UPSC IFoS Geology Optional

Geology Optional
Indian Forest Services
Paper Pattern

SYLLABUS

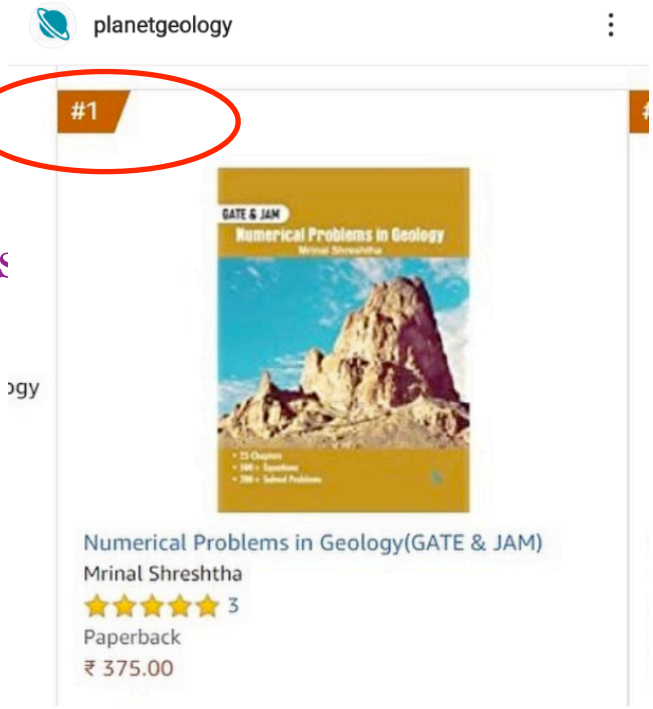
- **Paper 1**
  - ✓ Section A
    - ➡ General Geology, Gemorphology & Remote Sensing, Structural Geology
  - ✓ Section B
    - ➡ Paleontology, Stratigraphy & Geology of India, Hydrogeology & Engineering Geology
- **Paper 2**
  - ✓ Section A
    - ➡ Mineralogy, Igneous & Metamorphic Petrology, Sedimentology & sedimentary rocks
  - ✓ Section B
    - ➡ Economic Geology, Mining Geology, Geochemistry & Environmental Geology

LAWRENCE KANYAN

- IIT, AIEEE & Medical topper
- GATE AIR-1
- GMAT (780) & GRE (330) top scorer
- IIT Graduate,
- Authored several high quality research papers in international journals
- Experience in education and oil industry with some of the biggest companies in the world
- Student at the University of Texas at Austin
- Data Scientist

MRINAL SHRESHTHA

- IIT topper
- GATE AIR-24
- Author of **HIT** Text Book of Numerical Problems in Geology: **Has been ranked #1 Best Seller on Amazon in Earth Science books category**
- IIT Graduate,
- Authored several high quality research papers in international journals
- Experience in education and oil industry



PAPER-1

SECTION-A

- **General Geology:** The Solar System, meteorities, origin and interior of the earth. Radioactivity and age of earth; Volcanoes-causes and products, volcanic belts.Earthquakes-causes, effects, earthquake belts, seismicity of India, intensity and magnitude,seismongraphs. Island arcs, deep sea trenches and mid-ocean ridges. Continental drift-evidences and mechanics; sea-floor spreading, plate tectonics. Isostasy, orogeny and epeirogeny. Continents and oceans.
- **Geomorphology and Remote Sensing:** Basic concepts of geomorphology.Weathering and mass wasting. Landforms, slopes and drainage. Geomorphic cycles and their interpretation, Morphology and its relation to structures and lithology. Applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies. Geomorphology of Indian sub-continent.

  Aerial photographs and their interpretationmerits and limitations.The Electromagnetic Spectrum. Orbiting satellites and sensor systems.Indian Remote Sensing Satellites. Satellites data products. Applications of remote sensing in geology.The Geographic Information System and its applications. Global Positioning System.
- **Structural geology:** Principles of geologic mapping and map reading, projection diagrams, stress and strain ellipsoid and stress-strain relationships of elastic, plastic and viscous materials. Strain markers in deformed rocks. Behaviour of minerals and rocks under deformation conditions. Folds and faults classification and mechanics.Structural analysis of folds, foliations, lineations, joints and faults, unconformities. Superposed deformation. Time – relationship between crystallization and deformation. Introduction to petrofabrics

