

MN-106 -MINING GEOLOGY

Course Title	Mining Geology	Course Code	MN-106
Year	I	Course Group	Core
Teaching Scheme (L:T:P)	120:30:0	Credits	3
Methodology	Lecture +Tutorial	Total Contact periods	150
CIE	60 Marks	SEE	40 Marks

Prerequisites: Basic knowledge of surface Environment, Geography and Social science

Course Outcomes: On completion of the course, the student shall be able to

CO1	Comprehensive understanding of Geology and its diverse applications
CO2	Comprehensive understanding of minerals and their significance
CO3	Comprehensive understanding of the processes and characteristics of rocks
CO4	Identify the Structural features of rocks and understanding of Indian stratigraphy
CO5	Develop a solid understanding of prospecting and ore deposits
CO6	Relate the importance and formation process of Indian ore deposits and fossil fuels

COURSE CONTENT:

CO-1 Comprehensive understanding of Geology and its diverse applications

Duration: 30 HOURS

Definition and importance of Geology. Scope and uses of Geology in mining field. Different branches of Geology- Physical Geology, Mineralogy, Petrology, Stratigraphy, Paleontology, Geomorphology, Structural Geology, Hydrogeology, Economic Geology, Environmental Geology and Engineering Geology. Origin of the earth. Nebular hypothesis of Kant and Laplace. Internal structure of earth. Age of the earth.

Physical geology. Different types of weathering- Physical, Biological and Chemical weathering- (i) Erosion (ii) Deflation (iii) Abrasion (iv) Attrition and (v) Denudation. State the geological work of wind- end products of geological work of wind- (i) Ventifacts (ii) Pedestal Rocks (iii) Transverse Sand dunes (iv) Complex Sand dunes and (v) Barchans. Different stages of Rivers-end products geological work of Rivers- (i) Potholes (ii) Waterfalls (iii) Gorges (iv) Meanders (v) Oxbow lakes and (vi) Entrenched Meanders.

Earthquakes – (i) Earthquake (ii) Focus (iii) Epicenter (iv) Seismograph (v) seismogram (vi) Iso seismic and (vii) Coseismal. Earthquake waves propagation. Causes of earthquakes. Effects of earthquakes. Earthquake intensity scales

Volcanoes – (i) Volcano (ii) Vent (iii) Volcanic pipe (iv) Volcanic cone (v)Crater and (vi) Caldera Volcanoes- Active, Dormant and Extinct. Classification of the volcanoes- (i) Hawaiian (ii) Strombolian (iii) Vesuvian (iv) Plinian and (v) Pelean. Continental drift concept- (i) Isostasy (ii) Continental Drift and (iii) Plate tectonics

CO-2 Comprehensive understanding of minerals and their significance

Duration: 20 HOURS

Mineral and Mineralogy. Rock forming and Ore forming minerals. Important mineral groups- (i) Silica group (ii) Olivine group (iii) Amphibole family (iv) Pyroxene group (v) Feldspar group and (vi) Mica group. Physical properties of a mineral.

Optical mineralogy- optical properties of minerals. Ordinary light and Polarized light, Refractive index Isotropic and Anisotropic minerals. Double refraction- Ordinary ray and extraordinary ray- Birefringence Optic axis- Uni axial and Bi axial minerals.

Industrial uses of following Metallic Minerals- (i) Corundum (ii) Chromite (iii) Hematite (iv) Magnetite (v) Bauxite (vi) Barites (vii) Chalcopyrite (viii) Malachite and (ix) Kyanite

Industrial uses of following Non-Metallic Minerals- (i) Mica (ii) Graphite (iii) Calcite (iv) Gypsum (v) Apatite (vi) Ball clay (vii) China clay (viii) Fire clay and (ix) Quartz

Industrial uses of following Precious and Atomic Minerals- (i) Diamond (ii) Topaz (iii) Uranium (iv) Zirconium (v) Monazite and (vi) Beryllium.

Occurrence and distribution of minerals in Telangana and India.

