THIRUVALLUVAR UNIVERSITY

BACHELOR OF SCIENCE
B.Sc. GEOLOGY
DEGREE COURSE
CBCS PATTERN

(With effect from 2020-2021)

The Course of Study and the Scheme of Examinations

S. No.	Part	Study Components / Course Title		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
		SEMESTER I					**CIA**	**Uni. Exam**	**Total**
1.	I	Language	Paper-1	6	4	Tamil/Other Languages	25	75	100
2.	II	English (CE)	Paper-1	6	4	Communicative English I	25	75	100
3.	III	Core Theory	Paper-1	6	4	General Geology	25	75	100
	III	Core Practical	Practical-1	4	0	Structural Geology	0	0	0
4.	III	Allied -1	Paper-1	4	3	Chemistry I / Mathematics I	25	75	100
	III	Allied- 1	Practical-1	2	0	Chemistry I	0	0	0
5.	III	PE	Paper 1	6	3	Professional English I	25	75	100
6.	IV	Environmental Studies		2	2	Environmental studies	25	75	100
		Sem. Total		**36**	**20**		**150**	**450**	**600**
		SEMESTER II					**CIA**	**Uni. Exam**	**Total**
7.	I	Language	Paper-2	6	4	Tamil/Other Languages	25	75	100
8.	II	English (CE)	Paper-2	6	4	Communicative English II	25	75	100
9.	III	Core Theory	Paper-2	5	4	Structural Geology	25	75	100
10.	III	Core Practical	Practical-1	3	2	Structural Geology	25	75	100
11.	III	Allied-1	Paper-2	4	3	Chemistry II / Mathematics II	25	75	100
12.	III	Allied Practical - 1	Practical-1	2	2	Chemistry II	25	75	100
13.	III	PE	Paper 2	6	3	Professional English II	25	75	100
14.	IV	Value Education		2	2	Value Education	25	75	100
15.	IV	Soft Skill		2	1	Soft Skill	25	75	100
		Sem. Total		**36**	**25**		**225**	**675**	**900**
		SEMESTER III					**CIA**	**Uni. Exam**	**Total**
16.	I	Language	Paper-3	6	4	Tamil/Other Languages	25	75	100
17.	II	English	Paper-3	6	4	English	25	75	100
18.	III	Core Theory	Paper-3	4	4	Crystallography	25	75	100
	III	Core Practical	Practical-2	3	0	Palaeontology and Crystallography	0	0	0
19.	III	ALLIED-2	Paper-3	4	3	Physics I	25	75	100
	III	Allied Practical	Practical-2	3	0	Physics I	0	0	0
20.	IV	Skill based Subject	Paper-1	2	2	Engineering Geology	25	75	100
21.	IV	Non-major elective	Paper-1	2	2	Disaster Management	25	75	100
				30	**19**		**150**	**450**	**600**

		SEMESTER IV					**CIA**	**Uni. Exam**	**Total**
22.	I	Language	Paper-4	6	4	Tamil/Other Languages	25	75	100
23.	II	English	Paper-4	6	4	English	25	75	100
24.	III	Core Theory	Paper-4	4	4	Palaeontology	25	75	100
25.	III	Core Practical	Practical-2	3	3	Palaeontology and Crystallography	25	75	100
26.	III	ALLIED-2	Paper-4	4	3	Physics II	25	75	100
27.	III	Allied Practical-2	Practical-2	3	2	Physics II	25	75	100
28.	IV	**NMSDC : Digital Skills for Employability**	**Paper-2**	**2**	**2**	**Office Fundamentals**	**25**	**75**	**100**
29.	IV	Non-major elective	Paper-2	2	2	Environmental Geology	25	75	100
		Sem. Total		**30**	**24**		**200**	**600**	**800**
		SEMESTER V					**CIA**	**Uni. Exam**	**Total**
30.	III	Core Theory	Paper-5	6	6	Mineralogy	25	75	100
31.	III	Core Theory	Paper-6	6	6	Igneous Petrology	25	75	100
32.	III	Core Theory	Paper-7	6	5	Sedimentary and Metamorphic Petrology	25	75	100
	III	Core Practical	Practical-3	3	0	Mineralogy	0	0	0
	III	Core Practical	Practical-4	3	0	Petrology and Economic Geology	0	0	0
33.	III	Elective	Paper-1	3	3	Mining Geology	25	75	100
34.	IV	Skill based Subject	Paper-3	3	2	Gemology	25	75	100
		Sem. Total		**30**	**22**		**125**	**375**	**500**
		SEMESTER VI					**CIA**	**Uni. Exam**	**Total**
35.	III	Core Theory	Paper-8	5	4	Stratigraphy	25	75	100
36.	III	Core Theory	Paper-9	4	4	Economic Geology	25	75	100
37.	III	Core Theory	Paper-10	4	4	Hydrogeology	25	75	100
38.	III	Core Practical	Practical-3	2	2	Mineralogy	25	75	100
39.	III	Core Practical	Practical-4	2	2	Petrology and Economic Geology	25	75	100
40.	III	Compulsory Project	Paper -11	5	5	Group / Individual Project Project work in geological domain	25	75	100
41.	III	Elective	Paper-2	3	3	Remote sensing	25	75	100
42.	III	Elective	Paper-3	3	3	Marine Geology	25	75	100
43.	IV	Skill based Subject	Paper-4	2	2	Mineral Exploration	25	75	100
44.	V	Extension Activities		0	1		100	0	100
	-	NMSDC : Employability Readiness		-	-	(choose any one) • Naandi • Unnati • Quest • Izpay • IBM Skills build	-	-	-
		Sem. Total		**30**	**30**		**300**	**600**	**1000**
									4400

Part	Subject	Papers	Credit	Total Credits	Marks	Total Marks
Part I	Languages	4	4	16	100	400
Part II	Communicative English & English	4	4	16	100	400
Part III	Allied (Odd Semester)	2	3	6	100	200
	Allied (Even Semester)	2	5	10	100	200
	Allied Practical	2	2		100	200
	Electives	3	3	9	100	300
	Core	10	(3-5)	45	100	1000
	Core practical	4	(2-3)	9	100	400
	Professional English	2	3	6	100	200
	Compulsory Project (Group/Individual Project)	1	5	5	100	100
Part IV	Environmental Science	1	2	2	100	100
	Soft skill	1	1	1	100	100
	Value Education	1	2	2	100	100
	Lang. & Others /NME	2	2	4	100	200
	Skill Based	4	2	8	100	400
Part V	Extension Activities	1	1	1	100	100
	Total	**44**		**140**		**4400**

I.LIST OF LANGUAGES COURSES

:Paper-1 Tamil/Other Languages
:Paper-2 Tamil/Other Languages
:Paper-3 Tamil/Other Languages
:Paper-4 Tamil/Other Languages

II.LIST OF FOUNDATION COURSES

:Paper-1 English
:Paper-2 English
:Paper-3 English
:Paper-4 English

III.LIST OF CORE COURSES

:Paper-1 General Geology
:Paper-2 Structural Geology
:Paper-3 Crystallography
:Paper-4 Palaeontology
:Paper-5 Mineralogy
:Paper-6 Igneous Petrology
:Paper-7 Sedimentary and metamorphic petrology
:Paper-8 Stratigraphy
:Paper-9 Economic Geology
:Paper-10 Hydrogeology

IV. LIST OF CORE PRACTICALS

: Practical -1 Structural Geology
: Practical -2 Palaeontology and Crystallography
: Practical -3 Mineralogy
: Practical -4 Petrology and Economic Geology

V.LIST OF ALLIED THEORY SUBJECTS

:Paper-1 Chemistry
:Paper-2 Chemistry
:Paper-1 Physics
:Paper-2 Physics

VI.LIST OF ALLIED PRACTICALS

: Practical -1 Chemistry
: Practical -2 Physics

VII.LIST OF SKILL BASED SUBJECT

:Paper-1 Engineering Geology
Paper-2 Physical Geology
:Paper-3 Gemology
:Paper-4 Mineral Exploration

VIII.LIST OF ELECTIVES COURSES

:Paper-1 Mining Geology
:Paper-2 Remote Sensing
:Paper-3 Marine Geology

IX.LIST OF NON-MAJOR ELECTIVES COURSES

: Paper-1 Disaster Management
: Paper-2 Environmental Geology

X.LIST OF COMPULSARY COURSES

: Environmental Studies
: Value Education
: Extension Activities

THIRUVALLUVAR UNIVERSITY

BACHELOR OF SCIENCE

B.Sc. GEOLOGY

SEMESTER III

CORE PAPER 3

CRYSTALLOGRAPHY

Objective:

To familiarize about the nature , forms, habit, symmetry elements, measurements of interfacial angles and Twin crystals. The classification of crystal into system and classes.

UNIT - I

Definition of crystal - morphological characters of crystal - faces -forms - edges, solid angles - Interfacial angle. Contact Goniometer and its uses. Symmetry elements - crystallographic axes - crystal notation - parameter system of Weiss and Miller indices - axial ratio - laws of crystallography - the law of constancy of symmetry, the law of constancy of interfacial angles and the law of rational indices.

UNIT - II

Classification of crystals into systems and classes - Holohedral , Hemihedral, Hemimorphic and Enantiomorphic forms in crystals. Elementary knowledge of spherical and stereographic projections. study of the symmetry elements, and forms of the Normal, pyritohedral, tetrahedral and plagiohedral classes of cubic system with special reference to well developed crystals of Galena, Spinel, Garnet, Flourite, Diamond, Pyrite, Tetrahedrite, Boracite and cuprite.

UNIT - III

Study of symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Pyramidal Hemimorphic, Sphenoidal and Trapezohedral classes of Tetragonal system with special reference to well developed crystals of zircon, Rutile, Cassiterite, Vesuvianite, Apophyllite, Shellite, Melonite, Wulfenite and Chalcopyrite.

