application of coal petrology in petroleum exploration and its application in solving industrial and geological problems.</td>
<td>3 hrs</td>
</tr>
<tr>
<td><strong>Classification of Coal</strong></td>
<td></td>
</tr>
<tr>
<td>Methods of coal prospecting and estimation of coal reserves. Coal production and problems of coal industry in India. Evaluation of coal characteristics, commercial coal classification systems.</td>
<td>3 hrs</td>
</tr>
</tbody>
</table>
Indian coal grading. 1 hr
Preparation of coal for industrial purposes, coal carbonization, coal gasification and coal hydrogenation. 2 hrs

**Genetic Aspects of Coal**

Origin of coal: accumulation of vegetable matter, accumulation of plant debris, in situ theory, drift theory, transformation of vegetable matter into coal, biochemical stage, coalification, mechanistic theories, cellulose and lignin theory and coalification concept of Mazumdar. 3 hrs

**Coal Bed Methane**

A new energy resource. Maturation of coal and generation of methane in coal beds. Fundamentals of coal bed methane exploration and production. 2 hrs
Disturbance in coal seams, heat affected in coals, gases in coal seams 1 hr

**Nuclear Geology**

Radioactive minerals as source of energy. Mode of occurrence and sources of radioactive substances. 2 hrs
Methods of prospecting and productive geological horizons in India. 2 hrs
Global scenario on power generation.

**REFERENCES**

Davis, 2002: Statistics and Data Analysis in Geology. Wiley.

**PAPER HAGT 203: EXPLORATION GEOLOGY (2:2 or 4 hrs/wk)**

**GEOPHYSICAL EXPLORATION** 52 hrs

Introduction, Study of physical properties of rocks and minerals related to geophysics. geophysical anomalies. 3 hrs

**Electrical prospecting:** Electrical properties of rocks and minerals. Direct current method. Instruments used in electrical prospecting. Application of electrical methods in groundwater investigation. 5 hrs
**Gravity prospecting:** Earth gravity field. Regional and local gravity anomalies. Instruments used in gravity prospecting, principles of gravimeters. Types of corrections applied in gravity data. Interpretation of gravity anomalies. 5 hrs

**Magnetic prospecting:** Magnetic properties of rocks and minerals. Earth’s magnetic field. Regional and local anomalies. Magnetic balances and Torsion magnetometers. Airborne magnetometers. Interpretation of magnetic anomalies. 5 hrs

**Seismic prospecting:** Elastic properties of rocks. Different types of elastic waves. Refraction techniques. Time-distance relation for horizontal interfaces. Effects of dipping beds and faults. Seismic instruments. Data acquisition and processing. 5 hrs

**Well logging:** Description of a borehole environment. Different techniques of logging. 3 hrs

**GEOCHEMICAL EXPLORATION**

Introduction: Application of geochemistry in mineral exploration. Geochemical sampling media and scales of geochemical survey. 2 hrs

Basic principles involved in geochemical prospecting, geochemical environments, geochemical dispersion, geochemical anomaly, geochemical mobility, geochemical reactions, indicators and path finders and principles of interpretations. 4 hrs

Mode of occurrence of trace elements. 1 hr

Methods of sample decomposition. 1 hr

Primary dispersion patterns of deep-seated. Epigenetic anomalies in bedrock - diffusion and leakage halos. 3 hrs

Secondary dispersion patterns: Mechanical and biological dispersion, syngenetic and epigenetic dispersion. 3 hrs

Dispersion of elements in residual overburden: Anomalies in gossans, soils. 3 hrs

Geochemical drainage survey: Orientation survey, choice of material to be sampled, sample layout, collection and processing of samples, preparation of anomaly maps, interpretation of data. 3 hrs

Geochemical soil survey: Orientation survey, field operations, sampling layout; processing of samples and interpretation of data. 3 hrs

Biogeochemical and geobotanical survey: Biogeochemical anomalies, surveying techniques. Geobotanical indicators, geobotanical anomalies. 3 hrs

**REFERENCES**


PAPER HAGT 204: REMOTE SENSING AND GIS (3:1 or 4 hrs/wk) 52 hrs

REMOTE SENSING
1 hr
Fundamental concepts of electromagnetic energy and electromagnetic spectrum.
Radiation laws, Black body radiation, emissivity.
Atmospheric effects-Interaction of earth surface features with electromagnetic radiation.
Spectral signatures of vegetation, water and soil.
Remote sensing platforms – ground-based, airborne and space borne-satellite systems and orbits low and high altitudes.
Sensor systems – imaging and non-imaging types of sensors, optical sensors.
Types of scanners – multispectral scanner and push broom scanner.
Characteristics of sensors; Resolution – spatial, spectral, radiometric and temporal.
Satellite remote sensing – global and IRS mission.
Visual interpretation techniques of Images.


