

अंतरी पेटवू ज्ञानज्योत



**NORTH MAHARASHTRA UNIVERSITY,  
JALGAON**

**Syllabus for**

**T.Y. B.Sc.  
Semester V and VI**

**GEOLOGY**

**w. e. f. June 2017**

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**

**T.Y.B.Sc. GEOLOGY SYLLABUS**

( W. e. f. June 2017 )

**Semester V**

**GL 311:** Structural Geology

**GL 312 :** Indian Stratigraphy

**GL 313 :** Mineralogy and Optics

**GL 314 :** Igneous Petrology

**GL 315 :** Sedimentary Petrology

**GL 316 :** Geomorphology

**Practical**

**GL 317 :** Mineralogy

**GL 318 :** Sedimentary Petrology, Paleontology and Indian Stratigraphy.

**GL 319 :** Structural Geology, Geomorphology, Field Geology

**Semester VI**

**GL 321 :** Metamorphic Petrology

**GL 322 :** Economic Geology

**GL 323 :** Natural Resources – Minerals and Energy

**GL 324 :** Geotechniques

**GL 325 :** Environmental Geology

**GL 326 :** Hydrogeology

**Practical**

**GL 327 :** Igneous Petrology

**GL 328 :** Metamorphic Petrology

**GL 329 :** Structural Geology, Field Geology and Hydrogeology

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Syllabus for T. Y. B.Sc. Geology

Semester V

w. e. f. June 2017

**GL 311 : Structural Geology**

Unit No	Topic	Sub-topic	Periods	Marks
I	Mechanical principles	a) Force : Definition, representation, unit, and types (balanced and unbalanced forces) b) Composition and resolution of forces. c) Lithostatic / Hydrostatic pressure, different types of forces. d) Stress and strain: Concept and definition. e) Stages of Deformation: Elastic and plastic deformation of brittle and ductile substances, elastic limit and strength of rocks. f) Stress-strain diagram. g) Factors controlling rock deformation: Confining pressure, temperature, time, solutions, anisotropy and inhomogeneity of rocks.	15	06
II	Mechanics of Plastic deformation	a) Intergranular movements b) Intergranular movements. c) Recrystallization, Reicke's principle.	08	06
III	Fold	a. Definition of anticlinorium and synclinorium. b. Classification of folds based on <ol style="list-style-type: none"> <li>1. Size of interlimb angle</li> <li>2. Closing and facing direction</li> <li>3. Attitude of axial plane</li> <li>4. Nature of profile</li> <li>5. dip isogon</li> </ol> c. Mechanics of folding <ol style="list-style-type: none"> <li>i) Flexure / flexure slip folding.</li> <li>ii) Flow folding.</li> <li>iii) Shear folding.</li> </ol> d. Ultimate causes of folding – Tectonic and non tectonic processes.	10	16
IV	Principles of failure by rupture	a) Force: Definition of tensional, compression, couple and torsional forces. b) Tension and shear fractures. c) Complexity of the mechanics of rupturing. d) Relation of rupture to stress and strain	04	06

V	Fault	a. Genetic classification of faults. b. Mechanics of faulting: i) Mechanics of normal or gravity fault, horst and grabben ii) Mechanics of thrust faults with same horizontal stress and increase in horizontal stress. iii) Mechanics of strike-slip faults and movement along transform fault. c. Use of the strain ellipsoid in recognizing movements along faults	13	14
VI	Foliation (Cleavage) and Schistosity	a. Introduction and descriptive terminology. b. Relations of cleavage and schistosity to major structures.	5	4
VII	Secondary lineation	a. Introductions and kinds of secondary lineation. b. Relations of lineation to major structures.	5	4
VIII	Diapir and related structure	a. Introduction, Evaporite diapir (Shape, composition and internal structure) b. Structure of surrounding sedimentary rocks (Salt domes) – Introduction, structural evolution and origin.	5	4

**Reference Books:**

1. Structural Geology: M. P. Billings
2. Structural Geology: De Sitter
3. Techniques in Modern Structural Geology: Ramsay and Huber, Vol: 1, 2 & 3 (Academic Press)
4. Fundamental of structural geology – Marshak & Mitra. E.E.E. (PHP)
5. Structural Geology for Petroleum Geologists: Russel
6. Structural Geology – Ghosh, Academic Press
7. Structural and Tectonic Principles: Badgley P. C.
8. Structural Geology: Dennis
9. Theory of Structural Geology- N. G. Gokhale, CBS Publication
10. Analysis of Geological Structures: Prince N. J. and Cosgrove
11. Mechanics in Structural Geology: Bayly B
12. Structural Geology: Fundamentals of Modern Developments: Eds: Pergamon Press
13. Structural Geology of Rocks and region: Davis
14. An outline of Structural Geology: Hobbs B E, Means W. D. & Williams P. F.

