

Paper—V Economic Geology, Geology of raw material and resources of India and Metamorphic petrology 3 hrs 50

Paper--VI Environmental Geology applied geology, field geology.

Practical III Pertaining to paper V & VI

Practical work	35	
Sessional work	5	
Field work	5	5 hrs 50
Viva on field work	5	

*Note :* In addition to the courses prescribed for laboratory work. Geology excursion will be arranged each year for study of rocks in field and visits to mineralised area and sites of Geological occurrences.

### Detailed Courses of Reading

B. Sc. Ist year General for examination 1989 after 8 to 10 lectures of an hour for each unit.

Paper—I : Crystallography, Descriptive and Optical Mineralogy.

#### Crystallography

Unit I : Introduction and definition of Crystallography.

- Elementary idea about crystal formation.
- Elements of internal structure.
- Morphological characters of crystals, Faces, edges, solid angle, Crystal forms, Heteromorphism, Hemihedrism
- System of crystal notation, parameter, indices, use of contact Goniometer.

**Unit 2 : General idea of symmetry operations.**

- Elements of symmetry.
- Laws of Crystallography.
- Preliminary idea about stereographic projection of crystal.
- Basis of classification of crystals in systems and class.

**Unit 3 : Study of symmetry and forms of the following symmetry classes.**

**Isometric System :** Galena type, Pyrite type, Tetrahedrite,

**Tetragonal system :** Zircon type, Chalcopyrite type

**Hexagonal system :** Beryl type, Calcite type, Tourmaline type.

**Orthorhombic system :** Barytes type.

**Monoclinic system :** Gypsum type.

**Triclinic system :** Axinite type.

- Elementary idea about twinning its type.

## **Minerology**

**Unit 4 : Definition and scope of minerology.**

- Physical characters of minerals depending upon cohesion and elasticity; Specific gravity, light, Heat, Electricity, magnetism, taste and odour.

— Classification of minerals.

- Elementary idea about crystal chemistry.

— Isomorphism, Polymorphism, and Pseudomorphism.

**Unit 5 : Study of physical and chemical properties, classification, alteration, Occurrences and uses of following groups of minerals and their species :**

Quartz,

Felspar,



Feldspathoid (Nepheline, Sodalite, Azurite).

— Amphibole : (Hornblende, Tremolite, Actinolite, Asbestos).

— Pyroxene : (Hypersthene, Enstatite, Augite, Diopside)

— Mica : (Muscovite, Biotite, Lepidolite).

Unit 6 : Study of Physical, Chemical properties alteration occurrence and uses of following minerals :-

Olivine, Garnet, Epidote, Chlorite; Andalusite: Staurolite, Spinel, Topaz, Tourmaline, Talc, Gypsum, Calcite, Serpentine, Apatite, Fluorite, Corundum, Kyanite, Barite, Beryl, Zeolite, Aluminium, Silicates, Sillimanite, Zircon.

### *Optical Mineralogy*

Unit 7 : — General principles of optics.

Construction, uses description of Petrological microscope

— Accessory plates and their uses.

— Elements of optical crystallography.

— Isotropism and Anisotropism.

Uniaxial and Biaxial minerals.

— General idea about refractive index, double refraction.

Extinction, Pleochroism and interference colours.

Unit 8 : Study of optical properties of the minerals given unit 5 and 6 of the paper.

Paper-II: Palaeontology, principles of Stratigraphy; Sedimentation and sedimentary petrology.

Unit I Board Classification of Organism.

— Introduction, definition and importance of palaeontology and its branches.

— Fossils :- definition, requisites and mode of occurrence and preservation.

—Applied aspects and uses of fossils in various fields of earth science Viz. as indices of Palaeogeography, palaeoclimates, Palaeoecology, organic evolution and stratigraphic relation.

—Concept of organic evolution.

Unit 2 Study, classification, Morphology, Distribution and Geological history of the classes :-

Phylum Mollusca. Paleceopoda (Bivalvia), Gastropoda, and Cephalopoda.

Phylum Crustacea.

Unit 3 Study of Phylum Arthropoda (class Trilobita) its Morphology, classification and Geological history.

Phylum Coelenterata (Class Anthozoa-corals)

Morphology, Geological history.

Phylum Echinodermata : Brief survey of major classes class Echinoderia and Crinoidea their Morphology, classification, Geological distribution.

Phylum Protochordata (Order Graptolidea) its Morphology distribution and Geological history.

Unit 4 A brief account of the vertebrata sequence through the time.

Evolutionary trends in man, horse.

—Introduction of plant kingdom—classification.

—Description, Morphology of following plant fossils :-

Glossopteris, Gangamopteris, Vertebraria, Ptillophyllum, Lepidodendron, Willemsonia.

Principles of Stratigraphy, Sedimentation and sedimentary Petrology.

Unit 2 Stratification and various factors (Physical Chemical



and biological controlling stratification.

- Code of stratigraphic nomenclature in India, various stratigraphic units.
- Correlation (Both for fossiliferous and Unfossiliferous rock different method).

#### Unit 6 Sedimentary cycles and processes of sedimentation

- Lateral variation in rocks,
- Facies concept in stratigraphy.
- Standard Geological time scale.
- Transportation, Deposition of sediments in Marine basin.

#### Unit 7 Diagenesis and Lithification.

- Composition of sedimentary rocks.

Textures and structure of sedimentary rocks and their formation.

- Classification of sedimentary rocks.

Unit 8 Megascopic and microscopic study of the following rock types : Conglomerates, Breccia, Arkose, Sandstone, Gneiss, Shale, Limestone, Marl, Dolomite, Peat, and Lignite.

Practical I relating to Paper I and II.

#### A Crystallography

Study of crystal models, Drawing of crystallographic with unit cell, Morphological study of (Symmetrical elements) drawing of Clinographic projection of crystal forms of normal classes of the following system :—

Cubic, Tetragonal, Hexagonal, Orthorhombic Monoclinic.

Uses of Goniometer measurement of interfacial angle.



## Minerology

Study of physical properties and determination of hardness and specific gravity and optical phenomenon of minerals in hard specimen,

Megascopic study and spot identification of minerals (listed in theory papers) and their diagnostic character.

Microscopic study and identification of the following minerals :—

Quartz, Orthoclase, Microcline, Plagioclase, Olivine, Augite, Hypersthene, Hornblende, Actinolite, Biotite, Muscovite, Clacite, Tourmaline, Zircon, Garnet, Chlorite Sphene.

## Palaeontology

Description and identification of following important fossils their age and Taxonomy.

**Mollusca :** Trigonia, Gryphea, Unio, Pecten, Spondylus, Arca Cardita, Natica, Turritella, Cerethium, Murex, Pleurotomaria, Physa, Trochus, Orthoceras, Nautilus, perisphinctis, Hildoceras, Ceratites, Stephanoceras Belemnites.