CO-3 Comprehensive understanding of the processes and characteristics of rocks

Duration: 20 HOURS

Definitions in Petrology -Lava, Magma, rocks, igneous rock, Sedimentation and Metamorphism. Magmatic differentiation, reaction series of Bowen. Classification of Rocks- Igneous, Sedimentary and Metamorphic rocks. Forms, textures and structures of Igneous Rocks. Important Igneous rocks- Granite, Rhyolite, Gabbro, Basalt and Dolerite. Formation and Classification of Sedimentary Rocks – Structural features of Sedimentary rocks. Important Sedimentary rocks– Breccia, Conglomerate, Sandstone, Shale and Limestone. Formation of Metamorphic rocks and agents for metamorphism. Kinds of metamorphism. Important Metamorphic rocks – Gneiss, Schist, Marble, Slate and Quartzite.

CO-4 Identify the Structural features of rocks and understanding of Indian stratigraphy

Duration: 30 HOURS

Structural Geology-Primary and secondary structure of rock formation. Definitions- Bedding, Dip, True Dip, Apparent Dip, Strike, Overlap, Inlier and Outlier. Fold and its components. Classification and various kinds of folds. Fault and its terminology. Different Kinds of faults. Classification and description of joints. Distinguish between joints and faults. Unconformities and their types. Recognition of Unconformities.

Stratigraphy- Definition, principles of stratigraphy correlation and objectives. Fossils- (i) Fossil and (ii) Index fossil. Uses of fossil. Preservation of fossil. Geological time units and corresponding rock units- Geological time scale. Physiographic divisions of India. Stratigraphic divisions of India- Archaeans, Cuddapah group of rocks, Gondwana group of rocks, Dharwar system and Pakhal system of rocks. Stratigraphy of Telangana.

CO-5 Develop a solid understanding of prospecting and ore deposits

Duration: 30 HOURS

Prospecting- Uses of Prospecting. Guides for location of mineral deposits in the Field. Equipment required for geological field work. Method of field work for mining. Classify the Prospecting methods. Geological prospecting techniques-(i) Geological mapping (ii) Trenching (iii) Pitting (iv)

Aditting (v) Augering and wash boring (vi) Drilling. Geophysical methods of Prospecting - Electrical Prospecting Method- Gravity Prospecting Method-Seismic Prospecting Method - Radiometric Prospecting Method.

Definition Economic Geology, Define the following terms (i) Ore Minerals (ii) Gangue Minerals (iii) Tenor of Ore (iv) Associated Minerals (v) Syngenetic ore deposits (vi) Epigenetic ore deposits (vii) Resource (viii) Reserve (ix) Proved reserves (x) Probable reserves and (xi) Possible reserves. Different processes of mineralization with examples. Reserve estimation methods- triangular, square and rectangular method.

CO-6 Relate the importance and formation process of ore deposits and fossil fuels

Duration: 20 HOURS

Formation, stages and periods of Coal- Origin of Coal theories- Stages of Coal formation- Periods of Coal formation. Chemical properties of Coal- (i) Moisture content (ii) Volatile matter (iii) fixed carbon (iv) Fuel ratio (v) Ash content (vi) Sulfur content (vii) calorific value. Chemical properties and classification of coal- Banded constituents of Coal. Structural Features of Coal Seams. Coalfields of India.

Ore minerals of Iron- types of Iron ore deposits- occurrence and distribution of Iron ore deposits in India. Ore minerals of Manganese- types of Manganese ore deposits- Occurrence and distribution of Manganese ore deposits in India. Ore minerals of copper- types of copper ore deposits- Occurrence and distribution of copper ore deposits in India. Gold ore deposits- Occurrence and distribution of gold deposits in India. Sources for Lead and Zinc metals- distribution of Lead and Zinc deposits in India- Occurrence and distribution of Lead and Zinc deposits in India. Aluminum ore deposits- Occurrence and distribution of aluminum deposits in India. Occurrence and distribution of Uranium deposits in India. Distribution of critical minerals in India

Recommended Books

1. Parbin Singh-A Text Book of Engineering & General Geology- S.K.Kataria & sons
2. A Text book of Geology, G.B. Mahapatra- CBS Publishers & distributors.
3. Principles of Engineering Geology, K.M.Bangar- Standard Publishers distributors.
4. Elements of Photogrammetry with Applications in GIS, 4th Edition., Paul R.wolf
5. Text book of Remote sensing by Anji Reddy
6. Fundamentals of Historical geology & stratigraphy of India- Ravindra Kumar.
7. Field Geology by Compton
8. Lilesand, T.M. and Ralph W. Keifer., Remote sensing and Image Interpretation, John Wiley & Sons, 1987, New York.
9. Economic Mineral Deposits. By Bateman Alan M. and Jenson1981, John Willey & sons