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Semester V

w. e. f. June 2017

**GL 312 : Indian Stratigraphy**

Unit No	Topic	Sub-topic	Periods	Marks
I	Introduction	a. Physiographic divisions of India b. Introduction to Indian Stratigraphic Time Scale Tectonic framework of India and orogenic activity.	8	4
II	Archaean and Proterozoics.	a. Description based on stratigraphy, lithology and classification of i) Dharwar Craton (WDC and EDC) ii) Singhbhum Craton iii) Aravalli Craton ( Aravalli and Delhi) iv) Bastar Craton b. Proterozoic Sedimentary basins : Description based on stratigraphy, lithology and classification of i) Vindhyan basin ii) Cuddapah Basin	20	30
III	Gondwana Supergroup.	Description based on stratigraphy, lithology, structure, environment of deposition, intrusive activity, fossil and economic importance of Gondwana Supergroup.	8	6
IV	Mesozoic Formations of India.	a. Jurassic of Kutch – Stratigraphy and lithology and fossils. b. Cretaceous of Trichinopoly - Stratigraphy and lithology and fossils. c. Study of Bagh bed, Lametas. d. Deccan Volcanic Province – Introduction, Field structures of basaltic flows, Litho and Chemo stratigraphy Classification, Age, dykes in Deccan Traps e. Brief account of Inter and Intra-trappean beds	12	12
V	Cenozoic Formations in India	Tertiary of Assam: Stratigraphy, lithology and fossils.	5	4
VI	Himalayan Geology.	a.Introduction to Lesser, Central and Higher Himalayan formation. b.Siwaliks – Introduction, stratigraphy and sedimentation, fauna, and lithology.	5	4

### **Reference Books**

1. Singhbhum-Orissa Iron Ore Craton- Sinha Roy
2. Geology of India Vol.I & II, Geological Society of India, Special Publications
3. Geology of Karnataka: Radhakrishna B. P.
4. Geology of States of India – Geological Society of India, Special Publications
5. Geology of Maharashtra: G. G. Deshpande, G Society Spl. Publication
6. Purana Basins of India: G Society Spl Publicatin
7. Geology of Western and Central India: GSI Spl Publication
8. Stratigraphy of Lesser Himalaya: K. S. Valdiya
9. A Geological Time Scale: Brian Harland *et al.*
10. Stratigraphy of India and Burma: M. S. Krishnan
11. Fundamentals of Historical Geology and Stratigraphy f India: Ravindrakumar
12. Precambrian Stratigraphy: V. J. Gupta.
13. Greenstone Belt of South India: Janardhan.

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Semester V

w. e. f. June 2017

**GL 313 : Mineralogy and Optics**

Unit No	Topic	Sub-topic	Periods	Marks
I	Mineral Groups – I	Study of following mineral groups with respect to their Structure, chemistry, Optical and physical properties, Distinguishing characters, and Importance of : a) Olivine : Fo – Fa series b) Pyroxene : En – Fs, Di – He, Augite Series c) Amphibole : Tr – Ac, Hbl Series, Cation distribution. d) Feldspar : Alkali Feld., Ab – An Series, Perthites. e) Garnet : Pyralspite, Ugrandite	20	25
II	Mineral Groups – II	Introduction to the following Mineral Groups. i) Zeolites ii) Clay Minerals Feldspathoids	10	8
III	Mineral Groups – III	Structure, Chemistry, Optical and Physical properties, mode of occurrence and uses of : Chlorite, Talc, Staurolite, Fluorite, Apatite, Epidote, Topaz, Calcite, Cordierite, Zircon, Rutile, Sphene and Corundum.	8	7
IV	Optics	a) Refractive Index and Relief, Becke line and its uses. b) Uniaxial and Biaxial indicatrices. c) Explanation of Central uniaxial interference figure and its sign when the section is perpendicular to optic axis. d) Explanation of Biaxial interference figure perpendicular to Acute bisectrix and its sign	16	14
V	Crystallography	Introduction to 32 classes of crystallographic symmetry.	6	6

**Reference Books:**

1. Mineralogy and Optics – Dana
2. Rutley's elements of Mineralogy – C.D. Gribble
3. Elements of Mineralogy – Mason *et al*
4. Mineralogy and Petrology.
5. Mineralogy- A first cause – J. Sinkankas

