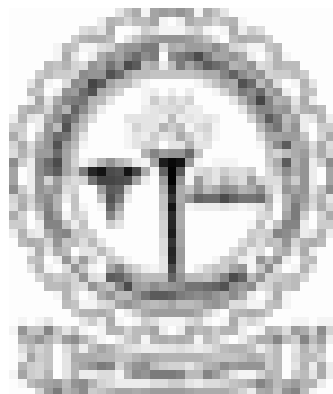


**BHAGWANT UNIVERSITY**

**Sikar Road, Ajmer**

**Rajasthan**



**Syllabus**

**Institute of Humanities & Social Sciences**

**M. Phil I Semester**

**(Geology)**

## Course Category

**MGL : M.Phil in Geology**

**CCC: Compulsory Core Course**

**ECC: Elective Core Course**

**Contact Hours:**

**L: Lecture**

**T: Tutorial**

**P: Practical or Other**

**Marks Distribution :**

**IA: Internal Assessment (Test/Classroom Participation/Quiz/Presentation/Assignment etc.)**

**EoSE: End of Semester Examination**

### First Semester:-

Subject code	Subject Name	Teaching hours			Marks		
		L	T	P	External	Internal	Total
01MGL101	Research Methodology	3	0	0	70	30	100
01MGL102	Petrology and Structural Geology	3	0	0	70	30	100
01MGL103	Mineralogy and Ore Geology	3	0	0	70	30	100
01MGL104	Seismology and Geochemistry	3	0	0	70	30	100
<b>Total</b>		<b>12</b>	<b>0</b>	<b>0</b>	<b>280</b>	<b>120</b>	<b>400</b>

**Second Semester:-**

Subject code	Subject Name	Teaching hours			Marks		
		L	T	P	External	Internal	Total
02MGL101	Advance Research Methodology	3	0	0	70	30	100
02MGL102	Mineralogy and crystallography	3	0	0	70	30	100
02MGL103	Metamorphic petrology and hydrology	3	0	0	70	30	100
02MGL201	Dissertation	3	0	0	70	30	100
<b>Total</b>		<b>12</b>	<b>0</b>	<b>0</b>	<b>280</b>	<b>120</b>	<b>400</b>

**Paper Code: 01MGL101**

**Paper – I**

## **RESEARCH METHODOLOGY**

### **Unit - 01**

**Research - definition** - importance and meaning of research - characteristics of research - types of research - steps in research - identification, selection and formulation of research problem – research questions - research design - formulation of hypothesis - review of literature

### **Unit - 02**

**Sampling techniques:** sampling theory - types of sampling - steps in sampling - sampling and non-sampling error - sample size - advantages and limitations of sampling. Collection of data : primary data - meaning - data collection methods - secondary data - meaning - relevances, limitations and cautions.

### **Unit - 03**

**Statistics in research** - measure of central tendency - dispersion - skewness and kurtosis in research. Hypothesis - fundamentals of hypothesis testing - standard error - point and interval estimates - important non-parametric tests : sign, run, kruskal - wallis tests and mann-whitney test.

### **Unit - 04**

**Para metric tests:** testing of significance - mean, proportion, variance and correlation - testing for significance of difference between means, proportions, variances and correlation co-efficient. Chi-square tests - anova - one-way and two-way.

### **Unit - 05**

**Research report:** types of reports - contents - styles of reporting - steps in drafting reports - editing the final draft - evaluating the final draft.

**Books Recommended:**

1. Kothari, C.R.(2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi.
2. Arya., P.P. and Pal, Y.(2001) Research Methodology in Management: Theory and Case Studies. Deep and Deep Publishers Pvt. Ltd., New Delhi.
3. Bedekar V. H. 1982 – How to write assignments, research papers, dissertations, Kanak New Delhi.

