UNIVERSITY OF PUNE

Semester wise course structure and revised draft of syllabus for

T.Y.B.Sc. Geology w.e.f. the Academic Year 2010-2011.

T.Y.B.Sc. Geology, Semester III

Paper	Course Title	Marks
GL-331	Mineralogy	50
GL-332	Igneous Petrology	50
GL-333	Sedimentary Petrology	50
GL-334	Structural Geology	50
GL-335	Precambrian Stratigraphy Of India	50
GL-336	Applied Geology I	50

T.Y.B.Sc. Geology, Semester IV

Paper	Course Title	Marks
GL -341	Metamorphic Petrology	50
GL -342	Environmental Geology	50
GL -343	Economic Geology	50
GL -344	Geotectonics	50
GL -345	Phanerozoic Stratigraphy Of India & Palaeontology	50
GL -346	Applied Geology II	50
GL -347	Practical Course I Related practicals from GL 331, 332, 333 & 341	100
GL -348	Practical Course II Related practicals from GL 334, 335, 343 & 345	100
GL -349	Practical Course III Related Practicals from GL -336, 342 & 346.	100

For, T.Y.B.Sc. Geology class there will be twelve theory papers of 50 marks each and three practical courses of 100 marks each. Six theory papers (from GL -331 to GL -336) will be taught in first term for semester III and remaining six theory papers (from GL -341 to GL -346) will be taught in second term for semester IV. The practical courses I, II, III (GL -347 GL -348, GL -349) will be conducted and completed through out the academic year. For theory papers examination will be conducted semester-wise, while for practical courses (I, II, III) the practical examination will be conducted at the end of the academic year. For each theory paper, there shall be University examination of 40 marks and 10 marks for internal assessment in each semester. So each theory paper will be of 50 marks, the practical courses I, II, & III each of 100 marks. The university practical examination of each course will be of 80 marks and 20 marks for internal assessment.

T.Y.B.Sc. Geology

Theory University Question Paper Pattern

Total: 40 Marks Time Allotted: 2 Hours

Que. 1 Ten marks should be allotted to objective type questions. There should be ten sub-questions. All sub-questions are compulsory and shall be based on entire syllabus. Each sub-questions for one mark.

Que.2 There should be three sub-questions. Each, sub-question of 5 marks. Student will be asked to attempt any two.

Que.3 There should be four sub-questions. Each, sub-question of 5 marks. Student will be asked to attempt any two.

Que. 4 Long essay type answer question for 10 marks. Student will be asked to attempt any one out of two such questions.

General Guidelines

While Setting University Question Papers.

1. Repetition of questions should be avoided.
2. Question should be testing conceptual knowledge and understanding of the basic concepts of the subject.
3. Question paper should cover the entire syllabus.

Internal Assessment and Question Paper

For comprehensive continuous internal assessment of students by the respective teachers, teaching the course shall evaluate the student on the basis of written test comprises of (1) MCQ (2) True/False (3) Basic definitions (4) Single line answers. Students be asked to answer 20 questions in 40 minutes. Each question will be for ½ marks. In the classroom, different sets of equivalent sets of question papers may be experimented. It will be preferred two such tests per course and average be considered for internal marks. If teacher prefers to conduct one test only, it should be at the end of the term covering entire syllabus.

ATKT (as earlier)

1. Student shall clear 8 heads of passing (out of 12 such heads) while going from F.Y.B.Sc. to S.Y.B.Sc., however he must pass in all F.Y.B.Sc. Subjects while going to T.Y.B.Sc.
2. Student shall clear 12 heads of passing (out of 20 such heads) while going from S.Y.B.Sc. to T.Y.B.Sc.

University of Pune

Equivalences for the Old Courses with New Courses in Geology

T.Y.B.Sc. Geology

Papers in Old Course	Equivalent papers in New Course
GL331: Indian Stratigraphy I	GL335: Precambrian Stratigraphy of India
GL332: Petrology I (Igneous & Metamorphic Petrology)	GL332: Igneous Petrology GL341: Metamorphic Petrology
GL333: Structural Geology	GL334: Structural Geology
GL334: Economic Geology I	GL343: Economic Geology GL346: Applied Geology II (Prospecting, Engineering Geology & Hydrogeology)
GL335: Environmental Geology	GL342: Environmental Geology
GL336: Field Geology, Geomorphology & Engineering Geology	GL336: Applied Geology I (Field Geology & Remote Sensing) GL346: Applied Geology II (Prospecting, Engineering Geology & Hydrogeology)
GL341: Indian Stratigraphy II	GL345: Phanerozoic Stratigraphy of India & Palaeontology
GL342: Petrology II (Igneous & Sedimentary Petrology)	GL332: Igneous Petrology GL333: Sedimentary Petrology
GL343: Geotectonics	GL344: Geotectonics
GL344: Economic Geology II	GL331: Mineralogy GL343: Economic Geology
GL345: Natural Resource Management	GL342: Environmental Geology GL346: Applied Geology II (Prospecting, Engineering Geology & Hydrogeology)
GL346: Principles of Remote Sensing, Photogeology & Geographical Information Systems (GIS)	GL336: Applied Geology I (Field Geology & Remote Sensing)
Practicals	
GL347: Petrology & Indian Stratigraphy	GL 347: Mineralogy & Petrology
GL348: Structural & Economic Geology	GL348: Structural Geology, Economic Geology, Paleontology & Indian Stratigraphy
GL349: Environmental Geology & Techniques in Geology	GL349: Applied Geology (Remote Sensing, Geohydrology, Geophysical Prospecting, Field Geology & Environmental Geology)

UNIVERSITY OF PUNE

T.Y.B.SC. (REVISED) GEOLOGY SYLLABUS

(W.E.F. JUNE 2010)

T.Y.B.Sc. Geology

GL – 331: Mineralogy

Unit 1) Mineral Optics (8Lectures)

a) Refractive Index: **(3 Lectures)**

1) Definition & outline
2) Relief of minerals
3) Methods of determining R.I. of minerals: Becke line, shadow method & immersion method

b) Accessory plates & their uses: (**3 Lectures)**

1 Mica, Gypsum & Quartz wedge
2 Uniaxial & Biaxial minerals, indicatrices, Compensation & determination of interference colours
3 Sign of elongation (optic sign) of Uniaxial minerals where C axis is known.
4 Vibration directions & Optic orientation
5 Pleochroism & absorption in Uniaxial & biaxial minerals

C) Isomorphism, polymorphism & Pseudomorphism **(2 Lectures)**

Unit II) Descriptive Mineralogy (27 Lectures)

a) Study of the following mineral groups (silicates) with reference to their silicate structure, chemical & optical characters, paragenesis & alteration products **(18 Lectures)**

1) Olivine group
2) Pyroxene group
3) Amphibole group
4) Feldspar group
5) Mica group
6) Aluminosilicates – Sillimanite, Kyanite, Andalusite & their comparison
7) Garnet group
8) Zeolite group
9) Feldspathoid group

b) Study of non silicates with reference to their chemical composition, physical properties, paragenesis & uses **(9 Lectures)**

1) Oxides – Corundum, Hematite, Ilmenite, Rutile
2) Hydroxide – Limonite
3) Sulphides – Pyrite, Sphalerite, Galena
4) Carbonates – Calcite, Magnesite, Dolomite
5) Phosphates – Apatite
6) Halides – Fluorite & Halite

Unit III) Non metallic mineral deposits :(10 Lectures)

Geological & Geographical distribution, mineralogy, properties, types & uses of the following:

1) Nonmetals – Gypsum, Baryte, Mica
2) Refractory minerals – types with examples of fire clay, Kyanite, Chromite, Graphite, Magnesite, dolomite
3) Precious & semiprecious stones

BOOKS:

1) Rutley's Elements of Mineralogy by H.H. Read.
2) Mineralogy by Berry & Mason
3) Mineralogy by Dexter Perkins
4) An Introduction to the rock forming minerals by Deer, Howie, Zussman
5) Manual of Mineralogy by Kleine & Hurlbut C.S.
6) Optical Mineralogy by Kerr P.F.
7) Optical Mineralogy by Whalstrom E.E.
8) Optical Mineralogy & Non opaque minerals by Philip W.R. & Griffen check D.T.
9) Dana's textbook of Mineralogy by William E. Ford.