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Semester V

w. e. f. June 2017

**GL 314 : Igneous Petrology**

Unit No	Topic	Sub-topic	Period	Marks
I	Igneous rocks and the solid Earth	Igneous rocks in a broad tectonic frame.	2	2
II	Crust and Mantle	Composition and recycling.	4	2
III	Melting of Magma	Temperature -Pressure conditions, generation of magma in their source region, boundary conditions.	15	10
IV	Classification of Igneous rocks	CIPW and IUGS.	8	8
V	Reaction series and its interpretation	Reaction series and its interpretation	8	6
VI	Evolution of Magma	a. Crystal fractionation, Fo-Fa and Fo-Silica systems. Separation mechanisms: i) Gravity settling. ii) Flow differentiation. iii) Flow crystallization. iv) Gas streaming. b. Liquid immiscibility (Silicate-Silicate) c. Contamination -Assimilation with melting Significance of contamination d. Mixing of magmas (Similar and dissimilar) e)Melting and crystallization of Ternary system (Di – Ab - An). f) Fractional crystallization of Basaltic magma. g) Introduction to Large Igneous Provinces	23	32

**Reference Books:**

1. Igneous Petrology: Anthony Hall
2. Igneous Petrology: McBirney
3. Igneous and Metamorphic Petrology: Myron Best
4. Principles of Petrology: G. W. Tyrell
5. Igneous, Metamorphic and Sedimentary Petrology: Ehler and Blatt
6. Igneous and Metamorphic Petrology: Turner and Verhoogen



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**GL 315 : Sedimentary Petrology**

Unit	Topic	Sub-topic	Periods	Marks
I	Origin of Sedimentary rocks	Introduction a) Exogeneic rocks (Allogenic) b) Endogeneic rocks (Authigenic)	4	2
II	Fabric	Fabric and frame work	4	2
III	Common Minerals	Abundance of common minerals	4	2
IV	Textural characters of Sedimentary rocks.	1) Concept of size, size terms. 2) Grain size distribution : <b>1) Grade scale:</b> <b>a. Introduction,</b> <b>b. Udden Scale</b> <b>c. Wentworth Scale</b> <b>d. phi (Φ scale)</b> <b>e. mesh scale</b> <b>2) Granulometric analysis :</b> a) Sample collection ( semi and consolidated sediments) b) Ro Tap machine ( Sieve shaker) c) Cumulative grain size distribution plots (simple graph and arithmetic probability sheet), d) Graphic parameters of size frequency (Mean, Standard Deviation, Skewness, Kurtosis. e) Grain size and Mode of transport : Selective Abrasion, Traction, Saltation, Suspension. f) Grain-size distribution and environment of deposition. 3) Shape and roundness: a)Shape (Form) – Wadell-Zing shape classes b) Roundness – Wentworth - Wadell – Roundness, grain-Petijhon. C) Introduction to Surface Texture of fluvial, marine and Aeolian environments. 4) Sedimentary rock classification: A) Sandstone : 1) Properties of Sandstone: a) Framework, b) Matrix, c) Maturity.	25	34

		<p>2) Classification of Sandstone By Dott and Folk</p> <p>B) Limestone: Genetic classification of limestone</p> <p>1. Texture and structure of Limestone: i) Allochem (Framework) : a) Oolites, fossil skeletons, intraclasts, pellets, ii) micrite, iii) sparry calcite.</p> <p>2. Classification of Limestones: a) Autochthonous and Allochthonous limestones, b) Classification of Carbonate rocks by Folk and Dunham.</p>		
V	Provenance	<p>1. Definition</p> <p>2. Mineral and Source rocks</p> <p>3. Mineral Stability series of Goldich</p> <p>4. Mobility of Oxides</p>	10	8
VI	Environment of Deposition	<p>1) Introduction</p> <p>2) Environmental Parameters</p> <p>    a) Physical Parameters</p> <p>    b) Chemical Parameters</p> <p>3) Classification of Environment – Fluvial (Alluvial), Shore zone, Marine, Glacial</p>	10	10
VII	Sedimentary Basins	Introduction and map of sedimentary basins of India	03	02

**Reference Books:**

1. Sedimentary Rocks: Pettijohn
2. Sedimentology: Leeder
3. Introduction to Sedimentology: Sengupta
4. Stratigraphy and Sedimentation: Krumbein and Sloss
5. Principles of Sedimentology: Friedman and Sanders.
6. Applied Sedimentology: R. K. Sukhatankar

