अंतरी पेटवू ज्ञानज्योत

(NAAC Re-Accredited)

KAVAYITRI BAHINABAI CHAUDHARI

NORTH MAHARASHTRA UNIVERSITY,

JALGAON

FACULTY OF SCIENCE AND TECHNOLOGY

Choice Based Credit System (CBCS) Pattern

Syllabus for T. Y. B. Sc. GEOLOGY

Semester V and VI

With effect from June, 2020

Structure of curriculum of T.Y.B.Sc. (GEOLOGY)

(CBCS) Pattern

Semester V

Discipline	Course Type	Course Code	Course Title	Credits	Hours/ Week (Clock Hours)	Total Teaching Hours	Marks (Total 100)	
							CA	UA
DSC	Core I	Geol- 501	Structural Geology	3	3	45	40	60
	Core II	Geol- 502	Sedimentary Petrology	3	3	45	40	60
	Core III	Geol- 503	Mineralogy	3	3	45	40	60
	Core IV	Geol- 504	Paleontology	3	3	45	40	60
DSC Skill Enhancement Course (SEC)	Skill Based	Geol- 505	Indian Stratigraphy	3	3	45	40	60
DSC Elective Course	Elective Course (Any One)	Geol- 506 (A)	Economic Geology	3	3	45	40	60
		Geol- 506 (B)	Exploration Geology					
DSC	Core Practical	Geol- 507	Practical related to 501	2	4 (Per Batch)	60	40	60
		Geol- 508	Practical related to 503	2	4 (Per Batch)	60	40	60
		Geol- 509	Practical related to 502, 504 and Field Geology	2	4 (Per Batch)	60	40	60
Non Credit Audit Course	Elective audit course (Any one)	AC- 501 (A)	NSS	No credit	2	30	100	-----
		AC- 501 (B)	NCC					
		AC- 501 (C)	Sports					

Structure of Curriculum of T.Y.B.Sc. (GEOLOGY)

(CBCS) Pattern

Semester VI

Discipline	Course Type	Course Code	Course Title	Credits	Hours/ Week (Clock Hours)	Total Teaching Hours	Marks (Total 100)	
							CA	UA
DSC	Core I	Geol- 601	Crystallography and Optics	3	3	45	40	60
	Core II	Geol- 602	Igneous and Metamorphic Petrology	3	3	45	40	60
	Core III	Geol- 603	Mineral and Fuel Resources	3	3	45	40	60
	Core IV	Geol- 604	Geomorphology	3	3	45	40	60
DSC Skill Enhancement Course (SEC)	Skill Based	Geol- 605	Environmental Geology	3	3	45	40	60
DSC Elective Course	Elective Course (Any One)	Geol- 606 (A)	Geotechnics	3	3	45	40	60
		Geol- 606 (B)	Physics and Chemistry of the Earth					
DSC	Core Practical	Geol- 607	Practical related to 601	2	4 (Per Batch)	60	40	60
		Geol- 608	Practical related to 602	2	4 (Per Batch)	60	40	60
		Geol- 609	Practical related to 603, 604 and Field Geology	2	4 (Per Batch)	60	40	60
Non Credit Audit Course	Elective audit course (Any one)	AC- 601 (A)	Soft Skill	No credit	2	30	100	-----
		AC- 601 (B)	Yoga					
		AC- 601 (C)	Practicing Cleanliness					

T Y B Sc. Geology (CBCS Structure)

(With Effect from June, 2020)

Semester V and VI

Preamble:

In continuation with CBCS system introduced for First Year B. Sc (2018-19) through Second Year B. Sc during the academic year 2019-20, the Choice Based Credit System (CBCS) is being implemented at Third Year B. Sc from the academic year 2020-21.

The contents of the syllabi have accommodated the widening horizons of the discipline of Earth Sciences. They do reflect the current changing needs of the students: specifically, for the courses that have social impact like Hydrogeology, Fuel Geology, Engineering Geology, Remote Sensing etc.

The well organized curricula include basics as well as advanced concepts in Geosciences spread over three years of Graduation. The syllabus lists new practical exercises so that the students get hands-on experience of the latest techniques that are in current usage in Geosciences.

The curriculum is designed to inspire the students to develop exquisiteness to pursuing higher education and to boost research mindset in Geology. Encourage the learners to become an entrepreneur, as also enable them to get employed in various organizations at National and International level like Research Institutes, Industries, Educational Institutes and in the various concerning departments of State and Central Government.

The overall syllabus does not compromise with the Principle of giving all the basic and sound fundamental foundation of the subject required for the learned to be a Graduate.

Introduction:

Geology is the study of everything we should know about the history of the 4.5 billion years of the Earth and evolution of life.

Geologists study society's important problems, like Energy, Water, Mineral, Metal and Rock as a resource; the Environment; Climate change; Natural hazards; and construction projects like Roads, Bridges, or Dams; Impacts of developments on the environment; to mention a few. Geologists are also responsible for exploring and finding resources required by a modern society, or even for our own survival.

We require trained Geologists to work in the fields of mining, oil and gas, environmental science, city planning, water & resource management, atmospheric & space science, oceanography, geotechnical engineering, hydrogeology, education & research, and many others.

The syllabus is therefore evolved according to the need to be a trained Geologist required as a Human Resource in our country.

At First Year of Under-Graduation (Semester I and II) the topics are related to the Introduction to Geology including exposure to Fundamental characters of Earth and Minerals, study of

Geochemical characters of rocks, Structural Geology etc. The practical course is aimed at developing interest in the subject and to equip the students with skills required for Mineral identification, Topography, Topographic sheets and Map reading, introduction to analytical instruments and also applications of Geology in various fields.

