

**ANDHRA UNIVERSITY  
DEPARTMENT OF GEOLOGY  
COLLEGE OF SCIENCE AND TECHNOLOGY**



Scheme of Instruction and Examinations  
**Advanced Post P.G. Diploma Course in  
Mineral Exploration and Resource Evaluation**

(With effect from the admitted batch 2013-2014)



Scheme of Instruction and Examinations

**I – SEMESTER, ADVANCED, P.G. DIPLOMA IN**  
**MINERAL EXPLORATION AND RESOURCE EVALUATION**

(With effect from the admitted batch 2013-2014)

S. No	Course	Teaching/Lab Hours Per week	Duration of Examination hours	Allotment of Marks		Total Marks	Subject Credits
				External	Internal (Sessionals)		
01	Paper-I Geological Exploration	3	3	85	15	100	4
02	Paper-II Geochemical Exploration	3	3	85	15	100	4
03	Paper-III Geophysical Exploration	3	3	85	15	100	4
04	Paper-IV Mineral Resources & Evaluation Modelling	3	3	85	15	100	4
05	Paper-I Geological Exploration (Practical)	4	3	50	-	50	2
06	Paper-II Geochemical Exploration (Practical)	4	3	50	-	50	2
07	Paper-III Geophysical Exploration (Practical)	4	3	50	-	50	2
08	Paper-IV Mineral resources & Evaluation Modelling (Practical)	4	3	50	-	50	2
09	Viva Voice	-	-	-	-	50	2
<b>TOTAL</b>						<b>650</b>	<b>26</b>



**II – SEMESTER, ADVANCED, P.G. DIPLOMA IN**  
**MINERAL EXPLORATION AND RESOURCE EVALUATION**

<b>S. No</b>	<b>Course</b>	<b>Total Marks</b>	<b>Subject Credits</b>
01	Project I	300	12
02	Project II	300	12
09	Viva Voice	100	4
<b>TOTAL</b>		<b>700</b>	<b>28</b>

Grand total of marks = **1350**

Grand total of Credits points = **54**

SYLLABUS

ADVANCED, P.G. DIPLOMA IN MINERAL EXPLORATION AND RESOURCE EVALUATION

PAPER- I, GEOLOGICAL EXPLORATION

I – SEMESTER.

**UNIT – I**

Introduction –Parameters and elements of exploration, Ore genesis in relation to mineral exploration. Controls of mineralization. Plate Tectonic Concept in relation to genesis Ore deposits, Rift- Related Ore Deposits, Arc- Related Ore Deposits, Massive sulphide Deposits, Mineral Deposits related to Divergent Plate Boundaries.

**UNIT – II**

Geological mapping: Surface and sub surface mapping, Methods of sampling. Guides to ore search –Physiographic, Mineralogical, Stratigraphic guides.

**UNIT – III**

Lithological and Structural guides. Regional exploration – Different stages. Planning and operation. Documentation and analysis of exploration data. Prospecting criteria and selection of target areas for exploration during reconnaissance and initial follow-up. Geological setting and prospecting criteria for important mineral deposits.

**UNIT – IV**

Drilling techniques, Geological aspects of site selection for drilling operations, planning of drilling operations, borehole surveys, correction of deviated boreholes and directional drilling, core-sampling, assaying, and RQD (Rock Quality Designation) measurements for Rock Mass characterisation.

**UNIT – V**

Case studies: Gold deposits, massive sulfide deposits, porphyry copper deposits, tin-tungsten deposits associated with acid magmatism, Uranium deposits and Heavy Mineral Deposits.

**PRACTICALS:**

Calculation of in-situ reserves from borehole data. Calculation of blocked reserves. Introduction to geostatistical estimation of reserves. Reserve estimation using UNFC, JORC (Joint ore reserves estimate codes) Australia and CIM (Canadian Institute of Mining) methods.

**Model Question Paper**

**I – Semester,**

**ADVANCED, P.G. DIPLOMA IN MINERAL EXPLORATION AND RESOURCE EVALUATION**

**Paper – I, GEOLOGICAL EXPLORATION**

**(Effective from the Admitted Batch of 2013-2014)**

**Time: 3Hrs**

**Max. Marks: 85**

**Answer FIVE questions, choosing ONE from each Unit.**

**All questions carry equal marks.**

**UNIT-I**

1. Write an essay on controls of mineralization

**OR**

2. Answer any **TWO** of the following
  - a) Parameters for Exploration
  - b) Rift related ore deposits
  - c) Nature of sulphide deposits