T.Y.B.Sc. GEOLOGY

GL 332 - IGNEOUS PETROLOGY

UNIT

Unit 1 : Types of magma : Primary and derivative; **(1 Lectures)**

Unit 2 : Characteristics and generation of magmas (5 Lectures)

a) The physico-chemical nature of magma – density, viscosity and temp-press.

b) Role of magma in geological processes : melting of rocks and generation of magmas, temperature and pressure conditions, generation of magmas in their source regions, their boundary conditions (in brief). Concept of Tecteno-magmatic associations.

Unit 3 : Crystallisation of magmas : **(5 Lectures)**

a) Binary magma with an incongruent melting compounds : Leucite – silica system

b) Ternary system : Ab-An-Di system.

c) Reaction series and its importance

Unit 4 : Magmatic evolution : Introduction, **(14 Lectures)**

a) Crystal fractionation in : i) Forsterite - Fayalite, ii) Forsterite - Silica systems.

b) Separation mechanisms : Gravitational settling, flow differentiation, flow crystallisation, filter pressing, selective nucleation, gas streaming, gravitational liquid separation.

c) Liquid immiscibility in silicate – silicate and silicate – water systems.

d) Liquid fractionation : Thermal diffusion and gravitational diffusion.

e) Mixing of magmas : Similar and dissimilar magmas.

f) Contamination : Assimilation by melting, without melting and equilibration of xenoliths, incorporation of the equilibrated foreign matter, contaminated granites, significance of contamination.

g) Role of volatile constituents.

Unit 5 : Significance of textures, structures and micro-structures in igneous rocks: (**5 Lectures**)

Textures : Granitic, porphyritic (poikilitic, ophitic, sub-ophitic, glomero-porphyritic, inter-granular, inter-sertal), cummulate, glassy.

Structures : Ropy, vesicular, amygdaloidal, Flow, Micro-structures: Orbicular, Corona, expansion cracks, graphic, reaction rim, myrmeketic, flow.

Unit 6 : Classification of igneous rocks: **(7 Lectures)**

i) Complexity in classification, ii) Types of classification,

iii) Study of Shand's, CIPW, IUGS (plutonic, volcanic) classifications:

Unit 7:Petrographic Provinces and Rock Kindreds : **(3 Lectures)**

Unit 8:Description of following rocks with regard to their characteristics, composition : **(5 Lectures**)

Origin and occurrence in relation to their tectonic setting: basalt, granite, pegmatite, aplite, andesite, anorthosite, peridotite.

Reference Books

1) Igneous Petrology : Anthony Hall

2) Igneous rocks : McBirney

3) Igneous and Metamorphic Petrology : Myron Best

4) Principles of Petrology : GW Tyrrell.

5) Igneous, metamorphic and sedimentary Rocks : Elher and Blatt

6) Igneous and metamorphic Petrology : Turner and Verhoogen

7) Principles of Igneous & metamorphic Petrology : Philpotts and Ague

8) Petrology of the Igneous rocks : Hatch, Wells and Wells

9) Petrography and Petrology : Grout

10) Igneous Petrology : Barker D. S.

11) Igneous and Metamorphic petrology : Raymond Loren

T.Y.B.Sc. Geology

GL – 333: Sedimentary Petrology

Unit

1 **Introduction : (4 Lectures)**

a) Branches of Sedimentology
b) Methodology: Field & Laboratory studies (in brief)
c) Application of Sedimentology in prospecting of hydrocarbons & sedimentary ores (Placer, Syngenetic & Epigenetic)

2 **Role of weathering in sedimentation : (5 Lectures)**

a) Surface processes of rock weathering
b) Chemistry of the weathering processes & mobility of oxides
c) Mineral stability series

3 **Concept of provenance : (5 Lectures)**

a) Introduction
b) Based on petrography, light & heavy mineral suites

4 **Dispersal of sediments: (5 Lectures)**

a) Dynamics of transportation
b) Concept of dispersal based on: size, roundness & sphericity, mineral composition & processes (Selective abrasion, Selective sorting & progressive dilution)

5 **Texture & structures of sedimentary rocks (8 Lectures)**

a) Definition of texture & factors controlling textures of sedimentary rocks
b) Concept of shape & size classification
c) Classification of sedimentary aggregates
d) Grade scales (Udden, Wentworth, Krumbein & Phi scale)
e) Mechanical / Sieve analysis: procedures & format for plotting & interpretation in brief.
f) Inorganic primary sedimentary structures & their significance (a brief mention of their varieties):
    1. Bedding
    2. Lamination
    3 Cross bedding
    4 Graded bedding
    5 Ripple marks
    6. Chemical structures: stylolites, concretions, nodules
    7. Miscellaneous marking(load-cast, flute-cast, mud-cracks)
g) Study of organic sedimentary structures (in brief) **(1Lecture)**

6 **Sedimentary basins & control on sedimentation: (5 Lectures)**

a) Sedimentary basins their formation & classification.
b) Climatic control.

7 **Sedimentary environments & facies (8 Lectures)**

a) Sedimentary environments: Depositional & Erosional
b) Physical & Chemical parameters of depositional sedimentary environments
c) Classification of depositional sedimentary environments
d) Concept of sedimentary facies: Definition, nomenclature & types of sedimentary facies with their hydrodynamic significance.

8 **Classification of sandstones & limestones: (4 Lectures)**

a) Dot's Classification of sandstones
b) Dunham's classification of limestones

Books:

1) Igneous, Metamorphic & Sedimentary petrology by Ehler & Blatt
2) Sedimentary Petrology by Pettijohn
3) Introduction to Sedimentology by Sengupta
4) Stratigraphy & Sedimentation by Krumbein & Sloss
5) Applied Sedimentology by R.K. Sukhatankar
6) Sand & Sandstones by Pettijohn, Potter & Siever.
7) Sedimentary basins and Environments by Rainik & Singh Enrirements.
8) Sedimentary structures by Sam Bogg.
9) Petrology of Sedimentary Rocks by S.J.Boggs (1992) Pettijohn.
10) Sedimentary Petrology : an Introduction to the Origin Sedimentary Rocks by M.E.Tucker (2001)
11) Principles of Sedimentology & Stratigraphy by S.J.Boggs (2006) Pettijohn.
12) Practical Approach to Sedimentology by Roy Lindholm (1987)
13) Origin of Sedimentary Rocks by Blatt, H. Middleton, G.V., & Murry, R.C.