In Second Year of Under-Graduation (Semester III and IV) students study the courses like Petrology, Stratigraphy, Hydrogeology and Watershed Management. The Practical includes developing further skills in the concerned courses that have societal importance.

During Third and Final Year of Under-Graduation (Semester V and VI) students get to understand the updated theory and practical content of respective courses.

Semester V includes further detailed studies of the various disciplines of the Geology like Structural Geology, Mineralogy, Paleontology, Sedimentary Petrology and Indian Stratigraphy. Skill based course as Remote Sensing and Engineering Geology is included, with choice to select either Economic Geology or Exploration Geology as elective course.

Semester VI covers the theory and practical courses related to Igneous and Metamorphic Petrology, Crystallography and Optics as core courses and Environmental Geology as a skill enhancement course. This will assist the students to create awareness towards Soil and Water as a resource and Natural Hazards. Students can also select either Mineral and Fuel Resources or Physics and Chemistry of Earth as discipline specific elective course.

Learning Objectives:

Student Learning Outcome for Learners and who successfully complete the Graduation in Geology are expected to demonstrate knowledge, skills and interest in order to:

1. Develop an understanding of the Earth through fundamentals of Earth Sciences.
2. Provide quality education, knowledge and information on different branches of Geology.
3. Provide basic knowledge of Minerals, Rocks, Natural Resources,
4. Inculcate interest and strong foundation to undertake further education and research in Geology.
5. Groom the students to apply fundamentals of Geology in creating awareness in society using platform of private and government organizations.
6. Develop skills in field techniques.
7. Make the students aware about importance of origin, distribution and conservation of Natural Resources, Energy and Environment.
8. Apply the fundamental principles of geology to understand geological processes and issues.
9. Describe the existence of our solar system and comprehend the history of Earth and surrounding spheres.

10. Understand how Geosciences works through inquiry, observation, verification, reason, critical thinking, synthesizing the data and communicate their knowledge of geological concepts through written and oral representation.

11. Students will develop the basic observational skills they need to function as Geoscientist

12. Perform tests and collect data to analyze geological materials, features, and processes both qualitatively and quantitatively.

13. Synthesize the principles learned in the classroom, in the laboratory, and during field studies to identify geological features, interpret geological history, and solve geological problems.

14. Demonstrate the ability to acquire and communicate scientific data, ideas, and interpretations through written, oral, visual, and digital means.

15. Provide quality education offering skill based programs and motivate the students for self employment in applied branches of Geology.

Program Specific Objectives (PSO) :

Inspiring our graduating students to be life-long learners in a diverse global community and prepare them to pursue a Geosciences career through innovative and hands-on involvement in the classroom, laboratory, and field activity.

Within 3 years of students graduating with a degree in Geology from KBCNM University, Jalgaon our alumni should possess the knowledge and skills to:

1. Achieve excellence in academic and scientific research in the field of Geology.

2. Develop and implement ways and means to ensure quality performance and output of Geology program.

3. Use modern technology in education and scientific research in Geology.

4. Get involved in advanced training to improve the skills of graduates in Geology and related disciplines.

5. Create academic and scientific environment to attract outstanding faculty, researchers and students.

6. Improve the national and international interactions with academic institutions and research centers.

7. Prepare the students to develop a mindset to apply scientific methods in understanding the earth sciences

8. Develop competence in basic lab skills, including use of modern instrumentation and computers.

9. Prepare the graduate students to handle diverse career opportunities through student centered learning and student-faculty interaction using a blend of traditional, current, and integrative pedagogical techniques in educational research.

Program Outcome (PO)

The Program outcome is to equip the students with scientific knowledge to be able to explore the Earth's holistic information and applying it to solve societal problems. The Program is dedicated to the enhancement of teaching, research as part of contribution to understanding and community relevance in the region. It is aimed :

1. To possess a good command of fundamentals in Geology and its relationship to other disciplines.

2. To get acquainted with theoretical, practical and field aspects in the sections of Geology and interrelations of materials of Earth.

3. To design and conduct experiments in Geology.

4. To develop skills in laboratory techniques in analysis of Geological materials.

5. To equip the student learners to be able to frame policies and legislation for Mining, Minerals and Groundwater etc.

6. To prepare students for writing field reports, giving presentations, and participating in discussions.

7. To develop skills to use computer software, applications and field techniques in Geology.

8. To understand and get familiar to the principles of research methodology.

9. To be able to demonstrate content knowledge appropriate to professional career goals,

10. To be able to communicate and disseminate geologic knowledge, findings and interpretations in reports to the stake holders in society.

Course Outcome (CO) :

Upon completion of the course students should be able to:

1. Create an understanding of geologic processes responsible for existence of the earth.
2. Analyze, development, understand the scope, and limitations of Principles of Geosciences.
3. Institute the ability to Access, evaluate, earth science information and compare it with current models of solid earth processes.
4. Make field and laboratory - based observations and measurements of rocks and minerals, and/or Earth's internal process, use scientific reasoning to interpret these observations and measurements, and compare the results with current models of solid earth processes identifying areas of congruence and discrepancy
5. Develop insight regarding origin of Universe, solar system and Earth, the diversity in minerals, rocks, structure and Fossils from Earth, Natural resources etc.
6. Understand the applications of Processes of Earth System Science.
7. Acquire skills in the Data collection, compilation, analysis and report writing in Geology.