**UNIT-II**

3. Discuss in detail about physiographic guides in mineral exploration

**OR**

4. Answer any **TWO** of the following
  - a) Channel Sampling
  - b) Surface Mapping
  - c) Mineral Alteration Products as guides

**UNIT-III**

5. Describe in detail about documentation of exploration data

**OR**

6. Answer any **TWO** of the following
  - a) Faults as guides in exploration
  - b) Lithological guides
  - c) Criteria for selection of area for exploration

**UNIT-IV**

7. Write an essay on different drilling techniques used in mineral exploration.

**OR**

8. Answer any **TWO** of the following
  - a) Core sampling.
  - b) Assaying.
  - c) Causes for deviation of drill holes.

**UNIT-V**

9. Write in detail about various steps involved in exploration for massive sulphide deposits.

**OR**

10. Answer any **TWO** of the following:
  - a) Gold deposits exploration.
  - b) Uranium deposits exploration.
  - c) Porphyry copper deposits exploration.

**SYLLABUS**

**ADVANCED, P.G. DIPLOMA IN MINERAL EXPLORATION AND RESOURCE EVALUATION**

**PAPER-II, GEOCHEMICAL EXPLORATION**

**I – Semester**

**UNIT – I**

Introduction to Geochemical Exploration. Geochemical cycle, mobility and association of elements, primary and secondary dispersion patterns and their classification.

**UNIT – II**

Geochemical surveys, sampling media – Geo chemical Exploration methods: lithogeochemical, hydrogeochemical, pedogeochemical, Biogeochemical and Radon emanometric techniques.

**UNIT – III**

Geochemical Surveying techniques, sample collection methods, data processing and presentation.

**UNIT – IV**

Concepts in analytical chemistry; Classical and rapid methods of analyses; Atomic absorption spectrometry; Inductively coupled plasma-atomic absorption spectrometry; X-ray fluorescence analysis; Energy dispersive X-ray spectrometry; X-ray diffraction analysis; micro beam and surface analysis techniques; neutron activation analysis, mass-spectrometry. Introduction to Analytical Techniques in Geochemical Exploration for U, Th. and RMRE. Preparation of anomaly maps. Interpretation of data.

**UNIT - V**

Case histories of geochemical surveys and integrated exploration programmes.

**PRACTICALS:**

Classical and rapid methods of sample analyses; Atomic absorption spectrometry; Inductively coupled plasma-atomic absorption spectrometry; X-ray fluorescence analysis; Energy dispersive X-ray spectrometry; X-ray diffraction analysis; micro beam and surface analysis techniques; neutron activation analysis, mass-spectrometry. Geochemical data maps and interpretation.

**Model Question Paper**

**I – Semester,**

**ADVANCED, P.G. DIPLOMA IN MINERAL EXPLORATION AND RESOURCE EVALUATION**

**Paper – II, GEOCHEMICAL EXPLORATION**

**(Effective from the Admitted Batch of 2013-2014)**

**Time: 3Hrs**

**Max. Marks: 85**

**Answer FIVE questions, choosing ONE from each Unit.**

**All questions carry equal marks.**

**UNIT-I**

1. Write a detailed account on primary dispersion of elements and its use in mineral exploration.

**OR**

2. Write any **TWO** of the following:
- a) Geochemical cycle.
  - b) Mobility of elements.
  - c) Secondary dispersion.

**UNIT-II**

3. Write a detailed account on Biogeochemical methods of exploration.

**OR**

4. Write any two of the following:
- a) Hydro geochemical methods
  - b) Litho geochemical methods.
  - c) Geochemical surveys.

**UNIT-III**

5. Give the various methods of sample collection and advantages of various methods.

**OR**

6. Write any **TWO** of the following:
- a) Geochemical data processing.
  - b) Muck sampling.
  - c) Drill hole sample.

**UNIT-IV**

7. Give a brief account on various instruments useful for geo-chemical analysis.

**OR**

8. Write any **TWO** of the following:
- a) Preparation of anomaly maps.
  - b) Interpretation of data.
  - c) XRF analysis.

**UNIT-V**

9. Give a detailed account on exploration of sulfide deposits with case studies.

**OR**

10. Write any **TWO** of the following:
- a) Exploration of Chromite deposits.
  - b) Exploration of Bauxite deposits.
  - c) Exploration of Manganese deposits.