PAPER-1

SECTION-B

- **Paleontology:** Species definition and nomenclature.Megafossils and Microfossils. Modes of preservation of fossils. Different kinds of micro fossils. Application of microfossils in correlation, petroleum exploration, paleo-climatic and pale oceanographic studies, Morphology, geological history and evolutionary trend in Cephalopoda, Trilobita, Brachiopoda, Echi-noidea and Anthozoa, Stratigraphic utility of Ammonoidea, Trilobita and Graptoloidea, Evolutionary trend in Hominidae, Equidae and Probo-scidae. Siwalik fauna, Gondwana flora and its importance.
- **Stratigraphy and Geology of India:** Classification of stratigraphic sequences: lithostratigraphic, biostratigraphic, chronostratigraphic and magnetostratigraphic and their interrelationships. Distribution and classification of Precambrian rocks of India. Study of stratigraphic distribution and lithology of Phanerozoic rocks of India with reference to fauna, flora and economic importance. Major boundary problems -Cambrian/Precambrian, Permian/ Triassic, Cretaceous/Tertiary and Pliocene/ Pleistocene. Study of climatic conditions, paleogeography and igneous activity in the Indian subcontinent in the geological past. Tectonic framework of India. Evolution of the Himalayas.
- **Hydrogeology and Engineering Geology:** Hydrologic cycle and genetic classification of water. Movement of subsurface water, Springs. Porosity, permeability, hydraulic conductivity, transmissivity and storage coefficient, classification of aquifers.Water-bearingcharacteristics of rocks. Ground-water chemistry. Salt water intrusion.Types of wells. Drainage basin morphometry. Exploration for groundwater. Groundwater recharge. Problems and management of groundwater, Rainwater harvesting.
  Engineering properties of rocks. Geological investigations for dams, tunnels and bridges. Rock as construction material. Alkali-aggregate reaction. Landslides causes, prevention and rehabilitation. Earthquake-resistant structures.

PAPER-2

SECTION-A

- **Mineralogy:** Classification of crystals into systems and classes of symmetry. International system of crystallographic notation. Use of projection diagrams to represent crystal symmetry. Crystal defects. Elements of xray crystallography. Petrological microscope and accessories. Optical properties of common rock forming minerals. Pleochroism, extinction angle, double refraction, birefringence, twinning and dispersion in minerals. Physical and chemical characters of rock forming silicate mineral groups. Structural classification of silicates. Common minerals of igneous and metamorphic rocks. Minerals of the caronate, phosphate, sulphide and halide groups.
- **Igneous and Metamorphic Petrology:** Generation and crystallisation of magma. Crystallisation of albite-anorthite, diopside-anorthite and diopsidewollastonite- silica systems. Reaction principle. Magmatic differentiation and assimilation. Petrogenetic significance of the textures and structures of igneous rocks. Petrography and petrogenesis of granite, syenite, diorite, basic and ultrabasic groups, charnockite, anorthosite and alkaline rocks. Carbonatites. Deccan volcanic province.
  Types and agents of metamorphism. Metamorphic grades and zones. Phase rule. Facies of regional and contact metamorphism. ACF and AKF diagrams. Textures and structures of metamorphic rocks. Metamorphism of arenaceous, argillaceous and basic rocks. Minerals assemblages, Retrograde metamorphism. Metasomatism and granitisation, migmatities, granulite terrains of India.
- **Sedimentology:** Sedimentary rocks: Processes of formation, diagenesis and lithification, Properties of sediments. Clastic and nonclastic rocks-their classification, petrography and depositional environment, Sedimentary facies and provenance. Sedimentary structures and their significance. Heavy minerals and their significance. Sedimentary basins of India.

