

॥ अंतरी पेटू ज्ञानज्योत ॥  
NORTH MAHARASHTRA UNIVERSITY, JALGAON.

T.Y.B.Sc. Syllabus

GEOLOGY

(W.E. From June, 1994)

SCHEME OF PAPERS FOR TYBSc GEOLOGY

PAPER I	Term	I	: Structural Geology.
	"	II	: Geomorphology.
PAPER II	Term	I	: Indian Geology.
	"	II	: Energy & Mineral Resources.
PAPER III	Term	I	: Mineralogy, Crystl & Optics.
	"	II	: Igneous Petrology.
PAPER IV	Term	I	: Economic Geology.
	"	II	: Exploration Geology.
PAPER V	Term	I	: Sedimentary Petrology.
	"	II	: Metamorphic Petrology.
PAPER VI	Term	I	: Environmental & Engg. Geology.
	"	II	: Hydrology & Geochemistry.

PRACTICAL

PAPER I	:	Mineralogy, Crystallography optics & Igneous Petrology.
PAPER II	:	Sedimentary, Metamorphic Petrology and Palaeontology.
PAPER III	:	Structural Maps, Problems, Geochemistry, Geomorphology, Hydrology & Field work.

PAPER I

STRUCTURAL GEOLOGY & GEOMORPHOLOGY

Term I

Structural Geology.

Lectures

Unit I	Mechanical Principles: Force, Composition and resolution of forces, lithostatic pressure, differential forces, Stress, Strain, Stages of rock deformation, Factors controlling behaviour of rock material under stress, Anisotropy and inhomogeneity	= 08
Unit II	Mechanics of plastic deformation	= 03
Unit III	Mechanics of folding	= 03
Unit IV	Failure by rupture : Study of mode of fracturing in rocks under tension, Compression, Couple and torsion, Concept of stress & strain ellipsoid, and their relation with rupture.	= 04
Unit V	Mechanics of faulting : Normal, Thrust and Strike-slip Fault, Introduction to Thrust & Reverse, Horst & Graben, Normal & Strike - slip fault.	= 12
Unit VI	Foliation & Lineation : Brief study of different types of foliation & lineation.	= 05
Unit VII	Cleavage and Schistosity.	= 02
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Total		= 37
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PAPER - I

TERM-II

Geomorphology.

Unit I	Basic Concepts and Significance, Geomorphic processes and parameters	= 02
Unit II	Geomorphic Cycles and their interpretation, Major landforms, geomorphic cycle, development of slopes, Nature of river valley, Development of drainage system, Tropical landforms, Coastal landforms, Desert & Glacial landforms.	= 10
Unit III	Relief features, Topography & its relation to Structures and lithology, Accuracy of contours, Profiles, Generalised contours, Altimetric and areal analysis, River profiles, Patterns of stream ordering, sampling and delimitation of drainage basins, Effects of rocks on relief movements of base level, Erosion surfaces & interpretations.	= 15
Unit IV	Basin Morphometry related to geomorphic processes, laws of drainage composition.	= 07-

Cont., 21.

Unit V	Geomorphic features of Indian Subcontinent	= 03
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	Total =	37
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PAPER II

INDIAN GEOLOGY & ENERGY & MINERAL RESOURCES.

TERM-I  
Indian Geology

Unit I	Introduction, classification, lithological, structural, palaeontological, stratigraphical characters, geological & geographical distribution and economic importance of following Super Groups :	
A.	Archean Supergroup of Peninsula : Mysore, Nagpur-Bhandara, Nagpur-Chindwara, Rajasthan, Singhbhum.	= 07
B.	Cuddapah Supergroup : Cuddapah basin of Andhra Pradesh, Kaladgi Group, Delhi Supergroup, Igneous activity in Cuddapah.	= 04
C.	Vindhyan Supergroup : Lower Vindhyan, Upper Vindhyan, Kurnool Group, Bhima Group.	= 04
D.	Gondwana Supergroup : Salient features Divisions (Talchir, Damuda, Panchet, Mahadeva, Rajmahal, Jabalpur, Unia), Marine- Permocarboniferous, Igneous activity in Gondwanas, Climate and sedimentation, East-Coast Gondwanas.	= 07
E.	Mesozoic of Peninsular India : Marine Transgression, Jurassic rocks of Cutch, Narmada Valley, and Trichinopoly Cretaceous.	= 04
F.	Deccan Traps : Extent, Dykes & Sills, Lameta beds, Intra & Intertrappean beds, Age of Deccan Traps.	= 04
G.	Tertiary of Assam, West Coast Tertiary and East Coast Tertiary.	= 03
H.	Shivaliks, Climate, Conditions of deposition.	= 02
I.	Pliocene to Recent : Karwas of Kashmir & Laterites.	= 02
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	Total =	37
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TERM-II

Energy & Mineral Resources.