**Brachiopoda :** Terebratula, Spilifer, Syringothyris, Phynchonella, Products Atrypa,

**Echinodermata :** Hemaster, Micraster, Pylaster, Cidaris.

**Coral :** Calceolo, Zaphrentes.

**Graptolite :** Monograptus, Dydimograptus.

**Plant Fossils :** Glossoptrix, Ginkgopttris, Vertibria, Ptillophyllum  
Megascopic and Microscopic study of sedimentary rocks given in the theory and their identification and environment,



B. Sc. II<sup>nd</sup> year Pass course.

For examination in 1990 and after (8 to 10 lectures per unit).

Paper III : Physical General Geology and Structural Geology.

### Physical and General Geology

Unit 1. Geology definition its subdivisions, scope and relation with other sciences.

— Earths 'relation with solar system: Earths shape structure and surface relief, Origin and Age of the earth, Interior of the earth.

Unit 2. Basic Idea of diastrophism.

— Earthquakes, Volcanism, their causas, effects types and distribution.

— Mountain building-epicosogenic and orgenic movements

Unit 3. Weathering and Mass wasting.

— Erosional, depositiral features and Geological works of Running water: Ground water and Glaciers.

Unit 4. Erosional, d positional features and Geological works of wind, oceans and lakes.

— Principles of isostacy, continental drift.

### Structural Geology

Unit 5. Elementry concept of structural geology.

— Mechanical principles of deformation.

— Definition of force, stress and strain, mechanics of plastic deformation.

— Elementry dip, strike, thickness and width of outcrops.



**Unit 6. Terminology and description of folds, its types and classification Effects of folds on the outcrops and their recognition. Top and bottom of bed. Plunge and raise of folds, drag folds.**

—Joints sets system and classification. Distinction from faults.

—Elementary idea about refolding uses of folds.

**Unit 7. —Faults, its terminology types and classification of faults. Effects of faults on the outcrops.**

—Reverse faults and thrusts. Normal faults and uses of faults. Definition on window, klippe and Nappe.

**Unit 8. Unconformity, its types, their recognition.**

—Distinction between unconformity and faults.

—Inclir-outclir and their significance.

—Hort and grabben.

—Clinometer compass-Brunton compass and measurements of dip, strike and direction.

—Elementary idea of Topographic features.

—Location I own position on topographic maps.

## **Paper-1V Stratigraphy and Igneous Petrology.**

### **Stratigraphy :—**

**Unit 1 Brief account of Archacogic rocks.**

—Dharwar Super Group of Karnatalsa.

—Iron ore group of India.

—Distribution of Protrozoic rocks in India and type area stratigraph of the Cuddapah super group and Vindhyan supergroup.

**Unit 2. Distribution of Palaezoic rocks in India.**

—Haimanta system and math quartzites.



—Permo carboniferous of Spiti and Kashmir.

—Gondwana Super group (Lower Gondwana sequence, upper Gondwana sequence and classification.

**Unit 3 Distribution of merozoic rocks in India.**

—Iriassic of Spiti.

—Jurassic of Kutch.

—Cretaceous rocks of South-East Coasts.

—Bagh bed, Umaria marine bed.

**Unit 4 Deccan Trops-Intertrappean and Infratrappean.**

—Distribution of Tertiary rocks in India.

—Siwalik system in Jammu,

—Subathu, Dharmasala, Dagsai and Kasauli group.

—Karewa beds of Kashmir.

**Igneous Petrology :**

**Unit 5 Igneous rocks and their constituents.**

—Nature and composition of Magma.

—Forms and structures of Igneous rocks. Extrusive and Intrusive rocks.

—Elementary idea about origin of Magma.

**Unit 6 Common Textures of Igneous rocks.**

—Bases of classification of Igneous rocks.

—Tabular classification.

—Elementary idea of Streckeisen's classification.

**Unit 7 Crystallisation of Unicomponent system.**

—Binary system.

—Crystallization of quartz-Albite and Albite-Anorthite system-

—Bowen's reaction principle and reaction series.



Unit 8 Elementary idea of Magmatic differentiation and assimilation. Petrographic description and elementary idea of Petrogenesis of the following:—

Granite

Charnokite

Syenite and Nepheline syenite

Gabbro

Peridotite

Basalt

Dolerite

Diorite

Practical II Reading to paper III and IV

Structural Geology :— Reading to paper to geographical maps of survey of India in different scales.

Locating own position on map.

— measuring dip, strike, dissection, bearing and back-bearing with clinometer compass and Brunton compass.

— Completion of outcrops on contoured maps.

— Study and interpretation of simple geological maps.

— Preparation of geological cross section of simple maps

— Simple problems on width of outcrops and thickness of strata.

— Determination of true dip and direction from two apparent dips and apparent dip direction from true dip direction.

Stratigraphy :— Recognition of simple stratigraphic rock and preparation of stratigraphic column.

Igneous Petrology : Megascopic study and description of following rocks and their classification and identification.

Tranite



Pegmatite

Charnockite

Syenite and nephelene syenite

Gabbro

Dolerite.

Basalt.

Phonolite.

Dacite.

Microscopic study, description, classification and identification of following rocks,

Granite.

Charnockite.

Syenite.

Nephelene Syenite.

Gabbro.

Basalt.

Diorite.

### B.Sc. IIIrd Year Pass Courses

For examination in 1991 and after at the end of 3rd year (8 to 10 lectures per unit).

Paper V : Economic Geology, Geology of Raw material, resources of India and Metamorphic Petrology.

*Economic Geology, Raw material and resources of India.*

Unit I Economic Geology, its definition scope and terminology.

—Syngenetic-Epigenetic minerals deposits.

—Fundamentals of classification of mineral deposits.

—Control of ore mineralization.

—Geological thermometers.



**Unit 2 Fundamental of ore genesis.**

Brief idea about processes of ore formation.

Magmatic and Hydrothermal processes.

Oxidation and supergene, enrichment.

—Mechanical and residual concentration.

**Unit 3 Physical properties, chemical composition, mode of occurrence Geographical and Geological distribution and uses of following ore deposits of India.**

Iron

Manganese

Copper

Lead & Zinc.

Aluminium.

Mineral wealth of Himachal Pradesh.

**Unit 4 General appraisal of India's mineral wealth and raw material.**

—Fuel minerals-coal petroleum their origin, distribution and uses in India.

—Physical properties, composition; occurrence and origin of following non-metalliferous minerals in India.

—Mica

—Magnesite

—Gypsum

**Metamorphic Petrology :****Unit 5 Metamorphism, definition and process.**

—Agents and their rock in metamorphism.

—Types of metamorphism.

**Unit 6 Texture and structure of metamorphic rocks.**

—classification of metamorphic rocks.