Duration: The course duration for B.Sc. degree program shall be consists of Three Years, spread over 6 semesters.

Medium of instruction: The medium of instruction for the courses shall be English.

Examination pattern : Each theory and practical course will be of 100 marks split into Internal / College Assessment (CA) of 40 marks and External / University Assessment (UA) of 60 marks.

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T. Y. B. Sc. (CBCS) GEOLOGY SYLLABUS

(w. e. f. June 2020)

Semester V

Discipline Specific Core Courses (DSC)

GEOL 501 : STRUCTURAL GEOLOGY

GEOL 502 : SEDIMENTARY PETROLOGY

GEOL 503 : MINERALOGY

GEOL 504 : PALEONTOLOGY

Discipline Specific Core Course; Skill Enhancement Course (SEC)

GEOL 505 : INDIAN STRATIGRAPHY

Discipline Specific Core Course; Elective Course

(Any one of A or B)

GEOL 506 : (A) ECONOMIC GEOLOGY

(B) EXPLORATION GEOLOGY

Discipline Specific Core Practical

GEOL 507 : PRACTICAL RELATED TO GEOL: 501

GEOL 508 : PRACTICAL RELATED TO GEOL: 503

GEOL 509 : PRACTICAL RELATED TO GEOL: 502, 504 AND FIELD GEOLOGY

Non Credit Audit Course

Elective Audit Course (Any one)

AC 501 (A) : NSS

AC 501 (B) : NCC

AC 501 (C) : SPORTS

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T.Y.B.Sc. (CBCS) GEOLOGY SYLLABUS

SEMESTER V

(w. e. f. June, 2020)

GEOL 501: STRUCTURAL GEOLOGY

Unit No	Topic	Sub-topic	Lec. Hrs	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 inhomogenity of rocks.	08	06
II	Mechanics of Plastic deformation	a. Intergranular movements b. Intragranular movements. c. Recrystallization, Reicke's principle.	05	06
III	Fold	a. Definition of fold. b. Classification of folds based on I. Size of interlimb angle II. Closing and facing direction III. Attitude of axial plane IV. Nature of profile V. Dip isogon c. Mechanics of folding I. Flexure / flexure slip folding. II. Flow folding. III. Shear folding. d. Ultimate causes of folding – Tectonic and non tectonic processes. e. Map symbols for Fold.	10	16

IV	Principles of Failure by rupture	a. Failure under tension, compression, couple and Torsion. 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. Definition of Fault b. Genetic classification of faults. c. Separation and Shift along Fault. d. Mechanics of faulting: I. Mechanics of normal or gravity fault, horst and graben. II. Mechanics of thrust faults under different conditions. a. Mechanics of strike-slip faults and movement along transform fault. b. Use of the strain ellipsoid in recognizing movements along Faults. c. Map symbols for Fault.	10	14
VI	Foliation (Cleavage) and Schistosity	a. Introduction and descriptive terminology. b. Relations of cleavage and schistosity to major structures.	03	4
VII	Secondary lineation	a. Introductions and kinds of secondary lineation. b. Relations of lineation to major structures.	02	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.	03	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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T.Y.B.Sc. (CBCS) GEOLOGY SYLLABUS

SEMESTER V

(w. e. f. June 2020)

GEOL 502: SEDIMENTARY PETROLOGY

Unit	Topic	Sub-topic	Lec. Hrs	Marks
I	Origin of Sedimentary rocks	a. Introduction b. Exogenic rocks (Allogenic) c. Endogenic rocks (Authigenic)	2	2
II	Formation of Sedimentary Rocks	a. Origin of Sedimentary rocks: Definition of Weathering, denudation and erosion, processes of weathering (Mechanical, Chemical and Biological) b. Goldich weathering scale. c. Chemical weathering of Basalts and Granites d. Modes of transportation; traction, saltation, suspension and solution.	4	2
III	Deposition of sediments.	Environment of Deposition : Glacial, Marine, Terrestrial (Fluvial, Lacustrine, Aeolian).	4	2
IV	Gain size distribution and environment of deposition.	a. Introduction, Grade scale: Wentworth Scale, phi (Φ scale), mesh scale. b. Granulometric analysis : i Sample collection (semi and consolidated sediments) ii Ro Tap machine (Sieve shaker) iii Cumulative grain size distribution plots (simple graph and arithmetic probability sheet), iv Graphic parameters of size frequency (Mean, Standard Deviation, Skewness, Kurtosis). c Grain-size distribution and environment of deposition based on different plots. d Relation of grain size distribution and tectonic setting.	15	34

v	Sedimentary rock characterization	a. Properties of Sandstone (Texture based on size, sorting and shape of grains). b. Mineral and Textural Maturity in Sandstone. c. Mineral composition of sandstones. d. Digenesis of Sandstone e. Classification of Sandstone by Folk f. Classification of Conglomerate and Breccia g. Digenesis of Limestone.	10	10
VI	Provenance	a. Definition b. Mobility of Oxides c. Mineral stability series of Goldich d. Mineral maturity e. Mineral and source rock f. Heavy Mineral zones g. Provenance and Texture (textural and mineral maturity)	5	6
VII	Palaeocurrent analysis.	a. Introduction to Palaeocurrent analysis. b. Cross bedding, ripple mark, sole marks and Palaeocurrent.	3	2
VIII	Sedimentary Basins	Introduction and map of Sedimentary basins of India.	2	2

Reference Books:

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

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T.Y.B.Sc. (CBCS) GEOLOGY SYLLABUS