UNIT - IV

Study of the symmetry elements and forms of Normal, Hemimorphic Tripyramidal, pyramidal Hemimorphic, Trapezohedral, Rhombohedral, Rhombohedral Hemimorphic, Trirhombohedral and Trapezohedral classes of Hexagonal system with special reference to well developed crystals of Beryl, Zincite, Apatite, Calcite, Corundum, Tourmaline, Phenacite and Quartz. Study of the symmetry elements and forms of the Normal, Hemimorphic and Sphenoidal classes of Orthorhombic system with special reference to well developed crystals of Barite, olivine topaz, staurolite, Sulphur, Calamine, Struvite and Epsomite.

UNIT - V

Study of the symmetry elements and forms of the Normal classes of the Monoclinic and Triclinic systems with special reference to well developed crystals of Gypsum, Orthoclase, Albite, Augite, Axinite and Kyanite. Twin crystals - Definitions - Effects of Twinning - laws of twinning - composition plane, twinning plane and twinning axis, indices of twins - simple and repeated (polysynthetic twins), contact and penetration twins: secondary twins. Study of twin laws pertaining to the following crystals - Fluorite (spinel law), Pyrite (iron cross twin). Rutile (geniculate), Calcite, Quartz (Brazil law), Aragonite (mimetic twin), Staurolite (cruciform), Gypsum, Augite and Feldspars (Carlsbad, Baveno , Manebach, Albite and Pericline).

TEXT BOOKS

1. Dana, F.S.(1955): A text book of mineralogy - Asia Publishing House - Willey.
2. Wade., F.A. & Mattox, R.B. : Elements of crystallography and mineralogy, Harper Bros.(1960)
3. Phillips, P.C (1956): An introduction to crystallography Longmans green & co.,
4. Kerr.P.F : Optical Mineralogy.

REFERENCE BOOKS

1. Phillips, W.R.: Optical Minerlogy,Griffen, D.T.1986.
2. Walhstrom, E.F.1960 : Optical crystallography - John wiley.
3. Winchel, A.n. 1968 : Elements of optical mineralogy, part 1 & 2 wiley Eastern.
3. Smith H.G.: Minerals under microscopy - Murby.

ALLIED - 2

PAPER - 3

PHYSICS I

Course Objectives

1. To understand the basics of gravitation and to study the properties of matter.
2. To learn the law of thermoelectric circuits and thermoelectric diagrams.
3. To teach the growth and decay of a transient current and magnetometer.
4. To explain production of ultrasonics and reverberation time.
5. To know the basics of laser and fibre optics principles and applications.

UNIT-1: Properties of Matter

Gravitation: Acceleration due to gravity -Determination of 'g' by Simple pendulum - Drawbacks of simple pendulum –Determination of time period of compound pendulum - 'g' by compound pendulum -Centre of Oscillation and Centre of Suspension are interchangeable-Determination of 'g' by Bar/compound pendulum.

Elasticity: Bending of beams -Expression for bending moment - Cantilever Depression at the loaded end of a cantilever Expression forYoung's modulus -non–uniform bending-Pin and microscope method.

Torsion : Torsion couple – Potential energy in a twisted wire – Torsional pendulum – Time period - Determination of rigidity modulus by Torsional oscillation (without masses).

Viscosity: Viscosity of a liquid -Viscous force - Co-efficient of viscosity of a liquid – Poiseuille's formula -Experimental method using Burette- Effect of temperature and pressure on viscosity-applications.

Surface Tension: Surface tension of a liquid-Surface Tension and interfacial surface tension by the method of drops-applications.

UNIT-2: Thermo Electricity

Seeback, Peltier and Thomson effects - laws of thermoelectric circuits -Peltier coefficient - Thomson coefficient -application of thermodynamics to a thermocouple and expressions for Peltier and Thomson coefficients -thermo electric power and thermo electric diagrams.

UNIT-3: Transient Current and Magnetism

Growth and decay of current in a circuit containing resistance and inductance- Growth and decay of charge in circuit containing resistance and capacitor - growth and decay of charge in a LCR circuit – condition for the discharge to be oscillatory – frequency of oscillation.

Magnetism -Magnetic moment and pole strength of a magnet – Deflection magnetometer – Tan C Position- Vibration magnetometer – Theory – Period of Oscillation – Determination of M and B_H using the deflection magnetometer and the vibration magnetometer .

UNIT -4: Acoustics

Sound: Transverse vibration of strings -Velocity and frequency of vibrations of a stretched string - laws -Sonometer -A.C. Frequency - Steel wire- Brass wire.

Introduction to Ultrasonics – Piezo electric effect–production by Piezo electric method – properties – applications- Acoustics of buildings – reverberation time – derivation of Sabine's formula – determination of absorption coefficient-Acoustic aspects of halls and auditoria.

UNIT-5:Lasers and Fibre Optics

Laser: Introduction - Principles of laser -Einstein's explanation for stimulatedemission – Differences between stimulated and spontaneous emission - Population inversion –Properties of laser -Types of lasers - He- Ne Laser - Semiconductor Laser-Applications of laser.

Fibre optics: Basic principle of an optical fibre -Total internal reflection -Basic structure of an optical fibre -Numerical aperture –Coherent bundle – Attenuation and dispersion - classification of optical fibres-step index and graded index fibers – single mode and multi mode fibers-Fibre optic communication system block diagram.-applications.

Text Books

Unit 1 and Unit 4

1. R. Murugesan and KiruthigaSivaprasath, Properties of Matter and Acoustics, S. Chand & Co. New Delhi, Kindle edition.

Unit 2 and Unit 3

1. R. Murugesan, Electricity & Magnetism, S. Chand & Co. New Delhi, 2019.

Unit 5

1. N Subrahmanyam, BrijLal and M.N Avadhanulu, A Text Book of Optics, S. Chand &Co. New Delhi, Revised Edition as per UGC model syllabus.

Reference Books

1. BrijLal and N Subrahmanyam,Electricity and Magnetism, S Chand & Company Pvt Ltd, New Delhi, 2000.
2. D.C. Tayal, Electricity and Magnetism, Himalaya Publishing House,Bombay, 2014.
3. BrijLal and N.Subrahmanyam, A Text Book of Sound,Vikas Publications, New Delhi (2 Edition)
4. C.L.Arora, Physics for Degree Students B.Sc First Year, S. Chand Publishing, 2013.
5. K.Thyagarajan and Ajay Ghatak, Introduction to Fibre optics-, Cambridge University.

6. Ajay Ghatak and K.Thyagarajan, Fiber optics and Lasers-The two revolutions, Macmillan, 2006.
7. K.Thyagarajan and Ajay Ghatak, Lasers; Fundamentals and applications, Springer.
8. Modern Physics – R,Murugeshan, KiruthigaSivaprasath, S.Chand&Co, New Delhi, 2016.

E-MATERIALS

1. https://courses.lumenlearning.com/physics/chapter/16-4-the-simple-pendulum/
2. https://www.youtube.com/watch?v=aw0_seEt4v0
3. https://en.wikipedia.org/wiki/Thermoelectric_effect
4. https://www.youtube.com/watch?v=S0I37M2sx_0
5. https://physicscatalyst.com/elecmagnetism/growth-and-delay-charge-R-C-circuit.php
6. https://www.youtube.com/watch?v=PLQQPXot6vE
7. https://www.youtube.com/watch?v=d0_Eff4MXwM
8. https://www.techglads.com/cse/sem1/production-of-ultrasonics-by-piezoelectric-methods/
9. https://thefactfactor.com/facts/pure_science/physics/optical-fibre/5159/
10. https://www.youtube.com/watch?v=auk1OS0SVWc (Tamil video)

Course Objectives

1. After studied unit-1, the student will be able to find the acceleration due to gravity at a place using simple pendulum and compound pendulum. Also can know the properties of matter like elasticity, viscosity and surface tension.
2. After studied unit-2, the student will be able to learn thermo emf using Seebeck and Peltier effects and hence understand thermoelectric circuits.
3. After studied unit-3, the student will be able to explain growth and decay of a transient current in a circuit containing resistance-inductance, resistance-capacitance and LCR in series. Also will be able to determine the horizontal components of earth's magnetic induction at a place using deflection magnetometer in Tan C position.
4. After studied unit-4, the student will be able to derive the expression for the velocity of a sound in a stretched string and hence they can determine the frequency of A.C mains.
5. After studied unit-5, the student will be able to understanding the principle of laser and can demonstrate the working of He-Ne laser and applications of laser. Also, the student will be able to learn the fibre optics, structure and application in communication

SKILL BASED SUBJECT

PAPER I

ENGINEERING GEOLOGY

OBJECTIVE:

To familiarise about the scope of Engineering Geology, properties of rocks, selection of reservoir sites, Tunnels and Foundation of geological investigations, and ground water problems.

UNIT - I

Definition and scope of Engineering Geology. Engineering properties of rocks. Soils: definition and engineering properties. Geological Investigations in engineering sites. Slope stability: definition, slope failure and safety, geological factors, groundwater conditions and remedial measures.

UNIT - II

Dams: definition, types, geological conditions, and site investigations. Short note on dam foundations and geological conditions. Outline of important Indian Dams.

UNIT - III

Reservoirs: definition, selection of reservoir sites, and groundwater conditions. Problems in reservoirs: sedimentation, slope control, leakage and seismicity. Short account of Indian reservoirs.

UNIT - IV

Tunnels: definition, parts of a tunnel, types, tunnelling in hard and soft rocks, geological investigations, and groundwater conditions.