- Nomenclature of metamorphic rocks.
- Elementary idea of Depth zones in metamorphism.
- Concept of facies.

**Unit 7. Dynamic metamorphism and its products.**

- Dynamothermal metamorphism and its products.
- Contact metamorphism of pelite and carbonate rocks.
- Regional metamorphism of Pelitic and carbonate rocks.

**Unit 8. Introduction to metasomatism, types and products.**

- Petrographic study of common types of metamorphic rocks and their identification.

—Metamorphic facies.

Migmatites.

**Paper-VI : Environmental Geology, Elements of Applied Geology and Field Geology.**

**Environmental Geology -**

**Unit 1. Fundamental principles of environmental geology, its definition and scope.**

- Basic concepts in brief.
- Physical system.
- Geologic Hazards, landslides, its causes and remedial measures, prevention and identification.

**Unit 2. Geologic resources and energy minerals.**

- Minerals and pollution.
- Water resources and energy.
- Fossil fuels and energy.
- Atmosphere its pollution, causes and remedies.



### Unit 3 Earthquake hazards, its causes and remedies.

- Prediction of Earth quakes.
- Constructions in Earthquakes prone areas.
- Volcanic hazards, its causes and remedies.
- Deforestation, causes and effects.

### Unit 4 Human activity-forming and sullage industries.

- Water pollution and pollution load.
- Pollutants and remedies.
- Elementary idea of water quality and destructive effects of water pollution.
- Waste disposal and treatments

### Elements of Applied Geology and Field Geology

#### Unit 5 Introduction to industrial mineralogy

- Industrial specification of minerals for following Industries.
- Fertilizer.
- Building material (cement and construction).
- Location of chemical industries and regional planning.

#### Unit 6 India's Mineral Policy.

- Properties of gemstones.
- Methods of mineral exploration.
- Introduction to mining methods (open cast and under ground).
- Future resources of mineral supplies.

#### Unit 7 Introduction and utilization of ground water and hydrologic cycle.

- Methods of groundwater exploration.
- Artificial recharge.



## Unit 8 Principles of remote sensing techniques,

- Study of soil types.
- Principles of Geological Surveying.
- Geological mapping with chain and compass,

### Practical-III

#### Economic Geology :

Megascopic study of physical Chemical properties and identification of following ore minerals :—

- Iron : magnetite, Hematite, Pyrite, Pyratite, Ilmenite.
- Manganese : Pyrolucite Psilomelane Rhodochrosite, Rhodochrosite.
- Copper : Cuprite Chalcocite, Chalcocite, Melachite.
- Lead-Zinc and Tin : Zincite, Sphalerite Cassiterite, Galena, Cerussite.
- Aluminium : Corundum, Bauxite, spinel.

Other Minerals : Halite, Kainite, Calcite, Anhydrite, Gypsum, apatite, Fluorite, Barytes, Beryl Magnesite, Cinnabar, Graphite, Lignite, Anthracite, Chromite, Lepidolite, Muscovite, Biotite, Talx, Stibnite, Realgar, orpiment, tapax, native, copper, Molybdenite, Azurite, Graphite, Siderite.

#### Metamorphic Petrology :

Megascopic study of following rocks and their description and identification. Petrological description and identification of the following rocks :—

Phyllite, Schist, Gneiss, Marble.

Chain and compass mapping.



## B.Sc. Honours Course in Geology

### Scheme of Examination

The 3 year B.Sc. Honours course in Geology will consists of Examination in Theory papers and the practicals including the field work. There shall be Eleven Theory papers (Paper I to XI) each of Three duration. There shall be one Practical (containing two parts of  $4\frac{1}{2}$  hours duration each at the end of 1st and 2nd years and three practicals of  $4\frac{1}{2}$  hours each at the end of 3rd years.

The honours examination for the Degree of Bachelor of Science shall also include.

1. A qualifying test in English at the end of 1st year of two papers of - 50 marks each.
2. A qualifying test in one of the following subjects at the end of 2nd year one paper 100 marks.

a- Physical Science consisting of Physics/Chemistry.

b- Life Sciences consisting of Botany/Zoology.

N. B.\* The candidates offering Physics/Chemistry as subsidiary shall have to opt for life sciences & those offering Botany/Zoology shall opt for physical sciences as qualifying subject.

**Subsidiary subjects :** Each candidates shall offer two subsidiary subjects for these subjects shall be taken for both theory and practicals at the end of 1st and 2nd years.

(i) Physics and Mathematics or Chemistry.

(ii) Zoology & Botany (iii) Botany or Zoology & Chemistry.

**Note :-** i) Each of the candidate shall offer two subsidiary and one qualifying subject (other than the subsidiary subjects offered.



- ii) 50% of marks secured in the two subjects in the examination shall be added towards the classification of results of the successful candidates.
- iii) 20% marks in the theory and practical examinations of Geology as Main subject shall be assigned for the teachers concerned on the basis of the student's performance in the tutorial and assignments as 'Assessment'.

### **Scheme of Honours Examination Geology**

**B. Sc. Part-I (Honours) Examination in Geology 1st examination at the end of 1989 and later.**

**Paper-I : Physical Geology, Basic Geomorphology and Elements of structural Geotectonics** 100 Marks

**Paper-II : Morphological crystallography and Mineralogy (Physical, Chemical, optical).** 100 Marks

**Paper-III : Invertebrate Palaeontology.** 100 marks

**Practicals : I Related to paper I, II & III** 100 marks

Laboratory records 15 marks

Records on Geology based on field training of 10 days minimum. 25 marks

Viva based on related theory/practicals 10 marks

**Total 450 marks**

**B. Sc.-II (Honours Examination in Geology.**

**1st Examination at the end of 1990 and later.**

**Paper-IV : General Palaeontology Vertibrata,**



<b>Palaeobotany and Micropalaeontology)</b>	
<b>&amp; Stratigraphic Palaeontology.</b>	
<b>Paper V : Geotectonics &amp; Sedimentation</b>	<b>100 marks</b>
<b>Papers-VI : Crystal Chemistry &amp; Igneous Petrology.</b>	<b>100 marks</b>
<b>Practicals II : Related to paper III, IV, V &amp; VI</b>	<b>100 marks</b>
<b>Outdoor field work report of minimum 10 days tour.</b>	<b>25 marks</b>
<b>Laboratory records</b>	<b>15 marks</b>
<b>Viva on theory &amp; field work</b>	<b>10 marks</b>
<b>B, Sc. III (Honours) year 1991</b>	
<b>Paper-VII : Sedimentary and Metamorphic Petrology.</b>	<b>100 marks</b>
<b>Paper-VIII : Indian Stratigraphy</b>	<b>100 marks</b>
<b>Paper-(IX) : Orogenesis and Indian Mineral deposits</b>	<b>100 marks</b>
<b>Paper-X : Elements of applied Geology</b>	<b>100 marks</b>
<b>Field Geology and Environmental Geology</b>	<b>100 marks</b>
<b>Paper XI : Objective type paper based on whole course</b>	<b>100 marks</b>
<b>Practical III Related to papers VII &amp; VIII</b>	<b>75 marks</b>
<b>Laboratory work including internal assessment.</b>	<b>25 marks</b>
<b>Practical IV Related to paper IX including internal assessment &amp; Laboratory work</b>	<b>75 marks</b>
<b>Practical V Related to paper X</b>	<b>25 marks</b>
<b>Surveying and field geology, including assessment.</b>	<b>50+25</b>
<b>Field Report (i) Geological field work and study of outcrops in related areas for about 10 days</b>	<b>= 75 marks</b>
	<b>25 marks</b>