SEMESTER V

(w. e. f. June, 2020)

GEOL 503 : MINERALOGY

Unit No	Topic	Sub-topic	Lec. Hrs	Marks
I	Introduction	a. Definition of Mineral and Mineralogy b. Branches of Mineralogy c. Types of Minerals - Pyrogenetic, Authigenic and Metamorphic. d. Mineral forming processes - Igneous, Sedimentary and Metamorphic.	4	5
II	Mineral Groups	Study of following mineral groups with respect to their Structure, chemistry, Optical and physical properties, paragenesis, and uses of : a) Olivine : Fo – Fa series b) Garnet : Pyralspite, Ugrandite c) Pyroxene : Ortho and Clino Pyroxenes d) Amphibole : Hbl Series, Cation distribution e) Mica f) Clay Minerals g) Silica h) Feldspar : Alkali Feldspars, Ab – An Series, Perthites. i) Feldspathoid. j) Zeolites	35	40
III	Description of Minerals	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.	6	15

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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T.Y.B.Sc. (CBCS) GEOLOGY SYLLABUS

SEMESTER V

(w. e. f. June 2020)

GEOL 504: PALAEONTOLOGY

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
I	Introduction	i) Definition and introduction of Palaeontology ii) Branches of Paleontology iii) Introduction to the origin of life.	2	3
II	Invertebrate Palaeontology	Study of fossils based on Systematic position, Hard part (internal & external) morphology, Geological and geographical distribution of the following Phylum : a) Phylum Mollusca i. Pelecypoda (Bivalvia) ii. Gastropoda iii. Cephalopoda (Nautilus, Ammonites, Belemnites) b) Phylum Brachiopoda: Difference between bivalves & brachiopods. c) Phylum Echinodermata: d) Phylum Arthropoda : Trilobites: Head, Thorax & Pygidium.	25	35
III	Micro palaeontology.	a. Introduction to Micropaleontology: Definition, size and composition of microfossils, branches of micropaleontology. b. Uses of Microfossils	8	3

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
IV	Microfossils	a. Foraminifera: a) Systematic position, morphology of test, environmental and Palaeo-ecological significance. b. Ostracods: a) Systematic position, morphology of Carapace, environmental and Palaeo-ecological significance.	8	14
V	Palaeobotany	Introduction to Palaeobotany.	2	5

Reference Books

1. A text book of Geology, Kulkarni et al., Nirali Publication, Pune
2. Palaeontology invertebrate, Woods, H, CBS Publication
3. Invertebrate Palaeontology and Evolution, Clarkson, E.N.K., Allen and Unwin Publication
4. Palaeontology: Evolution and Animal Distribution, Jain, P.C. and Anantharaman, MS.,Vishal Publication.
5. Microfossils, Howard Armstrong and Martin Brasier, Blackwell Publishing Ltd.

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T.Y.B.Sc. (CBCS) GEOLOGY SYLLABUS

SEMESTER V

(w. e. f. June 2020)

GEOL 505: INDIAN STRATIGRAPHY

Unit No	Topic	Sub-topic	Lec. Hrs	Marks
I	Introduction	Introduction to Indian Stratigraphic Time Scale	2	2
II	Archaeans and Proterozoics.	a. Study of Cratons based on Stratigraphy, Lithology and economic importance 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, Economic Importance of : i. Vindhyan basin ii. Cuddapah Basin	20	30
III	Gondwana Super Group	Stratigraphy, lithology, structure, environment of deposition, intrusive activity, fossil and economic importance of Gondwana Supergroup.	5	8
IV	Mesozoic Formations of India.	a. Jurassic of Kachchh – Stratigraphy, lithology and fossils. b. Cretaceous of Tiruchirappalli – Stratigraphy, lithology and fossils. c. Study of Bagh beds, Lametas. d. Deccan Volcanic Province – Introduction, Field structures of basaltic flows, Litho and Chemo Stratigraphic Classification, Age, dykes in Deccan Traps e. Brief account of Inter and Intra -trappeans	13	12
V	Cenozoic Formations in India	a) Tertiary of Assam: Stratigraphy, lithology fossils and economic importance. b) Siwaliks – Introduction, stratigraphy and sedimentation, lithology and fauna.	5	8

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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T.Y.B.Sc. (CBCS) GEOLOGY SYLLABUS

SEMESTER V

(w. e. f. June 2020)

GEOL 506 (A) : ECONOMIC GEOLOGY

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
I	Terminologies	Definition of Economic Geology, Ore mineral, Tenor of ore, Gangue minerals,	2	3
II	Classification of minerals deposits	Classification of minerals deposits as suggested by: Irving 1908; Lindgren Classification 1911; Bateman's Classification	5	5
III	Process of formation of Mineral Deposits.	a. Magmatic Concentration. b. Sublimation. c. Hydrothermal deposition : i. Principle of hydrothermal process ii. Openings in rocks iii. Hydrothermal alterations iv. Cavity fillings v. Metasomatic replacement d Contact Metasomatism i. Introduction ii. Process and effects iii. Resulting mineral deposits e Sedimentation i. Source of material ii. Solution, transportation and deposition iii. Conditions of deposition f Evaporation i. Process of mineral formation ii. Deposits from Oceanic water iii. Deposits from groundwater iv. Deposits from hot springs g Residual and Mechanical Concentration h Oxidation and supergene enrichment. i Metamorphism.	35	48
IV	Polymetallic nodules.	Polymetallic nodules.	3	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 V
(w . e. f. June 2020)