T.Y.B.Sc. Geology

GL 334: Structural Geology.

Unit I) Introduction (2 Lectures)

a) Objectives and applications of Structural Geology.

Unit II) Rock Deformation- Definition, Concept & fundamental principles:(6 Lectures)

a) Force: Definition, representation, types (balanced & unbalanced) & unit of force.
b) Confining / Hydrostatic pressure & differential forces.
c) Stress & Strain-Definition and concept.
d) Stress-Strain diagram with reference to following :
   i) Elastic & Plastic deformation
   ii) Brittle & Ductile substance
   iii) Rupture strength, Ultimate strength & Fundamental strength.
e) Factors controlling rock deformation: Confining pressure, temperature, time, solution, anisotropy & inhomogenity of rocks.
f) Rheology (definition & concept).

Unit III) Mechanics of Plastic deformation: (3 Lectures)

a) Definition & examples of plastic deformation
b) Mechanisms of plastic deformation: Intergranular & intragranular movements, recrystallization with & without change in shape, Reckie's principle.

Unit IV) Mechanics of folding: (6 Lectures)

(Based on internal processes operative within the rock)

Study of the following genetic styles of folding:

a) Flexure / Flexure-slip folding
b) Flow / Incompetent folding
c) Shear / Slip folding
d) Folds due to vertical movements & their comparison with flexure folds.
e) Salt domes

Unit V) Mechanics of Rupturing (Failure by rupture): (6 Lectures).

a) Concept of mechanics of rupturing
b) Two genetic types of fractures-tension & shear fractures
c) Rupturing under differential forces
d) Stress & Strain ellipsoid – Concept & their relation with rupture
e) Use of Strain ellipsoid in solving structural problems

Unit VI) Mechanics of faulting: (10 Lectures).

a) Concept of mechanics of faulting
b) Faulting along tension & shear fractures
c) Direction of displacement along shear fractures`
d) Stress & faulting:
   i) Relation between geometry / types of fault & stress
   ii) Mechanics of gravity, thrust & strike slip faults
   iii) Mechanics of high angle thrusts & low angle gravity faults

e) Factors introducing complexities in mechanics of faulting
f) Application of principles in mechanics of faulting to artificially produced gravity & thrust faults
g) Faulting & Strain ellipsoid:
h) Ultimate causes of folding & faulting

Unit VII) Foliations: (06 Lectures)

a) Definition, types & examples of foliations
b) Map symbols to express attitude of foliations & rock cleavages
c) Types of cleavages & schistosity (Secondary foliations):
   i) Slaty cleavages / schistosity
   ii) Fracture cleavages
   iii) Slip cleavages
   iv) Bedding cleavages
d) Origin of slaty cleavages / schistosity:
   i) Slaty cleavages as flow cleavages
   ii) Slaty cleavages as shear cleavages
e) Origin of fracture cleavages, slip cleavages & bedding cleavages
f) Cleavage banding & Segregation banding
g) Cleavage & schistosity in relation to major structure:
   i) Principles involved
   ii) Application of principles to isolated exposures
   iii) Use of slaty cleavages in determination of major structure
   iv) Use of slaty cleavages to determine amount of plunge of axis of fold
h) Use of fracture cleavage in determination of major structure
i) Repeated deformation

Unit VIII) Lineations: (06 Lectures)

a) Definition, types & examples of lineations (Primary & Secondary)
b) Types of secondary lineations & their origin:
   i) Linear parallelism of stretched pebbles / prismatic minerals / elliptical mica plates
   ii) Intersecting planar features
   iii) Axes of crinkles
   iv) Slicken-sides
   v) Boudins or Boudinage structures
   vi) Rodings
   vii) Axes of folds
   viii) Mullion structure
c) Map symbols to express attitude of lineations & foliations with lineations
d) Lineations in relation to major structures

Reference Books

1) Structural Geology : M.P.Billings
2) Techniques of Modern Structural Geology : Ramsay and Huber
3) Structural Geology : De Sitter
4) Structural Geology : Ramsay
5) Structural Geology for Petroleum Geologists : Russesl
6) Foldinf and fracturing of rocks : Ramsay J G
7) Structural and Tectonic Principles : Badgley
8) Analysis of metamorphic tectonites : Turner and Weiss
9) Introduction to Geology : Sander
10) Structural Geology : Dennis
11) Modern Structural Geology (Vol. 1 and 2) : Ramsay and Huber
12) Analysis of Geological structural : Price N.J. and Cosgrove
13) Mechanics in Structural Geology : Bayly B.
14) Structural Geology : Fundamentals of Modern Developments : Eds : Pergamon Press
15) Structural Geology of rocks and region : Davis
16) An outline of Structural Geology : Hobbs B E, Means W. D & Williams P. F.
17) Structure and Tectonics : Badgley P C

T.Y.B.Sc. Geology

GL – 335: Precambrian Stratigraphy of India

Unit

1. **Physiographic / Tectonic divisions of India and their comparisons: (2 Lectures)**

   a) Definition of Tectonic Elements of continents, Cratons, Folded Mountain belts, Shield – shelf – mobile belts & platform basins.
   b) General review of Indian Stratigraphy.
   c) Classification of the Indian litho-stratigraphic units, according to the Geological time scale.

2. **Precambrian rocks of Peninsular India: (2 Lectures)**

   a) World Precambrian history, in brief.
   b) Earlier and current classification of the Precambrian formations

3. **The Early Precambrian rocks of Peninsular India(PC – I, II, III): (3 Lectures)**

   Brief account of their distribution, Geographical location, classification lithological succession, structure and economic importance, with a broad stratigraphic correlation.

   a) **The Karnataka – Dharwar Craton:** General Stratigraphy of the region (in tabular form), distinction between older and younger Greenstone belts: Sargur Supergroup, Peninsular Gneisses, Dharwar Supergroup, Clospet Granite, Chamundi Granite. Charnockites and Granulites. **(5 Lectures)**
   b) **The Eastern Ghat mobile belt:** Description and distribution of the Chalk Hills, Anorthosites of Salem, Sitampundi Complex, Khondalites and Kodurites.
   (5 Lectures)
   c) **The Singhbhum – Orissa Iron Ore Craton:** General Stratigraphy of the region (in tabular form) Older Metamorphic Group (OMG), Iron Ore Group (IOG), Singhbhum Granite. **(4 Lectures)**
   d) **The Central Indian Craton:** General Stratigraphy of the region (in tabular form). Sausar Group, Sakoli Group, Dongargarh Supergroup. **(2 Lectures)**
   e) **Aravalli Craton:** General Stratigraphy in the Mangalwar Complex (BGC), Sandamatha Complex, Hindoli Group, Bhilwara Super Group, Aravalli Super Group, Bundelkhand Granite. **(4 Lectures)**

4. **The Precambrians of the Extra – Peninsula: (7 Lectures)**

   a) The Tectonic sub-divisions of the Himalayas
   b) Precambrians of the Western Lesser and of the Central Lesser Himalayas, Simla Group – Dogra Slate
   c) Salkhala Group
   d) Vaikrita Group
   e) Damta Group
   f) Jutogh Group
   g) Daling Group / Darjeeling Group