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**GL 316 : Geomorphology**

Unit No	Topic	Sub-topic	Periods	Marks
I	Geomorphology	1. Definition and Introduction to Geomorphology 2. Basic Fundamental concepts in geomorphology. 3. Recap of Weathering process (Agents and types)	10	8
II	Soil	1. Soil formation and types 2. Soil Profile 3. Soils of Maharashtra	8	6
III	Landforms	1. River : Mesa and Butte, Divides, Cuesta, Hogback 2. Sea : Longshore deposits ( Spits, Bar, Tombolo, Hooks, Lagoons, Tidal flats, marshes) 3. Glaciers : Tarns, Aretes, Horn, Cols, Fjords, Erratics and perched blocks, Outwash plains, Kettle holes, Kames, Eskers, 4. Karst Topography	16	18
IV	Genetic classification of streams	1. Phases of drainage network development 2. Genetic classification of Streams 3. Drainage network patterns (dendritic, trellis, rectangular, radial, annular, parallel, irregular) 4. Definition of terms : Antecedent and superimposed river, stream piracy,	10	10
V	Drainage basin Morphometric analysis	Drainage basin and network characters, 1. Stream Ordering and Bifurcation ratio. 2. Basin area and stream length 3. Drainage texture ( frequency and density)	10	10
VI	Applications of Geomorphology	Relation and applications of Geomorphology in: a) Hydrology b) Economic Geology c) Engineering Geology d) Oil Exploration	6	8

**Reference Books:**

1. Introduction to Geomorphology: Kale, V. S. and Gupta A. G.
2. Principles of Geomorphology: Easterbook, Don J.
3. Geomorphology: Chorley, R. J. Schumm, S. A., Sugden, D. E.
4. Fundamentals of Geomorphology: Rice. R. J.
5. Geomorphology and Hydrogeology: Small, R. J.
6. Principles of Geomorphology: Thornbury
7. Soils and Landforms: Gerrard, A. J.
8. Geomorphology – Savindra Singh, Meerat Publication

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**Semester V (Practical)**

**GL 317 : Mineralogy**

Unit No	Topic	Sub-topic
I	Mineralogy	<ol style="list-style-type: none"><li>1. Study of following minerals for its physical properties, uses, occurrences of<ol style="list-style-type: none"><li>a. Ore minerals - Sphalerite, Pyrrhotite, Orpiment, Realgar, Magnetite, Pyrolusite, Psilomelane, Magnesite, Malachite, Limonite</li><li>b. Rock forming minerals - Rock Crystal, Smoky Quartz, Milky Quartz, Zebra agate, Brown agate, Banded agate, Bloodstone, Calcite, Dolomite, Barite, Gypsum, Apatite, Olivine, Andalusite, Sillimanite, Mountain wood, Mountain Leather, Perthite, Biotite, Muscovite, Staurolite, Garnet, Epidote, Beryl, Tourmaline, Augite, Tremolite, Actinolite, Hornblende, Wollastonite.</li></ol></li><li>2. Hess calculation for Pyroxenes</li><li>3. Mineral calculation for Feldspars.</li><li>4. Optics: Optical Properties for Leucite, Sanidine, Plagioclase, Microcline, Orthoclase, Quartz, Augite, Hypersthene, Andalusite, Staurolite, Muscovite, Chlorite, Hornblende, Calcite, Kyanite and Garnet.</li></ol>
II	Economic Geology	<ol style="list-style-type: none"><li>5. Preparation of an ore-mineral map of India for the following: Iron, Manganese, Chromium, Copper, Lead, Zinc and Aluminum.</li><li>6. Petroliferous basins in India</li><li>7. Coal-fields of India</li></ol>

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**Semester V (Practical)**

**GL 318 : Sedimentary Petrology, Paleontology and Indian Stratigraphy**

Unit No	Topic	Sub-topic
I	Sedimentary Petrology	<p>1. Study of the following Megascopic rocks with regards to their texture/ structure, description, identification and classification, giving their sedimentological significance. Conglomerate, Breccia, Laterite, Bauxite, Freestone, Flagstone, Calcareous sandstone, Siliceous sandstone, Arkose, Speckled sandstone, Ferruginous and Carbonaceous Shale, Limestone, Calcrete, Crinoidal limestone, Fossiliferous Limestone.</p> <p>2. Thin section study of the following sedimentary rocks : Sandstone, Feuginous sandstone Arkose, Nummulitic limestone, Meliolitic limestone and Limestone.</p> <p>3. Interpretation of the sedimentary structures giving their geological significance. 1) Cross bedding. 2) Graded bedding. 3) Ripple marks. 4) Mud cracks / Sun cracks. 5) Laminations. 6) Tracks and trails.</p> <p>4. Plotting and calculation of the sieve analysis data and environmental interpretation and energy condition.</p>
II	Palaeontology	5. Study of 25 animal fossil/Shells and 5 plant fossils.
III	Indian Stratigraphy	6. Maps showing cratons, Mobile belts and sedimentary basins of India

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**Semester V (Practical)**

**GL 319 : Structural Geology, Geomorphology and Field Geology**

Unit No	Topic	Sub-topic
I	Geological Maps	i) Description of the topography and geology of the map. ii) Drawing of a section along a given direction. (maps with one and two series ,one or two Fault, vertical dyke and fold)
II	Structural problems	I ) Based on hill slope, true thickness of the bed, vertical thickness, dip of the bed and width of outcrop. II) Three point problems To find Strike, true dip direction and true dip amount of the bed.
III	Geomorphology	Bifurcation ratio of given basin.
IV	Field Geology	Field work for about one week in an area of geological interest, anywhere in India and preparation of field tour report or project report or review article.