(ii) Practice of geological mapping in the

selected areas and visit to areas of mineralization for about 21 days (three weeks) 50 marks

(iii) Field collection 25 marks

Viva related to course 25 marks

**Total 750 marks**

### **Detailed courses of study**

B. Sc. Part-I (Honours) first examination 1989 later 89 lectures for each unit of 60 minute duration.

**Paper I Physical Geology, Basic Geomorphology and elements of structural Geology.**

### **Physical Geology & Basic Geomorphology**

**Unit-I** History development of Geology its branches, scope, aims, applications, and relation with sciences.

—The Earth's surface relief, shape, size and its relation to solar system.

—Weathering and mass wasting.

—Mass movement and Geomorphological subdivisions of Indian sub-continent.

**Unit-2** Erosional and depositional features and the geological work of the following:—

(i) Running water (ii) ground water including springs and geogser (iii) Glaciers; including elementary ideas about glaciartion (iv) wind



Unit- 3 Internal structure and constituents of earth.

—earth quakes, Volcanism and other igneous activities, their causes, effects and distribution.

Unit- 4 Important methods of geological age determination salt contents of ocean, rate of sedimentation, rate of erosion Radioactive, Palaeontological methods.

Basic Principles of uniformitarianism, Actualism catastrophism.

Origin of Earth, Nebular hypothesis, two star hypothesis and other modern theories.

### Structural Geology

Unit- 5 Definition scope and utility of subject + Mech. terminology.

—Definition of force, stress, strain.

—Mechanism of Plastic deformation.

Strike dips (Apparent True) slope, gradient, thickness of bed, width of outcrop, depth,

Description of folds.

Various schemes of folds, classification, refolding plunging fold.

Drag fold, their geometry genesis.

Effects of folds on topography and width of outcrops their recognition in the field.

Economic importance of outcrop, lineament.

Unit- 6 Faults terminology, definition, and structures Associated fault plane, Elements of faults, translation and



rotational movement.

—Classifications of faults based on rake of net slip, separation, attitudes of faults in relation to adjacent bed,

—angle of dip of fault plane.

Effect of faulting on outcrops and their economic importance.

—Recognition of faults in the fields.

—Thrusts and related structures.

—Geometry of joints, definition, classification.

—Origin of joints and their relation with other structures.

Unit 7 Elements of planner, linear structures, schistosity Rock leakage lineation its definition, types, classification origin and significance.

—Unconformity, definition and types.

—Their recognition and significance, distribution from other structures.

Unit 8 Major tectonic events during Earth's history with special reference to Indian sub - Content.

—Plutons-definition, classification, types and modes of emplacements.

—Characteristics of Epi - Meso - Kata zone plutons.

—Interrelationship of igneous plutons, tectonic setting and mineral deposits.

—Important sedimentary and igneous structures their



classification and significance in geological history of an area.

- Foliation and its definition, types, classification origin and its relationships with bedding and metamorphism

**Paper-II Morphological crystallography and mineralogy. (Physical Chemical and Optical)**

### **Morphological crystallography**

**Unit 1** Introduction to crystallography forms and morphology of crystals. Elementary idea of crystal formation.

- System of crystal rotation.

—A general idea of symmetry operation, elements of symmetry interfacial angle and its measurement.

**Unit 2** Law of crystallography.

- Elements of internal crystal structure.

—Elementary idea about the different types of projections of crystal.

—Basis of classification of crystals into a system. Class (point group) and international symbols.

—Study of symmetry of Holohedral classes of cubic system, Tetrahedral system.

**Unit 3** Study of symmetry and forms of following symmetry

Hexagonal : Beryl type, calcite type, Tourmaline type.

Orthorhombic system : Barytes type.

Monoclinic system : Gypsum type.

Triclinic system : Aqueous type.



- Hemimorphism, Hemihedrism, Lnantromerism.
- Twining, terminology, important types of twining, in-different system of crystallography.
- Etched figures
- Peizo and Pyro Electricity.

#### Unit- 4 Minrology Descriptive.

- Physical Minrology, definition and scope of minerals. Physical properties of minerals.
- Elements of selclate structures.
- Classification of minerals.
- Elementary Idea of crystal chemistry, isomorphism, Polymorphism & Preudomorphism.

#### Unitr 5 Introduction to chemical properties.

- Study of physical chemical properties and occurances and uses of SIVICA group, Feldspar group, Micgfelsd pallions group.
- Study of physical, chemical properties, occurances and use of Amphidle group, Pyroxene group, odivine group, Epidote group, Zeolite group and Struphite, kyanete sillimanete, andalusite, chlorite, tale, serpenpine, calcele barettes Fluorite, Epidote, Tournalive, Apaptite, Beryl, Zireon, Topaz, Coriendum damond.

#### Minerology Optical

- #### Unit 6 Nature of light and wave theory, nature of wave flout and wave surface in isotropic and anisotropic minerals.



—Reflection, refraction and total reflection, Double reflection and back effect, Nicol prism.

Extinction and extinction angle.

Pleochroism, Polarisation of light and absorption.

**Unit 7** Description, construction, use of petrological microscopes its handling.

—Optical properties of minerals in plane polarised light

—Accessory plates and their use.

—Study of minerals in convergent polarised light.

—Optic figures, their determination, optic sign determination from interference figures.

### **Paper III Invertebrate Palaeontology**

**Unit 1** Broad units of classification of organisms, especially invertebrates :

—Introduction definition and importance of Palaeontology.

—Fossils -definition, requirements and mode of fossilization.

**Unit 2** Uses of fossils in various fields of Geology as indices of Palaeogeography, palaeoclimates, Palaeoecology, organic evolutions stratigraphy correlations.

**Unit 3** Applied aspect of Palaeontology.

— Bathymetric distribution of marine organisms.

— Elementary idea of binomial nomenclature and definition of species.

Invertebrate life through geological ages.

Unit 4 Basic Concept of organic evolution.

- Systematic methods of fossil collection.
- Study of phylum Mollusca, its evolution, distribution and geological history of classes (Gastropoda, Paleoproda, Cepha).