PHOTOGRAMMETRY
Introduction: Map and an aerial photograph, types and geometry of photograph.
Scale, ground coordinates relief displacement, flying height and tilt displacement in aerial photograph.
Stereoscopy, Stereoscope, vertical exaggeration and height determinations.

Digital Photogrammetry: Definition of digital photogrammetric images, creation of digital images, automatic measurement of fiducial marks, automated photogrammetric point measurement, automated surface modeling and digital photogrammetric work station, overview of digital photogrammetric hardware and software.
GEOGRAPHIC INFORMATION SYSTEM (GIS)
Principles of GIS and its applications to study of natural resources.
Advantages and disadvantages of raster and vector GIS
Web enabled GIS
GIS software packages: ISRO-GIS, IDRISI, ArcGIS, AutoCAD map, MapInfo. 13 hrs

REFERENCES

PAPER SAGT 205: SEQUENCE STRATIGRAPHY AND ENGINEERING GEOLOGY
(2:1 or 4 hrs/wk) 52 hrs

SEQUENCE STRATIGRAPHY
Introduction to concepts, terminology and significance. 4 hrs
Depositional system, sequence, unconformity 3 hrs
Systems tracts: lowstand systems tracts (LST), lowstand submarine fans, LST-prograding wedge; transgressive systems tract (TST)
Highstand system tract (HST) 6 hrs
Parasequence, parasequence set, progradational parasequence set, aggradational parasequence set, retrogradational parasequence set; sequence boundary (SB); flooding surfaces (FS), maximum flooding surface (MFS) 6 hrs
Type 1 sequence, type 2 sequence. 4 hrs
Application of sequence stratigraphy in Petroleum exploration with case studies. 3 hrs

ENGINEERING GEOLOGY
Role of geology in civil engineering and mining 2 hrs
Engineering properties of rocks and soils. 3 hrs
Geological consideration for dam and reservoir sites. 2 hrs
Geological consideration for tunneling, highway and bridge construction. 3 hrs
Mass movement with special emphasis to landslides and hill slope stability. 2 hrs
Seismic zones of India, Design of seismic resistant buildings. 1 hr
REFERENCES
An Online Guide to Sequence Stratigraphy, UGA Stratigraphy lab

PRACTICALS
PAPER HAGP 206: IGNEOUS PETROLOGY, PETROCHEMICAL CALCULATION AND GEOCHEMICAL EXPLORATION (2:2)
1) Megascopic and microscopic study of different Igneous rocks (Granite, Diorite, Syenite, Gabbro, Anorthosite, Ultramafic rocks, Lamprophyres, Basalts, andesites, Dacite, Trachyte and Phonolite)
2) Petrochemical Calculations: Niggli values, Niggli bases and norm classification: Plotting of chemical data on different variation diagrams.

PAPER HAGP 207: GEOPHYSICAL EXPLORATION, REMOTE SENSING AND GIS (2:1:1)

GEOPHYSICAL EXPLORATION: Use of resistivity meter. Interpretation of resistivity curves – 2 layer and 3 layer cases. Selection of sites for well location. Solution of direct problems in gravity and magnetic methods. Interpretation of seismic data from time–distance curves: Horizontal beds – 2 layer and 3 layer studies, dipping beds.