Unit I	Coal : Origin, Varieties (Peat, lignite, Bituminous, Anthracite) and their properties(Physical & chemical), Economics, Reserves & future prospects.	= 08
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Unit II	Geothermal Energy : Definition and types, Dry & Wet Steam, Hot and dry rock, Geopressurised cones, Uses & future prospects.	03
Unit III	Radioactive minerals : as an energy source (Nuclear properties of Uranium and Thorium)	= 03
Unit IV	Study of the mineral raw materials used in the following industries with reference to chemical composition, specifications for use and tests employed. Abrasive industry, Building and Construction industry, Chemical and paint industry, Ceramic industry, Refractory materials industry, Household industry, Precious & Semi-precious stones.	= 14
Unit V	Outline of different techniques used for testing mineral raw materials.	= 03
Unit VI	Oil & Natural Gas : Origin and formation of oil, Future prospects for oil and gas in India.	= 05
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Total =		36
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PAPER III

MINERALOGY, CRYSTALLOGRAPHY & MINERAL OPTICS AND IGNEOUS

Petrology.

Term I

Mineralogy, Crystallography & Mineral Optics.

Unit I	General knowledge about mode of occurrence of minerals in igneous, sedimentary and metamorphic rocks.	= 02
Unit II	Study of following mineral groups with reference to their distinguishing characters, paragenesis and alteration products and importance.	
1.	Pyroxene (Diopside-Hedenbergite, Aegerine-Aegerine augite, Augite-Ferroaugite, Wollastonite, Enstatite-Ferrosilite)	= 05
2.	Amphibole (Tremolite-Actinolite, Hornblende & Basaltic hornblende, Cation distribution in amphibole minerals)	= 05
3.	Feldspars (Alkali feldspar, formation and types of perthite, plagioclase feldspar)	= 05
4.	Aluminosilicates	= 02

Unit III Study of following mineral groups with reference to their silicate structure, chemical, physical & optical characters-and occurrence.

- a. Felspathoid = 01
- b. Zeolites. = 01
- c. Chlorites. = 01
- d. Clay minerals. = 01

Unit IV Crystallography : Twinning in Crystals : Cubic, Tetragonal, Orthorhombic, Monoclinic, Triclinic, Hexagonal (Definition of twinning, twin plane, axis & composition plane) =03

PAPER III

Term II

IGNEOUS PETROLOGY

Unit I Definition and types of primary magma & their Melting and generation : Melting of Magma - Temperature and pressure conditions. Generation of magma in their source region, Boundary Conditions. = 06

Unit II Classification of Igneous rocks : Shad's Classification, CIPW Classification, IUGS Classification. = 03

Unit III Magmatic Evolution.

Crystal Fractionation : eg. Fo-Fa&Fo-Silica. Separation Mechanism:..

- 1) Gravitational Settling.
- 2) Flaw differentiation.
- 3) Flow crystallisation,
- 4) Filter Pressing.
- 5) Selective nucleation.
- 6) Gas streaming.
- 7) Gravitational liquid separation.

Liquid Immiscibility : Silicate-Silicate immiscibility. Introduction to other types of immiscibility.

Liquid Fractionation : Thermal diffusion Gravitational diffusion.

Contamination : Assimilation by melting and without melting.

Significance of Contamination.

Mixing of magmas : Mixing of similar and dissimilar magmas.

Role of volatile Constituents. = 16

Unit IV	Melting and crystallisation of binary & ternary magma.	
a.	Binary system with a eutectic point (no solid solution) eg. An-Silica.	
b.	Binary system containing an incongruately melting compound eg. Le-Silica.	
c.	Binary system showing complete solid solution eg. Ab-An.	
d.	Crystallisation of Di-Ab-An system.	
e.	Crystallisation of basaltic magma (Note on fractional crystallisation of basaltic magma).	
f.	Reaction Series.	= 10
Unit V	Petrographic provinces, rock kinds or associations.	= 02
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		Total = 37
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PAPER IV

ECONOMIC GEOLOGY & EXPLORATION GEOLOGY.

TERM-I

Economic Geology.