Unit 5 Study of Phylum Brachyopoda its evolution distribution geological history and main evolutionary trends languages.

Unit 6 Study of unit Arthropoda (Class trilobita) with special ref. to evolutionary trends, provincialism, its stratigraphic sequence.

- Study of class Anthozoa (Phylum Cnidaria) stratigraphic importance and geological history, ontogeny, phylogeny of coelenterate.

Unit 7 Study of phylum Echinodermata, its division into various classes. Class Echinodermata its geological importance, history.

- Morphology and geological history of test of class Echinodermata main evolutionary trends.

Unit 8 Phylum Prolophozoa (order Graptolozoa),

- its morphology and classification.
- main evolutionary trends.
- stratigraphic significance and geological distribution.
- Study of invertebrate fossils phylum Protozoa (Foraminifera).
- its historical aspect, its life cycle, dimorphism, polymorphism.



- Morphology of test and geological history of foraminifera.

Practicals : I related to paper I, II, III.

### Laboratory work

Geomorphology—Delineation of simple Geomorphic features.

- Drawing of longitudinal and cross valley-profile.
- Area altitude relation.
- Simple morphometric relationships.

Structural Geology : Continue line, startum contour common symbols of representanting fold, thrust, joints, foliation, unconformities.

- Effects of topography on outcrops.
- Completion of outcrops on maps.
- Study of topographic and geological maps.
- Drawing of geological section.
- Structural problem relating to dip, strike, direction and -hickness outcrops, beds, fault plant solution.

Morphological crystallography :

- Use of goniometer.
- Morphological study of symmetry and form of hologym.
- metric classes of all the crystal systems.
- Study of symmetry hemachedral-classes.

—Drawing of chnographic projections of forms and defining them.

—Determination of Axial ratio of Teteagonal crystals.

### Minarology :

Use of Walker steel yards, Zolly's balance and determine.

—Action of specific gravity of minerals

—Use of hardness box and determination of hardness of minerals.

—Study. discription and identification of minerals given in theory there occurance, use.

### Optical Minarology :

Use of petrological micrographic

—Study of optical characters of following minerals (then section).

Under plane polarised light and cross nicols quartz, Othroclase, Microclive, plageoclase, olivene, angnete, Hyprethenc, hornblend, Actmolite, Biotite, Muscovete, caloete, tourmalive, zircon, sphene, garnet, chlorite, kyanite, leculete, nephelone, sordalete epidote, staurcolite, talc, sgipentene (Optical profit) e.g. ref. Index, Extinction, Pleochcoisem, and interference colours).

### Invertebrate Palacontology :

Morphological description and Identification of following fossils.

Braehiopoda : Lingula, productus, Spirifer, Rhynohnella, Penta-merus, Terebratula, Pholodomva, Pecten, Ostrea-Gryphaca,



Unio, arca, cardita, Merytrex, Nucula, Accetryonia, Pholodomya, Inoceramus.

Gastropoda : Murex, Tarritella, Netica, Cerethium, Cyprea, Conus, Physa, Sycon.

Cephalopoda : Orthocerus, Nantilus, Goniatites, Ceratites, Phyllocerae-Perisphinctes, Baculites, Tuldoceras.

Groptoloidea : Monograptus, Tetragraptus, Dendrograptus.

Corals : Calocola, Zaphreytis, Montluvalthia, Favoates.

Echenoide : Micraster, Hemiaster, Clypeaster, Clydeas, connus, Schizaster, eidaris, Hemicidaris.

Trilobita : Paradoxides, Olenus, Calymene, Agnstus, Bryozoa, Trymeous-Flicestilla, Polypona.

#### Sessional work :

Every student shall be required to keep and maintain upto-date record of practical work during the session properly signed by the teachers concerned, submit it to Hand of the Deptt. At the time of respective practical examinations.

#### Field work :

Every student shall be required to attend field Training around Dharmasala and shall submit the report of field work to the Head of the Deptt. All collections of specimens properly and arranged. The marks of field work shall be given on the basis of above mentioned filed report and clection.

#### Vava-Voce :

Every student shall appear for via based on theorys Practicals, Field work done by the students during the session.

## B. Sc.—Part-II (Honours)

First examination in 1990 and after 8, 9 lectures of 60 marks each/unit.

**Paper—IV : General Palaeontology (Palaeobotany, Micro Palaeontology, Vertebrate Palaeontology, & Stratigraphic Palaeontology).**

### General Palaeontology

**Unit 1 Broad classification of organisms especially vertebrate—species identification of fossils, describing a species, Functional morphology and Adaptation. Extinction of organisms and its causes.**

**Unit 2 Broad classification of plant kingdom.**

—Laws of Floral, Faunal succession.

—Ecology & Palaeoecology.

—Fossils as evidence of evolution with spe. ref. of Horse.

—Occurance of Principle divisions of plants and vertebrates in geological column.

**Pre-combrian Palaeontology (Preliminary) and its stratigraphy importance.**

### Vertebrate Palaeontology

**Unit 3 Introduction of vertebrate Palaeontology.**

—Main morphological and classification characters and division of vertebrate.



—A brief account of vertebrate sequence through Geological time.

#### Unit 4 Evolution of Law.

—Evolution history of Horse (EQUUS) & Trends of Evolution it

—Evolutionary History and Trends of evolution in Man.

#### Micropalaeontology :

#### Unit 5 Definition and scope of micropalaeontology.

Classification of micro organisms.

—Collection, Preparation and preservation of micro fossils.

Broad Morphological history and evolutionary trends in Foraminifera test.

—Ecology of Foraminifera.

—Broad Morphological history of Ostracode and their ecology.

—Diagrammatic illustrations and Identification, Morphology of following foraminifera Alveolina, Textularia, Globigerina, Quinqueloculina, Nummulites, Assilina, Fusulina.

#### Palaeobotany :

#### Unit 6 Introduction to palaeobotany, importance of Palaeobotany and palaeopalynology in geological studies.

—Identification and morphological description of important lower & upper Gondwana plant fossils.

- Laboratory study of petrification, compression, impression.

## Stratigraphic Palaeontology (Principle of Stratigraphy)

### Unit 7 Principles of stratigraphy.

- Evolution of stratigraphic nomenclature.

- concept of species & zones.

- order of superposition.

- Concept of correlation, time correlation, rock correlation, Biological method of time correlation.

### Unit 8 Geological concept of time the modern time scale, Evolutionary Period.

- Brief knowledge of paleogeography palaeocology, and Palaeoclimatology, Standard Geological time scale.

## Paper V : Structural Geology, Geotectonics & Sedimentation

### Geotectonics :

#### Unit 1 Crust and interior zone of earth.

- Isostasy, Principle, definition.

- deformation of Earth's crust, evidence of slow and Abrupt movements.

