FOUR YEAR UNDERGRADUATE PROGRAMMES (FYUGP)

IN GEOLOGY

UNDER RABINDRANATH TAGORE UNIVERSITY AS PER NEP-2020

(This is approved in the Board of Studies, Geology, RTU on 15.05.2024 and **Revised** on 14.06.2025)

The Rabindranath Tagore University, Hojai, Assam constituted the Board of Studies (BOS) in Geology with the following members:

1. Dr. Nibedita Dutta (Chairperson), Head, Department of Geology, Lumding College, Lumding.
2. Prof. Parag Phukon (Subject Expert), Department of Geological Sciences, Gauhati University.
3. Dr. Sujata Sen (Member), Associate Professor Department of Geology, Lumding College, Lumding.
4. Dr. Ajanta Sarma (Member), Associate Professor Department of Geology, Gurucharan College, Silchar
5. Prof. Balen Bhagabaty (Member), Department of Geological Sciences, Gauhati University.

In consultation with the Members of the BOS (Geology), Rabindranath Tagore University, the syllabi for FYUGP Geology (Major, Minor, Multidisciplinary Course, and Skill Enhancement Course) were prepared and approved on 15.05,2024 and revised on 14.06.2025

RabindranathTagore University:Four YearUnderGraduate Programme

(BasedonUGCCurriculumandCreditFramework with Major (2024-25))

The Rabindranath Tagore University has adopted under graduate Course curriculum Framework (UGCF) under New Education Policy, 2020 to be implemented from August, 2023. It is a structure for four-year under Graduate programmes in different disciplines with multiple exit options.

DesigneofCourses:

Thecategoriesofcoursesandrequirementofminimumcreditsfor4-yeardegreeas perUGCareasfollows:

1. **Major** **:80 Credits**
2. **Minor** **:32Credits**
3. **Multidisciplinary(GE)** **:9 Credits**
4. **AbilityEnhancementCourse** **:8 Credits**
5. **SkillEnhancementCourse** **:9Credits**
6. **ValueAdded Course** **:8 Credits**
7. **Summer Internship** **:2Credits**
8. **Dissertation/Researchproject** **:12Credits**

Thedetailsofthestructureareprovidedbelow:

StructureofUndergraduateCurriculumFramework(UGCF) Bachelorof(FieldofStudy/Discipline) withMajor (2024-25)									
Semester	**MAJOR**	**MINOR**	**GE/MDC**	**AECC**	**SEC**	**VAC**	**VOC./ MINORPROJ/ Summer Internship**	**Research Proj/ Dissertation**	**Credit**
1st	MAJOR -1(4)	MINOR-1(4)	GE-1(3)	AEC-1(2)	SEC-1(3)	VAC-1(2) VAC-2(2)	×	×	20
2nd	MAJOR -2(4)	MINOR -2(4)	GE-1(3)	AEC-2(2)	SEC-2(3)	VAC-3(2) VAC-4(2)	×	×	20
TOTAL	**8**	**8**	**6**	**4**	**6**	**8**	**-**	**-**	**40**
Studentsonexitshallbeawarded UndergraduateCertificate(inthefieldofstudy/discipline)aftersecuringtherequisitecredits44including vocational4creditsmandatoryoncompletionofsemesterII									
3rd	MAJOR-3(4) MAJOR-4(4)	MINOR -3(4)	GE-1(3)	AEC-3(2)	SEC-3(3)	×	×	×	20
4th	MAJOR-5(4) MAJOR-6(4) MAJOR-7(4)	MINOR -4(4)	×	AEC-4(2)	×	×	Summer Internship(2)	×	20
TOTAL	**28**	**16**	**9**	**8**	**9**	**8**	**2**	**-**	**80**
Studentsonexit shallbeawarded UndergraduateDiploma(inthefieldofstudy/discipline)aftersecuringtherequisitecredits88includingvocational4 Creditsmandatory oncompletion of semester IV									
5th	MAJOR-8(4) MAJOR-9(4) MAJOR-10(4) MAJOR-11(4)	MINOR -5(4)	×	×	×	×	×	×	20
6th	MAJOR-12(4) MAJOR-13(4) MAJOR-14(4) MAJOR-15(4)	MINOR -6(4)	×	×	×	×	×	×	20
TOTAL	**60**	**24**	**9**	**8**	**9**	**8**	**2**	**-**	**120**