## SYLLABUS

### ADVANCED, P.G. DIPLOMA IN MINERAL EXPLORATION AND RESOURCE EVALUATION

#### PAPER-III, GEOPHYSICAL EXPLORATION

##### I – SEMESTER,

##### UNIT – I

###### **Gravity Method of Exploration:**

The Earth's gravity field, the force of gravity on the surface of the Earth, the figure of the earth, geoid, spheroid and international Gravity formula, establishment of gravity bases, drift correction, principles of Gravity instruments, Reduction of gravity data, free air and Bouguer anomalies, preparation of gravity anomaly maps and their interpretation in terms of shape, size and depth.

##### UNIT –II

###### **Magnetic Method of Exploration:**

Earth's main magnetic field, Origin and temporal variations, Geomagnetic elements, magnetic moments, intensity of magnetization and induction, magnetic potential and its relation to field, Principle of magnetic prospecting instruments, field surveys and data reduction, preparation of magnetic anomaly maps and their quantitative interpretation. Magnetic anomalies due to simple pole and dipole, introduction to aeromagnetic surveys.

##### UNIT – III

###### **Electrical Method of Exploration:**

Principle of electrical Methods of prospecting, Different types of electrode arrays, field procedure, profiling and sounding application in ground water prospecting and civil Engineering applications.

##### UNIT- IV

###### **Seismic Method of Exploration:**

Fundamental principles of wave propagation, stress, strain and Hook's law, Elastic Module, wave equations, reflection, refraction, Critical refraction, diffraction, reflection and transmission coefficients. P & S wave velocities, Geophone and its performance, reflection and refraction surveys for single interface, concept of seismic channel and multichannel recording of seismic data, CDP method of data acquisition, interpretation of seismic data.

##### UNIT-V

###### **Case studies:**

Petroleum, Natural gas, Coal, Ground water, and other Minerals.

###### **PRACTICALS**

Processing and interpretation of Gravity, Magnetic, electrical and seismic data.



**Model Question Paper**  
**I – Semester, Advanced Post P.G. Diploma Course in**  
**Mineral Exploration AND RESOURCE EVALUATION**  
**Paper – III, GEOPHYSICAL EXPLORATION**  
**(Effective from the Admitted Batch of 2013-2014)**

**Time: 3Hrs**

**Max. Marks: 85**

**Answer FIVE questions, choosing ONE from each Unit.**

**All questions carry equal marks.**

**UNIT-I**

1. Write an essay on the preparation of gravity anomaly maps and their interpretation.

**OR**

2. Write any **TWO** of the following:
- Geoid, spheroid and international gravity formula.
  - Drift correction.
  - Free air and Bouguer correction.

**UNIT-II**

3. Define geomagnetic elements and draw neatly their vectorial representation. Give the mathematical relationships between different geomagnetic elements. Also discuss the origin of magnetic anomalies.

**OR**

4. Write any **TWO** of the following:
- Magnetic anomaly maps.
  - Aeromagnetic surveys.
  - Working principle of magnetometers.

**UNIT-III**

5. Describe the basic principles of resistivity method and write in detail about ground water prospecting using resistivity methods.

**OR**

6. Write any **TWO** of the following:
- Electrical methods of prospecting.
  - Sounding application in ground water prospecting.
  - Electrical arrays.

**UNIT-IV**

7. What is Geophone, Draw a neat sketches and explain in detail.

**OR**

8. Write notes on any **TWO** of the following:
- Principles of wave propagation.
  - Recording of seismic data.
  - Interpretation of Seismic data.

**UNIT-V**

9. Write in detail the application of geophysical methods in hydrocarbons exploration..

**OR**

10. Write notes on any **TWO** of the following:
- Case studies on Coal exploration.
  - Case studies on Ground water exploration.
  - Case studies on Economic minerals exploration.

## SYLLABUS

### ADVANCED, P.G. DIPLOMA IN MINERAL EXPLORATION AND RESOURCE EVALUATION

#### PAPER-IV, MINERAL RESOURCE EVALUATION AND MODELLING

##### I – SEMESTER,

### UNIT – I

Concept of mineral resources, Degree of Assurance and Techno economics. Classification of resources – International, Indian. Non - coal mineral resources classification, Coal Resources classification.

Methods of estimation of metallic, non metallic and fuel resources. Graphical Methods: Transverse sectional Method, Longitudinal section Method, Isochore Method, Isopach Method. Geometrical methods: Included area method, Extended area method, Polygonal method, Triangular method. Computer applications in Reserve estimation using appropriate software.

### UNIT- II

**Remote sensing:** Elements of photo and image interpretation. Introduction to digital image processing, Band ratioing. Alteration zone mapping. Image interpretation for geological and geomorphological features. Hyper spectral studies. Application of Remote Sensing in mineral exploration.