5. **The Proterozoic rocks of India:** Geographic distribution, classification, succession, lithology, fossils and their economic importance. The Archaean – Proterozoic boundary.
   a) Proterozoic history in brief, changes in marine and terrestrial environments, tectonic zonation in platformal and geosynclinals basins**(1 Lecture)**
   b) The Delhi Supergroup: Classification, succession in the main synclinorium, Ajmer – Mewar and Alwar region, metamorphism, igneous activity. **(2 Lectures)**
   c) Cuddapah Super Group **(2 Lectures)**
   d) The Vindhyan Super group: Classification, Succession, lithology, fossils and economic importance: **(2 Lectures)**
   e) The Kaladgi Supergroup. **(2 Lectures)**
   f) Bhima Super Group. **(2 Lectures)**

Reference Books

Singhum - Orissa Iron Ore Craton : Geological Society of India – Special Publication	By Sinha Roy
Geology of Karnataka: Geological Society of India – Special Publication	By Radhakrishna B.P.
Geological of Maharashtra- Geological Society of India – Special Publication	By G.G. Deshpande
Purana Basins of India: Geological Society of India – Special Publication	
Geology of Western and Central India: Geological Society of India – Special Publication	
Stratigraphy of Lesser Himalaya:	By K.S. Vaidiya
A Geological Time Scale:	By Brian Harland et. al.
Stratigraphy of India and Burma:	By M.S. Krishnan
Fundamentals of Historical Geology and Stratigraphy of India:	By Ravindra Kumar
Ramkrishna – Vaidhyanathan: Special Volume Geological Society Of India	
Green stone Belt South India	Janardhan

T.Y. B. Sc Geology

GL: 336- Applied Geology I (Field Geology, Remote- Sensing)

Unit 1: Field Geology: (6 lectures.)

Geology mapping: Definition, aim, uses & mapping techniques (Toposheet, satellite imagery & aerial photograph reading, for base map preparation)

a) ***Study of rock outcrops :*** Varied traverses, most likely locations of rock exposures, Study of outcrops to distinguish between loose boulders and in-situ outcrops, importance of rock contacts, distinguishing between igneous contacts, unconformities and faults, locating eruptive contacts, contacts concealed under soil or vegetation (open wells, road cuttings), determination of dip and strike of strata, field correlation**.**

b) ***Field Observations:*** Aims and objectives of the field work, reconnaissance survey, record of observations.

c) ***General****:* Selecting the field area, collection of selective mineral/ rock samples, preparing sketches and taking photographs, recording the observations.

d) ***Preparation of a geological report:***
   i) Compilation of field data,
   ii) Study of the mineral/ rock samples in the laboratory.
   iii) Preparation of a report (quotations and footnotes, illustrations, table of contents and index).

Unit 2: Principles of Remote Sensing: (9 lectures)

a) Definition, Types of Remote sensing Systems (Active & Passive), Elements of passive Remote sensing system (data acquisition & data analysis), applications of Remote sensing in studying the natural resources like minerals, ground water, soil, forests & in geo-technical investigations.

b) Energy source and radiation principles (EM wave, Wave theory, EM spectrum, particle theory, Stefan-Boltzman's law, Emissivity, Black, white & grey bodies.)

c) Energy interactions in the atmosphere (Scattering, absorption, atmospheric windows & related sensing systems); Energy interactions with the earth (principles of the Conservation of energy, specular & diffused reflectors), Spectral reflectance of vegetation, soil & water; Data acquisition & interpretation.

Unit 3: Photogeology: (15 lectures)

a) Aerial Photography: Classification of aerial photographs on the basis of Camera axis, Film and filter combination, lens -system, types of cameras, high and low sun angle photography.

b) Planning of Aerial photography: Time of photography, Acquiring stereographic photography. Discrepancies in aerial photographs (tip, tilt, drift, crab, gap) and their effects. Geometric characteristics of Aerial photos, marginal information on Aerial photos, Scale of Aerial photos, ground and photographic resolution of Aerial photos, Vertical exaggeration and relief displacement in Aerial photos. Mirror and pocket stereoscopes.

c) Photo recognition Elements: Tone, texture, pattern, shape, size, site, shadow, associations. Basic drainage patterns and their geological significance. Advantages and limitations of Aerial photos.
d) Photo-geological interpretations: Photo characters of Sedimentary, igneous and metamorphic rocks. Interpretation of geologic structures (folds & faults), Interpretation of photo-lineament maps.

Unit 4: Satellites and Satellite data (12 lectures)

1. Introduction: Brief history, Types of Satellites (Orbit Characteristics)
2. Satellites: Types and the information obtained with reference to latest IRS & LANDSAT satellites.
3. Sensors & their applications: MSS, TM, ETM, Hyperspectral Scanners, Active Microwave & LIDAR, Thermal Scanner
4. **Satellite data interpretation** :
   a) Image characteristics & Spectral responses of various features like Lithology, geologic structures, geomorphic features, vegetation (cultivated, forest), land use, water bodies (shallow, deep, clear, polluted), Utility (traffic, telecom, power, settlement etc.) & soils.
   b) Visual interpretation of Satellite imageries.
   c) Computer aided interpretation of digital data.
5. **GPS & GIS (3 Lectures) :**

   a) GPS- What is GPS? Working of GPS.
   b) GIS- What is GIS, Components of GIS, Spatial & Attribute data and data analysis.
   c) Applications of remotely sensed data using GPS & GIS.

Reference Books:

1) Manual of Field Geology : Compton R.J
2) Field Geology : Lahee
3) Remote Sensing and Image Interpretation : Kiefer & Lillesand
4) Principles and Applications of Photogeology : Pandey S.N.
5) Remote Sensing: Principles and Applications : Sabins F.F.
6) Remote Sensing & GIS : B. Bhatta
7) An Introduction to Geographical Information Systems : Ian Heywood e.tal.
8) Remote Sensing of the Environment. An earth resource perspective : by John R. Jenson (2003)
9) Introduction to Geographical Information Systems : Kang-tsung Chang (2002)

T.Y.B.Sc. Geology

GL – 341: Metamorphic Petrology:

Unit

1 **Metamorphism: (8 Lectures)**

a) Introduction, Definition & Characteristics.
b) Domain of metamorphism
c) Lower & Upper limits of metamorphism
d) Metamorphic recrystallization as distinct from igneous crystallization
e) Prograde & Retrograde metamorphism
f) The concept of metamorphic facies: Diagramatic representation of pressure temperature conditions (with depth) of the different facies of contact, regional & Plutonic metamorphism

2 **Metamorphic texture & structures (8 Lectures)**

a) Residual structures & textures.
b) Metamorphic reconstitution (Limit set to diffusion)
c) Characteristics of crystal growth in the solid state.
d) Significance of inclusions in metamorphic crystals
e) Forces of crystallization & the concept of the crystalloblastic series
f) Common habits of metamorphic crystals.
g) Petro genetic implications of metamorphic textures & structures

3 **Agents & types of metamorphism (salient features) – Based on Pressure temperature conditions & their relation with metamorphic facies:(8 Lectures)**

A) Thermal Metamorphism:

a) Definition & General characteristics of the sub types of thermal metamorphism
b) Factors controlling Thermal metamorphism
c) Attainment of Chemical equilibrium
d) Chemically active fluids in heat dominant metamorphism
e) Aureoles of Thermal metamorphism
f) Diagnostic structures of the thermally metamorphosed rocks
g) Effects of thermal metamorphism on :
   i. Igneous rocks (Intermediate & basic)
   ii. Aluminous & ferruginous deposits
   iii. Non – calcareous argillaceous sediments

B) Retrograssive metamorphism: (7 Lectures)

a) Definition & General characteristics
b) Rock deformation involved
c) Stress & metamorphic chemical reactions
d) Stress & solubility of minerals
e) Mechanics of the formation of slaty cleavages
f) Strain & solution effects in the crystalline rocks
g) Diagnostic structures of retrogressively metamorphosed rocks
h) Mineralogical changes in cleaved & crystallized rocks.