PAPER-2

SECTION-B

- **Economic Geology:** Ore, ore minerals and gangue, tenor of ore, classification of ore deposits. Process of formation of minerals deposits. Controls of ore locallisation. Ore textures and structures, Metallogenic epochs and provinces, Geology of the important Indian deposits of aluminium, chromium, copper, gold, iron, lead, zinc, manganese, titanium, uranium and thorium and industrial minerals. Deposits of coal and petroleum in India. National Mineral Policy. Conservation and utilization of mineral resources. Marine mineral resources and Law of Sea.
- **Mining Geology:** Methods of prospecting-geological, geophysical, geo-chemical and geo-botanical, Techniques of sampling. Estimation of reserves of ore, Methods of exploration and mining metalic ores, industrial minerals and marine mineral resources. Mineral beneficiation and ore dressing.
- **Geochemistry and Environmental Geology:** Cosmic abundance of elements, Composition of the planets and meteorites, Structure and composition of earth and distribution of elements, Trace elements, Elements of crystal chemistry – types of chemical bonds, coordination number, Isomorphism and polymorphism, Elementary thermodynamics.
  Natural hazards-floods, landslides, coastal erosion, earthquakes and volcanic activity and mitigation, Environmental impact of urbanization, open cast mining, industrial and radioactive waste disposal, use of fertilizers, dumping of mine waste and fly-ash. Pollution of ground and surface water, marine pollution, environment protection-legislative measures in India.

PAPER PATTERN

- Total Eight Questions
- **Question 1 (8x5=40)**
  - ✓Compulsory
  - ✓Questions from all the subjects in Section A
  - ✓5 Questions
- Question 2: 40 marks (15+15+10)
- Question 3: 40 marks (15+15+10)
- Question 4: 40 marks (15+15+10)

Each question has 3 sub-questions - one from each subject

- **Question 5 (8x5=40)**
  - ✓Compulsory
  - ✓Questions from all the subjects in Section B
- Question 6: 40 marks (15+15+10)
- Question 7: 40 marks (15+15+10)
- Question 8: 40 marks (15+15+10)

Each question has 3 sub-questions - one from each subject

PAPER PATTERN

PAPER-1A

SECTION A

Q1. **Answer the following within 150 words each :** *8×5=40*

(a) Discuss the characteristics and properties of the lithosphere and the asthenosphere. **General geology** 8

(b) Describe the origin of Karst topography. **Geomorphology** 8

(c) Write briefly on the Global Positioning System (GPS). **Remote Sensing** 8

(d) What is the significance of equal area projection in solving structural geology problems ? **Structural Geology** 8

(e) Enumerate the strain markers in deformed rocks, with the help of neat sketches. **Structural Geology** 8

Q2. (a) With the help of neat diagrams, discuss different types of plate boundaries and enumerate their characteristic features. 15 — **General Geology**

(b) Highlight the advantages and limitations of remote sensing studies with respect to conventional geological field work. 10 — **Remote Sensing & Geomorphology**

(c) Describe the different types of breaks in stratigraphic records and their identification in the field. 15 — **Structural Geology**

Q3. (a) Briefly enumerate the principles of radiometric dating using U – Pb isotopes. 15 — **General Geology**

(b) Discuss how lithology controls topography. 10 — **Remote Sensing & Geomorphology**

(c) What is thrust fault ? Explain the mechanism of development of thrust fault with neat sketches. 15 — **Structural Geology**

Q4. (a) Elucidate the present status of Continental Drift in light of the geological and geophysical evidences. 15 — **General Geology**

(b) Compare the geomorphic features along the Eastern and Western Coasts of India. 15 — **Remote Sensing & Geomorphology**

(c) What is recrystallisation of minerals ? How is it related to deformation ? Explain with neat sketches. 10 — **Structural Geology**

PAPER PATTERN

PAPER-1B

Q5. Answer the following within 150 words each : *8×5=40*

Paleontology

(a) Explain in brief the manner of preservation of traces of animals. 8

(b) In the context of Dollo's Law, discuss the different patterns of evolution observed in fossils. Paleontology 8

Indian Stratigraphy

(c) Describe the depositional environments prevailing during the deposition of the Paleogene belt of Sirmur Group of Himachal Pradesh. 8

Hydrogeology & Engg. Geology

(d) Describe the different techniques used to date groundwater. 8

Hydrogeology & Engg. Geology

(e) Enumerate the methods of groundwater exploration and development. 8

Q6. (a) Describe the lithostratigraphic succession of the Siwalik Group and comment on the paleoclimatic regime that prevailed during its deposition. 15 Indian Strati

Paleontology

(b) Draw neat labelled sketches to depict the evolution of toes in Equidae. 10

(c) Describe various groundwater recharge structures with the help of neat diagrams. 15 Egg. & Hydro.

Q7. (a) With the help of neat diagrams, depict the evolutionary trends in Proboscideans. 15 Indian Strati

Paleontology

(b) Discuss the tectonic evolution of the Aravalli Craton. 15

(c) Describe the various groundwater quality criteria prescribed for drinking, agriculture and industrial use. 10 Egg. & Hydro.