**Paper II:****Paper Cod: 01MGL102****PETROLOGY AND STRUCTURAL GEOLOGY****Unit I**

**Igneous Petrology:** Magma; nature, cooling behavior, properties and chemistry; volatiles in silicate melts, magmatic crystallization. Mechanisms of partial melting and magma generation in the Earth; magma evolution by differentiation. Rock associations and classification schemes of igneous rocks; Chemical classification.

**Unit II**

**Metamorphic petrology:** Metamorphism and metamorphic processes, factor controlling metamorphism, types of metamorphism, metamorphic minerals, Index minerals, Mineral assemblages, Metamorphic Facies.

**Metamorphic reactions:** Basic characteristics of metamorphic reactions: solid-solid reactions, dehydration reactions, decarbonization and oxidation-reduction reactions. Metasomatism and anataxis.

**Unit III**

**Structural Geology:** Mechanical principles and properties of rocks and their controlling factors. Theory of Rock failure. Concept of stress and strain: Folds classification (geometrical)

**Unconformities:** Definition, types of unconformities. Criteria for recognition of unconformities.

**Concordant pluton:** sills, laccoliths, lopoliths, and phacoliths. Discordant pluton: dykes, volcanic vents, ring dykes.

Joints- Morphology and classification (Geometrical). Faults- classification Criteria for recognition of faults.

## Unit IV

**Global Tectonics:** Important concepts about Earth dynamics: Continental drift theory, Plate tectonic models. Basic concepts and definitions, Plate margins, Types and important characters of plate margins. Plate tectonics in relation to the distribution of seismic, volcanic and island arc belts. late tectonic models for the origin of mountain belts: Ocean-ocean, ocean-continent, Continent- Continent types of convergent boundaries.

### Books Recommended

1. Anthony Philpotts & Jay Ague: Principles of Igneous and Metamorphic Petrology 2nd Edition, Kindle Edition
2. Haakon Fossen: Structural Geology 2nd Edition, Kindle Edition
3. Gautam Sen Petrology: Principles and Practices 2013
4. Maurice E. Tucker: Sedimentary Petrology: 1981

### Paper III:

Paper Cod: 01MGL103

## MINEROLOGY AND ORE GEOLOGY

### Unit I

**Mineralogy:** Systematic mineralogy: Atomic structure, mineral chemistry and their PT-stability and mode of occurrence of, Feldspars, Pyroxenes, Garnet, oxides, hydroxides and carbonates. General physical properties of minerals, Moh's scale of hardness. Scalar and vector properties of minerals.

### Unit II

**Ore Geology:** Ore Geology Overview of space-time distribution of mineral deposits and global metallogeny. Synoptic view of the principal mechanisms of formation of the igneous, sedimentary

and metamorphic mineral deposits. Magmatic deposits; hydrothermal deposits with reference to: a) Porphyry copper deposit b) Vein deposits of tin and tungsten. Ore deposits and plate tectonics.

### **Unit III**

**Coal: Introduction;** Constituents of coal: Rank and grade of coal; Varieties of coal Origin of coal. Distribution of Coal in time and space.

### **Unit IV**

**Fuel Geology:** Origin of Petroleum– Organic versus inorganic theories, transformation of organic matter into Petroleum. Migration and accumulation of petroleum: primary and secondary migration.

#### **Books Recommended:**

1. Guilbert J.M. :THE GEOLOGY OF ORE DEPOSITS Paperback – 2005
2. Anthony M. Evans :Ore Geology and Industrial Minerals: An Introduction Paperback – 24 Oct 2011
3. Herbert Henry Thomas :the Geology of Ore Deposits Paperback – Import, 22 Aug 2017
4. Rabindra Nath Hota: Practical Approach to Crystallography and Mineralogy Kindle Edition

#### **Paper IV:**

**Paper Code: 01MGL104**

## **SEISMOLOGY AND GEO-CHEMISTRY**

### **Unit I**

**Seismology:** Seismology: Earthquake and Seismic waves, effects of seismic waves. Basic features of seismographs; Magnitude and intensity of an earthquake Types of earthquakes: tectonic and volcanic. Induced seismicity, Elastic rebound theory statement and geodetic evidence. Earthquake location: Focus, epicenter and hypocenter; Earthquake belts; Focal depth of earthquake

Earthquake focal mechanisms - how these are obtained. Seismic wave reflection and refraction. Structure of the Earth: Crust, mantle; Outer core, inner core; wave speed and density distribution. Earthquake Prediction.