UNIT - V

Foundations: definition, geological investigations, and ground water problems. Outline of support structures: rods, bolts, anchors, arches, rings, linings, and retaining walls.

TEXT AND REFERENCE BOOKS

1. Bell,F.G.(2005).Fundamentals of Engineering Geology. B.S.Publications. Hyderabad.
2. Krynine,P.D. & W.R. Judd.(1956). Principles of Engineering Geology & Geotechnics. CBS. Delhi.
3. Legget,R.F. & A.W.Hatheway.(1988). Geology and Engineering. 3 rd ed. McGraw Hill. New York.
4. Blyth,F.G.H. & M.H.De Freitas.(1984).A Geology for Engineers. 7th ed. Elsevier. New Delhi.
5. Parbin Singh,B.(2005). A Textbook of Engineering and General Geology. S.K.Kataria & Sons.Delhi

NON-MAJOR ELECTIVE

PAPER I

DISASTER MANAGEMENT

OBJECTIVE:

To understand about Natural disasters, monitoring and disaster management measures for Earthquake, Landslide, Volcanoes and Tsunamis

UNIT - I

An introduction to Natural disasters: floods- cyclones - earthquakes - volcanoes - landslides tsunamis. Monsoons: North East and South West monsoon - cyclones and storms - surface water flows and river flows. Flooding flood control measures: check dams. Precautionary measures: warning systems and cyclonic shelters. Failure of monsoons and droughts. Remedial measures and preparedness.

UNIT - II

Earthquake: Definition - Type of shock waves: Body waves: P waves, S waves. Surface waves: P waves, L waves - Causes of earthquakes. Destructions due to earthquake - Richter scale - Major earthquakes in India. Prediction of Earthquakes and warning systems. Earthquake monitoring and disaster management measures.

UNIT - III

Volcanoes: type of volcanoes - causes of volcanoes - products of volcanoes. Destruction due to volcanic eruptions. Major volcanic eruptions in India. Submarine volcanoes. Prediction of volcanic eruptions and early warning systems. Active volcano monitoring and disaster management measures.

UNIT - IV

Landslides: definition - terminology - classification. Causes of landslides: slope changes - tectonic activity - rock structures - role of water in landslides - effects of Human activity. Destruction due to landslides - precautionary measures. Glaciers and its avalanches. Major landslides in India. Landslides warning systems and early detection. Landslide disaster management measures.

UNIT - V

Tsunamis: definition - causes of tsunami: submarine earthquakes and tsunamis - Impact of tsunamis - Major Tsunamis. Advance warning systems for Tsunamis - Tsunamis disaster management measures - seiche waves in lakes.

TEXT AND REFERENCE BOOKS

1. Holmes,A & P.L.Duff. (1996). Principles of Physical Geology,4th revised Edition, ELBS, London
2. Radhakrishnan,V. (1996). General Geology, V.V.P. Publishers,Tuticorin.
3. Mahapatra,G.P. (1994). Physical Geology,CBS Publishers,New Delhi.
4. Mahapatra,G.P. (1992). Textbook of Geology, CBS Publishers,New Delhi.
5. Emiliani,C.(1992). Planet Earth, Cambridge University Press, Delhi.

6. Porter,S.C. & B.J. SkinnerJ. (1995). The Dynamic Earth, John Wiley & Sons, New York.
7. Leet,D & Judson,S (1987). Physical Geology, McGraw Hill. New Jersey.
8. Zumberge,J.(1980). Physical Geology, Freeman, New York.
9. Patwardhan,A.M. (1999). Dynamic Earth System, Prentice Hall, New Delhi.
10. Mukherjee,A.K. (1990). Principles of Geology,EW Press,Kolkata.
12. Reed,J.S. & T.H. Wicander. (2005). Essentials of Geology, McGraw Hill., New York.
13. Miller,T.G. (2004). Environmental Science. Wadsworth Publishing. USA.

SEMESTER IV
CORE PAPER - 4
PALAEONTOLOGY

OBJECTIVE

To make the participant to acquire knowledge on ancient life, skills on identification and documentation of paleobiota. To use the skills for characterizing ancient climate, environment and catastrophies and resource exploration

UNIT - I

Definition of Palaeontology - organic world- Animal Kingdom - classification of animals - Habitates and Habits of animals. Definition of fossils - nature and modes of preservation of fossils: Body fossils and; Unaltered hard parts, Altered hard parts: Petrifaction, permineralisation, carbonisation, recrystallisation, silicification; trace fossils - mould, casts, tracks, trails, borings; Uses of fossils - stratigraphic indicators - climatic indicators- indicators of palaeogeography - indicators of evolution and migration of life forms - indicators of new deposits of coal and petroleum - life through ages.

UNIT - II

Phylum Arthropoda - Class - Trilobita - General morphology : classification - geological history. Phylum Porifera - A short account of sponges.Phylum coelentrata - class Anthozoa - zoological features - General morphology: classification - tabulate corals - Rugose corals geological distribution- stratigraphic importance. Sub phylum Hemichordata - class Graptozoa: order Dendroidea and Graptoloidea - general morphology, classification, geological distribution and stratigraphic importance.

UNIT - III

Phylum Mollusca - Class Pelecypoda - General characters - ornamentation , classification , geological history. Class Gasteropoda:- General morphology, shell forms - types of coiling - Dextral and sinistral - ornamentation, classification and geological history.Class Cephalopoda:- General morphology, (Nautilitic, Goniotitic, Ceratitic and Ammonitic) - shell forms - ornamentation - classification, geological history - morphology of a Belemnite shell.

UNIT - IV

Phylum Brachiopoda - General morphology - Brachial skeleton - morphometric details, ornamentation , classification , geological history. Phylum Echinodermata: Class Echinoidea: General morphology, corona (Ambulacra, inter ambulacra) - peristome - regular and irregular echinoids - classification - geologicial history. Class Crinoidea:- General morphology , classification, geological history. Class Blastoidea: General morphology.

UNIT - V

Phylum protozoa - Order: Foraminifera: General morphology - dimorphism - classification, geological history and stratigraphic importance. Class Crustacea - Sub class: Ostracoda - morphology - classification and geological history - A brief outline of the classification of vertebrates. A short account of Devonian fishes, Mesozoic Reptiles, Siwalik mammals. General classification of plant kingdom - plant fossils from India - A brief account of the following plant fossils :- Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepididendron and Sigillaria. Applications of Micro palaeontology.

TEXT AND REFERENCE BOOKS

1. Henry woods: Inveretebrate palaeontolgy - Cambridge.
2. Romer, A.S.: Vertebrate palaeontology, Chicago press.
3. Arnold, C.A.,: An introduction to Palaeobotany., MC-Graw
4. B.U. Hag and A. Boersma (1978) : Introduction to marine Micropalaeontology. Elsevier, Netherlands
5. Jain, P.C., and Anatharaman, M.S.,: An introduction to Paleontology, Vishal Publications.
6. Raup, D.M. and Stanely, M.S.: Principles of Palaeontology, CBS Publishers.
7. Moore , R.C., Laliker , C.G.& Fishcher, A.G.: Invertebrate Fossils , Harper brothers
8. Shrock. R.R. and Twenhofel , W.H - 1953 : Principles of invertebrate Palaeontology, Amold publication Easton - Invertebrate Paleontology

ALLIED - 2
PAPER - 4

PHYSICS II

Course Objectives

1. To study the concept of special theory of relativity.
2. To expose the structure of atom with different models.
3. To know the definition of binding energy and to study about nuclear models
4. To learn the different number system in digital electronics and logic gates
5. To give an introduction about nanomaterial.

UNIT-1: Special Theory of Relativity

Frames of reference-inertial frames and non-inertial frames -Galilean transformations -Michelson-Morley experiment-interpretation of results - postulates of special theory of relativity Lorentz transformation equations -length contraction - time dilation - transformation of velocities -variation of mass with velocity -Mass-energy equation.

UNIT-2: Atomic Physics

Bohr atom model – Critical Potentials - Experimental determination of critical potentials - Franck and Hertz's experiment -Sommerfield's Relativistic atom model The vector atom model – spatial quantization–spinning of an electron –quantum numbers associated with the vector atom model – coupling schemes –LS and jj coupling – the Pauli's exclusion principle – Stern and Gerlach experiment

UNIT-3: Nuclear Physics

Binding energy-Binding energy per nucleon-Packing fraction-Nuclear models – liquid drop model – semi empirical mass formula – merits and demerits -shell model -evidences for shell model – nuclear radiation detectors –ionization chamber – G.M Counter-Wilson cloud chamber-Particle accelerators-Cyclotron-Betatron.

Unit-4: Digital Electronics

Number systems -Decimal, Binary, Octal and Hexadecimal system – Conversion from one number system to another- Binary Arithmetic -Addition –Subtraction- 1's and 2's complement -Binary codes- BCD code – Excess 3 code, Gray code.

NAND, NOR and EXOR – functions and truth tables. NAND & NOR as universal gates-Half adder and Full adder - Half subtractor and Full subtractor using NAND gate only.

UNIT-5: Nanomaterial

Introduction-Nanomaterial- Properties of nanomaterial (size dependent) -synthesis of nanomaterial-sol gel- hydrothermal method-Scanning Electron Microscope (SEM)- Principle and Instrumentation-Fullerenes- Carbon nanotubes- Fabrication and structure of carbon nanotubes - Properties of carbon nanotubes (Mechanical and Electrical) - Applications ofCNT's.