III SEMESTER

PAPER HAGT 301: SEDIMENTARY AND METAMORPHIC PETROLOGY (2:2 or 4 hrs/wk) 52 hrs

SEDIMENTARY PETROLOGY

Introduction, composition, classification, relative abundance of common sediments; texture, particle size of detrital rocks, concepts of size, shape and roundness, Framework geometry of detrital sediments 5 hrs

Structures: mechanical (primary), chemical and organic structures 4 hrs

Sedimentary environments and facies: continental alluvial, lacustrine; aeolian and glacial sedimentary systems 4 hrs

Conglomerates, Breccias, Sandstone, Greywackes, Limestone, Shale, Evaporites 9 hrs

Palaeocurrents 1 hr

Provenance 2 hrs

METAMORPHIC PETROLOGY

Introduction, agents and types of metamorphism 3 hrs

Texture and classification of metamorphic rocks 2 hrs

Metamorphic zones, depth zone concept and metamorphic grades 2 hrs

Facies concept – facies of thermal, regional and high pressure metamorphism 6 hrs

Ultra high temperature and ultra high pressure metamorphism 2 hrs

Chemographic phase relations in metamorphic systems 2 hrs

Role of fluids in metamorphism and metasomatism 2 hrs
Geothermobarometry 1 hr
Khoandalite, Amphibolite and Eclogite 2 hrs
Anatexis and Migmatites 1 hr
Charnockites 2 hrs

REFERENCES
Davis, R.A, Jr. 1992: Depositional systems. Prentice hall
Einsele, G, 2002: Sedimentary Basins. Springer Verlag
Pankhurst, 2000: Igneous and Metamorphic rocks. Prentice Hall

PAPER HAGT 302: STRATIGRAPHY OF INDIA AND MINERAL ECONOMICS
(3:1 or 4 hrs/wk) 52 hrs

STRATIGRAPHY OF INDIA
Physiographic divisions of Indian Peninsular 2 hrs
Structure and tectonics of India 2 hrs
Tectonic evolution of the following cratonic blocks: Dharwar, Baster, Singbhum, Bundelkhand, Aravalli, and Marwar. 8 hrs
Mobile belts: Eastern Ghats, Pandyan and Satpura.
The Archean Group:
Archean Basement Complex: Peninsular Gneiss of Karnataka, Banded Gneissic Complex of Rajasthan, Older Metamorphics of Eastern India. 4 hrs
Green schist belts of Karnataka: Sargurs and Dharwar Supergroup. 3 hrs

4 hrs

Palaeozoic, Paleogeographic and paleoclimatic conditions prevailing in Indian subcontinent during Paleozoic, Mesozoic and Cenozoic eras.

5 hrs

Igneous activity in Indian subcontinent in relation to break up of Gondwanaland. Mountain building activities in Indian subcontinent during Cenozoic Era.

3 hrs

Archean-Proterozoic, Proterozoic-Cambrian, Permian-Triassic and Cretaceous-Tertiary boundary problems in Indian subcontinent.

8 hrs

MINERAL ECONOMICS

Introduction, concept and importance.

2 hrs

Significance of minerals in national economy, demand and supply.

2 hrs

Strategic, Critical and Essential Minerals.

1 hr

Conservation and substitution of minerals.

2 hrs

International status of mineral trade, supply, demand, monopolies, embargo and cartels.

3 hrs

Mineral legislation of India, Mineral Concession rules of India, taxation system.

2 hrs

National Mineral Policy.

1 hr

REFERENCES


Krishnan, M.S. 1982: Geology of India and Burma. CBS Publications.


PAPER HAGT 303: MINING GEOLOGY AND MINERAL PROCESSING

(2:2 or 4 hrs/wk) 52 hrs

MINING GEOLOGY

Mining – Its scope – changing facets of mining in relation to exploration and metallurgy. 1 hr
An overview of different exploration strategies: Geological, Geochemical, Geophysical, Geobotonical and Remote sensing approach and their merits and limitations.  
Guides in the Ore search; Lithological, structural, geomorphological,mineralogical (including alteration patterns) features useful in mineral explorations.  
Sampling techniques – Channel sampling methods; chip, muck and car sampling.  
Drilling – relevance of drilling in geological investigations. Methods of drilling – Diamond core drilling, rotary drilling, churn and other drilling methods.  
Drill cores – their logging methods and interpretations of drill core data.  
Techniques of ore reserve estimation  
Mining in the past and the present.  
Open cost mining – Alluvial and marine mining methods.  
Underground mining – Mine layout, shaft sinking, Drives and cross cut, Winzes and other auxiliary developments.  
Underground mining methods – Stoping, Breast stoping.  
Blasting and explosives used in mining.  
Mine support and ventilation.  
Mining hazards.  