Studentsonexit shallbeawardedBachelorof(inthefieldofstudy/discipline)Majorwithout Honours(3Years)after securingtherequisitecredits 120 oncompletion of semester VI									
7th	MAJOR-16(4) MAJOR-17(4) MAJOR-18(4) MAJOR-21(4)*	MINOR-7(4)	×	×	×	×	×	Dissertation Project (4)	20
8th	MAJOR-19(4) MAJOR-20(4) MAJOR-22(4)* MAJOR-23(4)*	MINOR-8(4)	×	×	×	×	×	Dissertation Project (8)	20
TOTAL	**80**	**32**	**9**	**8**	**9**	**8**	**2**	**12**	**160**
StudentsonexitshallbeawardedBachelorof(inthefieldofstudy/discipline)Honours/HonourswithResearchaftersecuringtherequisite 160creditsoncompletionofsemesterVIII									

ImportantPoints:

1. Studentoptstoexitaftercompletionof1styearsecuring40creditss/hemaybe awardedaUGCertificate, if s/hecompleted one vocational course of 4 credits during summer vacation of first year.
2. StudentoptstoexitaftercompletionofSecondyearsecuring80creditss/hemaybeawardedaUGDiploma,ifs/he completed one vocational course of 4 credits during summer vacation of second year.
3. Student opts to exit after completionof either 1st year or completionof2ndyear may be allowedto re-enter within three years and complete the degree programme within the stipulated maximum period of seven years.
4. StudentoptstoexitaftercompletionofthirdyearsecuringcreditswillbeeligibleforUGdegreewithMajor discipline without Honours.

5. For4-yearHonours degreethemajorsubject/disciplinerequires 80creditsandtheminor subject/disciplinerequires 32 credits. The student who exits after completion of 6th Semester/3rd Year, s/he requires 60 credits in the major subject/discipline and 24 credits in the minor subject/discipline.

6. Studentswhointendtocompletefouryeardegreeprogrammewillhavetwooptionsin7thand8thsemesteras:

   i) Students who choose Research in 4th year are to study MAJOR-16, MAJOR-17, and MAJOR-18 of 4 credits eachand to complete a dissertation/project of 4 credits mandatorily in 7thsemester.

   Accordingly,in8thsemesterthesestudentswillstudyMAJOR-19,MAJOR-20of4creditseachandtocompletea dissertation/project of 8 credits.

   ii) Students who don't choose Research will study MAJOR-21*, MAJOR-22*, MAJOR-23* mandatorily in lieu of dissertation/project in 7thand8thsemester in addition to (MAJOR-16 to MAJOR-20) leading to Honours without Research.

7. Studentswho completedfouryeardegreeprogrammewithdissertation/projectwill beawardedBachelorDegreeof Honours with Research. And students who completed four year degree without dissertation/project will beawarded Bachelor Degree of Honours.

8. Courselevel(refertoUGC'sCurricularFramework):

    a. 0-99: Pre-requisite
    b. 100-199: Foundation&Introductory
    c. 200-299: Intermediate-level
    d. 300-399: Higher-level
    e. 400-499: Advancedcourse
    f. 500-599: First-yearMasters-level
    g. 600-699: Second-yearMasters-level
    h. 700-799: Doctorallevel

    Courselevels0-499areforFourYearUnderGraduateProgramme

9. Thelevelofcourse/paperfor thecategoryof DSC(Major)andDSE(Minor)ineachsemestershallbeas under:

	DSC (Major)	**DSE (Minor)**
1st Semester	Level 100	Level100
2nd Semester	Level100	Level100
3rd Semester	Level200	Level200
4th Semester	Level200	Level200
5th Semester	Level300	Level200
6th Semester	Level300	Level200
7th Semester	Level400	Level300
8th Semester	Level400	Level300

Dr. A. Gautam

AcademicRegistrari/c

STRUCTURE OF FOUR -YEARS UNDERGRADUATE PROGRAMME (FYUGP) IN GEOLOGY FOR AFFILIATED COLLEGES UNDER RABINDRANATH TAGORE UNIVERSITY AS PER NEP

