15. GEOLOGY

APPENDIX 'A'
(Outlines of Tests)

<table>
<thead>
<tr>
<th>Paper 'A'</th>
<th>General Geology, Mineralogy/Petrography (Time : 3 Hours)</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Paper 'B'</td>
<td>Geomorphology, Palaeontology/Stratigraphy (Time : 3 Hours)</td>
<td>75</td>
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</table>

Practical 
(Time : 4 Hours) 
F0

Total 290

APPENDIX 'B'
(Syllabi and Courses of Reading)

Paper 'A' : General Geology : Mineralogy/Petrography : 75

Section (A) : General Geology : 25

The earth as a planet, its place in the universe and its origin. Introduction to Geomagnetism and the earth's gravity field. Earthquakes, the internal structure of the earth, the age of the earth.

Volcanism, the material and Chemistry of the earth crust, plutonic rocks, metamorphic rocks.

Faulting and Folding, epeirogenetic forces and isostacy, orogenic forces and mountain building. Nature of Jointing and cleavage.

Introduction of modern trends and techniques

Section (B) : Mineralogy and Petrography : 50

(i) Elementary Crystallography.

Formation of crystals, development of the science of Crystallography. Regular arrangement of point in space, the space lattice, Elements of symmetry, relation of crystal lattice to the crystal symmetry, Crystal forces, each figures and solution pits, crystal axes and Miller Indices, Crystal edges, lattice rows and zone axes. The choice of axes in crystals. The crystal classes.

Symmetry operations, Triclinic system, Monoclinic system, Hexagonal system, Tetragonal system and Cubic system.

Crystal aggregates, twinned crystals, effect of twinning, causes of twinning.

(ii) Physical Properties of Minerals :

Colour, Streak : Cleavage ; Parting, fracture: hardness, tenacity: specific gravity properties depending upon light, electricity, magnetism and heat.
Classification and description of common mineral groups, namely: Native Elements, Sulphides, Sulphates Oxides, Halides, Carbonates, Nitrates, Borates, Chromatek, Sulphates Molybdenite, Tungstenite, phosphates, Vanadates, Silicates.

(iii) Optical Mineralogy:

Examination in plane polarized light.

Crystal form, cleavage, inclusions, colour, pleochroism, refractive index, relief.

(d) Representation of statistical data in maps and diagrams (the data used shall be related to the regions studied in Paper B).

(e) Preparation of survey plan with the help of following:

(i) Chain surveying.
(ii) Plane Table surveying.

N.B:—Map Work and Practical will be taught along with Paper A and B, as indicated above. But there shall be a separate examination carrying 50 marks. The examination in crossed polars:

Double refractions, isotropism and anisotropism, extinction and extinction angles, interference colours, birefringence, elongation, twinning.

Examination in Convergent Light:

Interference figures, Uniaxial and Biaxial crystals, determination of optic sign and estimation 2V.

Diagnostic properties of common rock-forming minerals in thin sections

(iv) Elementary Classification of rocks and their Petrography:

Forms Igneous Rock Bodies, nature of magma, sequence of events in the crystallization of magma, textures and classification of igneous rocks on the basis of field, textural mineralogical and chemical criteria. The clan concept and Petrography of common rock types in (i) Ultramafic Clan (ii) Calc-Alkali Gabro Clan (iii) Diorite Monzonite and Syenite Clans (iv) Granodiorite, Adammellite and Granite Clans. Introduction to petrogenesis of Igneous rocks. Structures in Igneous rocks

Pyroclastic Rocks:

Classification of volcanic ejecta according to size, mode of origin and composition, Alteration.

Metamorphic Rocks:

Concepts of regional contact and dynamic metamorphism, Petrography of common types (gneiss schist quartzite, slate marble, serpentine, hornfels, cataclastic and mylonites),
Sedimentary Rocks:

Petrography of common varieties calcareous, arenaceous, rudaceous argillaceous sedimentary rocks. Texture, size sorting, sphericity, roundness packing and orientation of mineral grains in sediments.

Introduction of modern trends and techniques.

Paper ‘B’ : Geomorphology : Palaeontology/Stratigraphy : ...

Section (a) : Geomorphology :

Weathering and soils : Processes of physical and chemical weathering : their effects : growth and nature of soils.

Fluvial Processes : Valley development : Base level and its types : drainage Patterns and their significance : stream meandering and the development of Flood Plain : Concept of a Geomorphic cycle ; Rejuvenation and its evidence ; Aggregation ; River Terraces and their significance.

Glaciology : Types of Glacier ; Glacial Erosional Feature ; the unstratified Deposit (Till).

Wind Action : Wind Erosional land forms, Dunes and Loess.

Introduction of modern trends and techniques.

Section (b) : Palaeontology and Stratigraphy.

(i) Stratigraphy :

Introduction to the Principles of Stratigraphy : Stratigraphy of Pakistan in brief.

(ii) Palaeontology (Invertebrates).

Fossils : Fossilisation, modes of Preservation, Geological Significance.


Coelenterata : Morphology of Rugose, Scleractonian (Hexacorals) and Tabulate Corals and their geological distribution Characteristic features of Calicea, zephyrals, Heliophyllum, Parasphilia, Streptaela, Lithostrotion, Lonsdalea, Fevorsites, Halysites.

Graptolites : Morphological features, evolution and geological importance of Graptolites, Characteristic features of Monograptus, Diplograptus, Tetrograptus Phylograptus Didymograptus.

Bryozoa : Salient features of Bryozoa and their geological importance.


**Arthropoda** : Morphological features of Trilobites and their geological significance characteristic feature of Truncosoma, Paradoxides, Calymene, Redlichia, Phacops.

Introduction of modern trends and techniques.

Practical : (Time : 4 Hours) 

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<th>Mark</th>
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<tbody>
<tr>
<td>(i) Map Work</td>
<td>30</td>
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<tr>
<td>Map projections, topographic maps.</td>
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Elementary geological map exercises-including use of strike in map work construction of cross-sections, interpretation of geological maps involving straight strikes and constant dips.

(ii) Mineralogy and Petrology : Identification of crystal modal minerals and rock specimens related to theory Paper A (ii) ;

(iii) Palaeontolog and Stratigraphy : Identification of fossils and stratigraphic specimens related to theory.

Paper B (ii)

(iv) Geological Excursion, Field notes and Viva : 10

Books Recommended :
2. Introduction to Physical Geology: Longwell and Flaunt.
5. Principles of Petrology; G.W. Tyroll.
8. Metamorphism; Harkar.
9. The Study of Rocks in this Section; W.W. Moorhouse, 1964 (I.S.E.)
10. Invertebrate Fossils; Niirem Kakeker/Fischer.
12. Petrology; Haung.
14. Mineralogy; Berry and Mason.
15. Recognition of structural features and their orientation.
16. Geological Raw materials; Mining and industry.

Every student will maintain a field note book. He will carry out samples, labelling and book entries. This note book will be presented at the time of Viva Voce examination, which should be properly signed by the concurrent teacher/s in the field.

At the end of field excursion, every student will write a field report carrying 100 marks distribution as below:

**Distribution of marks:**

<table>
<thead>
<tr>
<th>Text based on field notes</th>
<th>Viva Voce</th>
<th>Total</th>
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<tbody>
<tr>
<td>60</td>
<td>40</td>
<td>100</td>
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