MINERAL PROCESSING  
Introduction: Scope and objectives of the processing of metallic and non-metallic minerals.  
Comminution: Principles of Comminution, Theory and grindability.  
Grinding methods.  
Gravity Concentration: Principles of gravity concentration – Gravity Separators, Jigs, Shaking Tables, Pneumatic Tables.  
Heavy Medium Seperation (HMS): The Heavy medium – Liquids, Suspensions, Seperating vessels – Gravitational vessels, Centrifugal Separators.  
Froth flotation, principles of flotation – anionic collectors, cationic collectors, frothers, regulators. The importance of pH, the importance of pulp potential. Control of flotation plants.  
Magnetic separation methods: principles and functional techniques.  
Dewatering: sedimentation – coagulation and flocculation, selective flocculation, gravity sedimentation, high-capacity thickeners, centrifugal sedimentation, filtration.  
Tailings disposal: methods of disposal of tailings; tailing dams.
REFERENCES
Mckinstry, H.F, 1999: Mining Geology. Prentice-Hall
Arogyaswamy, R.R, 1982, Progress in Mining Geology. IBH
Brookes, R.P, 1997: Geobotanical and Bio Geochemical Exploration. IBH.

PAPER OE 304: THE WORLD OF ROCKS AND MINERALS (4 or 4 hrs/wk) 52 hrs
Introduction to Geology 1 hr
Minerals: Definition, Formation, Classification 3 hrs
Physical properties of minerals 3 hrs
Study of some important groups of minerals – Quartz, Feldspar, Mica, Garnet, Amphibole and Pyroxene group. 5 hrs
Ore minerals: Metallic and non-metallic minerals and their industrial Application 6 hrs
Distribution of important metallic and non-metallic minerals deposits in India – Iron, Manganese, Chromium, Gold, Copper, Aluminium, Lead and Zinc. Mica, Asbestos, Magnesite, Clay, Kyanite, Diamond and Corundum 8 hrs
Gemstones: Definition, Physical and Optical properties of precious and Semiprecious varieties of gemstones, Gemstone deposits of India. 4 hrs
Rocks: Definition, Classification – Igneous, Sedimentary and Metamorphic Forms of Igneous rocks, Intrusive and extrusive rocks, Study of some common Igneous rocks 3 hrs
Texture and classification of sedimentary rocks; primary and secondary sedimentary structures; study of some common sedimentary rocks 5 hrs
Textures and classification of metamorphic; study of some common metamorphic rocks. 5 hrs
Uses of igneous, sedimentary and metamorphic rocks. 4 hrs
REFERENCES
Dana, 2003 : Text Book of Mineralogy, Wiley Bastern Ltd.

PAPER OE 304: WATER RESOURCES (4 or 4 hrs/wk) 52 hrs

Hydrological Cycle: precipitation, evaporation, evapotranspiration, runoff, infiltration – measurements and instruments. 10 hrs

Surface Water Resources: description of surface water resources including ponds, lakes, streams, rivers and storage reservoirs and selection of suitable site for a reservoir, factors governing the selection, distribution of water.
Vertical distribution of groundwater, groundwater reservoirs – aquifers, aquiclude, aquifuge and aquitard.
Global water budget, India’s water budget, precipitation and its types.
Subsurface water regime, types of aquifers.
Geological factors, governing the occurrence of groundwater, groundwater movement.
Hydrogeological properties of rocks.
Method of groundwater exploration. 22 hrs

Groundwater management and recharge methods.
Groundwater recharge, artificial recharge water harvesting, watershed–wasteland management, structures, contours, bunds, contour barriers (vegetative and stones), contour trench, check dams, percolation pond and irrigation tanks. 20 hrs

Water harvesting techniques in dry land areas, contour bunds for tress, semicircular bunds, permeable rock dams, background technical detail and construction.

REFERENCES

PRACTICALS

PAPER HAGP 305: SEDIMENTARY AND METAMORPHIC PETROLOGY (2:2)

Sedimentary Petrology: Study of primary, secondary and biogenic sedimentary structures in hand-specimens; Megascopic and microscopic study of clastic and chemical sedimentary rocks.

Metamorphic Petrology: Megascopic and microscopic study of different metamorphic rocks. Estimation of pressure and temperature using different models of geothermobarometry.