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**Semester VI**

**GL 321:** Metamorphic Petrology

**GL 322:** Economic Geology

**GL 323:** Natural Resources – Minerals and Energy

**GL 324:** Geotechniques

**GL 325:** Environmental Geology

**GL 326:** Hydrogeology

**Practical**

**GL 327 :** Igneous Petrology

**GL 328 :** Metamorphic Petrology

**GL 329 :** Structural Geology, Field Geology and Hydrogeology

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( W. e. f. June 2017 )

**Semester VI**

**GL 321: Metamorphic Petrology**

Unit No.	Topic	Sub Topic	Periods	Marks
I	Metamorphic Petrology	1. Scope of Metamorphic Petrology 2. Definition and types of metamorphic rocks	4	6
II	Controls and process of metamorphic rocks.	1. Controls: Pressure, Temperature and Composition of original rock 2. Metamorphic processes: initiation of metamorphic processes, preferred orientation, 3. Upper limits of metamorphism.	6	8
III	Mineral changes	1. Mineral changes during metamorphism. 2. Mineral variation related to initial rock composition	6	6
IV	Classification and nomenclature of metamorphic rocks	1. Classification and nomenclature of metamorphic rocks based on a. Fabric b. Composition c. genesis d. grade and e. Facies	10	10
V	Thermal metamorphism	1. Metamorphic Aureole, Thermal metamorphism of Impure calcareous rocks. 2. Introduction to facies of contact metamorphism.	10	10
VI	Regional metamorphism	1. Barrovian zones. 2. Introduction to Facies of regional metamorphism-and its mineral assemblages	12	10
VII	Stability of metamorphic minerals	P-T boundaries and mineral equations of : Zeolites, Chlorites, Muscovite, Biotite, Staurolite, Garnets, Pyroxenes, Amphiboles, Aluminosilicates	12	10

**Reference Books:**

1. Metamorphism: Alfred Harker
2. Petrography of the Igneous and Metamorphic rocks in India: S. C. Chatterjee
3. Metamorphic Petrology, Mineralogy and Field aspects: Turner
4. Metamorphism and Metamorphic belts: Miyashiro
5. Petrology (Igneous, Sedimentary and Metamorphic): Blatt and Tracy.
6. Analysis of Metamorphic techniques: Turner and Weiss
7. Metamorphic Petrology: B. Bhaskar Rao



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**GL 322: Economic Geology**

Unit No.	Topic	Sub Topic	Periods	Marks
I	Brief history of use of minerals	Brief history of use of minerals and development of Economic Geology.	4	6
II	Terms	Ore mineral, Tenor of ore, Gangue minerals,	4	6
III	Classification of minerals deposits	Classification of minerals deposits as suggested by: 1)Irving 1908, 2) Lindgren Classification 1911 3) Bateman's Classification	10	8
V	Process of formation of Mineral Deposition.	a) Magmatic Concentration. b) Sublimation. c) Hydrothermal deposition i. openings in rocks ii. hydrothermal alterations iii. cavity fillings iv. metasomatic replacement d) Contact Metasomatism i. Introduction ii. Process and effects e) Sedimentation i. Source of material ii. Solution, transportation and deposition iii. Conditions of deposition f) Evaporation g) Residual and Mechanical Concentration h) Oxidation and supergene enrichment. i) Metamorphism.	36	36
VI	Polymetallic nodules.	Polymetallic nodules.	6	4

**Reference Books:**

1. Economic Mineral Deposits: Bateman
2. Mining Geology: Mckenstry
3. Ore deposits of India: Gokhale and Rao
4. Mineral Economics: Sinha R K 5. Ore Deposits of India – Prasad, CBS Publication

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Semester VI

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**GL 323: Natural Resources – Minerals and Energy**

Unit No.	Topic	Sub Topic	Periods	Marks
I	Coal	1. Origin and varieties 2. Different Classifications, 3. Rank and Grades 4. Distribution of coal in India.	10	16
II	Stratigraphy of Coal fields	Stratigraphy, structure, lithology of: 1. Raniganj, 2. Neyveli lignite. 3. Coalfields of Maharashtra	05	4
III	Petroleum	1. Origin 2. Migration 3. Distribution of oil and gas in India.	10	10
IV	Stratigraphy, structure, lithology of oil fields	Stratigraphy, structure, lithology of oil fields: 1. Upper Assam 2. Bombay High and 3. Cambay Basin	7	6
V	Geothermal Energy	1. Introduction and distribution in India. 2. Types of geothermal systems.	10	6
VI	Nuclear fuels	1. U and Th- Mineralogy, Uses and Distribution.	8	6
VII	Mineral Deposits of India	Geological and geographical distribution, uses and characters of: Metallic : Gold, Manganese, Iron, Aluminum, Lead, Zinc, Copper. Non Metallic : Diamond, Mica, Graphite, Feldspar, Gypsum, Ochre, Clay minerals in ceramics. Introduction to Mineral resources of Maharashtra	10	12