GEOL 506 (B): EXPLORATION GEOLOGY

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
I	Mineral Resources	Mineral Resources: Resource reserve definitions, Mineral resources in industries - historical perspective and present, A brief overview of classification of mineral deposits with respect to processes of formation in relation to exploration strategies.	2	6
II	Prospecting and Mineral Exploration	Prospecting and Exploration, Principles of mineral exploration, Prospecting and exploration- conceptualization, methodology and stages, Sampling, subsurface sampling including pitting, trenching and drilling Geochemical exploration	2	6
III	Data Evaluation	Evaluation of data Evaluation of sampling data Mean, mode, median, standard deviation and variance.	5	8
V	Drilling and Logging techniques	Drilling and Logging Core and non-core drilling Planning of bore holes and location of boreholes on ground Core-logging	6	4
VI	Reserve Estimations	Reserve estimations and Errors, Principles of reserve estimation, density and bulk density Factors affecting reliability of reserve estimation, Reserve estimation based on geometrical models (square, rectangular, triangular and polygon blocks) Regular and irregular grid patterns, statistics and error estimation	30	36

Reference Books:

1. Elements of Mining, Clark, G.B. 3rd Ed. John Wiley & Sons.
2. Moon, C.J.,Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration,
3. Arogyaswami, R.P.N. 1996 Courses in Mining Geology. 4th Ed. Oxford-IBH.

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

SEMESTER V (PRACTICAL)

(w. e. f. June 2020)

GEOL 507: PRACTICAL RELATED TO GEOL- 501(STRUCTURAL GEOLOGY)

Unit No	Topic	Sub-topic
I	Geological Maps	1. Study of topography and geology of the map and drawing section along the given direction (maps with two series, Fault and fold)
II	Outcrop completion	1. Junction of beds 2. Based on three points
III	Structural problems	1. Problems with true and apparent dip given in ratio. 2. Problems using stereographic projection- Strike, true dip and apparent dip of the bed.

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T.Y.B.Sc. (CBCS) GEOLOGY SYLLABUS

SEMESTER V (PRACTICAL)

(w. e. f. June 2020)

GEOL 508: PRACTICAL RELATED TO GEOL- 503(MINERALOGY)

Unit No	Topic	Sub-topic
I	Mineralogy	Study of following minerals for its physical properties, uses, occurrences of a. Ore minerals - Sphalerite, Pyrrhotite, Orpiment, Realgar, Magnetite, Pyrolusite, Psilomelane, Magnesite, Malachite, Limonite 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. c. c. Hess calculation for Pyroxenes d. d. Mineral calculation for Feldspars
II	Economic Geology	a. Preparation of an ore-mineral map of India for the following: Iron, Manganese, Chromium, Copper, Lead, Zinc and Aluminum. b. Petroliferous basins in India, c. Coal-fields of India

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SEMESTER V (PRACTICAL)

(w. e. f. June 2020)

GEOL 509: PRACTICAL RELATED TO GEOL- 502 AND 504 (SEDIMENTARY PETROLOGY, PALEONTOLOGY, INDIAN STRATIGRAPHY AND FIELD GEOLOGY)

Unit No	Topic	Sub-topic
I	Sedimentary Petrology	a Study of the following Megascopic rocks with regards to their texture/ structure, description, identification and classification, giving their sedimentological significance of : Conglomerate, Breccia, Laterite, Bauxite, Freestone, Flagstone, Calcareous sandstone, Siliceous standstone, Ferruginous sandstone, Arkose, Speckled sandstone, Ferrugenous and Carbonaceous Shale, Limestone, Calcrete, Crinoidal limestone, Fossiliferous Limestone. b Thin section study of the following sedimentary rocks **:** Sandstone, Ferruginous sandstone Arkose, Nummulitic limestone, Meliolitic limestone and Limestone. c Plotting and calculation of the sieve analysis data and environmental interpretation and energy condition.
II	Invertebrate Micropalaeontology Palaeobotany,	Study of 25 animal fossil/Shells, 5 microfossils and 5 plant fossils.
III	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 (not more than 100 pages) OR REVIEW ARTICLE (not more than 100 pages).**

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Discipline Specific Core Courses (DSC)

GEOL 601: CRYSTALLOGRAPHY AND OPTICS

GEOL 602: IGNEOUS AND METAMORPHIC PETROLOGY

GEOL 603: MINERAL AND FUEL RESOURCES

GEOL 604: GEOMORPHOLOGY

Discipline Specific Core Course; Skill Enhancement Course (SEC)

GEOL 605: ENVIRONMENTAL GEOLOGY

Discipline Specific Core Course; Elective Course

(Any one of A or B)

GEOL 606: (A) GEOTECHNICS

(B) PHYSICS AND CHEMISTRY OF THE EARTH

Discipline Specific Core Practical

GEOL 607: PRACTICAL RELATED TO GEOL: 601 (CRYSTALLOGRAPHY AND OPTICS

GEOL 608: PRACTICAL RELATED TO GEOL: 602 (IGNEOUS AND METAMORPHIC PETROLOGY)

GEOL 609: PRACTICAL RELATED TO GEOL: 603, 604 (GEOMORPHOLOGY, MINERAL AND FUEL RESOURCES AND FIELD GEOLOGY

Non Credit Audit Course

Elective Audit Course (Any one)

AC 601 (A) : SOFT SKILLS

AC 601 (B) : YOGA

AC 601 (C) : PRACTICING CLEANLINESS

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(w. e. f. June 2020)