Unit I	Definition of metalliferous & nonmetalliferous deposits. Ore minerals, Gangue Minerals and Tenor of ore.	= 02
Unit II	Classification of economically important mineral deposits-Metalliferous & nonmetalliferous deposits.	= 01
Unit III	Processes of formation of mineral deposits :	
a.	Magmatic Concentration : Early magmatic deposits, (Dissemination, Segregation, Injection) Late magmatic deposits (Residual liquid segregation, Residual liquid injection, Immiscible liquid segregation, Immiscible liquid injection).	= 05
b.	Hydrothermal processes : Principles of Hydrothermal process, characters of solution, Types of openings in the rocks. Factors affecting deposition (Chemical changes, Temperature & pressure conditions) from hydrothermal solutions. Wall rock alteration.	= 07
c.	Cavity filling deposits : Processes and characteristic features, Resulting mineral deposits, Fissure veins & its types (Stock-work, Saddle-roof, ladder-vein,	

	Pitches & flats, Breccia-filling deposit, Solution cavity filling).	= 04
d.	Oxidation & Supergene Enrichment :	
	Oxidation: Requirement, processes, ore deposition, gossan formation - types.	
	Supergene enrichment: Requirement, processes, ore deposition, Recognition of S.E.	
	Gossans & capings : Role of iron in gossan.	= 07
e.	Sedimentation : Processes of sedimentation, Residual deposits, mechanical concentration conditions favouring residual deposits. Brief account of principles and processes of formation of placer deposits- eluvial, alluvial, beach & acolin.	= 07
	Evaporites : Brief account of non-metallic, deposits of ocean water, lake-water, groundwater and hot springs.	= 04

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Total = 37

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 TERM-II

Exploration Geology.

Unit I	Sampling : Types of Sampling, Channet, Grab, Chip-Bulk sampling, Collection of samples, Preparation of samples, sizing, coning & quartering.	= 03
Unit II	Prospecting.	
a.	Introduction to geological prospecting .	= 01
b.	Geological Criteria : Climate, Stratigraphic facies, lithological, structural, geochemical, magmagenic, geomorphological.	= 03
c.	Physiographic guides- Topographic Expressions, environment of ore deposition physiography Physiographic/in relation to oxidation and enrichment.	= 03
d.	Mineralogical guides : Rock alteration, Target rings of mineral distribution, Oxidation products, significance of accessory minerals and gangue minerals.	= 03
e.	Stratigraphical & lithological guides : Syngenetic & epigenetic guides. Fracture pattern as guide, Contact & Folds as guide.	= 03
Unit III	Biogeochemical prospecting .	= 02
Unit IV	Geophysical prospecting methods :	
	Magnetic, Electrical, Gravity, Seismic, (Reflection & Refraction)	
	(Electrical-Self-potential, equipotential resistivity)	
	Gravity -Gravimeter)	= 12

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Unit	V	Drilling : Types of drills, methods of drilling; diamond, rotary- and percussion drilling. Geological logging of bore hole samples.	=-07
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PAPER V

SEDIMENTARY PETROLOGY & METAMORPHIC PETROLOGY .

TERM-I

Sedimentary Petrology

Unit	I	Classification of limestone and sandstones (Folk & Ekada)	= 04
Unit	II	Modification of sediments during dispersal based on size, roundness & sphericity, & flatness, concept of selective abrasion, sorting and progressive dilution.	= 04
Unit	III	Provenance : Concept of mobility of oxides, mineral stability concept, mineralogical and textural maturity of sediments, Heavy minerals, allogenic & autigenic minerals, Minerals in sedimentary rocks, Zoning and maturity of sediments.	= 10
Unit	IV	Granulometric analysis : Definition of different methods used, Sieve analysis, Obtaining data, Representation of data and Inference, Grade Scales-Udden, Went worth & Phi scale.	= 05
Unit	V	Environment of deposition : factors constituting environments (Classification of environments into types, Sub-types & prominent environment)	= 07
Unit	VI	Diagenesis : Diagenetic processes & their impact on sandstones.	= 03
Unit	VII	Tectonic control on sedimentation.	= 03
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Total =			36
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PAPER-V TERM-II

Metamorphic Petrology.

Unit	I	Metamorphism : Definition, Agents, Types, Textures, Structures, Stress & Anti-stress minerals, Growth in solid state, Crystalloblastic Series, Classification of metamorphic rocks.	= 04
Unit	II	Effect of Cataclastic metamorphism on argillaceous and crystalline rocks.	= 03