Text Books

Unit 1 to Unit 3

1. Modern Physics – R,Murugeshan, KiruthigaSivaprasath, S.Chand&Co, New Delhi, 2016

Unit 4

1. V.Vijayendran, Introduction to Integrated Electronics (Digital & Analog), S. Viswanathan, Printers & Publishers Private Ltd, Chennai, 2007

Unit 5

1. V. Raghavan, *Material Science and Engineering* ,Printice Hall India.,2004.

Reference Book

1. Allied Physics – R. Murugesan S. Chand & Co. New Delhi, 2005.
2. A Text book of Digital electronics – R.S.Sedha, S.Chand&Co, 2013
3. Malvino and Leech, Digital Principles and Application, 4th Edition, Tata McGraw Hill, New Delhi, 2000.
4. Dr. M.N. Avadhanulu, *Material science*, S.Chand& Company, New Delhi, 2014.
5. M.Arumugam, *Material science*, Anuradhapuplishers, 1990.
6. V. Rajendran, *Material Science*, Tata McGraw Hill Ltd, New Delhi,2001.
7. D.C.Tayal, Nuclear Physics, Himalaya Publishing House, 2009

E-MATERIALS

1. https://en.wikipedia.org/wiki/Galilean_transformation
2. https://www.youtube.com/watch?v=NH3_1IkSB9s
3. https://www.youtube.com/watch?v=EEWuUst2GK4
4. https://en.wikipedia.org/wiki/Vector_model_of_the_atom
5. https://www.tutorialspoint.com/what-is-a-geiger-muller-counter
6. https://www.youtube.com/watch?v=jxY6RC52Cf0
7. https://www.tutorialspoint.com/digital_circuits/digital_circuits_number_systems.htm
8. https://www.youtube.com/watch?v=4ae9sJBBkvw
9. https://en.wikipedia.org/wiki/Nanomaterials
10. https://www.youtube.com/watch?v=mPxoJz6treE (Tamil video)

Course Outcomes

1. After studied unit-1, the student will be able to study the frames of reference, Galilean transformation equations and special theory of relativity.
2. After studied unit-2, the student will be able to describe the different atomic models and Stern and Gerlach Experiment.
3. After studied unit-3, the student will be able to explain binding energy, liquid drop model, G.M counter and particle accelerators.
4. After studied unit-4, the student will be able to know the conversion of number systems from one to other and also will be able to design universal gates using NAND and NOR gates.
5. After studied unit-5, the student will be able to understanding the basics of nanomaterial, synthesis and its applications.

ALLIED PRACTICAL- PHYSICS

List of Experiments (Any 12 Experiments only)

1. Determination of 'g' using Compound pendulum.
2. Young's modulus-Non-Uniform bending-Pin & microscope
3. Rigidity Modulus – Torsional oscillation method (without masses).
4. Rigidity Modulus – Static Torsion method using Scale and Telescope.
5. Surface tension and Interfacial Surface tension by Drop Weight method.
6. Sonometer – Frequency of a Tuning fork.
7. Sonometer –Determination of A.C. frequency- using steel and brass wire
8. Air Wedge – Determination of thickness of a thin wire
9. Newton's Rings – Radius of Curvature of a convex lens.
10. Spectrometer – Refractive index of a liquid – Hollow prism.
11. Spectrometer grating – Minimum Deviation- Wavelength of Mercury lines.
12. Potentiometer – Calibration of Low range voltmeter.
13. Deflection magnetometer and Vibration magnetometer-Tan C Position-Determination of m and B_H.
14. Figure of merit- Table galvanometer.
15. Construction of AND, OR gates using diodes and NOT gate using a transistor.
16. NAND/NOR as universal gate.
17. Half adder and Full adder using NAND gate.
18. Half subtractor and Full subtractor using NAND gate.
19. Lasers: Study of laser beam parameters.
20. Measurement of Numerical aperture (NA) of a telecommunication graded index optic fiber.
21. Fiber attenuation of a given optical fiber.

Text Books

1. C.C. Ouseph, U.J. Rao, V. Vijayendran, Practical Physics and Electronics, S. Viswanathan, Printers & Publishers Private Ltd, Chennai,2018.
2. M.N.Srinivasan, S. Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, Sultan Chand & Sons, New Delhi, 2015.

Reference Books

1. Dr. S. Somasundaram, Practical Physics, Apsarapublications,Tiruchirapalli, 2012.
2. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

SKILL BASED SUBJECT
PAPER 2
PHYSICAL GEOLOGY

OBJECTIVE

To make the participant appreciative of natural physical geology and use the acquired knowledge and skills. To apply for solving environmental issues, resource evaluation, exploration and management.

UNIT - I

Weathering of Rocks - Environment of weathering - weathering processes, chemical and mechanical weathering - Rates of weathering - kinds and products of weathering - weather & climate - Role of weathering in Geologic cycle, Economic importance of weathering. Atmosphere - Its composition and zones. Movements of atmosphere - wind - Geological actions of wind- sand dunes and their types - loess - arid cycle of erosion - characteristics of deserts.

UNIT - II

Running water - source and surface flow - erosion, transportation and deposition - land reforms resulting from erosion and deposition - valley development - drainage patterns - fluvial cycle (youth maturity and old age) - interruptions to the normal cycle - stream rejuvenation - river capture.

UNIT - III

Underground water - sources - water table - zone of saturation - springs and wells - artesian wells - geysers - spring deposits - aquifer - geological work of ground water - solution - Karst topography - development of karst features - characteristics of Karst regions - origin of L.st. caverns - artesian belts of Tamilnadu.

UNIT - IV

Glaciers - origin and types of glaciers - movement of glaciers - transportation and deposition - glacio fluvial deposits - landforms produced by glaciers - Ice ages. Lakes - classification - types of lakes - lake deposits.

UNIT - V

Seas and Oceans - waves, tides and currents- sea as a geological agent - classification of shore lines - shore line types - description of continental margin - continental shelf - continental slope - ocean basin - submarine canyon, sea mount , guyot, mid oceanic ridge; ocean deposits; coral reef - their types and origin.

TEXT AND REFERENCE BOOKS

1. Philip G.Worcester : A text book of Geomorphology - D. Nostrandcomp Inc. New York.
2. Radhakrishnan.V, 1996 : General Geology, VVP, Tuticorin.
3. Mahapatra, G.b. A text book of Geology, CBS, Delhi
4. Arthur Holms : Principles physical Geology Thomos Nelson & sons, London

5. Chakranarayanan,A.B. et.al:Concepts of Geology, Scientifica Publication
6. D.Leet & Shelton Judson: Physical Geology - prentice Hall, Internation Inc. Englewood, Cliff, U.S.A.
7. William J, Miller : An introduction to physical Geology, D. Van Nostrand Company, Inc New York.

NON-MAJOR ELECTIVE
PAPER - 2
ENVIRONMENTAL GEOLOGY

OBJECTIVE

To know about the basic concepts of environmental Geology, Causes, effects, strategies for their mitigation, Natural Hazards and Coastal processes.

UNIT - I

Environmental Geology : Earth's place in space. Fundamentals concepts of Environmental Geology: Human Population Growth - Sustainability - Earth as a System - Hazardous Earth Processes - Scientific Knowledge and Values. Internal Structure of Earth and Plate Tectonics - Plate Tectonics & Environmental Geology. Minerals and Rocks. Ecology and Geology.

UNIT - II

Natural Hazards: Hazards, Disasters, and Nature Processes - Evaluating Hazards: History, Linkages, Disaster Prediction, and Risk Assessment - Fundamental principles concerning Nature Hazards - Human response to Hazards - Global Climate and Hazards - Population Increase, Land - use Change and Nature Hazards.

UNIT - III

Volcanoes and Earthquakes: Earthquakes: Magnitude and intensity. Plate boundary related Earthquakes - Earthquake processes (Faulting, Tectonic group). Earthquake shaking (seismic waves, seismograph) - Earthquake cycle - Earthquake caused by Human Activity - Effects of Earthquakes - Tsunami - Earthquake risk and Earthquake prediction - Earthquake warning system. Volcanic activity - Volcanic Hazards, Forecasting volcanic activity. Landslides: Human use Landslide - Minimising the Landslide Hazards- Perception of Landslides,

UNIT - IV

River, Flooding, and Coastal Hazards: Rivers and Flooding: Sediments in River - River velocity, Discharge, Erosion, and Sediments deposition- Effects of Land - use Change - Channel Pattern & Floodplain Formation - River Flooding - Urbanisation & Flooding- The Nature and Extent of Flood Hazards - Adjustments to Flood Hazards - Perception of Flooding. Coastal processes: Erosion - Coastal Hazards & Engineering structure - Human activity and Coastal erosion - Perception of and Adjustment to Coastal Hazards.

UNIT - V

Resources and Pollution: Water Resources: A brief global prospective surface water - Groundwater - Interactions between surface water and Ground water - Desalination - Water Managements - Water and Ecosystem. Water Pollution: Selected Water Pollutions - Oxygen - Demanding Waste - Pathogenic Organisms - Nutrients - Toxic Substances - Synthetic Organic Chemicals - Heavy Metals - Surface Water Pollution and Treatment- Point Source and Non-point Source - Ground water Pollution and Treatment. Mineral resources: Mineral of Human use - Geology of Mineral Resources - Environmental Impact of Mineral Development - Recycling Mineral Resource Energy. Geothermal Energy.

TEXT AND REFERENCE BOOKS

1. Valdiya, K.S (1987), Environmental Geology - Indian Context. Tata McGraw-Hill., Delhi.
2. Kellar, E.A. 1979, Environmental Geology, Charles. Merrill Publishing Co.ohio.
3. Lundgren, I. 1986, Environmental Geology, Prentice Hall.