C) Regional Metamorphism (8 Lectures)

a) Definition & general characterists of the sub types of regional metamorphism
b) Depth zones & characteristic minerals
c) Diagrammatic representation of the conditions controlling metamorphism

d) Barrovian zones of regional metamorphism.
e) Development of textures & structures of regionally metamorphosed rocks
f) Crystal growth under stress
g) Foliations (Schistosity, Gneissosity & Cleavages)
h) Effects of regional metamorphism:
    i. Argillaceous (Non – calcareous) sediments – (Barrovian zones)
    ii. Ferrugenous & aluminous sediments
    iii. Calcareous sediments
    iv. Igneous (acidic & basic)

D) Plutonic metamorphism (2 Lectures)

a) Definition & General characteristics
b) Formation of Granulites, Charnockites & Eclogites

E) Pneumatolysis / Metasomatism (4 Lectures)

a) Definition & General characteristics of the various types of metasomatism
b) Metasomatic textures & structures
c) Pneumatolytic processes – Tourmalinisation, Greissening, Scapolitisation & Autometasomatism

Reference Books:

1) Igneous & Metamorphic petrology : by Myron Best
2) Principles of Petrology : by G.W. Tyrell
3) Igneous, Metamorphic & Sedimentary petrology : by Ehler & Blatt
4) Igneous & Metamorphic petrology : by Turner & Verhoogen.
5) Metamorphism : by Alfred Harker.

T.Y.B.Sc. Geology

GL – 342: Environmental Geology

Unit

1 **Concept, objectives & scope of Environmental Geology. (3 Lectures)**

a) Physical, Biological & Socio- Geological environment

b) The Biogeochemical Cycle

2 **Deterioration of land surface: Erosion, cause & control. (6 Lectures)**

a) Dimension of erosion, processes, causes of accelerated erosion, remedial measures

b) Desertification & degradation of land : meaning, extent, causes & preventive measures

c) Soil conservation, badland topography, alkalinity & salinity of soils.

3 **Natural Hazards: Definition, type, natural hazard zones & impact assessment, Natural Hazard zonation maps, Role of Geologists in disaster Management plans.**

a) Distinction between hazards & disasters (with examples), local & regional context, Disaster profile of India. **(3 Lectures)**

b) Earthquakes: Introduction, general characteristics, effect of disasters on human life & habitation, origin & Severity of earthquakes, precursors (instrumental & natural) Vulnerability, Seismic zones of India, impact assessment & mitigation measures. **(5 Lectures)**

c) Volcanoes: Introduction, types of volcanic activity & their origin, distribution, hazards, effects (lava flows, pyroclastic activity, toxic gases, mud flows, fires), prediction & mitigation. **(5 Lectures)**

d) Floods: Introduction, definition, classification, causative factors, vulnerability, predictability (Forecasting), mitigation measures, Flood hazards in India. **(5 Lectures)**

e) Mass Movement: Introduction, causes & types of mass movement, Identification of landslide zones, control measures, avalanches & their causes, mitigation & concept of safety factor. **(4 Lectures)**

f) Coastal Hazards: Introduction causes & impacts of coastal erosion, tsunami, storms and their predictability& mitigation measures. **(3 Lectures)**

Mining hazards & restoration techniques. **(1 Lecture)**

4 **Crises & Conservation of Natural Resources: (6 Lectures)**

a) Classification & types of Resources (renewable & non – renewable)

b) Conservation & development of natural resources.

c) Energy Crises & Man: Crises faced by mankind with regards to conventional & non- conventional energy resources, Conservation & development of energy resources, Potential resources of energy: Solar, tidal bio- mass & nuclear.

5 **Pollution: Definition, types of pollution: (4 Lectures)**

Water Pollution: Characteristics of water, types of water, types of water pollution (natural & manmade)

i) Minamata (Japan) disease

ii) Arsenic poisoning (West Bengal)

iii) Fluorosis (Bhandara)

Soil Pollution: Soil pollution sources & causes: Use of pesticides, fertilizers, industrial & domestic waters & their effects.
Air pollution: Sources of air pollution (Aerosols, particulate matters in urban & industrial area),
case history:
i) Chernobyl disaster
ii) Bhopal Gas disaster.

Reference Books

1. Environmental Geology : By K.S. Valdiya
2. Environmental Geology : by E.A. Keller (Latest Edition)
3. Mining & Environment : by Bharat B. Dhar
4. Mineral Economics : by Sinha R.K.
5. Geology in Environmental planning : by A.D. Howard.

T.Y.B.Sc. Geology

GL – 343: Economic Geology

Unit

1 **Introduction: (2 Lectures)**

a) Definition of metalliferous & non – metalliferous deposits, ore minerals, gangue, tenor industrial minerals, overburden & country rock.

b) Classification of economically important metalliferous & non – metalliferous mineral deposits.

c) Processes of formation of mineral deposits.

2 **Magmatic Concentration: (2 Lectures)**

a) Early magmatic deposits

b) Late magmatic deposits

3 **Hydrothermal processes (6 Lectures)**

a) Principles of hydrothermal processes, characters of solutions, types of openings in rocks, factors affecting deposition from hydrothermal solution, wall rock alterations.

b) Types of hydrothermal deposits (Cavity filling & Metasomatic replacements) Cavity filling deposits:

i) Processes & characteristic features

ii) Types of cavity filling deposits: Fissure veins & its types (in brief), stock work, saddle reefs, ladder veins, pitches & flats, breccia filling deposits, solution cavity fillings.

Metasomatic replacement : Definition, Criteria of replacement; resulting mineral deposits.

4 **Oxidation & Supergene enrichment (6 Lectures)**

a) Oxidation & solution in the zone of oxidation

b) Gossans & Cappings, the role of iron in gossans, indigenous & transported limonite, false gossans, gossans as guides to the hidden deposits

c) Ore deposition in the zone of oxidation & their method of precipitation

d) Supergene sulphide enrichment:

i) Requirements for supergene enrichment

ii) Factors influencing supergene enrichment

iii) Recognition of supergene enrichment

5 **Evaporation, Residual concentration, Mechanical concentration: (6 Lectures)**

a) Evaporation:

i) Processes of mineral formation by evaporation

ii) Evaporation deposits: Brief account of deposits of oceanic water, lake water, ground water & hot springs

b) Residual concentration (residual deposits):

i) Conditions favoring of residual deposits

ii) Brief account of residual deposits: Bauxite, Clay & iron formation.

c) Mechanical concentration (placer deposits):

i) Principles involved in the process of mechanical concentration

ii) Study of placer deposits: Eluvial, Alluvial, Beach & Aeolian

6. Metallic deposits of India (6 Lectures)

a) Study of metallic deposits with reference to geological & geographical distribution, mineralogy, properties & uses of the following:
   i) Precious metals: Gold, Silver.
   ii) Non – ferrous metals: Copper, lead & zinc
   iii) Iron & Ferro alloy metals – Iron, Manganese, Nickel & Chromium
   iv) Other metals: Aluminium

b) Plate tectonics & mineral deposits: Mineral deposits associated with different plate boundaries **(1 Lecture)**

8 **Radioactive minerals: (2 lectures)**

Mode of occurrence, mineralogy, geological & geographical distribution & uses of Uranium & Thorium deposits of India.