PAPER HAGP 306: ENVIRONMENTAL GEOLOGY, GEOSTATISTICS AND SURVEYING (2:1:1)


Water sample analysis – Ca, Mg, Na, K, Cl, SO4, NO3, HCO3, CaCO3 and F by Volumetric/Ion-meter/AAS methods.

Presentation of chemical analysis data and plotting chemical classification diagrams.

Evaluation of environmental impact assessment of air and groundwater pollution.


SURVEYING: Chain, Prismatic Compass – Radiating and Intersection, Plane Table – Radiating and Intersection method.

FIELD PROGRAMME

During the III semester, the students shall carry out a field program of about 10 days, during which they have to study some typical geological sections, visit important mines and collect samples. A detailed field reports have to be submit separately. Both the reports that is, fieldwork/mapping program conducted in I Semester and field tour of III Semester will be evaluated in IV Semester.

IV SEMESTER

PAPER HAGT 401: HYDROGEOLOGY AND METEOROLOGY (3:1 or 4 hrs/wk)

HYDROGEOLOGY

52 hrs

Hydrological Cycle: Precipitation, evaporation, evapotranspiration, runoff, hydrograph, infiltration – measurements and instruments. 6 hrs

Vertical distribution of groundwater, groundwater reservoirs- aquifers, aquiclude, aquifuge and aquitard. 2 hrs
Types of aquifers – confined, unconfined, semi-confined (leaky), perched and coastal.  

**Hydrological Properties of Rocks:** Porosity, specific yield, specific retention, hydraulic conductivity, transmissivity and storativity. Water table contour maps and flow-net analysis.  

**Well Hydraulics:** Darcy’s law and flow equations. Methods of pumping tests, drawdown, cone of depression, safe yield and delayed yield. Radial flow to wells under Steady and Unsteady state in confined and unconfined aquifers. Evaluation of aquifer parameters.  

**Water Well Technology:** Development and maintenance of wells.  

Water management in rural and urban areas, salt water intrusion in coastal regions – G-H relation, remedial measures and hydrofracturing.  

Artificial recharge of groundwater, conjunctive use of surface and groundwater, problems of overexploitation.  


Hydrogeochemical zones of India and Groundwater provinces of India  

**METEOROLOGY**  

**Climatology:** Earth and Sun relationship, latitudinal and seasonal variations of insolation.  

**Atmosphere:** Composition and structure  

Climatic changes, Green house warming and Stratospheric ozone depletion.  

Temperature, Humidity, wind.  

Types of clouds, cloud top temperatures, winds and rainfall temperature.  

Palaeoclimatology, climatic zones of India.  

Meteorological Satellites and their applications in detection of cyclones.  

Weather analysis and their interpretation. Weather station  

**REFERENCES**  


PAPER HAGT 402: MICROPALAEONTOLOGY AND MARINE GEOLOGY

(2:2 or 4 hrs/wk)  
52 hrs

MICROPALAEONTOLOGY

Introduction – Field sampling and collection, separation of microfossils from rock matrix and modern sediments, picking and mounting of microfossils.  
5 hrs
Morphology, classification and evolution of foraminifera  
5 hrs
Application of micropaleontology in hydrocarbon exploration.  
5 hrs
Palaeoenvironmental interpretation using microfossils  
5 hrs
Morphology and Geological distribution of Ostracoda, Calcareous Nannofossils, Algae, Marine Diatoms, Dinoflagellates, Spores and Pollen.  
2hrs

MARINE GEOLOGY

Introduction to Marine Geology  
2 hrs
Ocean morphology: Continental shelf, continental slope, continental rise. Deep ocean floor and various topographic features: ridges, sea mounts, coral reefs and Atolls-types of coral reefs, trenches and canyons.  
8 hrs
Oceanic Circulation: Causes of ocean currents, Surface currents, Deep currents, currents of the Atlantic, Pacific and Indian Ocean. Currents of the Artic and Antarctic ocean, mirror currents. Waves- Waves erosion, classification of waves  
8hrs
Major components of marine sediments and distribution of marine microfossils.  
2 hrs
Mineral Resources of the Oceans: Placers deposits and aggregates; Authigenic minerals and sediments-ferromangenese nodules (Polymetallic nodules) and encrustations, factors determining and distributions of nodules, phosphorites, organic deposits-Petroleum, metalliferous sediments and hydrothermal ores.  
8 hrs