PALAEONTOLOGY

CORE PRACTICAL II

Megascopic identification and description of the following fossils:- Corals: Calceola, Zaphrenits, Favosites, Halysites,; Brachiopoda: Spirifer, Productus, Terebratula, Rhynconella, Atrypa, Athyris, Orthis, Echinodermata: Pentrimites, Cidaris, Hemicidaris, Micraster, Holaster, Hemisaster, Stygmatophygus, Mollusca: Pelecypoda: - Arca, Cardium, Meretrix, Cardita, Pecten, Trigonia, Megaladon, Pholodomya, Gryphea, Exogyra, Ostrea, Inoceramus, Alectryonia. Gasteropoda:- Natica, Turbo, Trochus, Turritella, Cerethium, Conus, Voluta, Murex, Fusus, Physa, Bellerophon. Cephalopoda:-Nautilus, Goniatites, Ceratites, Acanthoceras, Scholenbachia, Perispinctus, Hamites, Scaphites, Baculites, Turrilites and Belemnites, Arthropoda: Trilobita:- Paradoxides, Calymene, Phacops. Trinucleus, Graptolites: - Phyllograptus, Tetragraptus, Didymograptus, Diplograptus, Monograptus, Plant fossils:- Glossopteris, Gangamopteris, Ptillophyllum, Lepidodentron, Sigillaria and Calamites.

Micro fossils:-
Lagena, Nodosaria, Textularia, Operculina, Elphidium, Ammonia.

Diagrams:-
Paradoxides, Pentremites, Trigonia, Arca, Meretrix, Murex, Turritella, Nautilus, Spirifer.

CRYSTALLOGRAPHY

Identification and description of the following crystal models:-

Galena, Garnet, Fluorite, Pyrite, Tetrahedrite, Boracite, Sphalerite, Cuprite, Zircon, Cassiterite, Rutile, Octahedrite, Apophyllite, Vesuvianite, Scheelite, Meonite, Wulfenite, Chalcopyrite, Beryl, Zincite, Apatite, Calcite, Haematite, Dolomite, Corundum, Tourmaline, Phenacite, Dioptase, Quartz, Olivine, Topaz, Barite, Andalusite, Cordierite, Sulphur, Staurolite, Hypersthene, Calamine, Struvite, Epsomite, Gypsum, Orthoclase, Augite, Hornblende, Epidote, Sphene, Axinite, Albite, Kyanite and Rhodonite.

Simple twin models:-
Galena, Fluorite, Pyrite, Rutile, Calcite, Quartz, Staurolite, Gypsum, Augite, Orthoclase, Albite.

SEMESTER V

CORE PAPER - 5

MINERALOGY

OBJECTIVE

To understand the crystallography, its internal and external structures and the classification of crystals into systems and classes. and to know about the technique of x-ray diffraction pattern and their interpretation in mineralogy

UNIT - I

Definition of Mineral and Mineraloid, Scope of Mineralogy - Chemical elements and Periodic Table - Bonding of atoms and their types - Isomorphism, polymorphism and pseudomorphism in minerals - Atomic substitution and solid solution in minerals - Non crystalline minerals - Metamict state.

UNIT - II

Physical properties of minerals - Optical properties of minerals - Determination of specific gravity of minerals - Joly balance, Beam balance methods, Pycnometer method and Heavy liquids - Structure and classification of silicates.

UNIT - III

Mineralogy, structure, chemical composition, optical and physical properties, modes of occurrence and industrial uses of the following group of minerals: Quartz - Feldspar - Feldspathoid - Zeolite.

UNIT - IV

Mineralogy, structure, chemical composition, optical and physical properties, modes of occurrence and industrial uses of the following group of minerals: Pyroxene - Amphibole - Mica - Olivine - Garnet- Spinel - Clay minerals.

UNIT - V

Physical and optical properties, chemical composition, uses and modes of occurrence of the following minerals: Epidote, Chlorite, Scapolite, Cordierite, Talc, Serpentine, Steatite, Calcite, Dolomite, Andalusite, Kyanite, Sillimanite, Topaz, Staurolite, Beryl, Tourmaline, Wollastonite, Fluorite, Apatite, Zircon, Rutile, Sphene and Corundum.

TEXT AND REFERENCE BOOKS

1. Berry, L.G., Mason, B.H and R.V. Dietrich (1983). Mineralogy: Concepts, Descriptions, Determinations. W.H. Freeman & Co., 612p.
2. Dana, E.S (2011). A Text-Book of Mineralogy, Read Books Design Publishers, London, 550p.
3. Dana, J.D (2012). Manual of Mineralogy, Merchant Books Publilshers, New York, 454p.
4. Erni, H (2010). Mineralogy Simplified, Forgotten Books Publishers, London, 436 p.
5. Mason, B and Berry, L.G (1978). Elements of Mineralogy, W.H. Freeman & Co. 453p.
6. Nesse, W.D (2014). Introduction to Mineralogy, Oxford University Press, USA, 480p.
7. Rutley, F (2012). Rutley's Elements of Mineralogy, Springer Science & Business Media, New Delhi, 560p.

CORE PAPER - 6

IGNEOUS PETROLOGY

OBJECTIVE

To learn about the formation of rock due to Igneous activity and magma types, Classification of Igneous Rocks, Petrography and Petrogenesis of various igneous rocks.

UNIT - I

Definition of Petrology - Earth zones. Composition and constitution of magmas - Primary and Parental Magmas. Forms of Intrusive igneous rocks: Concordant forms - Sill, Laccolith, Lopolith and Phacolith, Discordant forms - Dykes, Cone Sheets, Volcanic neck, Ring dyke, Batholiths, Stocks, Bosses and Psymaliths. Forms of Extrusive igneous rocks: Lava flows, Pyroclastic deposits - Agglomerate, Lapilli, volcanic ash and volcanic froth

UNIT - II

Structures vesicular and Amygdaloidal structures - block lava - Ropy lava - pillow structure - flow structure - sheet joints- mural jointing - columnar jointing - rift and grain. Textures: Definition and description - crystallinity: crystallites and microlites - Devitrification - Granularity - shapes of crystals , mutual relations - Equigranular textures: allotriomorphic hypidiomorphic, Panidiomorphic. inequigranular Textures: porphyritic and Intergrowth texture - Trachytic texture - Intergrowth texture structures orbicular structure Spherulitic structure - Perlitic fracture. , Directive textures, Overgrowth textures, Reaction textures - Micro Structures

UNIT - III

Classification: bases of classification - megascopic classification - classification based on colour index - based on the proportion of Alkali to plagioclase feldspars. Based on silica saturation - based on alumina saturation - A short account of CIPW classification, Normative minerals, salic and femic groups - mention of the main divisions, classes, orders, suborders, rangs and subrangs only. Merits and defects of CIPW classification - Tyrrels tabular classification.

UNIT - IV

Texture, Mineralogy, Classification, and Modes of occurrence of: Granite, Granodiorite, Syenite, Diorite, Gabbro, their hypabyssal and volcanic equivalents. Petrographic characters, distribution in India and origin of Pegmatites, Lamprophyres, Alkaline rocks, Dunite, Peridotite and Anorthosites.

UNIT - V

Crystallization of Unicomponent magma - Crystallization and petrogenetic significance of Binary magmas: Diopside - Anorthite Eutectic system, Albite - Anorthite Solid-Solution system, Forestrite - Silica incongruent melting system and Ternary system (Ab - An - Di). Reaction principle and Bowen's reaction series - Causes for the diversity of Igneous rocks - Magmatic Differentiation: Fractional Crystallization, Liquid immiscibility, Assimilation - Short notes on: Consanguinity, Variation diagrams and petrographic provinces.

TEXT AND REFERENCE BOOKS

1. Tyrrel, G.W. (1978) The principles of petrology - Chapman and Hall Ltd., London.
2. Bowen, N.L. The Evolution of the Igneous Rocks - Dover publication, Inc, New York.
3. Barth, FW. (1962) Theoritical petrology - Wiley.
4. Walstrom, E.E. (1961) Theoritical Igneous petrology, Wiley.
5. Turner.F.J and Verhoogen.J -1960.- Igneous and Metamorphic petrology - McGraw Hill.
6.Hatch, F.H. Wells, A.K.(1949),Petrology of Igneous Rocks, Thomas Murby & Wells, M.K.
7.Johannesen, A (1962) Descriptive petrography of Igneous Rocks.

CORE PAPER - 7
SEDIMENTARY AND METAMORPHIC PETROLOGY

OBJECTIVE

To learn about the occurrence, origin, classification, texture and structure, petrographic and petrogenesis of sedimentary and metamorphic rocks.

UNIT - I

Sedimentary process - disintegration & decomposition of rocks - transportation - deposition - diagenesis. A broad classification of sedimentary rocks into residual mechanical, chemical and organic Groups. Structures of sedimentary rocks. mechanical, chemical and organic structures. Textures of sedimentary rocks - clastic and non - clastic textures.

UNIT - II

Residual deposits - terra rossa , clay, laterite and bauxite and soils. Mechanical deposits - rudaceous, arenaceous and argillaceous groups. Heavy minerals in sand and sandstones. A descriptive study of Conglomerate, Breccia, Sandstones and Shales.

UNIT - III

Chemical deposits - siliceous , carbonaceous, ferruginous and salt deposits. organic deposits - calcareous, siliceous, phosphatic, ferruginous and carbonaceous deposts. A breief study of Flinit, Chert, Siderite, Gypsum, Rock Salt, Caliche. Guano and Kiesellgher. Descriptive study of different types of calcareous and carbonaceous deposits.

UNIT - IV

Definition of metamorphism -Agents and kinds of metamorphism - facies, zones and grades of metamorphism - metamorphic structures and textures. cataclastic metamorphism and its products. Retrograde metamorphism. Thermal metamorphism of pelitic sediments, pure and impure calcareous rocks. A brief study of Breccia, Flaser, Mylonite, Hornfels, Marble, Ophicalcite.