Q8. (a) The Permian – Triassic boundary represents a phase of mass extinction in the Earth's history. Discuss the Permian – Triassic boundary problem in stratigraphy. 15 Indian Strati

Paleontology

(b) Describe the evolutionary trends in the eyes of trilobites. Illustrate your answer with suitable sketches. 15

(c) Discuss in detail the geotechnical parameters used for selection of tunnel sites. 10 Egg. & Hydro.

PAPER PATTERN

PAPER-2A

1. (a) Explain briefly about the extinction angle of augite, hornblende and hypersthene with suitable diagrams. **Mineralogy** 8

   (b) Discuss briefly about the geographical distribution, tectonic setting and petrogenetic aspects of Deccan Volcanic Province. **Igneous & Meta** 8

   (c) Briefly explain the secondary structures of sedimentary rocks with suitable diagrams. **Sedimentology** 8

   (d) Why do anisotropic minerals exhibit interference colours between crossed polars? Explain with the help of neat sketches. **Mineralogy** 8

   (e) How would you distinguish between the following pairs of rocks petrographically? **Igneous & Meta** 8
   (i) Granite and Gabbro
   (ii) Syenite and Charnockite

2. (a) Describe the sedimentary basins of India and mention their types, area, hydrocarbon prospects and regions. 15 **Sedimentology**

   (b) Define the term 'cataclastic metamorphism' and describe the important products formed due to cataclastic metamorphism. 15 **Igneous & Meta**

   (c) Elaborate the symmetry elements of 'normal class' of cubic system with the help of neat well-labelled diagrams. 10 **Mineralogy**

3. (a) Explain the significance of heavy minerals in relation to mineral stability during transit and intrastratal solution. 15 **Sedimentology**

   (b) Explain the factors responsible for the diversification of magma in igneous systems. 10 **Igneous & Meta**

   (c) Describe the crystal structure, types, mineralogy, composition, physical and optical properties of mica group of minerals. 15 **Mineralogy**

4. (a) Write the mineral composition, texture and petrological characteristics of conglomerate and shale. 10 **Sedimentology**

   (b) Discuss the significance of texture in understanding the origin and formation of igneous rocks with the help of suitable sketches. 15 **Igneous & Meta**

   (c) Discuss the diagnostic physical, optical and chemical characteristics of two common rock-forming minerals each from inosilicates and nesosilicates. 15 **Mineralogy**

PAPER PATTERN

PAPER-2A

5. (a) Write briefly about the origin of ore minerals from residual liquid of magma. 8 — **Economic Geology**

(b) Mention briefly about the important types, depth and resources of important marine minerals. 8 — **Mining Geology**

(c) Discuss briefly any four Pauling's rules related to crystal structure. 8 — **Geochemistry & Environmental**

(d) Discuss briefly the nature and morphology of concordant ore bodies with suitable sketches. 8 — **Economic Geology**

(e) What do you understand by polymorphism? Also add a note on different types of polymorphism. 8 — **Geochemistry & Environmental**

6. (a) Give a brief account of mineralogy, modes of occurrence and distribution of gold deposits in India. 15 — **Economic**

Geochem & Env

(b) Discuss the causes and impacts of an earthquake on mankind. Mention the measures to be taken to reduce the disaster during the earthquake. 15

(c) What are industrial resource minerals? Mention their applications with examples. 10 — **Mining**

7. (a) Write the necessary conditions for the formation of oil pool and also mention the kinds of oil and gas traps. 15 — **Economic**

Geochem & Env

(b) Discuss the geochemical classification of trace elements and explain the role of HFSE (high field strength elements) in magmatic crystallization. 10

(c) Discuss in detail about the classification of mining methods with the help of suitable diagrams and examples. 15 — **Mining**

8. (a) What are the main objectives and highlights of 'National Mineral Policy' approved in 2019? 10 — **Economic**

Geochem & Env

(b) Mention briefly about the various types of chemical bonds found in minerals giving suitable examples and neat sketches. Also throw light on chemical bonding in diamond and graphite. 15

(c) Discuss various principal methods used in geophysical investigations with suitable diagrams and examples. 15 — **Mining**

PAPER-2

SECTION-B

- The paper is very evenly distributed across various subjects.
- No part is more or less important than others. All are equally important
- You should prepare with syllabus in hand
- It is important to solve previous year papers
- Paper is not very (usually) difficult

THANKS???