Suggested E-learning references

1. <http://geology.com/>
2. <http://cgm.ncode.in/SitePages/Home.aspx>
3. <http://emg.geoscienceworld.org/content/current>
4. http://en.wikipedia.org/wiki/Mineral_exploration
5. <http://en.wikipedia.org/wiki/Geology>
6. <http://geology.about.com/>
7. <http://geology.com/>
8. www.nptel.com

Suggested Learning Outcomes:

On completion of the subject the student shall be able to

CO1: Comprehensive understanding of Geology and its diverse applications (Physical Geology)

- 1.1. Define the term of Geology
- 1.2. Explain the scope and uses of Geology
- 1.3. Mention the various branches of Geology
- 1.4. Define the following terms - (i) Physical geology (ii) Mineralogy (iii) Petrology (iv) Stratigraphy (v) Paleontology (vi) Geomorphology (vii) Structural Geology (viii) Hydrogeology (ix) Economic Geology (x) Environmental Geology (xi) Exploration Geology (xii) Engineering Geology (xiii) Geochemistry and (xiv) Mining Geology
- 1.5. State the applications of geology in Mining field
- 1.6. Role of Geology in the opening of Shaft and Incline
- 1.7. Classify the origin of the Earth theories
- 1.8. Describe the Nebular hypothesis of Kant and Laplace
- 1.9. Discuss the internal structure of the earth
- 1.10. Mention the different methods to determination of the age of the earth
- 1.11. Define the terms (i) Weathering (ii) Erosion (iii) Deflation (iv) Abrasion (v) Attrition and (vi) Denudation
- 1.12. List the different types of weathering
- 1.13. Explain the Physical, Biological and Chemical weathering
- 1.14. Explain the geological work of Wind
- 1.15. Describe the geological work of Rivers
- 1.16. Explain the different stages of Rivers
- 1.17. State the landforms made by action of Underground water - (i) Sinkhole (ii) Caverns (iii) Solution Valleys (iv) Karst Topography (v) Stylolite (vi) Stalactite and Stalagmite (vii) Geode (viii) Polje
- 1.18. Define the terms - (i) Earthquake (ii) Seismology (iii) Focus (iv) Epicenter (v) Seismograph and Seismogram (vi) Iso-seismal and Coseismal (vii) Scale of Intensity
- 1.19. Describe the earthquake waves propagation
- 1.20. Mention the causes and effects of earthquakes
- 1.21. Define the terms - (i) Volcano (ii) Vent (iii) Volcanic pipe (iv) Volcanic cone (v) Crater (vi) Caldera (vii) Volcanic products (viii) Magma and Lava
- 1.22. Explain the classification of Volcanoes
- 1.23. Describe the products of volcanic eruption.
- 1.24. Explain the terms - (i) Isostasy (ii) Continental Drift and (iii) Plate tectonics

CO2: Comprehensive understanding of minerals and their significance (Mineralogy)

- 2.1. Define the terms (i) Mineral and (ii) Mineralogy
- 2.2. Differentiate between rock forming and ore forming minerals
- 2.3. Explain the Silicate mineral structures
- 2.4. List the important mineral groups
- 2.5. Explain the following mineral groups (i) Silica group (ii) Olivine group (iii) Amphibole family (iv) Pyroxene group (v) Feldspar group and (vi) Mica group
- 2.6. Describe the physical properties of a mineral
- 2.7. Define the term Optical mineralogy
- 2.8. Explain the optical properties of minerals
- 2.9. Describe the terms Ordinary light and Polarized light
- 2.10. Explain the Refractive index of a mineral
- 2.11. Explain Isotropic and Anisotropic minerals
- 2.12. Explain the Double refraction of a mineral
- 2.13. Explain the terms Ordinary ray and extraordinary ray
- 2.14. Describe the Birefringence of a mineral
- 2.15. Explain the Optic axis of a mineral
- 2.16. Explain the Uni axial minerals and Bi axial minerals
- 2.17. List the industrial uses of following Metallic Minerals- (i) Corundum (ii) Chromite (iii) Hematite (iv) Magnetite (v) Bauxite (vi) Barites (vii) Chalcopyrite (viii) Malachite and (ix) Kyanite
- 2.18. Mention the industrial uses of following Non-Metallic Minerals- (i) Mica (ii) Graphite (iii) Calcite (iv) Gypsum (v) Apatite (vi) Ball clay (vii) China clay (viii) Fire clay and (ix) Quartz
- 2.19. List the industrial uses of following Precious and Atomic Minerals- (i) Diamond (ii) Topaz (iii) Uranium (iv) Zirconium (v) Monazite and (vi) Beryllium
- 2.20. Discuss the occurrence and distribution of minerals in Telangana and India