UNIT - V

Dynamo thermal metamorphism of pelitic sediments. plutonic metamorphism petrography and origin of charnockites - metamorphic differentiation - pneumatolytic injection metamorphism - anatexis and palingenesis. Brief study of Slate, Phyllite, Quartzite, Schist. Gneiss, Granulite, Leptynite, Charnockite, Ecologite, Amphibolite, Schorl, Adinole, Lit- Par- Lit - gneiss and Migmatite.

TEXT AND REFERENCE BOOKS

1. Tyrrel, G.W- Principles of petrology, Asia Publishing House.
2. Huang, W.T.-Petrology, MC Graw Hill
3. Pettijhon, F.J.-Sedimentary Rocks, Harper & Bros.
4. Harker, A. -Petrology for Students, Cambridge,
5. Turner,F,J &Verhogen,J -Igneous and Metamorphic Petrology, MC Graw Hill.
6. Williams, H, Turner, F.j. & Gillibert, C.M. - Petrography, Freeman.
7. Winkler, A. G.F.- Petrogenesis of Metamorphic Rocks, Mc Graw Hill.

INTERNAL ELECTIVE
PAPER - 1
MINING GEOLOGY

OBJECTIVE

To understand the basic fundamental concepts of various mining methods, their terminologies, and the type of sampling adopted, explosives used in the mine, and and to have a basic knowledge about mine machineries.The subject owes its growth to many civil structures which failed due to lack of geological application in the past. Therefore study of engineering geology is required

UNIT - I

Role of geology in mining industries - definition of mining terms, shaft, Hanging wall, Adit, roof, Drive crosscut, Tunnel, Raise, Winze, Stope, Ventilation, Haulage; Surface methods of mining, Alluvial mining - pan & betea, sluicing, Hydraulicking, Drift mining and Dredging. opencast mining. Benches, Explosives, working slope, mining equipments - Dragline, Mine machinery-power shovel, bucket wheel excavator, conveyor and spreader.

UNIT - II

Subsurface mining:- Underground mining - advantages and limitations. Stoping - open stopes, supported stopes, pillar supported stopes - square supported stoping - timber supported stopes-filled stopes - shrinkage stopes - shaft sinking. Caving;

UNIT - III

Top slicing. Sublevel caving and Block caving. Coal mining (surface mining) Strip mining and Augering- transportation -cleaning -Grading - Shipping. Underground mining. Room and pillar method- Longwall method- hydraulicking. Mineral Economics and its concept. Role of Minerals in National Economy.. Mineral conservation and substitution.

UNIT - IV

Mining terms and their descriptions. Sampling - Principles - Types of sampling - Collection & preparation of samples. Drilling: Types of drills and methods of drilling. Geological logging. Explosives and Blasting Methods. Rock excavations. Assaying and evaluation of ore-bodies and their extensions-ore reserve estimation.

UNIT - V

Types of mining- Glory hole, Kaolin mining, Granite mining, sand mining, stripping. Ground water control -Power source roofing - Mining and environment, Mitigation of mining hazards. Factors controlling the choice of various mining methods.

TEXT AND REFERENCE BOOKS

1. Curran, P (1988). Principles of remote sensing. Corgman Publishers, London
   Lillesand, T.M and R.W. Kiefer (2000). Remote sensing and image interpretation.
2. John Wiley & Miller, V.C (1961). Photogeology. McGraw-Hill Publishers, New York
3. Pandey, S.N (1987). Principles and applications of photogeology. Wiley Eastern Ltd.,New Delhi
4. Sabins, F.F (1987). Remote sensing principles and interpretation. Freeman Publishers, New York
5. Siegal, B.S and R. Gillespie (1980). Remote sensing in Geology, John Wiley & Sons, New York
6. Arogyaswamy, R.N.P. Courses in Mining Geology - Oxford &IBH, New Delhi.
7. Thamus, P.J. 1979 An introduction to mining, Methun.
8. Mc Kinstry, H.E 1960 Mining Geology, New york.
9. Allum, J.A.E (1978). Photogeology and regional mapping, Pergamon Press Ltd., Oxford
10. Anji Reddy, M (2001). Textbook of remote sensing and GIS, BSP PS Publications, New Delhi
11. Rampal, K.K (1999). Handbook of aerial photography and interpretation. Concept Publishers Company, New Delhi
12. Jean Yves Scanvic (1997). Aerospatial remote sensing in geology. Oxford & IBH Publishers Co. Pvt. Ltd.
13. Agarwal, C.S and Garg, P.K (2000). Textbook on remote sensing in natural resources monitoring and management, Wheeler Publishing Company Ltd., New Delhi
14. Narayan, L.R.A (1999). Remote sensing and its application. Universities Press Ltd., Hyderabad.

SKILL BASED SUBJECT
PAPER - 3
GEMOLOGY

OBJECTIVE*:*
To understand about the Physical, Chemical and Optical properties of Gemstones, occurrences and distribution of gemstones and Gemstone treatments.

UNIT - I
Introduction to Gems - Basic properties of gems. Precious and semi-precious minerals. Formation of gem stones. Nature of gem material: quality necessary in gems-beauty, rarity, durability. Distinction between crystalline, amorphous and metamict materials. Crystal form and habit. Classification of gem stones. Observations with hand lens (10x)-importance and uses. Units of measurement: metric scale, carat, pearl and grain.

UNIT - II
Nature of crystals: distinction between crystalline and amorphous material, crystal symmetry, Twinning, parallel growth, crystal form, crystal habit, seven crystal system. Identification of rough stones.

UNIT - III
Physical properties: hardness and its applications in gemmology and limitations. Cleavage, Fracture, parting, and their importance in gemology and lapidary work. Specific gravity-utility and determination by hydrostatic weighing, heavy liquids, floation and pycnometer. Inclusions and other features of gemstones.

UNIT - IV
Optical properties: The electromagnetic spectrum, reflection and its importance in gemology - lustre, aventurescence, sheen, chatoyancy, asterism, luminescence, play of colours, labradorescence, inclusions etc.. Laws of refraction, refractive index (R.I), total reflection- in design of refractometer. Construction and use of refractometer. Polariscope-construction and use in gemmology. Dichroscope construction, use of Chelsea colour filter, Infra-red ultraviolet and x-rays in gem identification.

UNIT - V
Enhancement and treatments- enhancement methods -coloured and colourless impregnation, dyeing, bleaching and its identification. Methods of treatment - laser drilling, irradiation, heat treatment, surface modifications, diffusion treatment and its identification. Composites - types, classification and identification.

TEXT AND REFERENCE BOOKS
1. Karanth,R.V. (2000). Gem and gem industry in India, Memoir 45, Geological Society of India, Bangalore.

2. Babu,T.M. (1998). Diamond in India, Economic Geology Series 1, Geological Society of India, Bangalore.
3. Hall,C. (2005). Gemstones, Dorling Kindersley,London.
4. Sinkankas,J.J. (1964). Mineralogy: A first Course, Van Nostrand Reinhold, New York.
5. Krishnan,M.S. (1964). Mineral Resources of Madras, Memoir Vol 80, Geological Survey of India ,Kolkota
6. Prasad,U. (2003). Economic Mineral Deposits, CBS Publishers, New Delhi.
7. Read,P.G. (1984). Beginner's Guide to Gemmology, Heinemann Professional Publishing Ltd,London.
8. O'Donoghue,M. (2006). Gems. Elsevier, Singapore.
9. Keller,P.C. (1990). Gemstones and their origins, Van Nostrand Reinhold, New York.
10. Herbert Smith,G.F (1912). Gemstones. Metheun,London.
11. Read,P.G. (2005). Gemmology, 3rd ed. Elsevier,Singapore.
12. Walton,L. (2004). Exploration Criteria for Colored Gemstones, Canada.

SEMESTER VI
CORE PAPER - 8
STRATIGRAPHY

OBJECTIVE

To impart knowledge about the concept of time in stratigraphy, Stratigraphic Nomenclature, Sequence Stratigraphy, Chemostratigraphy.To acquaint students with knowledge of biostratigraphic units, biogeographic zone, provinces, controlling factors, zonation and their time significance

UNIT - I

Principles of stratigraphy: law of order of superposition. law of uniformitarianism and law of faunal succession. Correlation: fossiliferous and unfossiliferous rocks. Standard stratigraphic scale and Indian Geologic Time scale. Imperfections in Geological record. Geological divisions. Stratigraphic classification and Nomenclature. Stratigraphic Units: Homotaxis. Physiographic divisions of India: Peninsular India, Indogangetic alluvial plains, Extra Peninsular India

UNIT - II

Precambrian Stratigraphy: Archaeans of Dharwar Province, Archaeans of Eastern Ghat - The Sausar and Sakoli Series, Archaeans of Singhbhum - Iron Ore Series and Gangpur Series. Archaeans of Tamilnadu, Mineral Wealth of Archaeans of India, The Eparchaean Unconformity, Stratigraphy and Mineral Wealth of Cuddapahs, Stratigraphy and Mineral Wealth of Vindhyans, Kurnool group, Life during Precambrian

UNIT - III

Paleozoic Stratigraphy: Distribution of Paleozoic rocks in India, Cambrian of Salt Range, Age of Saline Series, Upper Carboniferous and Permian rocks of Salt Range, Paleozoic rocks of Kashmir Valley, Paleozoic rocks of Spiti Valley, Paleozoic rocks of Peninsular India,

UNIT - IV

Mesozoic Stratigraphy: The Depositional Environment-distribution-life-classification and economic importance of Gondwana formations of India, Coastal Gondwana of India, Gondwana formations of Tamilnadu, Triassic of Spiti - The Lilang System, Jurassic of Kutch, Cretaceous of Tiruchirapalli - Pondicherry - Bagh Beds, Deccan traps : distribution , structure , Lameta beds - infratrapean and intertrappean beds, age of the Deccan traps.