REFERENCES


PAPER HAGT 403: ORE GEOLOGY AND ANALYTICAL TECHNIQUES

(3:1 or 4 hrs/wk)  
52 hrs

ORE GENESIS

Modern concepts of ore genesis and their evolution.
Metallogenic epochs, periods and distribution of major ore deposits.
Metallogeny and plate tectonics.  
3 hrs
Classification of ore deposits. Relationship of ore and host rocks, textures, zoning and paragenesis of ores.  
Ore-bearing fluids, their source and origin and behaviour.  
Wall rock alteration; controls of ore deposition with case studies.  
Fluid inclusion studies; Methodology and application in ore genesis.  
Study of major ore associations with Indian examples.

Ores of igneous affiliation:
1. Ores of mafic and ultramafic association  
2. Ores of felsic association

Ores of metamorphic affiliation.

Ores of sedimentary affiliation.

Chemical and clastic sedimentation, stratiform, strata bound Mn-Fe, non-ferrous ores, placers and palaeoplacers and structural ore deposits.

Ores related to weathering and weathered surfaces – Laterite, bauxite, Ni/Au Laterites


Mode of occurrence, mineralogy, genesis and distribution of the following metalliferrous deposits in India: Fe, Mn – nodule, Cr, Cu, Pb, Zn, Al, Mg, Au, Sn, W and U, their deposits of India.

ORE MICROSCOPY
Preparation of sample for reflected light microscopy and electron microprobe analysis.
Principles of ore microscopy.
Transmitted light microscopy versus reflected light microscopy.
Microscopic properties of ore minerals.
Study of ore textures.
Quantitative ore microscopic properties.

ANALYTICAL TECHNIQUES
Sample preparation.
Dissolution procedures for geological samples-partial and total digestions.
Chemical separation of elements, classical and rapid methods.
Atomic Absorption Spectrophotometry.
X-Ray fluorescence spectrometry (energy dispersive & wave length dispersive) and X-ray diffractometry.
Scintillation Counter, SEM, ICP, EPMA, Fluid inclusion studies.

REFERENCES
PAPER HAGT 404: DISSERTATION (4 or 4 hrs/wk)  
52 hrs
The student will select a topic of his/her interest and a detailed investigation/study will be carried out including mapping, analysis and interpretation of the data to finalize the dissertation work. Evaluation of Dissertation and viva-voce will be conducted.

PRACTICALS
PAPER HAGP 405: HYDROGEOLOGY, METEOROLOGY AND MICROPALAEONTOLOGY (2:1:1)

HYDROGEOLOGY
Calculation of average depth of precipitation, Determination of evaporation and evapotranspiration, Water budget calculations, River discharge estimations, Construction of hydrographs, separation of different components of a hydrograph. Calculation of porosity, Determination of specific capacity, Calculation of aquifer parameters using Theiss, Jacob, Papadopulos-Cooper methods. Selection of sites for wells using hydrogeomorphological techniques.

METEOROLOGY
Instruments used to determine meteorological parameters, Temperature, Humidity, Wind speed. Determination of Missing Rainfall data and rain gauging station. Problems on meteorological parameters. Study of weather plotting symbols, Interpretation of weather maps and Assessment of weather data.

MICROPALAEONTOLOGY
Processing of samples, picking and mounting of fauna. Study of morphological characters of selected microfossils. Preparation of thin sections of selected larger microfossils.

PAPER HAGP 406: ORE GEOLOGY, ORE RESERVE ESTIMATION AND FIELD REPORT EVALUATION (2:2)

ORE GEOLOGY
Megascopic study of structures and fabrics of different ores and their associations. Mineralogical and textural studies of common ore minerals under ore-microscope Petrological study of other
industrial and non-metallic ore minerals. Exercises in the determination of reflectivity and micro hardness of common ore minerals.

ORE RESERVE ESTIMATION
Different methods of ore reserve estimations: grid (both limited and unlimited areas), triangular, polygonal methods.
Ore reserve estimation of vein type ore bodies.
Borehole problems; estimation of ore reserves: simple bedded, folded and faulted ore bodies.

FIELD REPORTS OF I AND III SEMESTERS WILL BE EVALUATED.
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