CO-3 Comprehensive understanding of the processes and characteristics of rocks (Petrology)

- 3.1. Define the term Petrology
- 3.2. Define the terms- (i) Lava (ii) Magma and (iii) Rock
- 3.3. Explain the Classification of Rocks
- 3.4. Define the terms Igneous, Sedimentary and Metamorphic rocks
- 3.5. Describe the Rock cycle
- 3.6. Explain the Magmatic differentiation and reaction series of Bowen

- 3.7. Explain the classification of Igneous Rocks
- 3.8. Explain the Forms of Igneous Rocks
- 3.9. Describe the textures of Igneous Rocks
- 3.10. Explain the structures of Igneous Rocks
- 3.11. Explain the important igneous rocks- (i) Granite, (ii) Syenite, (iii) Gabbro, (iv) Basalt and (v) Dolerite
- 3.12. Explain the formation of Sedimentary Rocks
- 3.13. Explain the classification of Sedimentary Rocks
- 3.14. Explain the Structural features of Sedimentary rocks
- 3.15. Explain the important Sedimentary rocks-(i) Breccia, (ii) Conglomerate, (iii) Sandstone, (iv) Shale and (v) Limestone.
- 3.16. Explain the Formation of Metamorphic rocks
- 3.17. Explain the textures and structures of metamorphic rocks
- 3.18. Describe the agents for metamorphism
- 3.19. Explain the various kinds of metamorphism.
- 3.20. Describe the Important Metamorphic rocks-(i) Gneiss, (ii) Schist, (iii) Marble, (iv) Slate and (v) Quartzite

CO4: Identify the Structural features of rocks and understanding of Indian stratigraphy (Structural geology and Indian stratigraphy)

- 4.1. Definition of Structural Geology
- 4.2. Explain the Primary and secondary structures of rock formation.
- 4.3. Definitions- (i) Bedding (ii) Dip (iii) True Dip (iv) Apparent Dip (v) Strike (vi) Overlap (vii) Inlier and (viii) Outlier
- 4.4. Explain the term Fold and its components
- 4.5. Explain the Classification and the various kinds of Folds
- 4.6. Definition of Fault and its terminology
- 4.7. Explain the different Kinds of faults
- 4.8. Define the term Joints
- 4.9. Distinguish between Joints and Faults
- 4.10. Explain the Unconformities and their types
- 4.11. Explain the recognition of unconformities in the field
- 4.12. Define the term Stratigraphy
- 4.13. State the Objectives of Stratigraphy
- 4.14. State the principles of the Stratigraphy
- 4.15. Define the terms (i) Correlation (ii) Fossil and (iii) Index fossil

- 4.16. Discuss the principles of correlation
- 4.17. Summarize the uses of Fossil
- 4.18. Choose the methods for preservation of fossil
- 4.19. Classify the geological Time units and corresponding Rock units
- 4.20. Categorize the Geological Time Scale in stratigraphy
- 4.21. Importance of Physiographic divisions of India
- 4.22. List the different stratigraphic divisions of India
- 4.23. Describe each of the following systems with their distribution and economic importance (i) Archeans (ii) Cuddapah Super group (iii) Gondwana Group (iv) Dharwar system (v) Pakhal system
- 4.24. Discuss the Stratigraphy of Telangana

CO-5: Develop a solid understanding of prospecting and ore deposits (Prospecting techniques and Economic Geology)