## **Unit II**

**Geochemistry:** Introduction to geochemistry. Geochemical classification of elements. Major, Trace & Rare Earth Element (REE) geochemistry. Distribution of REE in earth's mantle and crust. Cosmic abundance of elements. Geochronology and age of Earth. Relative and absolute dating techniques for age determination.

## **Unit III**

**Hydrology:** Distinction between Hydrology, Geohydrology and hydrogeology; Occurrence of groundwater, water table, aquifer and its types (unconfined, confined and perched). Hydrological properties of rocks—porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, and Storativity. Hydrological classification of geological formations. Darcy's law  
Hydrological cycle and its components. Water quality parameters and standards for drinking purposes.

## **Unit IV**

Tectonic evolution of Himalayas. Tectonic divisions (Extra-peninsula; Indo- Gangetic Plain and Peninsular Shield), their tectonic characters and major structural trends. Northward movement of the Indian Plate and the origin and evolution of the Himalayas and its thrust belts.

### **Books Recommended:**

1. Jonathan Frost An Introduction to Seismology Hardcover – Import, 11 Apr 2017
2. J.R. Kayal : Micro earthquake Seismology and Seism tectonics of South Asia Paperback – Import, 19 Oct 2010
3. Shuanggen Jin: GNSS Atmospheric Seismology: Theory, Observations and Modeling Hardcover – Import, 11 Dec 2018
4. John Victor Walther; essentials of geochemistry 2005



## SEMESTER-II

### Paper I-02MGL101

#### ADVANCED RESEARCH METHODOLOGY

##### UNIT I

**Basic concepts:** Research process, problem identification, research designs, informal experimental designs. Completing randomised design, randomized block design, latin square design, factorial designs

##### UNIT II

**Sampling and testing of hypothesis:** Concept of probability, probability distribution, Normal, Poisson,  $\chi$ -square, t-test. Sampling distribution, central limit theorem, Sandler's A-test, standard error, population mean, population proportion, sample size, confidence intervals, null hypothesis and alternative hypothesis, level of significance, two tailed and one tailed tests, Z-test, t-test,  $\chi^2$ -test, F-test, testing of correlation coefficients, ANOVA one way ANOVA, two way ANOVA Tukey's HSD.

##### UNIT III

**Non-parametric tests:** Sign test, Fisher-Irwin test, Mc Nemer test, Wilcoxon Mali test, Wilcoxon, Mann-Whitnery test, Kruskal-Wallis test, one sample runs test. Spearman's rank correlation, Kendall's coefficient of concordance.

##### UNIT IV

**Multivariate analysis:** Multiple regression, multiple discriminant analysis, multiple analysis of variance, canonical correlation analysis, Factor analysis cluster analysis, path analysis. Computational techniques.

##### UNIT V

Computer Application, Basic of Computer, System Software & Application Software. Computer as a tool of Research: Application in data Analysis, related software. MS Office, SPSS, Data Communication, LAN & WAN Data Exploration using internet tools, e-journal, e-books, Basic concept of teleconferencing & related configuration.

#### References:

1. Kothari, C.R.(2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi.

2. Arya., P.P. and Pal, Y.(2001) Research Methodology in Management: Theory and Case Studies. Deep and Deep Publishers Pvt. Ltd., New Delhi.
3. Bedekar V. H. 1982 – How to write assignments, research papers, dissertations, Kanak New Delhi.
4. Barzam J. and Graff Henry, 1977 – The Modern Researcher, Hercoust Brace. Javanavish Inc. 3<sup>rd</sup> Ed.
5. Gatner, E. S. M. & F. Cardasco 1970 – Research and report writing, Pb. Bernes and Noble, N.Y.