**Reference Books:**

1. India's Mineral Resources: Krishnaswami
2. Indian Minerals: D. N. Wadia
3. Geology of Industrial rocks and minerals: Robert L. Bates
4. National Mineral Policy: G.O.I. Publications

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Semester VI

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**GL 324: Geotechniques**

Unit No.	Topic	Sub Topic	Periods	Marks
I	Remote sensing	<p>A. Remote Sensing - Introduction, types - active and passive, working principle of remote sensing system, advantages and limitations of remote sensing</p> <p>B. Electro-magnetic radiation, electro-magnetic spectrum, energy interaction with atmosphere, interaction of EMR with earth's surface materials - water, vegetation, and soil</p> <p>C. Remote sensing platform: Definition, types - space based, air based and ground based, Orbits: definition and orbit types - sun-synchronous and geo-synchronous, Sensor: definition, sensor resolution- spectral, spatial, radiometric and temporal.</p> <p>D. Image interpretation, elements of image interpretation: tone, texture, pattern, shape, size, shadow and association</p> <p>E. GIS: Introduction, history, advantages and components of GIS</p> <p>F. GPS: Introduction, history and segments: space, control and user</p> <p align="center">OR</p> <p>G. Introduction to GIS and GPS</p>	20	26
II	Prospecting	<p>A) Criteria and guides for Prospecting</p> <p>B) Study of following methods of geophysical prospecting, with reference to physics of the method, working principles of the instruments used and applications.</p> <p>i) Resistivity.</p> <p>ii) Magnetic.</p> <p>iii) Gravity.</p> <p>iv) Seismic (refraction and reflection)</p>	20	14
III	Engineering Geology	<p>i) Engineering properties of rocks, road metal and their characteristics.</p> <p>ii) Geotechnical investigations for site selection of dam-site, tunnels, bridges and road ways.</p>	20	20

### **Referance Books:**

1. General Geology: V. Radhakrishnan
2. Plate Tectonics and Crustal Evolution: Condie
3. Aspects of Tectonics: K. S. Valdiya.
4. Tectonics: E. M. Moores and R. J Twiss
5. Geotectonics: V. V. Belousov
6. Geochemistry: Mason
7. Physical Geology: A. Homes.
8. Global Tectonics: Keray P and Vine F. J.
9. Our Evolving Planet: Bergen, Alma, Mater Fortag
10. Dynamic Himalaya: K. S. Valdiya
11. Geomorphology and Global Tectonics: Summerfield M. A.
12. M. Anji Reddy, Textbook of Remote Sensing and Geographical Information Systems, 3rd Edition, BS publication
13. Lillesand and Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, New York (1976)
14. George Joseph, Fundamentals of Remote Sensing, University Press Pvt. Ltd. Hyderabad (2004)
15. Campbell J. B., Introduction to Remote Sensing, 5th edition, Taylor & Francis, London (2002)
16. <http://earthobservatory.nasa.gov/Features/RemoteSensing/remote.php>

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Syllabus for T. Y. B.Sc. Geology  
Semester VI

Geology Semester VI  
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**GL 325: Environmental Geology**

Unit No.	Topic	Sub Topic	Periods	Marks
I	Fundamental Concepts of Environmental Geology	a) Seven fundamental concepts of Environmental Geology	8	8
II	Land as a Resource	i) Land classification - Agricultural land-use pattern, Land productivity, capability. ii. Human settlement and land use iii. Land use pattern in India iv. Assessment of impact of land use v. Desertification and degradation of land	13	12
III	Soil as a resource	i. Introduction to soil ii. soil conservation	13	10
IV	Water as a resources	i. Water resources of India ii. Groundwater provinces of India iii. Pollution and Quality of Surface and ground water iv. Water logging and development of alkaline and acidic soils, v. Water management	13	16
V	Natural and Man-Made hazards	a. Difference between Natural Hazards and Disaster. b. Natural hazards, causes and prevention of- i) River flooding ii) Landslides iii) Earthquakes iv) Volcanic activity v) Coastal hazards vi) Introduction to mining hazards.	13	14

**Reference Books:**

1. Environmental Geology: K. S. Valdiya
2. Environmental Geology: Edward A. Keller
3. Mining and Environment: Bharat B Dhar
4. Environmental Chemistry: A K De
5. Environmental Geology – Lindgreen
6. Environmental Geology – Savindra Singh
7. Environmental Sciences – Bharucha
8. Environmental Geology - Tank