- 5.1. Define the term Prospecting
- 5.2. Make uses of Prospecting in Mining
- 5.3. List the guides for location of mineral deposits in the Field
- 5.4. Mention the field equipment required for geological field work
- 5.5. Explain the classification of Prospecting
- 5.6. Mention the Geological prospecting techniques
- 5.7. Explain the geological prospecting terms
(i) Geological mapping (ii) Trenching (iii) Pitting (iv) Aditting (v) Augering and wash boring
(vi) Drilling
- 5.8. List the Geophysical methods of Prospecting
- 5.9. Describe the Electrical Prospecting Methods
- 5.10. Explain the Gravity Prospecting Method
- 5.11. Summarize the Seismic Prospecting Method
- 5.12. Determine the Radiometric Prospecting Method
- 5.13. Explain the term Economic Geology
- 5.14. Define the following terms (i) Ore Minerals (ii) Gangue Minerals (iii) Tenor of Ore (iv) Associated Minerals (v) Syngenetic ore deposits (vi) Epigenetic ore deposits (vii) Resource (viii) Reserve (ix) Proved reserves (x) Probable reserves and (xi) Possible reserves
- 5.15. List the different processes of mineralization with examples
- 5.16. Explain the different processes of Mineralization
- 5.17. List the various reserve estimation methods
- 5.18. Explain the triangular technique for reserve estimation
- 5.19. Estimate the reserves by using square and rectangular method

CO6: Relate the importance and formation process of Indian ore deposits and fossil fuels (Ore and Fuel Geology)

- 6.1. Outline the formation, stages and periods of Coal
- 6.2. Discuss the Origin of Coal formation theories
- 6.3. List the chemical properties of Coal
- 6.4. Define the terms (i) Moisture content (ii) Volatile matter (iii) Fixed carbon (iv) Fuel ratio (v) Ash content (vi) Sulfur content (vii) Calorific value
- 6.5. Elaborate the chemical properties of Coal and classification of coal based on Rank
- 6.6. Summarize the Banded constituents of Coal
- 6.7. List the Structural Features of Coal Seams
- 6.8. Describe the coalfields of India
- 6.9. Name the ore minerals of Iron ore
- 6.10. Explain the different types of Iron ore deposits
- 6.11. Summarize the occurrence and distribution of Iron ore deposits in India
- 6.12. List the ore minerals of Manganese
- 6.13. State the different types of Manganese ore deposits
- 6.14. Explain the occurrence and distribution of Manganese ore deposits in India
- 6.15. Mention the ore minerals of copper
- 6.16. Explain the different types of copper ore deposits
- 6.17. Discuss the occurrence and distribution of copper ore deposits in India
- 6.18. Choose the different types of gold ore deposits
- 6.19. Explain the occurrence and distribution of gold deposits in India
- 6.20. Explain the sources for Lead and Zinc metals
- 6.21. List the distribution of Lead and Zinc deposits in India
- 6.22. Discuss the occurrence and distribution of Lead and Zinc deposits in India
- 6.23. Mention the ore minerals of Aluminum
- 6.24. Discuss the occurrence and distribution of Aluminum deposits in India
- 6.25. Discuss the occurrence and distribution of Uranium deposits in India
- 6.26. Distribution of critical minerals in India

Suggested Student Activities

1. Student visits Library to refer to Geology magazines
2. Student inspects the available equipment in the Lab to identify the components
3. Visit nearby mine quarry and collect samples
4. Quiz
5. Group discussion
6. Surprise test
7. Student should prepare models of Physiographic divisions of India
8. Student should prepare charts of Geological Time Scale and various stratigraphic systems
9. Collection of different Fossils
10. Maps preparation of various mineral resources and reserves in India
11. Visiting nearby areas and prepare the local mineral resource maps
12. Collection of mineral samples and study its properties
13. Download research papers related to Mining geology and give the Seminars
14. Student to know the various prospecting methods-by attending the nearby Geophysical and Geological surveys conducted by various organizations like SCCL
15. Visit the nearby mines to know the geology of the particular areas
16. Clean and green activities to protect the environment in the institute and nearby places
17. Attending motivational classes given by experts
18. Guiding junior students in academic affairs
19. Attending yoga classes

NOTE: Students should select any one of the above or other topics relevant to the subject approved by the concerned faculty, individually or in a group.