Unit III	Thermal metamorphism in general, Metamorphic aureoles, Thermal metamorphism of argillaceous, quartzo felspathic, carbonate and basic igneous rocks.	= 10
Unit IV	Regional metamorphism, Definition, Conditions, Causes, Pressure- Temperature diagram, Effects of regional metamorphism on argillaceous, quartzo-felspathic, carbonate and basic igneous rocks.	= 10
Unit V	Metasomatism : Definition, Principle types, Textural & Chemical Evidences.	= 05
Unit VI	Introduction to metamorphic facies with a brief account of facies of contact and regional metamorphism.	= 03
Unit VII	Definition of following terms : Uralitisation, Chloritisation, Saussuritisation, Albitisation, Tourmalinisation, Scapolitisation, Felsar-rocks, Migmatitisation, Kaolinisation, Dcdlomitisation, Schrot rock, Granulite, Leptite, Charnockite, Eclogite, Migmatite, Greisening, Anala-tisation Lit-par-lit gneiss, Palingenesis, Anatexis.	= 02
Total =		37

PAPER VI

ENVIRONMENTAL GEOLOGY & ENGINEERING GEOLOGY.

AND

HYDROLOGY AND GEOCHEMISTRY.

TERM-I

Environmental & Engineering Geology Environmental Geology.

Unit I	Definition, Nature & Scope & objectives of Environmental Geology.	= 02
Unit II	Ecological perspective of environment. Biosphere, Biotic communities, Basic elements of Ecosystem, Dynamics of human population.	= 02
Unit III	Earth resources : Land-Human settlement and landuse, Soil-Nature of soil, Classification & Type of Soil, Soil Conservation, Water-Water resource of India, Surface water, Nature of groundwater, Effects of Groundwater withdrawal, Quality of water, water	

logging, Water management, Soil salinity, Mineral Conservation of mineral resource, Impact of mining activity on environment. = 05

Unit IV Natural Hazards- Brief account at Air, Water noise & Soil pollution. Nature of natural hazards. Hazards related to earthquakes - effect of earthquakes and coping with seismic hazards, Coastal hazards - cyclones, flood, causes & management in India,

Reservoirs - Silting, environmental pollution, ground-water pollution due to industrial & domestic effluents. Nuclear pollution; = 10

### ENGINEERING GEOLOGY

Unit I Introduction : Significance of geology in civil engineering. Knowledge of geomorphology, petrology, mineralogy, stratigraphy, photogeology, Structural geology as applied to civil engineering projects. = 04

Unit II Engineering properties of rocks : Specific gravity, porosity, sorption, compressive strength, tensile strength, elasticity of rocks, Residual stresses, shear stress. = 02

Unit III Rock as a construction materials :

a) Types of rocks used in construction, How they are obtained from nature. Use of rock as facing stone, Factors influencing the engineering service of rocks.

b) Use of rocks as an aggregate : Use of rock aggregate in different types of constructions. Source of different grades of aggregate. Properties of aggregates : size, surface texture, soundness, coating cement-aggregate reaction. Thermal effects on aggregate. = 04

Unit IV Tunnel : Terminology, Geological conditions for tunnel sites, (Structural, lithological, hydrological), Tunnels near slopes, Tunnels in Deccan Traps. = 03

Unit V Dams & Reservoir : Terminology, Types of dam, (Gravity, Buttress & arch dam), Geological conditions for selection of dam & reservoir sites, Environmental impact of dams & reservoirs, Alternatives to big dam. = 03

Unit VI	Landslides : Causes, types & prevention of land slides.	= 02
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Total =		36
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TERM-II

Geochemistry & Hydrology.

Unit I	Definition and History of Geochemistry.	= 01
Unit II	Meteorite and its composition, Structure and Composition of Earth, Geochemical classification of elements (Goldsmith and Periodic), Distribution of elements in igneous, sedimentary and metamorphic rocks.	= 06
Unit III	Structural Chemistry : Covalent bonds, Electronegativity, Silicate structure, Isomorphism, Substitution, Polymorphism.	= 04
Unit IV	Chemical weathering : Nature of weathering reactions, Changes in rock composition, Sequence of mineral alteration, Solution and Hydration, Geochemical Cycle (Surface) & human influence on cycle.	= 07

Hydrology.

Unit I	Introduction to hydrology	
	a. Definition, scope and groundwater development in India.	
	b. Origin & distribution of groundwater, hydrologic cycle.	
	c. Porosity and permeability of rocks (their types and effects).	= 07
Units II	Aquifers (confined and unconfined) Darcy's law, Groundwater distribution : Factors controlling groundwater distribution (topography, climate, structural, geological, proximity of tanks, rivers) Groundwater fluctuations due to seasonal changes, stream-flow changes, Evapotranspirational changes.	= 07
Unit III	Introduction to artificial recharge methods : Flooding basin, ditch and furrow, natural channel, irrigation, Pits & shafts, Recharge wells.	= 03
Unit IV	Exploration techniques in hydrology (Electrical resistivity survey & its data interpretation).	= 02
Total =		37

Practical Paper I

MINERALOGY, CRYSTALLOGRAPHY, OPTICS AND IGNEOUS PETROLOGY.