GEOL 601 : CRYSTALLOGRAPHY AND OPTICS

Unit No	Topic	Sub-topic	Lec. Hrs	Marks
I	Introduction	a. Definition of Crystal and Crystallography b. External morphology of crystals : Face, Edge, Corner, Form, Solid Angle, Interfacial Angle and its Law . c. Crystal symmetry : Plane, Axis, Centre. d. Crystallographic axis e. Index System of Miller – Law of rational Indices	3	5
II	Descriptive Crystallo-graphy	Study of crystal systems with respect to their crystallographic axis, elements of symmetry, forms present with indices of : a. Cubic System : Pyrite and Tetrahedrite type b. Hexagonal System : Beryl, Calcite, Quartz, and Tourmaline type c. Monoclinic System : Gypsum Type d. Triclinic System : Axinite Type	20	25
III	Crystal Lattice	Bravais' 14 Space Lattice	2	5
IV	Twin crystals	a. Definition b. Genesis of twining- Twin growth, transformation and deformation c. Terminology related to twinning- twin plane, twin axis, composition plane and re-entrant angle, d. laws of twinning, e. Classification of twins- Contact, penetration, repeated, polysynthetic, simple, compound	3	5

IV	Optics	a. Refractive Index, Relief and Twinkling, Becke line and its uses. b. Color and Pleochroism c. Compensation and Determination of Interference colors d. Accessory plates : Types and uses e. Sign of elongation : length fast and length slow f. Uniaxial and Biaxial Minerals : Definition, indicatrices and optic sign g. Explanation of Central uniaxial interference figure and its sign when the section is perpendicular to optic axis. h. Explanation of Biaxial interference figure perpendicular to Acute bisectrix and its sign	17	20

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
6. Dana : Elements of Mineralogy
7. Winchell : Elements of Optical Mineralogy
8. Kerr : Optical Mineralogy
9. Whalstrom : Optical crystallography
10. Deer, Howie Zussman : Rock forming minerals, Vol. I - IV
11. Cracknell : Crystals and their structure
12. Frye Keith : Modern Mineralogy

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GEOL 602: IGNEOUS AND METAMORPHIC PETROLOGY

Unit No	Topic	Sub-topic	Lec. Hrs	Marks
I	Crust and	Composition and recycling.	2	2
II	Mantle Melting	a. Melting of mantle -, Rising temperature, Lowering pressure and Volatiles b. Generation of Primary Magma	2	5
III	Classification of Igneous rocks	CIPW Classification	1	5
IV	Reaction series	Reaction series and its interpretation	2	5
V	Evolution of Magma	a. Crystal fractionation- Fo- Fa and Leucite- Silica systems b. Separation mechanisms: i. Gravity settling. ii. Flow differentiation. iii. Gas streaming. c. Liquid immiscibility (Silicate-Silicate) d. Contamination -Assimilation with melting and without melting e. Significance of contamination f. Mixing of magmas (Similar and dissimilar) Melting and crystallization of Ternary system (Di – Ab - An). g. Fractional crystallization of Basaltic magma.	18	18
VI	Introduction to Metamorphism	a. Types of metamorphism and their controlling factors b. Classification and nomenclature of metamorphic rocks based on Fabric c. Barrovian zones	4	5

VII	Metamorphic facies	a. Definition, b. Description of – i. Facies of contact metamorphism ii. Facies of regional metamorphism	10	12
VIII	Stability of metamorphic minerals	P-T boundaries and mineral equations of : Zeolites, Chlorites, Muscovite, Biotite, Staurolite, Garnet, Pyroxenes, Amphiboles, Aluminosilicates	6	8

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
7. Metamorphism: Alfred Harker
8. Petrography of the Igneous and Metamorphic rocks in India: S. C. Chatterjee
9. Metamorphic Petrology, Mineralogy and Field aspects: Turner
10. Metamorphism and Metamorphic belts: Miyashrio
11. Petrology (Igneous, Sedimentary and Metamorphic): Blatt and Tracy.
12. Analysis of Metamorphic techniques: Turner and Weiss
13. Metamorphic Petrology: B. Bhaskar Rao
14. Theoretical petrology by Barth

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GEOL 603: MINERALS AND FUEL RESOURCES

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
I	Coal	a. Origin of Coal b. Varieties of Coal c. Classifications of coal d. Rank and Grades e. Distribution of coal in India. f. Introduction to Coal Bed Methane	10	16
II	Coal fields of India	Study of Stratigraphy, structure, lithology of following coal fields : i. Raniganj, ii. Neyveli lignite. iii. Coalfields of Maharashtra	05	4
III	Petroleum	a. Origin of Oil and Natural Gas b. Migration of Oil and Natural Gas c. Distribution of oil and gas in India. d. Introduction to Gas Hydrates	10	10
IV	Oil fields of India	Study of Stratigraphy, structure, lithology of oil fields: i. Upper Assam ii. Bombay High iii. Cambay Basin Cauvery Basin	5	6
V	Geotherma l Energy	Introduction and distribution in India. Types of geothermal systems.	4	6
VI	Nuclear fuels	U and Th- Mineralogy, Uses and Distribution.	3	6

VII	Mineral Deposits of India	Geological and geographical distribution, uses and characters of: a. Metallic Minerals : Gold, Manganese, Iron, Aluminum, Lead, Zinc, Copper. b. Non Metallic Minerals : Diamond, Mica, Graphite, Feldspar, Gypsum, Ochre, Clay minerals c. Introduction to Mineral resources of Maharashtra	8	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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GEOL 604: GEOMORPHOLOGY