CO-PO Mapping Matrix

	Basic and Discipline Specific Knowledge	Problem Analysis	Design/ Development of Solutions	Engineering Tools, Experiment and Testing	Engineering Practices for Society, Sustainability and Environment	Project management	Lifelong Learning	Linked PO
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO1	1	3				2		1,2&6
CO2	2	1	3		3			1,2,3&5
CO3	3	2	2					1,2&3
CO4	2	3		1				1,2&4
CO5	3	2	1	2				1,2,3&4
CO6	3	1		3	3	2		1,2,4,5&6

Semester End Examination

S.No	Unit No.	Questions to be set for SEE					Remarks
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
					11(a)	15(a)	
					11(b)	15(b)	
6	VI			7,8	10(b)	14(b)	
		12(a)			16(a)		
		12(b)			16(b)		
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

BOARD DIPLOMA EXAMINATION (C-26)
MID -I Model Question Paper
MN-106 Mining Geology

[Time: 1Hour]

[Total. Marks: 20]

PART-A

Answer **all** questions. Each Question carries one-mark

4x1 = 4 Marks

1. Define the term Geology
2. List any TWO uses of geology in Mining field
3. Define the term Optical mineralogy
4. List the industrial uses of Corundum

PART-B

Answer **TWO** questions. Each question carries THREE marks

2x 3 = 6 Marks

5(a). Write a short note on crust of the earth
(OR)

5(b). Mention the various branches of geology

6(a). Name the important Minerals of Olivine group
(OR)

6(b). Write a short note on Hardness of a Mineral

PART-C

Answer any **TWO** questions. Each question carries FIVE marks

2x 5 = 10 Marks

7(a). Sketch and explain internal structure of the earth with a neat sketch

(OR)

7(b). Describe the Nebular hypothesis of Kant and Laplace

8(a). Explain the Mica group of minerals

(OR)

8(b). Write an essay on Physical properties of a Mineral

BOARD DIPLOMA EXAMINATION (C-26)

MID -II Model Question paper

MN-106 Mining Geology

[Time: 1 Hour]

[Total: 20 Marks]

PART-A

Answer **all** questions. Each Question carries one-mark

4x1 = 4 Marks

1. Mention any Four igneous rocks
2. Define the term Petrology
3. Define the term Stratigraphy
4. Define the term Index fossil

PART-B

Answer TWO questions. Each question carries **THREE** marks

2x 3 = 6 Marks

5(a). Write a short note on Igneous rock textures
(OR)

5(b). Briefly explain Metamorphism

5(c). Write a short note on Fold
(OR)

6(b). Define the term Reverse Fault

PART-C

Answer TWO questions. Each question carries **FIVE** marks

2x 5 = 10 Marks

7(a). Write an essay on Structural features of Sedimentary rocks
(OR)

7(b). Write an essay on agents of Metamorphism

8(a). Explain the Various kinds of Folds
(OR)

8(b). Write an essay on recognition of Unconformities in the field

BOARD DIPLOMA EXAMINATION, (C-26)
End Examination Model Question Paper
MN-106 Mining Geology

[Time: 2 Hours]

[Total Marks: 40]

PART-A

Answer **all** questions. Each question carries **one** mark.

8x1 = 8 Marks

1. Mention any TWO industrial uses of Calcite
2. List the various forms of Igneous rocks
3. Define the term syngenetic ore deposits
4. List the various structures of Sedimentary rocks
5. Define the term ore mineral
6. List the geological prospecting methods
7. List out any two minerals of Iron ore
8. List out any two minerals of copper ore

PART-B

Answer any **FOUR** questions. Each question carries three marks.

4 x 3 = 12 Marks

- 9(a). Write a short note on Feldspar group
(OR)
9(b). Summarize the Magmatic processes of mineralization
- 10(a). Write a short note on Conglomerate
(OR)
10(b). Briefly explain the Occurrence of gold in India
- 11(a). Briefly explain the Probable reserve
(OR)
11(b). Write a short note on sublimation deposits
- 12(a). Briefly explain the distribution of Aluminum deposits in India
(OR)
12(b). Write a short note on of Manganese ore mineral

PART-C

Answer any **FOUR** questions. Each question carries **five** marks.

4 x 5 = 20 Marks

- 13(a). Describe the Physical properties of minerals
(OR)
13(b). Explain the oxidation and supergene enrichment deposits with examples.

14(a). Explain the significance of Unconformities in the field

(OR)

14(b). Explain the Occurrence and distribution lead and zinc deposits in India

15(a). Explain the Triangular technique for reserves estimation

(OR)

15(b). Explain the hydrothermal deposits

16(a). Explain the Occurrence and distribution copper ore deposits in India

(OR)

16(b). Explain the Occurrence and distribution Manganese ore deposits in India