9 **Geothermal Energy: (2 lectures)**

Definition & types: Dry steam, wet steam, hot & dry rocks, Geo-pressurized zones.

10 **Fossil Fuels: (12 lectures)**

a) Petroleum & Natural Gas: Origin & Entrapment, Types of traps, Formation of oil & gas pools, Surface indicators, description of oil fields in India (Cambay, Assam, Bombay high & Krishna Godavari Basins)

b) Coal: Origin varieties, mode of occurrence, occurrences of coal in India (Raniganj & Bokaro). The coal fields of Maharashtra.

Reference Books

1.	Economic mineral deposits	**:** by Bateman
2	Ore deposits of India	**:** by Gokhale & Rao
3	India's Mineral Resources	**:** by Krishnaswami
4	India's Minerals	**:** by D.N.Wadia
5	Industrial Minerals	**:** By Deb.
6	Geology of the industrial rocks & minerals	**:** by Rober L. Bates
7	Economic Geology	**:** By Umeshwar Prasad
8	Geology of Petroleum	**:** By A. I. Levorsen.
9	Economic Mineral deposits of India. Vol. I & II	**:** by Umate (IBM).
10	Elements of Petroleum Geology	**:** by R. C. Selly (2002)

T.Y.BSc. Geology

GL: 344-Geotectonics

Unit I) Internal structure of the Earth: (6 Lectures)

a) Direct & indirect observations in exploration of Earth's interior

b) The variable interior- evidences:

c) Nature & structure of the Earth

d) Seismic waves & Earth's interior:

i) Types of seismic waves & their characteristics

ii) Seismic wave velocity & depth curve to indicate layered structure of the Earth

e) Spherical zones of the Earth:

i) Composition, physical properties & characteristics of three spherical zones of the Earth namely crust, mantle & core

ii) Concept of Lithosphere, Asthenosphere & Mesosphere

iii) Concept of LVZ & geothermal gradient

iv) Concept & types of discontinuities –Conrad, Moho, Guttenberg & Lehman's discontinuity.

Unit II) The theory of Plate tectonics (15 Lectures)

a) Plate tectonics as a unifying theory

b) Concept of plate tectonics

c) Historical background of the theory

d) Elements of plate tectonics

e) Characteristics of lithospheric plates

f) Concept of plate margin & plate boundary

g) Three plate boundaries- (Divergent, Convergent & Transform faults-description & examples).

1) Divergent boundary as a constructive plate boundary:

   i) Divergent boundary as a source of new oceanic crust

   ii) Concept of a rift valley & mid-oceanic ridges

   iii) Structural environment at divergent plate boundary

   iv) Examples of divergent plate boundary

2) Convergent boundary as a destructive plate boundary :
   (Description & examples of the following types) of convergent plate boundaries :
   i) Oceanic-oceanic subduction.

   ii) Oceanic-continental subduction

   iii) Continent-continent collision

3) Concept of trench, subduction zone, Benioff zone & Ophiolite suites
4) Transform fault as a conservative plate boundary
5) Distinction between Transform & Transcurrent faults.

h) Basin tectonics - fore arc, back arc, fore land & rift basins.
Back arc basins.

i) Migration of plate boundaries and triple junction with their examples

j) Plate motion-Nature & its measurement
- i) Lithospheric motion,
- ii) Asthenospheric motion,
- iii) Convection mechanism,
- iv) Thermal boundary layer concept.

k) Present motion of world's large plates

l) Assumptions & problems in plate tectonics

m) Concept of hot plumes & hot spots with examples

n) Plate tectonics & mineral deposits

Unit III) Palaeomagnetism & Plate-tectonics(4 Lectures)

A. Introduction to Palaeomagnetism
   a) Earth is Magnetic field & geodynamo
   b) Remnant magnetisation – TRM, DRM, CRM, VRM.

B. Polar wandering & its application in plate – tectonics.
   a) Concept of Polar winding
   b) Apparent & True Polar winding (with example)

C. Magnetic anomalies & sea floor Spreading
   a) Magnetic reversal & geomagnetic time scale.
   b) Mechanisms and Application of sea floor spreading.

Unit IV) Mountain Building & Orogenic Process (12 Lectures)

A) Introduction:

a) Concept of Diastrophism as a mountain building process
b) Definition of terms like hillocks, hill, mountain, group, range, system, chain & cordillera.
c) Classification / types of mountains- based on mode of origin:
   i) Depositional mountains (Accumulation types)
   ii) Erosional mountains (Relict / Residual types)
   iii)Diastrophic mountains (Fold mountains, Fault block mountains & Domed mountains)
d) Life cycle of mountains:
   i) Initial stage, ii) Youth stage, iii) Mature stage, iv) Old stage
   Characteristics of above stages, in life-cycle of mountains.

B) Origin of mountains: **(8 Lectures)**

a) Older Concepts:

i) Contraction theory, ii) Friction heat theory, iii) Geosynclinal theory,
iv) Isostatic adjustment theory, v) Continental drift hypothesis,
vi) Thermal cycle hypothesis, vi) Convection current theory

b) Modern Concepts:

i) Plate tectonic model, ii) Deformation of sedimentary basins,
iii)Plutonism & metamorphism, iv) Orogenies in space & time,

v)Outline of origin of Himalayas

Reference Books

1. General Geology : V. Radhakrishnan
2. Plate tectonics and Crustal evolution : Condie
3. Aspects of Tectonics : Valdiya K. S.
4. Tectonics : Moore and Twiss
5. Geochemistry : Mason
6. Geotectonics : V. V. Beloussov
7. Physical Geology : Arthur Holmes
8. Global Tectonics : Keray P and Vine F.J
9. Our evolving planet : Bergen, Alma Mater Fortag
10. Dynamic Himalaya : Valdiya K. S.
11. Geomorphology and Global Tectonics : Summerfield M. A.

T.Y.B.Sc. Geology

GL – 345: Phanerozoic Stratigraphy of India and Palaeontology

Unit

1 Introduction to Phanerozoic Stratigraphy the following Geological systems with reference to their type area, broad lithology, fossils content and classification:
Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian, Triassic, Jurassic, Cretaceous & Tertiary, including the boundaries. **(14 Lectures)**

2 **The Paleozoic Formations of Peninsular India: (4 Lectures)**
A brief history of the Paleozoic Formation,
Gondwana Super group (all aspects)

3 **The Mesozoic Formations of Peninsular India: (5 Lectures)**
A brief history of the Mesozoic formations.
a) The Jurassic of Kutch
b) The Narmada Valley – Cretaceous – Bagh beds.
c) The Cretaceous of Cauvery basin.

4 **The Deccan Traps** (3 Lectures)
Distribution, extent, age and stratigraphy, Lameta beds, Infra and Intertrappean beds.