Unit No	Topic	Sub-topic	Lec. Hrs	Marks
I	Geomorphology	Definition and Introduction to Geomorphology Fundamental concepts in geomorphology	2	6
II	Soil	a. Soil formation and types b. Soil Profile c. Soils of Maharashtra	4	6
III	Landforms	a. River: Mesa and Butte, Water divides, Cuesta, Hogback b. Sea: Longshore deposits (Spits, Bar, Tombolo, Hooks, Lagoons, Tidal flats, marshes) c. Glaciers: Tarns, Aretes, Horn, Cols, Fjords, Eratics and perched blocks, Outwash plains, Moraines, Kettle holes, Kames, and Eskers. d. Karst Topography	16	18
IV	Genetic classification of streams	a. Phases of drainage network development b. Genetic classification of Streams c. Drainage network patterns (dendritic, trellis, rectangular, radial, annular, parallel) d. Definition of terms : Antecedent and superimposed streams, River piracy	10	12
V	Drainage basin Morphometric analysis	a. Drainage basin and network characters, b. Linear aspects: Stream Ordering, stream length and Bifurcation ratio c. Aerial aspects: Basin area, Drainage Density, Stream frequency and Drainage texture.	8	10

VI	Applications of Geomorphology	Applications of Geomorphology in: a. Hydrology b. Economic Geology c. Engineering Geology d. Oil Exploration	5	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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GEOL 605: ENVIRONMENTAL GEOLOGY

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
I	Fundamental Concepts	Fundamental concepts of Environmental Geology	2	8
II	Land as a Resource	a. Land classification - Agricultural land-use b. pattern, Land productivity and capability. c. Human settlement and land use d. Land use pattern in India e. Assessment of impact of land use f. Desertification and degradation of land	12	12
III	Soil as a resource	Methods of Soil Conservation	8	10
IV	Water as a resource	a. Water resources of India b. Groundwater provinces of India c. Pollution and Quality of Surface and ground water d. Water logging and development of alkaline and acidic soils e. Effect of withdrawal of Groundwater f. Water management	11	16
V	Natural and Anthropogenic hazards	Definition and Nature of Natural Hazards Natural hazards, causes and prevention of- a. River flooding b. Landslides c. Earthquakes d. Volcanic activity e. Coastal hazards f. Mining hazards.	12	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

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GEOL 606 (A): GEOTECHNICS

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
I	Remote sensing	a. Definition, Necessity, Importance, Concept and Scope of Remote sensing, b. Active and Passive type of Remote sensing. c. Electromagnetic Radiation- EM spectrum d. Absorption, Transmission, Reflection, e. Energy interaction in atmosphere- Scattering of light (Raleigh, Mie, Nonselective) and atmospheric window f. Interaction of EMR with water, vegetation and Soil. g. Resolution in Remote Sensing- spatial, pixel, spectral, radiometric, temporal resolution h. Orbit- Definition, Sun synchronous and Geo stationary orbit i. Sensors and Platforms- Definition and types j. MSS bands- Blue, Green, Red, Near IR and FCC k. Indian Remote Sensing satellites, l. Difference between Aerial Photographs and Satellite imageries m. Image interpretation - Tone, texture and pattern. n. Introduction and working of GIS & GPS	20	26
II	Hydro-geology	Groundwater investigation by Electrical method of Wenner and Schlumberger (VES) Three layer model interpretation by curve matching technique, type of curves (Type H, A, K and Q) Water conservation methods in Maharashtra Water Budget- Definition and calculation.	12	14

III	Engineering Geology	Engineering properties of rocks, aggregate and their characteristics Geotechnical investigations for site selection of Dam, Tunnels, Bridges And Road Ways.	13	20

Reference 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. Beloussov
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. Remote Sensing : Patel and Sinha
13. Groundwater ; Raghunath
14. Engineering geology : Krynine and Judd

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GEOL 606 (B): PHYSICS AND CHEMISTRY OF THE EARTH

Unit No.	Topic	Sub Topic	Lec. Hrs	Marks
I	Earth: surface features	Continents, continental margins, oceans	3	5
II	Earth's interior	a. Variation of physical quantities and seismic wave velocity inside the earth, b. Major sub divisions and discontinuities. c. Concepts of Isostasy; Airy and Pratt Model Core: Seismological and other geophysical constraints. d. The geodynamo-Convection in the mantle	10	15
III	Elements of earth's magnetism.	a. Secular variation and westward drift b. Solar activity and magnetic disturbance	5	8
IV	Elements: Origin of elements/ Nucleo-synthesis.	a. Abundance of the elements in the solar system / planet earth b. Geochemical classification of elements. c. Earth accretion and early differentiation. d. Isotopes and their applications in understanding Earth processes. e. Stable isotopes: Stable isotope fractionation. Oxygen isotopes f. Sublithospheric Mantle (Mineralogy/phase transitions)	20	20
V	Environmental geochemistry	a. Geological disposal of nuclear waste b. Lead in environment and effect of lead on human health	7	12

Reference Books:

1. Holmes, A., Principles of Physical Geology, 1992, Chapman and Hall

2. Condie, K.C. Plate Tectonics and Crustal Evolution, Pargamon Press, 1989.

3. Krauskopf, K. B., & Dennis, K. Bird, 1995, Introduction to Geochemistry. McGraw-Hill

4. Faure, G. Principles and Applications of Geochemistry, 2/e (1998), Prentice Hall, 600 pp.

5. Anderson, G. M. (1996).Thermodynamics of natural systems. John Wiley & Sons Inc.

6.Steiner, E. (2008).The chemistry maths book. Oxford University Press.7.Yates, P. (2007) Chemical calculations. 2nd Ed. CRC Press.