### GL 326: Hydrogeology

Unit No.	Topic	Sub Topic	Periods	Marks
I	Introduction:	<ol style="list-style-type: none"> <li>1. Definition of terms like Hydrology, Geohydrology and Hydrogeology,</li> <li>2. Scope of groundwater geology.</li> <li>3. Distribution of water on earth's surface with percentage</li> <li>4. Groundwater in the Hydrologic cycle and hydrologic properties: precipitation, infiltration, soil moisture, evaporation, transpiration.</li> </ol>	12	8
II	Occurrence Distribution and Movement of Groundwater:	<ol style="list-style-type: none"> <li>1. Rock Properties affecting groundwater occurrence.</li> <li>2. Vertical distribution of groundwater.</li> <li>3. Type of Aquifers : (Aquiclude, Aquifuge, Aquitard),</li> <li>4. Formations of springs.</li> <li>5. Types of Wells (Dug, Bore and Tube). Introduction to well inventory</li> <li>6. Groundwater Movement: Darcy' s Law</li> <li>7. Permeability, conductivity, transmissivity, storativity, piezometric level.</li> </ol>	12	16
III	Watershed Development and resources management strategy	<ol style="list-style-type: none"> <li>1. Concept of watershed</li> <li>2. Classification of watersheds</li> <li>3. Watershed characteristics and multidisciplinary approach to watershed management.</li> </ol>	12	12
IV	Groundwater Investigation:	<ol style="list-style-type: none"> <li>1. Groundwater Investigation:</li> <li>2. Groundwater Investigation by VES method (Wenner and Schlumberger) Different dowsing methods.</li> </ol>	12	12
V	Artificial recharge of Groundwater:	Artificial recharge of Groundwater: Surface, subsurface recharging methods used in Deccan Traps (Maharashtra)	12	12

#### Reference Books:

1. Hydrogeological measurements for watershed research: Wasi Ullah, S. K. Gupta and Dalal S. S.
2. Watershed management in India: J. V. S. Murthy
3. Groundwater: Hydrology: D. K. Todd
4. Groundwater: H. Raghunath
5. Groundwater Assessment, Development and Management: K. R. Karnath
6. Groundwater Surveys and Investigation: Gautam Mahajan

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Syllabus for T. Y. B.Sc. Geology

Semester VI (Practical)

w. e. f. June 2017

**GL 327: Igneous Petrology**

Unit No	Topic	Sub-topic
II	Igneous Petrology	<p>1. Study of the following Megascopic rocks with regard to their texture, mineral composition, colour index, identification and classification.</p> <ul style="list-style-type: none"> <li>a) Grey Granite, Micro granite</li> <li>b) Basalt</li> <li>c) Andesite, Trachyte, Rhyolite</li> <li>d) Gabbro, Anorthosite, Norite,</li> <li>e) Felsite, , Graphitic Granite</li> <li>f) Peridotite,</li> <li>g) Lamprophyre,</li> <li>h) Felsite Porphyry, Diorite Porphyry, Orthoclase Porphyry</li> </ul> <p>2. Thin section study of the following rocks with regard to their texture, mineral composition, colour index, identification and classification.</p> <ul style="list-style-type: none"> <li>a) Granites</li> <li>b) Olivine basalt</li> <li>c) Norite</li> <li>d) Anorthosite</li> <li>e) Phonolite</li> <li>f) Lamprophyre</li> <li>g) Peridotite</li> <li>h) Trachyte Andesite</li> </ul> <p>Description, Genesis and Significance of the following Megascopic textures / structures : Granitic, Porphyritic, Graphitic, Ropy, Glassy, Columnar, Vesicular and Amygdaloidal.</p> <p>4. Description genesis and significance of the following textures / structures seen in thin section :</p> <ul style="list-style-type: none"> <li>a) Equigranular</li> <li>b) Porphyritic</li> <li>c) Intergranular</li> <li>d) Intersertal</li> <li>e) Poikilitic</li> <li>f) Ophitic-Subophitic Graphitic</li> </ul> <p>5. CIPW Norm calculation of saturated rocks based on given chemical data.</p>

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**GL 328 : Metamorphic Petrology**