UNIT - V

Cenozoic Stratigraphy: Comprehensive account of the geological events took place during Cenozoic era in India, rise of Himalayas, stratigraphy of Siwalik system, fauna and flora of Siwaliks, Tertiary rocks of Assam, Karewa formation, Tertiary rocks of Tamilnadu, Tertiary rocks of Kerala, Pleistocene Glaciation - Mineral wealth of Tertiary rocks of India:

TEXT AND REFERENCE BOOKS:-

1. Krishnan M.S. (2003) - Geology of India and Burma, 6th Edition, CBS.
2. Wadia D.N. (1953) - Geology of India, TATA McGraw - Hill.
3. Ravindrakumar K.R. - Stratigraphy of India.
4. Lemon R.Y (1990) - Principles of Stratigraphy, Merrill Publishing Co.
5. Pascoe, E.H.(1968) - A manual of the Geology India and Burma, Govt of India Publications.
6. Gregory , J.W. and Barret B.H- General stratigsraphy Mathuen.

CORE PAPER - 9

ECONOMIC GEOLOGY

UNIT - I

Historical development of economic Geology. Materials of mineral deposits - ore minerals, gangue minerals, tenor and grade or ores. classification of mineral deposits. Outline of Lindgren's and Bateman's classification. Controls of ore localization - structural controls, stratigraphic physical and chemical - brief study of metallogenetic epochs and provinces - geologic thermometers.

UNIT - II

Magmatic processes - mode of formation - Early magmatic processes and deposits, disseminations. segregations and injections - Late magmatic processes and deposits -Residual liquid segregation and injection - immiscible liquid segregation and injection - sublimation. Contact Metasomatic processes - the process and effects - resulting mineral deposits. Hydrothermal processes - principles - Factors affecting deposition - wall rock alteration - minerals sequence - cavity filling deposits Fissure veins, shear zone, stock work, saddle reef, ladder vein, fold cracks, breccia filling, solution cavities, pore space and vesicular filling - replacement deposits, the process and deposits - criteria of replacement.

UNIT - III

Sedimentary processes and cycles - principles involved in sedimentation - cycles of Iron and manganese, weathering processes - principles- Residual concentration process and deposits - mechanical concentration principles - eluvial, alluvial, beach and eolian placers - paystreak and bonanza. Oxidation and supergene sulphide enrichment - solution and deposition in the zone of oxidation - secondary sulphide enrichments - Gossans and capping. Metamorphic processes - Formation of Graphite, Asbestos, Talc, Soapstone and Sillimanite group of minerals.

UNIT - IV

National mineral policy and their role in National economy. Mineral based Industries in India. Geology, mode of occurrence, origin, distribution and uses of the raw materials of the following Industries: Refractory, Abrasives, Ceramic, Cement, Construction and Fertilizer.

UNIT - V

Strategic, Critical and Essential minerals. Mineralogy, mode of occurrence, uses and distribution in India of the following precious metals and minerals. Gold deposits - Gem stones. Character, distribution and mode of occurrence of structural and building materials. Fossils fuels:- Coal - uses, classification, constitution, origin and distribution in India. Petroleum- composition, uses, theories of origin, oil traps, and important oil fields of India. Outline of Gas Hydrates.

TEXT AND REFERENCE BOOKS

1. Bateman Allan, M. -Economic Mineral Deposits, Asian Publishing House, 2nd Edition 1962.
2. Lindgren, W. -Mineral Deposits, MCGraw Hill, 1933.
3. Coggin, B. and Dey, A.K. - India's Mineral Wealth, oup 1955. Park, C.F. and Macdiarmid, R.A- Ore deposits, Freeman, 1970

4. Krishnaswamy ,S. - India's Mineral Resources, oxford and IBH.

5. Deb.S. - Industrial Minerals and Rocis of India, Allied, 1980.
6. Gokhale, K.V.G.K. and Rao, T.C- Ore deposits of India, their distribution and processing, Thosmson press, 1978.

CORE PAPER - 10

HYDROGELOGY

OBJECTIVE:

Estimation of chemical dissolved constituents*:* major, minor and traces in groundwater using standard laboratory techniques. *Diagrammatic representation of hydrochemical data:* bar, circular radial, multivariate schoeller diagram, four coordinate diagram, stiffs diagram, horizontal and vertical scale diagram.

UNIT - I

Definition of hydrogeology and groundwater - Types of groundwater based on origin - Hydrological cycle - Vertical distribution of ground water - Springs: types, geological conditions favoring development of springs - Definition of aquifers, aquitards and aquicludes - Types of Aquifers: unconfined, semi-confined, confined and perched - Artesian wells

UNIT - II

Rock properties affecting groundwater: types of openings, porosity, specific yield, specific retention and permeability - Groundwater movement - Darcy's law and its applications - Determination of permeability in field and lab - Groundwater occurrence in igneous, sedimentary and metamorphic rocks

UNIT - III

Groundwater exploration by electrical resistivity method - Outline of dug wells, tube wells, jetted wells, infiltration galleries and collector wells - Well design and development - Fluctuations of groundwater - Groundwater recharge methods

UNIT - IV

Pump tests and evaluation of various aquifer parameters through pump tests - Conjunctive and consumptive use of groundwater - Sea water intrusion: causes, consequences and, preventive and control measures - Groundwater provinces of India - Groundwater resources of Tamil Nadu including its quality, Ground water quality in various rock types - Parameters considered for assessing groundwater quality suitability for drinking and irrigation purposes - The latest drinking and irrigation water standards of WHO and BIS - Waterborne diseases - Rainwater harvesting methods

UNIT - V

Groundwater Recharge:- Recharge methods - Basin method, Stream channel method, Ditch or Furrow method, Flooding method, Irrigation method, Pit method, Recharge well method. Rainwater Harvesting systems.

TEXT AND REFERENCE BOOKS

1. Todd, D.K and L.W. Mays (2004). Groundwater Hydrology. John Wiley & Sons, 656p..

2. Davis, S.N. & Deweist., R.J.M (1966). Hydrogeology , John Wiley & Sons, New York, 463p.
3. Ragunath, H.M (2007). Groundwater, New Age International Publishers, New Delhi, 520p..
4. Karanath, K.R (1987). Groundwater Assessment, Development & Management, Tata McGraw Hill, 720p.
5. Ramakrishnan, S (1998). Groundwater. K.G. Graph Arts, Chennai, 471p.

INTERNAL ELECTIVE
PAPER - 2
REMOTE SENSING

OBJECTIVE:
To understand about the Basic principles of Remote Sensing, Aerial remote sensing, optical remote sensing, Thermal Remote Sensing and application of Remote Sensing.

UNIT - I
Definition and scope of Remote Sensing in Geology. Electromagnetic spectrum - definition and components. Energy sources and radiation - outline of interaction of electromagnetic spectrum with atmosphere and earth surface features - spectral signatures - atmospheric windows.

UNIT - II
Types of remote sensing: based on 1) Energy sources: active and passive. 2) Platforms: aerial and satellite and 3) Sensors: optical, thermal, and microwaves. 4) RADAR. Aerial remote sensing: Types of Aerial Photographs: vertical and oblique. Scale of aerial photographs - flight procedures. Stereoscopes : pocket and mirror stereoscopes.

UNIT - III
Photo interpretation elements. Mosaics: controlled and uncontrolled mosaics - advantage and disadvantages - application of mosaics in geology studies. Satellite remote sensing: Principles of optical remote sensing: Satellite orbiting mechanisms - Brief account of multi spectral scanning - along track and across track scanning. Types of resolution - data acquisition and interpretation.

UNIT - IV
Thermal Remote Sensing: Thermal radiation principles - atmospheric windows - advantages and disadvantages. SLAR - principle and applications. A short account of LANDSAT, SPOT and India Remote Sensing satellites. Indian Space Missions.

UNIT - V
A short account of the remote sensing techniques in the study of drainage patterns, major land forms, geological structures. Groundwater exploration and mineral exploration.

TEXT AND REFERENCE BOOKS

1. Curran,P.B. (1985). Principles of Remote Sensing. ELBS. London.
2. Drury,S.D. (1993). Image Interpretation in Geology. Allen & Unwin. London.
3. Miller,V.C. (1961). Photogeology. McGraw Hill. New York.
4. Pandey,S.N. (1989). Principles and Applications of Photogeology. Wiley Eastern. Delhi.
5. Sabins,F.F. (1974). Remote Sensing Principles and Interpretation. Freeman. New York.
6. Reddy,A. (2010). Principles of Remote Sensing and GIS. CBS. Delhi.
7. Guptha,R.P. (2003). Remote Sensing Geology. Springer. New Delhi.
8. Lillisand,T.M & R.W.Kiefer. (2000). Remote Sensing and Image Interpretation. Wiley.

INTERNAL ELECTIVE

PAPER - 3

MARINE GEOLOGY

OBJECTIVE:

To understand about the Physical and chemical properties of Ocean water, behavior of tides and waves, marine resources, physical, chemical and biological oceanography.

UNIT - I

Introduction and historical development, physical features and origin of Ocean Basin. Submarine topographic forms - continental margin, ocean basin floor, mid - ocean ridge system, submarine canyons, oceanic trenches, seamounts and guyots. A brief outline of formation, development and classification of coast.

UNIT - II

Physical and chemical properties of Ocean water. General oceanic circulation of water waves and currents - Factors affecting surface flow of currents - Coriolis effect Ekman's spiral. Tides and their types. Natural mineral resources of the ocean, law of the sea and its implications.