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SEMESTER VI (PRACTICAL)

(w. e. f. June 2020)

GEOL 607: CRYSTALLOGRAPHY AND OPTICS

Unit No	Topic	Sub-topic
I	Crystallography and Optics	a. Optical properties of following minerals: Quartz, Orthoclase, microcline, sanidine, Plagioclase, Muscovite, Biotite, Garnet, Leucite, Olivine, Augite, Hypersthene, Hornblende, Tourmaline, Staurolite, Silimanite, Kyanite, Calcite b. Uniaxial and Biaxial interference figure and their sign. c. Study of crystal systems with respect to their crystallographic axis, elements of symmetry, forms present with indices of : 1. Cubic System : Pyrite and Tetrahedrite type 2. Hexagonal System : Beryl, Calcite, Quartz and Tourmaline type 3. Monoclinic System : Gypsum Type 4. e Twin crystals

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(w. e. f. June 2020)

GEOL 608: IGNEOUS AND METAMORPHIC PETROLOGY

Unit	Topic	Sub-topic
I	Igneous Petrology	a Study of the following Megascopic rocks with regards to their texture, mineral composition, colour index, identification and classification : Granite, Diorite, Norite, Anorthosite, Dunite, Graphic Granite, Pencil Pegmatite, Felsite Porphyry, Diorite Porphyry, Orthoclase Porphyry And Dolerite , Trachyte, Rhyolite, Mega Porphyritic Basalt b Thin section study of the following rocks with regards to their texture, mineral composition, colour index, identification and classification. Granites, Gabbro, Norite, Dunite, Graphic Granite, Basalt, Olivine Basalt, and Trachyte c Description, Genesis and Significance of the following Megascopic textures / structures : Granitic, Porphyritic, Graphic, Ropy, Glassy, Columnar, Vesicular and Amygdaloidal. d CIPW Norm calculation of saturated rocks based on given chemical data.

II	Metamorphic Petrology	a. Study of the following Megascopic rocks with regards to their texture/structure, mineral composition, type of metamorphism, grade, facies and the original rock : Slate, Phyllite, Chlorite Schist, Biotite Schist, Hornblende Schist, Kyanite Schist, Mica-Garnet Schist, Hornblende Gneiss, Augen Gneiss, Biotite Gneiss, Charnockite, Banded Hematite Quartzite, Quartzite and Marble. b. Study of the thin sections of the following rocks with regard to the their texture/ structure, mineral composition, colour, type of metamorphism and grade: Chlorite Schist, Staurolite Schist, Kyanite Schist, Biotite Schist, Mica-Garnet Schist, Hornblende Gneiss, Charnockite, Marble and Quartzite. c. Megascopic Fabrics – Granulose, Schistose, Gneissose, Slaty Cleavage, Augen structure, Granoblastic.

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(w. e. f. June 2020)

GEOL 609: PRACTICAL RELATED TO 603, 604 AND FIELD GEOLOGY (MINERAL AND FUEL RESOURCES AND GEOMORPHOLOGY, GEOTECHNICS AND FIELD GEOLOGY)

Unit No	Topic	Sub-topic
I	Geomorphology	a. Calculation of Stream ordering and Bifurcation ratio. b. Calculation of Basin area, Stream length, Perimeter and Drainage texture. c. Identification and description of following landforms - d. River: Mesa and Butte, Water divide, Cuesta and Hogback e. Sea: Longshore deposits (Tombolo, Lagoons and Tidal flats) f. Drainage network patterns (dendritic, trellis, rectangular, radial, annular, parallel) g. Study of Soil profile.
II	Hydrogeology	Interpretation of Vertical Electrical Sounding for Groundwater exploration.
III	Engineering Geology	a. Study of different type of Dams. b. Data analysis on core recovery and Rock Quality Designation. c. Use of building stones.
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 (not more than 100 pages)** **OR** **REVIEW ARTICLE (not more than 100 pages).**

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Job Opportunities for B. Sc Geology Students

There are many careers available to Geologists in National and International level in Government and NGOs in the fields including Environmental Geology, Pollution Control, High Altitude Geology, Geological Surveying, Water Supplies, Engineering Geology, Ground Investigation, Geochemistry, Space / Remote Sensing, Geotechnical Engineering, Hazard management and identification, Gemology, Geologists can opt for Teaching and Research or undertake independent research.

Potential employers include environmental agencies and consultancies; oil, gas, petroleum, groundwater, civil engineering and construction companies; nuclear research bodies and commissions; government organizations and NGOs and also can become good enterprisers in the field of water resource, natural building stones, minerals etc.
Most geologist jobs involve a combination of fieldwork, laboratory and office work, and career growth perspectives often involve some management responsibilities.

If the student decides to change career path, the skills that the student acquires and learns in the three years of graduation will still be useful. For instance, communication skills, life skills, writing skills, quantitative reasoning and digital skills will allow thru to shift into many other areas such as research, engineering, laboratory work, finance, government consultancies and journalism, law etc.

The few to list are :

1. In competitive exams of State and Central Governments as MPSC and UPSC
2. State and Central Forest departments through exams
3. As a consultant in groundwater exploration, water shed management
4. As a consultant gem and jewelry
5. As a consultant in geotechnical field.
6. As a geologist in different NGOs.
7. As Mining Geologist