#### Unit 2 Epigenetic, organic movements.

- Mountains their classification and structures.

- Geosynclines.

- Elementary knowledge of different geotectonic Units



shield, orogenic belts, mid oceanic ridges, land Arches, Tranches, rifting.

Unit 3. Distribution of land & sea with special reference to oceans and continents belt of volcanic activity and earth quakes.

—Diastrophism

Unit 4 Continental drift its causes, evidences.

—outline of theories of continental drift.

Introduction to plate tectonics.

—Sea floor spreading, conveyor belt hypothesis, Palaeomagnetism.

#### Sedimentation :

Unit 5. Sedimentation processes and lithification, diagenesis.

—Deposition of clastic, non clastic rocks.

—Concept of sedimentary facies, lateral and vertical variation.

Unit 6 Parameters & Reconstruction of ancient sedimentary environments their implication in the stratigraphy

—Summary description of sedimentary environments.

Unit 7. Diastrophism and orogeny, its relation to rate of sedimentation, igneous activity, global tectonics and sedimentary tectonics their relation and importance.

—Determination and interpretation of statistical parameters Roundness, sphericity & elongation of detrital grains.

Physical, chemical, biological parameters of sedimentation.

Unit-8 Introduction to Stratigraphic mapping fossils, permeability.

Paper-VI : Crystal Chemistry and Igneous Petrology.

### Crystal Chemistry

Unit I. Atoms, ions and periodic table, bonding forces in crystals.

—Correlation principle, radium ratio. Polymorphism. Polytypism.

### Igneous Petrology :

Unit-2 Introduction and scope of petrology.

—Igneous rocks and their constituents.

—Nature and composition of magmas their properties, chemistry and cooling behaviour-volatile constituents of magma.

Origin of magma, Nature of Mantle.

—Texture & structure of igneous rocks.

Unit-3 Magma types and magma series.

—Primary magma Partial and derivative magmas.

—Forms and structures of igneous rocks, extrusive, intrusive.

—Basis of classification of igneous rocks.

—Chemical, Textural, Modern classification.

Unit-4 Saturation principle, elementary idea about Streckeisen's classification.

—Principles governing crystallization of silicate melts.



— Variation diagrams.

— Phase relationship.

#### Unit-5 Crystallization of unicomponent magma (system).

— Binary system with Eutatic, with solid solutions, and with intermediate compound melting, incongruent-melting.

— Crystallization of following binary systems.

(a) Diopside-Anorthite system.

(b) Quartz-Albite system (c) Albite-Anorthite system, with role of pressure, volatiles and trachionatism about systems.

#### Unit-6 Bowen's Reaction principle and reaction series, its petrographic evidences.

— Elementary idea about magmatic differentiation.

— Fractional crystallization and liquid immiscibility, Hybridism.

Partial melting and fusion.

#### Unit-7 Distribution of igneous rocks in time and space.

— Consistency and kinds of igneous rocks.

— Petrographical provinces and periods.

Granitic magma its field relationship, emplacement (granitic).

— Anatexis-Palingensis-Granitization.

#### Unit-8. Basaltic magma, and classification of basalts.

— Elementary idea about magmatic ridges basalt, Oceanic island basalts, continental flood basalts, ophiolites

spilites. Petrographic description, and elementary idea of petrogenesis of important igneous rocks.

Practicals : related to papers IV, V, VI.

Laboratory work : Palaeontology: (a) Identification and description (with diagram) of Schizoneura, Sphenopteris, Dadoxion, Glossopteris, Gangamepteris, Vertebraria, Thinnfeldia, Cladophlebis, Ptilophyllum, Otzamites, Williamsonia, Aveolrue, Textuaria, Globogerina, Quinqueloculina, Nummulites, Assilina, Dispecyline, Miogypsina, Dictyocnoides, Orbitolina, Ostracoda.

Geotectonics :- (a) palaeographic map of Gondwana land.  
(b) A few advanced geological maps their interpretation and section drawing.

Igneous Petrology : Study of following igneous rock types and their petrological description, in hand specimen and their identification. Granite, Granodiorite, Syenite, Nephelina Syenite, diorite, Granite, Nonodeorit, sdunite, dolerite, Peridotite, Rhyblite, Bosalt  
Viva-Voce :- The viva of the student shall be based on the theory papers and on the geological field work done during second year (Honours).

Sessional Work :- Every student shall be required to keep the record and maintain upto date practical work during the course of study. The note books duly signed by concerned teachers must be submitted to Head of Department.

Field work :- Every student shall be required to undertake a field trip of concerned subjects and the report of field work, collection of specimens must be submitted to Head of the deptt. The marks assigned to the students for field work shall be on the basis of report and collection.



## B. Sc. Part (Honours)-III

First examination in 1991 and after 8 to 9 lectures of sixty minutes each for every unit.

### Paper-VII : Sedimentary & Metamorphic Petrology.

**Unit-1** Sedimentary processes, products :- An outline of classification of sedimentary rocks, Residual deposits, their mode of formation characteristics and important types.

**Unit-2** Sedimentary structures & classification in detail.

- Determination of paleo current direction.

- Important primary structures (bedding, cross, graded bedding) Parting, Lamination, ripple marks & sole structures.

**Unit-3** Chemical and mineralogical compositions, including.

- heavy minerals of sedimentary rocks.

- Heavy minerals, their significance in sedimentary analysis and graphical methods.

- Folisch's Stability series.

**Unit-4** Classification and types of igneous rocks, characteristics origin of igneous rocks, classification, characteristics of types of igneous rocks. Concept of Maturity of igneous rocks.

- Mechanical analysis and Graphical representation of igneous rocks.

- Petrological description of igneous rocks.

## Metamorphic Petrology

### Unit 5 Definition, & scope of metamorphism.

— metamorphic processes & Metamorphism.

— Agents and their roles in metamorphism.

Kinds of metamorphism—Metamorphic minerals under Prograde, retrograde metamorphism.

— Texture, structures, Habric of metamorphic rocks & their significance.

— Classification & nomenclature of metamorphic rocks—  
Deptt. zone, grades, facies of metamorphism

### Unit 6 Barrovian zones of required metamorphism & principle of Isograd mapping.

— Roschbusches : zones of thermal metamorphism.

— Dynamic metamorphism & its products.

— Contact metamorphism of Pelitic mafic and carbonate rocks,

### Unit 7 Metamorphic differentiation.

Metasomatism—types and products (introduction),

Chemical behaviour of metamorphic rocks—equilibrium phase rule and graphical representation of phases (introduction).

— Migmatites.



## Pade,-VIII : Indian Stratigraphy

### Unit 1 Physiographic divisions of India.

—Introduction of Indian Stratigraphy.

—Basement complex and gneiss their composition and age.

—Eoarchean unconformity and its significance.