UNIT - III

Physical Oceanography: T-S diagrams; mixing processes in the oceans; characteristics of important water masses. Wind generated waves in the oceans; their characteristics; shallow and deep water waves. Propagation, refraction, and reflection of waves. Wave spectrum, principles of wave forecasting. Tide-producing forces and their magnitudes; prediction of tides by the harmonic method; tides and tidal currents in shallow seas, estuaries and rivers.

UNIT - IV

Chemical Oceanography: Composition of seawater - Classification of elements based on their distribution; major and minor elements, their behavior and chemical exchanges across interfaces and residence times in seawater. Chemical and biological interactions - Ionic interactions; biochemical cycling of nutrients, trace metals and organic matter. Air-sea exchange of important biogenic dissolved gases; carbon dioxide, carbonate system; alkalinity and control of pH; biological pump.

UNIT - V

Biological Oceanography: Classification of the marine environment and marine organisms. Physio-chemical factors affecting marine life - light, temperature, salinity, pressure, nutrients, dissolved gases; adaptation and biological processes. Primary and secondary production; factors controlling phytoplankton and zooplankton abundance and diversity; plankton and fisheries oceanography; benthic organisms; coastal marine communities and community ecology - estuaries, coral reefs and mangrove communities, deep-sea ecology including hydrothermal vent communities.

TEXT AND REFERENCE BOOKS

1. Kuenen, Ph.H., 1950, Marine Geology, Wiley.
2. Shepard, F.P., 1973, Submarine Geology, Harper and Row.
3. Paul R Pinet, 1999, Oceanography, West Publishing Company, USA.
4. Valdiya, K.S (1987), Environmental Geology - Indian Context. Tata McGraw-Hill., New Delhi.
5. Kellar, E.A. 1979, Environmental Geology, Charless. Merrill Publishing Co.ohio.
6. Lundgren, I. 1986, Environmental Geology, Prentice Hall.
7. K.Siddhartha (2013)"Oceanography A Brief Introduction

SKILL BASED SUBJECT

PAPER - 4

MINERAL EXPLORATION

OBJECTIVE:

To understand about the various techniques used for mineral exploration, basic principles, instruments, data generation in the field and exploration.

UNIT - I

Guides to ore deposits: Mineralogic, lithologic, structural, stratigraphic, and physiographic. Controls of ore localization. Sampling of ores and minerals: definition and types of samples. Outline of sampling methodology. Geochemical Exploration: definition and scope. Basic principles: Concepts of background, threshold, and anomalous values. Distribution of elements around ore bodies: primary, secondary, and leakage haloes. Outline of lithogeochemical and hydrogeochemical methods.

UNIT - II

Gravity Method: Definition of gravity. Newton's Law of Gravitation. Gravity measurements: Absolute and relative. Gravity units. Gravimeters: Outline of Stable and Unstable gravimeters. Gravity Surveys. Applications and limitations of gravity methods. Magnetic Methods: Components of earth's magnetic field. Magnetic character of rocks and minerals. Units of measurement. Magnetometers: Types. Magnetic surveys. Applications and limitations of magnetic methods.

UNIT - III

Electrical Methods: Definition - Ohm's Law - Resistivity and conductivity - Electrical properties of rocks and minerals - Units of measurement. Resistivity surveying equipment. Electrode configurations: Wenner - Schlumberger. Applications and limitations of resisitivity methods. Seismic Methods: General principles. Methods of generating artificial seismic waves. Geophones - types and their limitations. Recording equipment. Refraction Methods: Principle - Instruments and equipment - Field Methods: Fan, Arc, and Profile shooting. Reflection Methods: Principle - Instruments and equipment - Field Operations: Shot point and Detector spreads. Applications and limitations.

UNIT - IV

Definition of coal geology and its scope. Coal: definition, types and rank of coal. Outline of chemical and physical characters of coal. Origin of coal. Outline of Coalification process. Indian Coal deposits: Gondwana Coal and Tertiary Lignite. Radioactive Minerals: definition, radioactive minerals and their host rocks. Outline of Geiger Muller Counter. Distribution of radioactive minerals in India with special reference to Tamil Nadu.

UNIT - V

Definition of Petroleum Geology and its scope. Petroleum: definition, composition, physical properties. Outline of origin. Migration of petroleum. Petroleum Traps and seals. Reservoir rocks and

their properties. Oil window. Concept of Kerogen. Oil fields of India: Assam, Gujarat, Bombay High and Cauvery basin. Short account of Natural Gas deposits in India. Natural gas hydrates: definition and outline of uses.

TEXT AND REFERENCE BOOKS

1. Banerjee,P.K. & S.Ghosh. (1997). Elements of Prospecting for Non Fuel Mineral Deposits. Allied. Chennai.
2.Arogyaswamy,R.N.P. (1980). Courses in Mining Geology.Oxford & IBH,New Delhi.
3.Hawkes,H.E. (1959). Principles of Geochemical Prospecting. Bulletin 1000F.USGS.
4.Moon,C.J et al.(2006). Introduction to Mineral Exploration. Wiley Blackwell. New Delhi.
5.Ramachandra Rao,M.B. (1993). Outlines of Geophysical Prospecting. EBD Publishers, Dhanbad.
6.Kearey,Pet al.(2002). An Introduction to Geophysical Exploration. Wiley. Delhi.
7.Mussett,A.E.& Khan,M.A.(2000). Looking into the Earth. Cambridge University Press, New Delhi.
8. Sharma,P.V. (2005). Environmental and Engineering Geophysics. Cambridge University Press. Delhi.
9. Prasad,U. (2003). Economic Mineral Deposits. CBS. Delhi.
10. Banerjee,D.K. (1998). Mineral Resources of India.World Press. Kolkata.
11. Deb,S.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.
12. Krishnasamy,S. (1988). India's Mineral Resources. Oxford & IBH. Delhi.
13. Sharma,N.L & R.K.Sinha. (1985), Mineral Economics. Oxford & IBH.Delhi.
14. Gokhale,K.V. G.K.&D.M.Rao.(1981).Ore Deposits of India. Oxford & IBH.Delhi.

CORE PRACTICAL III

MINERALOGY

Megascopic Mineralogy:

Description of megascopic properties and their identification of the following minerals: Quartz, Rosy quartz, Amethyst, Chalcedony, Agate, Flint, Jasper, Chert, Opal, Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Nepheline, Leucite, Sodalite, Enstatite, Bronzite, Hypersthene, Diopside, Augite, Spodumene, Acmite, Rhodonite, Wollastonite, Anthophylite, Tremolite, Actinolite, Hornblende, Glaucophane, Olivine, Serpentine, Muscovite, Biotite, Vermiculite, Chlorite, Epidote, Garnet, Olivine, Natrolite, Stilbite, Apophyllite, Talc, Steatite, Andalusite, Kyanite, Sillimanite, Staurolite, Cordierite, Apatite, Beryl, Topaz, Calcite, Dolomite, Tourmaline, Zircon, Fluorite.

Microscopic Mineralogy:

Description of optical properties and their identification of the following minerals: Quartz, Orthoclase, Microcline, Albite, Labradorite, Nepheline, Leucite, Enstatite, Hypersthene, Augite, Diopside, Hornblende, Glaucophane, Biotite, Muscovite, Olivine, Epidote, Garnet, Apatite, Zircon, Sphene, Tourmaline, Calcite, Andalusite, Kyanite, Sillimanite, Staurolite, and Cordierite

CORE PRACTICAL IV
PETROLOGY AND ECONOMIC GEOLOGY

PETROLOGY:

Megascopic identification of the following rocks:

Granite, Graphic granite, Pegmatite, Aplite, Schorl Rock, Granite Porphyry, Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite, Dolerite, Dolerite Porphyry, Basalt, Trachyte, Rhyolite, Obsidian, Pumice, Scoria. Conglomerate, Breccia, Sandstone, Arkose, Shale, Limestone, Laterite, Peat, Lignite, Slate, Phyllite, Schists, Gneisses, Quartzite, Marble, Amphibolite, Ecologite, Leptynite, Charnockite, Khondalite, and Basic Granulite.

Microscopic identification and description of the following rocks:-

Mica Granite, Hornblende Granite, Tourmaline Granite, Schorl Rock, Aplite, Graphic Granite, Mica Syenite, Hornblende Syenite, Nepheline Syenite, Diorite, Gabbro, Norite, Dunite, Peridotite, Granite - porphyry. Syenite - porphyry, Diorite - porphyry, dolerite, minette, Vogasite, Anorthosite, Trachyte, Andesite, Basalt, Phonolite, Volcanic Breccia, Vitrophyre, Conglomerate, Breccia, Sandstone, Arkose, Shale Limestone, Slate, Chlorite Schist, Mica Schist, Kyanite Schist, Staurolite Schist, Garnetiferous Schist, Glaucophane Schist, Granulite, Charnockite, Ecologite Amphibolite, Leptynite, Khondalite, Cordierite, Gneiss, Garnet - Sillimanite Gneiss, Calc Granulite.

ECONOMIC GEOLOGY:-

Megascopic identification and description, Indian occurrences and uses of the following ore and industrial Minerals: -

Realgar, Orpiment, Stibnite, Molybdenite, Galena, Sphalerite, Cinnabar, Covelite, Bornite, Chalcophyrite, Pyrite, Arsenopyrite, Marcasite, Barite, Celestite, Gypsum, Cuprite, Zincite, Corundum, Hematite, Ilmenite, Magnetite, Chromite, Franklinite, Cassiterite, Rutile, Pyrolusite, Psilomelane, Goethite, Limonite, Bauxite, Calcite, Dolomite, Magnesite, Siderite, Aragonite, Witherite, Strontionite, Cerussite, Azurite, Malachite, Chrysocolla, Columbite, Halite, Fluorite, Phosphatic Nodule, Monazite, Graphite, Coal and its varieties.

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