- A. Megascopic Mineralogy :  
Serpentine, hypersthene, hornblende, tremolite, andalusite, wollastonite, epidote, apophyllite, chlorite, staurchite, stilbite, apatite, corundum, amethyst, biotite, tourmaline, fluorite, moonstone, garnet, olivine, iak, beryl, gypsum, calcite, orthoclase.
- B. Ore minerals : Chromite, pyrite, galena, hematite, malachite, bauxite, braunite, sphalerite, phrolucite, magnesite.
- C. Acquaintance with varieties of precious and semi-precious stones (5 each)
- D. Microscopic mineralogy : Quartz, garnet, olivine, sanidine, perthite, hypersthene, tremolite, andalusite, staurchite, kyanite, epidote, leucite, wollastonite, actinolite, biotite.
- E. Hess calculations and plotting of pyroxenes.
- F. Crystallography : To study study the twin crystal models (.8 models )
- G. Optics : Identification of interference figures and to find optic sign for uniaxial (central) and biaxial (perpendicular to optic axis) figures.
- H. To find sign of elongation of mineral.

IGNEOUS PETROLOGY :

- I. Megascopic : Granite, syenite, diorite, gabbro, norite, dunite, pegmatite, syenite porphyry, felsite porphyry, felsite, basalt, rhyolite, dacite.
- J. Microscopic : Norite, picrite, anorthosite, dunite, diorite, felsite porphyry, pitchstone, phonofite, limburgite.
- K. Study of the following textures/structures under the microscope (description and genesis) Equigranular, porphyritic, glomerate porphyritic, intergranular, poikilitic, ophitic, sub-ophitic, graphic, & mirmekitic.
- L. Study of the following textures/structures in hand specimens (description and genesis) Granitic, porphyritic, graphic, ropy, glassy, flow, columnar, vesicular, amygdaloidal.
- M. CIPW Norms for saturated rocks.

PRACTICAL PAPER II

Sedimentary Petrology, Metamorphic Petrology & Palaeontology.

- I Sedimentary Petrology:
- A Megascopic : Laterite, bauxite, conglomerate, breccia, grit, arkose, speckled sandstone, carbonaceous shale, mudstone, argillaceous shale, varieties of sandstone, varieties of limestone - chemical & organic, (fossiliferous limestone, crinoidal limestone, Nummulitic limestone, chemical limestone, Types of soils.
  - B. Microscopic : Sandstone & its varieties.  
Limestone - Chemical and organic varieties.
  - C. Heavy mineral studies.
  - D. Sieve/Granulometric analysis.
  - E. Study structures in hand specimen. (origin and description)  
Sandstone showing graded bedding, ripple marks; Tool marks, Mudcracks/Sun-cracks, lamination in shales, Stylolite.  
Metamorphic petrology :
  - F. Megascopic : Slate, phyllite, talc-chlorite schist, chlorite schist, mica schist, hornblende schist, actinolite schist, mica gneiss, hornblende gneiss, augen gneiss, acid charnockite, quartzite, banded hematite quartzite, white marble, serpentine marble.
  - G. Microscopic : Mica-garnet schist, biotite schist, hornblende schist, chlorite schist, staurolite schist, hornblende gneiss, quartzite, marble.
  - H. Plotting of ACF diagram.
  - I. Study of microscopic structures- granular, schistose, gneissose, porphyroblastic, idia blastic.
  - J. Palaeontology : Identification, classification of following fossil specimen.
    - a. Plant fossils and fossil wood.
    - b. Invertebrate fossils ( Total 20.)

PRACTICAL PAPER III

GEOCHEMISTRY & STRUCTURAL MAPS & PROBLEMS.

1. Practicals related to geomorphology, structural geology and hydrology.
  - A. Structural maps : Description and drawing sections of maps showing :
    - a. Inclined bed.
    - b. Unconformity.
    - c. Vertical dyke.
    - d. Vertical fault.
    - e. Simple fold.
  - B. Completion of outcrops :
    - a) 3 point problem.
    - b) by junction.
  - C. Structural problems  
Problems involving strike and dip of bed (true and apparent), dip given in gradient and degrees.
  - D. Geochemistry : To determine pH, electrical conductivity, alkalinity, hardness, K, Na and sulphate content of a given sample.
  - E. Interpretation of electrical resistivity data.
  - F. Drainage analysis, longitudinal profiles, Hypsometric analysis.
  - G. Study of types of faults & folds models.
  - H. Field work submission of field work report.

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