—Pre-cambrian stratigraphy of Dharwar super group and its main equivalents in Indian shield.

### Unit 2 Aravalli Super group :— Concepts of Dharwar, Delhi

—cycles in relation to orogeny and stratigraphy.

—Distribution of proterozoic (Purana) rocks in India the type area Stratigraphy of Cuddapah, Delhi, Vindhyan Bijawar Super groups.

### Unit 3 Introduction to life in, Pre-cambrian and Riphean stratigraphy of India.

—Proterozoic and Archean stratigraphy of Extra peninsular India J. K. Himachal, Kumaon, Garo (only).

—India of Pre cambrian, Pre-cambrian- cambrian boundary in India.

### Unit 4 Palaeozoic Era and distribution of Palaeozoic rock of India- Detailed study of different systems of Palaeozoic Cambrian system as salt range, Hamirpur system Muth Quarlyite.

—Permian-Permian rocks of salt range, Jammu-Kashmir the malayas.

—Palaeogeography of India during different times geographical periods of Palaeozoics.

Unit 5 Introduction to Silurian-Devonian Boundary in India.

Study of 'Gondwana Super group' Lower Gondwana Sequence, Palaeochimates during Gondwana, Palaeogeography during Gondwana, deposits.

The Idea of Permian-Triassic Boundary.

Unit 6 Mesozoic Era and distribution mesozoic rocks in India.

—Triassic of spites, jurranic of kutch (Petaceous of South East India).

—Deccan traps, Infratrappeans Intertrappean rocks.

Unit 7 Tertiary Era, and its distribution in India.

—Sivalik system of Jammu, its equivalents in Assam.

—A brief account of Himalayan orogeny.

—Sabathu, Mnsree, Dharamsala, Degshai-Kasauli groups.

Introduction to Cretaceous-Eocene boundary problem.

Unit 8 Quaternary Era.

Placocene glaciation and its products.

—Karewa beds.

—Origin of Thar desert & Ganga Plain. Introduction to Pliocene-Pleistocene Boundary problem.

Paper-IX : Geogenic & Indian Mineral deposits Economic Geology).



Unit 1 Definition, and General introduction, concept, Terminology and scope.

—Syngentic & epigenetic deposits, ore genesis.

—Concentration factors, economic considerations and characteristic of economic mineral deposits.

—Ore bearing fluids, control of localization of ore deposits, their classification required local factors, Primary and secondary features physical, chemical controls.

—Paragenesis and zoning causes of sequential deposits.

Unit 2 Geothermometry, Geochronology ; Brief idea about ore forming.

—Orthomagmatic and magmatic segregation pegmatite deposits.

—Metasomatic and pyrometamorphic process.

—Hydrothermal process, hypothermal, mesothermal deposits epithermal zerothermal process.

Unit 3 Mechanical accumulation, sedimentary precipitation and residual processes, secondary and supergene enrichment and oxidation processes. Metamorphic process.

—Concordant ore bodies in sedimentary host rocks

Limestone host, argillaceous host, arenaceous host, Rudaceous host, chemical sediments host. Igneous host rocks, volcanic host, Plutonic host, Metamorphic host rock bodies.

Discordant ore bodies,

- Regularly shaped bodies, tabular ore bodies, irregularly shaped bodies.

#### Unit 4 Disseminated ore deposits & irregularly replavent bodies, classification of ore deposits

- Elementary idea about the concept of metalogenetic epoch and provicence.

- Elementary idea about mtneralization in relation to geogynclive.

- At concept of plato tectonics.

#### Unit 5 Intro luction to fuel minerals.

Origin of coal, coal series geological and geographical distribution with special reference to India & its uses

- Study of Indian coal, coal fields, (Theria & Raniganj) Legnite fields, their run rals & mode of occairance.

- Petroleum & Natural gas its orgen, traps cap rock, reservoir

- rocs mode of occurance, geological and geog-aphical distribution of gas, petroleum and its uses in India.

Geology of cambary and As an oil fields.

Radioacture & Atomic minerals, Physical, Chemical, Optical properties, mode of occurance uses geological and geographical distribution India.

- Minerais of chemical Industry, sulpher, and pysite, Berites Fluorspar, salt and saline products.



—Minerals of ceramic glass industry, gypsum, talc, soap stone, Felspar, Glass sands, and clay.

—Minerals of Fertilizer Industry : Rock phosphate and phosphorite.

Refractory minerals, graphite, dolomite, magnesite, kyanite, sillimanite and andalucite. Ball clays, fire clays.

—Rock & minerals used in construction, lime stone, cement and cementing materials used in construction building stone, and crushed stones, sands.

—Minerals for insulation + Electrical industry. Mica and mica deposits of India, Asbestos.

—Minerals used for pigments and filler material.

Precious & semiprecious stones, Abrasive material Beryl, Corundum.

Unit 6 Ore minerals and ores of important metallic deposits of India. Their genesis, physical, chemical, optical properties and other diagnostic properties, Industrial specification uses and distribution, Copper, Manganese, Iron, chromite, Nickel.

Unit 7 origin, mode of occurrence, distribution, tenor and grade of the following ore deposits in India.

—Precious metals, Gold deposits. Silver and Platinum

—Non ferrous metals, lead-zinc and Aluminium.

—Still hardening metals.

—Rare elements.

**Paper-X : Elements of Applied Geology, Field geology and Environmental geology.**

**Surveying+Geological mapping**

**Unit 1 Topographical surveying. for Geological works using chain, compass and tape.**

—Compass survey in area containing magnetic minerals, Branton and prismatic compass.

—Plain table survey, alidades, Abney and dumpy level.

—plotting of survey & data.

Types of maps used for geological works and preparation of different types of maps and different scales.

—Mine plan maps, minerals deposits maps and minerals for Casing maps and their preparations.

**Photogeology+Remote sensing**

**Unit 2 Principles of Aerial photography, and types of areal Photography.**

—Uses of air surveys and characteristics of vertical photographs.

—Use of stereoscopes and other photogrammetric accessories.

—Interpretation and approval of aerial photographs.

—Vertical exaggeration and distribution of relief.

—Preliminary steps and features, identified on photos. depositions Structure contours.



- Use of aerial photographs in Geological studies.
- Basic idea of remote sensing, satellite imageries false colour imageries. Application of remote sensing in mineral and oil exploration.

### Engineering Geology

#### Unit 3 Engineering properties of minerals : specific, gravity

- Porosity, absorption, compressive strength Modulus of elasticity and Modulus of compression.

Classification, properties and types of different types of foundations and geological consideration relating to building stones, and road material.

Geological consideration relating to dams and reservoirs highway tunnels, bridges.

- Land slides, their problems and remedies.
- Engineering geology in relation to town planning.

### Mining Geology

#### Unit 4 Mine definition and terminology.

- Classification of mining methods, open cast, quarrying and underground mining. Long wall mining, Horizontal mining, step mining

- Elementary idea of reserves calculation.