5 **The Cenozoic Formations of Peninsular India: (3 Lectures)**
A brief history of the Cenozoic formations
a) Tertiary of Assam
b) Tertiary of the K-G basin
c) Tertiary formations along the West Coast.

6 **The Phanerozoic Stratigraphy of Extra – Peninsular India: (5 Lectures)**
Classification, lithological succession and fossil content of the:
a) Spiti area b) Siwaliks c) Karewas

7 **Laterites:** (Origin & distribution) **(1 Lecture)**

8 **The Geology and Stratigraphy of Maharashtra(2 Lectures)**

9 **Palaeontology and Palaeobotany (8 Lectures)**
a) Morphology, Classification & distribution of Graptolites.
b) Mass extinction, causes, evidence, major mass extinction, Permo- Triassic & K/T boundry.
c) Paleaobotany: Definition, Conditions and different modes of preservation of plants through the geological ages.
Study of following genera with respect to their classification, generic definition, characteristic and distribution – Ptillophylum, Glossopteris, Gangamopteris, Vertebraria and Nilsonia

Reference Books

1	Evolutionary trends in Invertebrates	Swinnerton
2	Microfossils	Brassier
3	Invertebrate Palaeontology	Clarkson
4	Micropaleontology	Daniel Jones
5	Paleaobotany	Arnold
6	Geology and Evolution of the Indian Plate	S.M. Naqvi
7	Invertebrate Palaeontology	M.A.Koregave
8	Geology of Maharashtra: Geological Society of India Special Publication	G.G. Deshpande
9	Geology of Western & Central India: Geological Society of India Special Publication	
10	Stratigraphy of lesser Himalaya	K. S. Valdiya
11	A Geological Time Scale	Brian Harland et.al
12	Stratigraphy of India and Burma	M. S. Krishnan
13	Fundamentals of Historical Geology & Stratigraphy of India	Ravindra Kumar
14	Ramkrishna-Vaidhyanathan: : Geological Society of India Special Publication	

T.Y. B. Sc Geology

GL: 346-Applied Geology II (Engineering Geology, Geohydrology & Prospecting)

Unit I: Engineering Geology (20 Lectures)

a) ***Introduction*:** Significance of geology in Civil engineering, knowledge of geomorphology, petrology, mineralogy, stratigraphy, photo geology and structural geology as applied to Civil engineering projects.

b) **Engineering properties of rocks:** Specific gravity, porosity, sorption, strength of rocks (Compressive, shear & tensile), elasticity of rocks, residual and shear stresses in rocks.

c) ***Rocks as Construction Material*:** How are they obtained in nature? Use of rocks as facing stone. Factors influencing engineering usefulness of the rocks.

d) ***Use of rocks as an aggregate*:** Use of rocks as an aggregate in different types of constructions, source of different grades of aggregates, Properties of aggregates (shape, size, surface texture, roundness and coatings), cement aggregates reaction, thermal effects on aggregates. Types of aggregates (Highway, railway ballast and runway).

e) Geological and geotechnical investigations for Civil engineering projects:

i) Tunnels: Terminology, geological conditions for tunnel sites, tunnel in bedded rocks and folded rocks, influence of divisional planes, effects of faults and crushed zones. Tunnels in the vicinity of slopes. Role of groundwater in tunneling. Tunnels in the Deccan Traps. Names and locations of at least six very important tunnels in India.

ii) Dams and Reservoirs: Geological conditions for the selection of dam and reservoir sites, terminology associated with dams. Types of dams (Gravity, buttress, arch and earthen), types of spillways. Location with type of all the important dams and hydroelectric projects in India.

iii) Road alignments & Bridges.

Unit 2: Geohydrology: (15 Lectures)

a) **Introduction:** i) Definition- Hydrology, Geo-hydrology, Hydrogeology. ii) Scope & groundwater development in India. c) Vertical distribution of groundwater, Origin & rock properties affecting groundwater (porosity, permeability, their types & effects).

b) **Aquifers, Darcy's law, Groundwater distribution & fluctuations** :

i) Geologic formations as aquifers.

ii) Types of aquifers (Confined, Unconfined, and Perched).

iii) Groundwater movement (Darcy's law).

iv) Groundwater fluctuations due to seasonal changes, stream-flow changes, evapo-transpiration changes.

v) Factors controlling groundwater distribution (topography, climate, structural, geological, proximity of tanks, rivers etc.)

c) **Groundwater recharge methods:**

1) Introduction to artificial recharge methods.

2) Types of recharge methods: -

i) Water spreading methods (Flooding, Basin, Ditch & furrow, Natural channel, Irrigation).

ii) Recharge through Pits & Shafts, Recharge through wells.

iii) Rain water harvesting.

iv) Groundwater recharge methods in Maharashtra (bore-blast & jacket-well techniques).

Unit 3: Prospecting: (10 Lectures)

a) Objectives, stages & types of prospecting.

b) Geological Prospecting:

i) Geological Criteria: Climatic, Stratigraphic, Lithological, Structural, Geochemical, - Magmagene and - Geomorphological.

ii) Physiographic Guides: Topographic expressions, Physiographic environment of the ore deposits, physiography in relation to oxidation & environment.

iii) Mineralogical Guides: Rock alteration, Target rings of mineral distribution, Significance of accessory & gangue minerals. iv) Stratigraphic & lithologic guides for Syngenetic & Epigenetic deposits, Fracture pattern as guides, Contacts & folds as guides.

c) Broad outline of geophysical prospecting: Principles and applications of following geophysical methods along with their measured parameters, operative physical properties and names of the instruments used.

i) Electrical (S.P. & Resistivity)

ii) Magnetic

iii) Gravity

iv) Seismic refraction.

Reference Books

1) Principles of Geophysical Prospecting : M.B. Ramchandran
2) Geophysical Prospecting : Dobrin
3) Ground water Hydrology : Todd
4) Ground water : H.M. Raghunathan
5) Principles of Engineering Geology : Krynine & Judd
6) Engineering Geology : Parbin Singh

T. Y. B.Sc. Geology

GL – 347: Mineralogy and Petrology

Megascopic Mineralogy:
Identification and the study of the following minerals with reference to physical properties and geological occurrence
Diopside, Mesolite, Andalusite, Albite, Phlogopite, Garnet, limonite, dolomite, halite, olivine, hornblende, augite. **(any 10)**

Microscopic mineralogy:
Identification and the study of the following minerals with reference to optical properties:
Glaucophane, glauconite, staurolite, zircon, apatite, aegerine, hornblende, garnet, biotite, augite, plagioclase, microcline, olivine. **(any 10)**

Mineral Optics:

a) Comparison of R.I of mineral / mounting medium using Becke line method
b) Study of accessory plates: Quartz wedge, gypsum and mica plate
c) Sign of elongation of minerals.

Megascopic igneous petrology:
Study of the following megascopic igneous rocks with regard to their texture, mineral composition, colour index, identification and classification:
Varieties of gabbro (anorthosite, troctolite, norite), felsites, peridotite, lamprophyre, serpentinite, varieties of basalt, carbonatite, granite, rhyolite. **(any 10)**

Microscopic igneous petrology:
Study of the following megascopic igneous rocks with regard to their texture, mineral composition, identification and classification:
Norite, troctolite, anorthosite, peridotite lamprophyre, olivine basalt, granite, carbonatite, rhyolite, andesite **(any 8)**

Description, genesis and significance of the following megascopic textures and structures:
Granitic, porphyritic, graphic, ropy, glassy, columnar, vesicular/ amygdaloidal.