## **Paper-02MGL102**

### **MINEROLOGY AND CRYSTALLOGRAPHY**

#### **Unit -1**

**Mineralogy:** Systematic mineralogy: Atomic structure, mineral chemistry and their PT-stability and mode of occurrence of, Feldspars, Pyroxenes, Garnet, oxides, hydroxides and carbonates. General physical properties of minerals, Moh's scale of hardness. Scalar and vector properties of minerals.

#### **Unit-2**

**Mineral optics:** Elements of optics. Optics of isotropic medium – refractive index, Snell's law of critical angle, anisotropic media. Polarization and interference of light. Polaroid, polarizing microscope- construction and use. Pleochroism and Birefringence.

#### **Unit-3**

**Optical indicatrix:** isotropic, uniaxial and biaxial indicatrix. Optical properties of minerals under plane-polarized and cross-polarized light: Forms, cleavage, fractures and parting, refractive index and relief.

#### **Unit-4**

**Crystallography:** Introduction to crystallography, External & Internal symmetry in crystals; Symmetry elements;

**Morphology of crystals:** Face, edge and solid angle, interfacial angle and Law of constancy of interfacial angles. Axial system and axial ratios. Parameter system of Weiss, Miller indices.

Law of Rationality of indices.

Crystal growth and twinning: Growth of crystals from solutions and from a melt under controlled conditions, crystal growth in open fractures, solution cavities and vesicles.

### **Unit-5**

**Twining in crystals:** Types, causes and laws

**Crystal forms:** Crystallized, crystalline, cryptocrystalline and amorphous. Crystal habit: elongated, tabular, flattened and equant. Form of crystalline and cryptocrystalline aggregates–types, examples and use in mineral identification.

**Crystal chemistry:** Dimorphism, polymorphism, pseudomorphism, isomorphism and solid solution.

### **Essential Readings:**

1. C.R.Kothari: Coal Geology: An Opportunity for Research and Study 11 Sep2018
2. John W Cresswell :Qualitative enquiry and Research design 15 July 1997
3. Uwe Flick: Introducing Research methodology
4. Michael Crody: The foundations of social Research 1998

## **Paper III-02MGL103**

### **METAMORPHIC PETROLOGY AND HYDROLOGY**

#### **Unit-I**

Introduction to metamorphic petrology: Metamorphism and metamorphic processes, factor controlling metamorphism, types of metamorphism, Metamorphic minerals, Index minerals, Mineral assemblages, Metamorphic differentiation.

#### **Unit-2**

Metamorphic Facies.

Metamorphic reactions: Basic characteristics of metamorphic reactions: solid-solid reactions, dehydration reactions, decarbonization and oxidation-reduction reactions. Metasomatism and anataxis.

### **Unit-3**

Regional metamorphism and paired metamorphic belts in reference to plate tectonics. P-T - Time paths. Thermal gradient of the earth, paleomagnetism, Isostasy: Observation; Pratt and Airy schemes of the isostatic compensation, elastic crust on viscous mantle.

### **Unit-4**

Introduction: Groundwater in the hydrologic cycle. Groundwater table - Groundwater table fluctuations and controlling factors. Subsurface inflow and outflow; Period of re-charge and discharge. Average groundwater fluctuations, effluent and influent streams.

Elementary theory of groundwater flow Darcy's law and its range of validity. Steady and unsteady flow.

### **Unit-5**

Occurrence of groundwater, water table, aquifer and its types (unconfined, confined and perched). Hydrological properties of rocks—porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, and Storativity Hydrological classification of geological formations. Darcy's law

Hydrological cycle and its components. Water quality parameters and standards for drinking purposes.

#### **Reference Books:**

1. Gate geology and Geophysics 2018( Amar Singh & Jitendra Sharma)
2. An Introduction to Geology (V S Joji)
3. Gautam Sen Petrology: Principles and Practices 2013
4. John W Cresswell :Qualitative enquiry and Research design 15 July

### **Paper IV: GL203 DISSERTATION**