- Sampling of deposits, tenor and grades.

- Ore beneficiation and related procedure and their use in ore dressing. Indian examples of coal washing and ore dressing practicals.

—Geological prospecting practices, techniques, concepts ore guides, prospecting ore tech.

Modern methods of development exploration methods (introductory part).

Geohydrology :-

Unit 5 Introduction and utilization of ground water and hydrological cycle.

—Elementary idea of atmospheres components.

—Origin and vertical distribution of ground water.

Aquifers and their classification and types.

—Inter species ; porosity, specific yield, efficient of storage permeability and transmissibility.

—Ground water movement and Darcy's law.

—Chemical quality of ground water, Methods of analysis, suitability of ground water, Management of ground water resources

—Elementary idea about artificial recharge, to ground water recharge, discharge of ground water relationship in aquifer system.

—Occurrence of ground water in India.

—Hydrological data appraisal depth of water maps, fence diagram water table contour map.



## Geochemistry :

### Unit 6 Geochemical classification of Elements.

- Metcosites, their characteristics & classification.
- Thermodynamics : basic concepts and Gibbs function.
- Phase rule, phase diagram Solid solution & its types.
- Polymorphism, Tromorphism, substitution & Electronegativity.
- Gold S. Chnudts rule, Elementary idea about Environmental Geochemistry.
- Role of trace elements in chemistry, petrogenesis, ore genesis.
- Geochemical prospecting : concept definition, dispersion and geochemical provinces and methods (Elementary idea only).
- Geochemical data appraisal & its interpretation.
- Elementary knowledge of analytical Geochemistry.

Principle of wet analysis, + titrimetry, spectrophotometry flame photometry colorimetry.

## Geophysics

### Unit 7 Introduction & fundamental principles of gravity prospecting.

- Instruments for ensuring gravity data, in geological investigations and prospecting.
- The earth's magnetism : basic concept and definitions variation with time in earth's magnetic field.

Introduction to instruments in magnetic prospecting and magnetic measurements of land and interpretation of vertical field data.

—Air born magnetometer its advantage and limitation of aero-magnetic surveying.

Introduction to electrical prospecting methods; resistivity method, inductive method.

—Seismic waves this characteristic and principle of seismograph and seismic prospecting methods (reflection refraction).

—Correlation of seismic data with surface and subsurface geology.

—Introduction to Radiometric method of prospecting Principles methodology and detection of radiations.

## Environmental Geology and Gemology

Unit-8 Introduction to environmental Geology basic.

—Concept of physical system.

—Geological resources of energy minerals. water resources and fossil fields.

—Geological hazards of landslides, floods.

—Human activity, farming, service and sulphate industries pollution load, water pollution.

—Elementary idea of water quality and the destructive effect of water pollution.

—Air pollution, causes, remedies.



- Introduction to gemology.
- Occurrence and distribution of gem stone, in India.
- Classification and properties of gem stones, their evaluation,

Papee-XI : Objective type questions out of complete course.

Practical-III : Related the paper VII and VIII

Stratigraphy : Preparation of Paleographic maps of Indian Sub continent during different palaeozoic periods and Gondwana periods.

Study of characters of stratigraphic rocks and preparation of stratigraphic column by assigning them their proper ages.

Sedimentology :

Study spot identification and description of following sedimentary rocks in hand specimen, Braccia, congoimelate Greywack, Arkose, sand stone, clay, slate, marl, limestone, dolomite, iron stone. Petrographic description, identification, classification of following rocks under microscope, conglomerate, greywack, braccia sand stone, lime stone, shelly lime stone, micaceous sand stone.

Metamorphic Petrology :

Study, identification and description, (Petrography & petrogenesis) following metamorphic rocks types in hand-specimens slate, phyllite, schists, gneiss, augen gneisses, marble, quartzite granulate, migmatite.

Microscopic study of thin sections and petrological description of following metamorphic rocks; slate, phyllite, schists, gneiss augen gneisses, quartzite.

Ore Minerology : principles of ore microscopy (reflection) and study of polished section of common oxides sulphide under microscope,

Practical IV : related to paper IX & X

Economic Geology : Distribution of Economic minerals deposits in the outline map of India.

Physical, chemical, properties and spot identification of important Economic minerals and ores these distribution and genesis.

Sulphide :- Realgar, orpiment, stibnite, molybdenite, galena, antimony, chalcocite, sphalerite, cinabar, pyrochlore, conchoidal, malachite, azurite, stephanite, enargite, stannite.

Halides :- Halite, sylvestrite, fluorite, cryolite.

Oxides :- Cuprite, zincite, corundum, hematite, ilmenite, spinel magnetite, franklinite chromite, cassiterite, rutile, pyrochlore, monazite, bauxite, brucite, psilomelane.

Carbonates :- Calcite, aragonite, dolomite, magnesite, siderite, Rhodochrosite, smithsonite, cerussite, malachite, azurite,

Silicates :- Rhodochrosite, Beryl, garnet, zircon, topaz, lepidolite, muscovite, soapstone, kyanite, chrysotile, andalusite.

Phosphate :- Monazite

Sulphate Ect :- Wolframite, wolfeite.



**Native :-** grairbrite native copper, sulpher.

**Industrial minrology :**

**Description and specification of various of minerals Industrial use, description and dientification of building mate ial with quality control.**

**Geomology :-** Description and identification of rough, concept cut previous and semi-previous semi-stone.

**Specific gravity and optical characters, grading of gemstones.**

**Hydology :** Preparation, interperatation of depth water maps, water laste contour and hydrogological analysis. Evalution of hydrological parameters of aquifer processing and interper-tation of pump test data.

**Geoprospecting Geoexploration :-** Maps exerclses on different methods of propecting, exploration, sampling and extimation of reserves.

**— Geophysical exploration methods :** Electrical, Magnetic methods

**Photogeology :-** Prelimilinary study of air photograph.

**Practical V :** Related to paper X (surveying part only)

**— Use of chnometer, Presuatic, and Brronton compas, chain survey plain table surveys, level, dumpy level, theodolite and Microptic, alidade, Plothing to survey and section.**

**Internal Assessment :-** The assessment shall be based on work done in lab, and field by the student during whole year.

**Sessional work :-** Every student shall have to keep the record of the lab. work and duly signed by teacher concerned should be submitted to Head of the Deptt. during practical exams.

**Field work :-** The attending of compulsory field training and submission of report in proper order to the Head of Deptt. along with the field specimen, sample collected only shall entitle them for the marks kept for this purpose. Survey sheets maps prepared must be signed by teacher concerned before being submitted.

**Viva-Voce :-**

The viva at the time of Examination (Practicals) shall be based on the theory and practicals, related to field work done by the students during whole year.