Microscopic igneous structures: Study of the following microscopic igneous textures/ structures, with regard to their genesis and significance:
Granitie, porphyritic (intergranular/ intersertal, poikilitic, ophitic and sub-ophitic), graphic, glassy, flow, serrate, vitrophyric, microlitic, spherulitic, orbicular, reaction rims, expansion cracks, spinifex, perlitic cracks, myrmekitic **(any 8)**

Megascopic sedimentary rocks with regard to their texture / structure, mineral composition, identification, classification and sedimentological significance: Laterite, bauxite, Conglomerate, breccias, grit, arkose, speckled sandstone, sandstone with dendritic markings, ferruginous and carbonaceous shale, limestone (Chemical and Organic), calc-tuffa.

Thin section study of the following sedimentary rocks: Sandstone, arkose, greywacke, nummulitic and oolitic limestones, varieties of limestones with micrites and sparites. (any 8)

Interpretation of the sedimentary structures giving their geological significance:
Sandstone showing parallel bedding, cross bedding, graded bedding, ripple marks, Mud / sun cracks, laminations, tracks and trails.

Study of the following metamorphic megascopic rocks with regard to their texture / structure, mineral composition, colour, type of metamorphism, grade facies and the original rocks:
Slate, phyllite, chlorite schist, mica(Biotite) schist, hornblende schist, staurolite schist, Kyanite schist, talc – tremolite schists, mica gneiss, hornblende gneiss, sillimanite gneiss, augen gneiss, eclogite, charnockite, fuschite quartzite, banded haematite quartzite, marbles (White, Pink, Black, Green and dolomite varieties), schorl, skarn. (any 8)

Study of the thin sections of the following metamorphic rocks with regard to their / structure, mineral composition, colour, type of metamorphism, grade, facies and the original rock:
Chiastolite slate, chlorite schist, staurolite schist, kyanite schist, mica gneiss, sillimanite gneiss, augen gneiss, eclogite, charnockite, khondalite, banded haematite quartzite. (any 8)

T.Y.BSc. Geology

Practical II-GL348: Structural Geology, Economic Geology, Palaeontology & Indian Stratigraphy

Structural Geology:

Unit I) Geological maps: (At least 8 maps)

b. Description of topography & geology of the map
c. Drawing vertical section of the map along desired direction

Note: Geological maps should contain different topographic patterns & all possible structural complexities like unconformity, vertical / inclined faults (strike /dip /oblique), vertical / inclined dykes, lava flows, sills & symmetrical non-plunging folds.

Unit II) Completion of outcrops: (At least 10 maps)

Completion of an outcrop with the help of given topographic & lithological data

Note: One junction line may be partly shown or location of one junction line at three non-collinear points may be given along with geologic / stratigraphic column. Such maps should also contain different topographic patterns & structural complexities like unconformity, vertical / inclined faults (strike /dip / oblique) & vertical / inclined dykes.

Unit III) Structural problems:

A) Graphical problems-(To be solved by using method of descriptive geometry)

Type I) Hill slope, attitude of the exposures of top & bottom of the bed on the hill slope along with true thickness / vertical thickness / true width of outcrop of the bed given, finding out true dip direction, true dip amount & other geometrical parameters of the bed. With comment on normal or overturned bed.

Type II) Problems involving a single planar feature containing a linear feature:

a) Attitude of planar feature along with the bearing of a linear feature contained in it given, finding out plunge & rake of a linear feature in the given planar feature.

b) Attitude of a planar feature along with rake of a linear feature contained in it given, finding out bearing & plunge of the linear feature.

c) Strike, true dip direction of a planar feature along with bearing & rake of a linear feature contained in it given, finding out true dip amount of the planar feature & plunge of the linear feature.

Type III) Three point problems:

Drill hole data for a hidden planar feature at three non-collinear points given in the form of location, elevation & absolute depth of planar feature, finding out strike, true dip direction & true dip amount of the planar feature. Also determining one of the three parameters (location, elevation & absolute depth) where the other two parameters are known.

B) Stereographic Problems: (To be solved by using stereographic net)

Type I) Problems involving strike, true & apparent dip of a bed

a) Strike & true dip of the bed given, finding out apparent dip amount of the bed in the given apparent dip direction.

b) Strike & true dip of the bed given, finding out apparent dip directions for the given apparent dip amount.

c) Apparent dip amount of the bed in two different apparent dip directions given, finding out strike direction, true dip direction & true dip amount of the bed.

Type II)- Problems involving a single planar feature containing a linear feature.

Types (a,b,c) are same as types (a,b,c) from the graphical problems respectively.

Type III) Problems involving two intersecting planar features- Same as type III from graphical problems.

Economic Geology:

I) Megascopic-

a) Ore minerals- To study at least 10 selected ore minerals

b) Industrial minerals- - To study at least 10 selected industrial minerals.

II) Preparation of an ore mineral map of India for the following:

Fe, Mn, Cr, Cu, Pb, Zn & Al.

Palaeontology:

Generic definition, geological & geographic distribution of the following plant genera:

Glossopteris, Gangamopteris, Nilsonia, Ptilophyllum, Vertebraria & Calamites.

Indian Stratigraphy:

Preparation of maps showing geographical distribution of the following stratigraphic units of India:

a. Dharwar Supergroup,
b. Orissa – Singhbhum belt,
c. Aravalli Supergroup
d. Cuddapah Supergroup,
e. Vindhyan Supergroup,
f. Palaeozoic of Spiti
g. Gondawana Supergroup,
h. Jurassic of Kutch, Cretaceous of Trichinopoly, Bagh Beds,
i. Deccan Traps,
j. Siwaliks,
k. Tertiaries.

T.Y.B.Sc. Geology

GL – 349: Practical - III: Remote Sensing, Geohydrology, Environmental Geology, Geophysical Prospecting & Field Geology:

Unit

1 **Remote Sensing:**

A)Problems related to:

1) Scale of aerial photographs & relief displacement
2) Tracing of the drainage of an area with the help of aerial photographs
3) To identify geomorphology of an area from aerial photographs
4) Lithological & structural interpretation of aerial photographs

B) Visual interpretation of false colour composite (FCC) OR B/W satellite imageries. Identification of the geology, structures, vegetation (Crops & forest cover), Land use patterns & soil conditions

C) Engineering Geology: Problems in the form of maps with respect to Tunnel site, Dam site & slope failure.

2 **Geohydrology:**

A)Preparation of hydrogeological maps from the given data on:

1) Well inventory (Well locations, geological sections, Water level fluctuations)
2) Water table contour maps.

B)Drainage Basin Analysis:

1) Area of Basin
2) Stream Ordering
3) Bifurcation ratio.

3 **Environmental Geology:**

1) Hazard Zonation Maps (Earthquakes, Landslides, Flood)
2) Physical properties of soil: colour, texture & grain size

4 **Geophysical Prospecting:**

Problems related to Resistivity data (VES) for Location of bore /dug well.

Field Geology: Field work for about two weeks, in an area of geological interest anywhere in India. Systematic collection of geological samples, data collection & preparation of geological field report.