### UNIT-III

**GIS:** Spatial data models, datum and projections, transformations and operations, exploratory analysis of geochemical anomalies. Introduction of descriptive and inferential statistics. Elements of geostatistics. Methods of geostatistical mapping, spatial modelling for mineral prospects mapping. Use of soft ware's (Rock ware), Arc GIS for integration of multi thematic data and reserve calculation.

### UNIT-IV

Statistical methods in reserves estimation. Theory of Probability: Linear models ANOVA. Linear and multiple regression. Introduction to multivariate techniques PCA, factor analysis, Kriging method, linear discriminant function analysis, classification.

### UNIT – V

Modelling techniques. Demand analysis, analysis of time scale data; analysis based on land use, macroeconomic variations, econometric model.

### **PRACTICALS**

Remote sensing: Image preparation and interpretation. Hyperspectral image interpretation for mineral bodies. GIS modelling.

**Model Question Paper**  
**I – Semester, Advanced Post P.G. Diploma Course in**  
**Mineral Exploration AND RESOURCE EVALUATION**  
**Paper – IV, MINERAL RESOURCES EVALUATION AND MODELLING**  
**(Effective from the Admitted Batch of 2013-2014)**

**Time: 3Hrs**

**Max. Marks: 85**

**Answer FIVE questions, choosing ONE from each Unit.**

**All questions carry equal marks.**

**UNIT-I**

1. Explain in detail about the Geometrical methods of reserves estimation.

**OR**

2. Write short notes on any **TWO** of the following:
  - a) Classification of Coal resources.
  - b) Isochore method of reserves estimation.
  - c) Marginal resources.

**UNIT-II**

3. Give a brief account on mineral targeting using hyperspectral Remote Sensing citng Indian examples.

**OR**

4. Write short notes on any **TWO** of the following:
  - a) Geological image interpretation.
  - b) Interaction of EMR with earth surface features.
  - c) Terrain elements used for image interpretation.

**UNIT-III**

5. What are spatial data models. Discuss the advantages and disadvantages of different models.

**OR**

6. Write short notes on any **TWO** of the following:
  - a) Different Modules in Arc GIS.
  - b) Spatial Modelling.
  - c) Data integration in GIS for Mineral targeting.

**UNIT-IV**

7. Explain the types and geological applications of Factor Analysis.

**OR**

8. Write short notes on any **TWO** of the following:
  - a) ANOVA.
  - b) Discriminant Analysis.
  - c) Probability distribution.

**OR**

9. Dicuss in detail about econometric modeling technique.

**UNIT-V**

10. Write short notes on any **TWO** of the following:
  - a) Macroeconomic variations.
  - b) Analysis of time scale data.
  - c) Demand analysis.

**ADVANCED P.G. DIPLOMA IN  
MINERAL EXPLORATION AND RESOURCE EVALUATION**

<b>Organized by</b>	: Geology Department, Andhra University and GSI Training Institute, Hyderabad.
<b>Duration of the Course</b>	: One year.
<b>Eligibility</b>	: P. G. in Geology & Geophysics
<b>No. of Seats</b>	: 24+6 Foreigners
<b>Ratio of the seats</b>	: 2:1 Geology: Geophysics
<b>Reservation for A.U. students</b>	: 25% of the seats – 6 (Geology – 4: Geophysics – 2)
<b>Mode of admission</b>	: Based on the marks obtained in PG courses
<b>Responsibilities of the A.U.</b>	: Admission : Evaluation of papers : Award of Diploma and assistance in placement
<b>Responsibilities of the GSI</b>	: Teaching and Field Project supervision and all Academic activities.
<b>Tuition Fee</b>	: Rs. 20,000/- per annum.
<b>To Andhra University</b>	: Admission Fee & Examination Fee : Tuition Fee: 50% to A.U
<b>To GSI Training Institute</b>	: Tuition Fee: 50% to GSI Training Institute. : Project Field work expenses (Boarding and Lodging) will be borne by individual students. Necessary logistics for field work (exploration and surveys) will be arranged by GSI TI.
<b>Project expenses in II Semester</b>	: To be borne by the candidate.
<b>Course Commencement</b>	: Academic session starts in the first week of July.
<b>Field training</b>	: Regional traverses, guided mapping and independent mapping in selected blocks like Chitradurga (gold/ copper/ iron) / Wajrakarur (diamond and gold)/ Kothagudem (Coal/iron ore)/ Garividi (manganese/ bauxite /dimension stone), etc.