Unit No	Topic	Sub-topic
I	Metamorphic Petrology	<p>1. Study of the following Megascopic rocks with regard to their texture/structure, mineral composition, colour, type of metamorphism, grade and the original rock:</p> <p>Slate, Phyllite, Chlorite Schist, Biotite Schist, Hornblende Schist, Staurolite schist, Kyanite Schist, Mica-Garnet Schist, Hornblence Gneiss, Sillimanite Gneiss, Augen Gneiss, Charnokite, Fuschite Quartzite, Banded Haematite Quartzite, Marble, Serpentine Marble</p> <p>2. Study of the thin sections of the following rocks with regard to the their texture/ structure, mineral composition, colour, type of metamorphism and grade:</p> <p>Chlorite Schist, Staurolite Schist, Kyanite Schist, Biotite Schist, Mica-Garnet Schist, Sillimanite Gneiss, Augen Gneiss, Charnockite, Marble, Quartzite, Slate.</p> <p>3. Interpretation of Microscopic structures giving their geological significance:</p> <p>Granulose, Schistose, Gneissose, Idioblastic.</p> <p>Megascopic Fabrics – Granulose, Schistose, Gneissose, Slaty Cleavage, Augen structure, Granoblastic.</p>



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**Semester VI (Practical)**

**GL 329 : Structural Geology, Geomorphology, Hydrogeology and Field Geology**

Unit No	Topic	Sub-topic
I	Structural Problems	I) Problems using stereographic projections :-Strike, true dip and apparent dip of a bed. II) problems with true and apparent dip given in ratio
II	Outcrop Completion of the Map	Completion of geological maps (outcrops) with given data. 1. Junction of a bed 2. Based on three points
III	Geomorphology	Calculation of Basin area, Stream length and Drainage texture.
IV	Hydrology	Vertical Electrical Sounding for Groundwater exploration
V	Field Geology	Field work for about one week in an area of geological interest, anywhere in India and preparation of field tour report, or Review Article or Project Report.

# **NORTH MAHARASHTRA UNIVERSITY, JALGAON**

## **Job Opportunities for B.Sc Geology Students**

- 1. In competitive exams of State and Central Governments as MPSC and UPSC where minimum qualification is Graduate.**
- 2. State and Central Forest departments through exams**
- 3. As a consultant in groundwater exploration, water shed management**
- 4. As a consultant gem and jewelery**
- 5. As a consultant in geotechnical field.**
- 6. As a geologist in different NGOs.**

## T.Y.B.Sc Geology Equivalence Table

With effect from June 2014	With effect from June 2017
Pattern 40:10 Sem V	Pattern 60:40 Sem V
<p> <b>GI 351</b> : Structural Geology  <b>GI 352</b> : Indian Stratigraphy  <b>GI 353</b> : Mineralogy and Optics  <b>GI 354</b> : Igneous Petrology  <b>GI 355</b> : Sedimentary Petrology  <b>GI 356</b> : Geomorphology </p> <p><b>Practical (Pattern 80:20) Annual Exam</b></p> <p> <b>GI 307</b> : Mineralogy &amp; Igneous Petrology  <b>GI 308</b> : Sedimentary, Metamorphic Petrology and Indian Stratigraphy  <b>GI 309</b> : Structural Geology, Environmental Geology and Hydrology </p>	<p> <b>GI 311</b> : Structural Geology  <b>GI 312</b> : Indian Stratigraphy  <b>GI 313</b> : Mineralogy and Optics  <b>GI 314</b> : Igneous Petrology  <b>GI 315</b> : Sedimentary Petrology </p> <p><b>GI 316</b> : Geomorphology</p> <p><b>Practical (Pattern 60:40) Semester Exam</b></p> <p> <b>GI 317</b> : Mineralogy  <b>GI 318</b> : Sedimentary, Palaeontology and Indian Stratigraphy  <b>GI 319</b> : Structural Geology, Geomorphology and Field Geology </p>
Pattern 40:10 Sem VI	Pattern 60:40 Sem VI
<p> <b>GI 361</b> : Metamorphic Petrology  <b>GI 362</b> : Economic Geology  <b>GI 363</b> : Natural Resources – Minerals and Energy  <b>GI 364</b> : Geotechniques  <b>GI 365</b> : Environmental Geology  <b>GI 366</b> : Hydrogeology </p> <p><b>Practical (Pattern 80:20) Annual Exam</b></p> <p> <b>GI 307</b> : Mineralogy &amp; Igneous Petrology  <b>GI 308</b> : Sedimentary, Metamorphic Petrology and Indian Stratigraphy  <b>GI 309</b> : Structural Geology, Environmental Geology and Hydrology </p>	<p> <b>GI 321</b> : Metamorphic Petrology  <b>GI 322</b> : Economic Geology  <b>GI 323</b> : Natural Resources – Minerals and Energy  <b>GI 324</b> : Geotechniques  <b>GI 325</b> : Environmental Geology  <b>GI 326</b> : Hydrogeology </p> <p><b>Practical (Pattern 60:40) Semester Exam</b></p> <p> <b>GI 327</b> : Igneous Petrology  <b>GI 328</b> : Metamorphic Petrology  <b>GI 329</b> : Structural Geology, Field Geology and Hydrogeology </p>