SEMESTER	COURSE(MAJOR)		CREDIT	LEVEL	MARKS
1st	Paper-Earth System Science Code-MAJ-GLG-1.1		4	100	100
2nd	Paper-Crystallography and Mineralogy Code-MAJ-GLG-2.1		4	100	100
3rd	Paper- Structural Geology and Geo-tectonics Code-MAJ-GLG-3.1		4	200	100
	Paper-Petrology-I Code-MAJ-GLG-3.2		4	200	100
4th	Paper-Petrology-II-Igneous Code-MAJ-GLG-4.1		4	200	100
	Paper-Petrology-II-Sedimentary Code-MAJ-GLG-4.2		4	200	100
	Paper-Petrology-II-Metamorphic Code-MAJ-GLG-4.3		4	200	100
5th	Paper-Paleontology Code-MAJ-GLG-5.1		4	300	100
	Paper-Principles of Stratigraphy and Indian Stratigraphy Code-MAJ-GLG-5.2		4	300	100
	Paper-Economic Geology Code-MAJ-GLG-5.3		4	300	100
	Paper- Geomorphology and Hydrogeology Code-MAJ-GLG-5.4		4	300	100
6th	Paper-Remote Sensing and GIS Code-MAJ-GLG-6.1		4	300	100
	Paper-Fuel Geology Code-MAJ-GLG-6.2		4	300	100
	Paper-Exploration and Mining Code-MAJ-GLG-6.3		4	300	100
	Paper-Engineering Geology and Environmental Geology Code-MAJ-GLG-6.4		4	300	100
7th	Paper- Elements of Geophysics and Geochemistry Code-MAJ-GLG-7.1		4	300	100
	Paper- Climatology and Oceanography Code-MAJ-GLG-7.2		4	300	100
	Paper- Geology of North East India Code-MAJ-GLG-7.3		4	300	100
	Paper- Seismology/ Dissertation Project Code-MAJ-GLG-7.4		4	300	100
8th	Paper- Research methodology Code-MAJ-GLG-8.1		4	300	100
	Paper- Earth and Climate Code-MAJ-GLG-8.2		4	300	100
	Paper- Geodynamics and Global tectonics Code-MAJ-GLG-8.3	Dissertation Project	4	300	100
	Paper- Geohazards Code-MAJ-GLG-8.4		4	300	100

SEMESTER	COURSE(MINOR)	CREDIT	LEVEL	MARKS
1st	Paper-General Geology Code-MIN-GLG-1.1	4	100	100
2nd	Paper-Crystallography and Mineralogy Code-MIN-GLG-2.1	4	100	100
3rd	Paper- Structural Geology and Geotectonics Code-MIN-GLG-3.1	4	200	100
4th	Paper-Petrology Code-MIN-GLG-4.1	4	200	100
5th	Paper-Economic Geology, Stratigraphy and Palaeontology. Code-MIN-GLG-5.1	4	200	100
6th	Paper-Engineering Geology, Hydrogeology and Remote Sensing Code-MIN-GLG-6.1	4	200	100

SEMESTER	COURSE(MD)	CREDIT	LEVEL	MARKS
1st	Paper-Introduction to Geology Code-MD-GLG-1.1	3	100	75
2nd	Paper-Minerals and Rocks Code-MD-GLG-2.1	3	100	75
3rd	Paper-Geology of North East India Code-MD-GLG-3.1	3	100	75

SEMESTER	COURSE(SEC)	CREDIT	LEVEL	MARKS
1st	Paper- Basic Field Training Code-SEC-GLG-1.1	3	100	75
2nd	Paper- Geological Mapping Code-SEC-GLG-2.1	3	100	75
3rd	Paper- Basic Laboratory Techniques in Geology Code-SEC-GLG-3.1	3	100	75

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AS PER NEP-2020

1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-1)
3. Semester: First Semester
4. Course Name: Earth System Science
5. Paper Code: MAJ-GLG-1.1
6. Course level: 100
7. Credit:4(Th-3, Pract-1)

Programme Specific Outcome: *The Bachelor of Science in Geology (Major) Programme in Four Years Undergraduate Programme (FYUGP) of Lumding College under Rabindranath Tagore University includes a Graded Semester System which combines detailed theoretical knowledge, practical knowledge and extensive Field Survey/ Field work. The Primary goal of this Undergraduate Programme is to provide students' Academic competencies, ethical values and professional skills that facilitate their transition from Undergraduate to Post-graduate work or Professional positions. Students will develop the aptitudes and dispositions necessary to help democratized society by obtaining and maintaining employment as a professional Geologist.*

Course Outcome: *This course provides integrated understanding of the Solar system, Earth as a Planet, its complex processes, past and future evolution and interaction with society. This course also aims at complex interaction among Lithosphere, Biosphere and Atmosphere. Students will get a clear concept about topics related to geomorphological processes and their impact on Earth's surface and landscape development.*

Syllabus showing each unit against class number and marks:

Unit No.	Unit Content	No. Of Classes	Marks
Unit-1 (Theory)	Holistic understanding of the dynamic planet 'Earth'. Introduction to various branches of Earth Sciences. General characteristics and origin of the Universe, Solar System and its planets. The terrestrial and Jovian planets. Meteorites and Asteroids; Earth in the solar system - origin, size, shape, mass, density, and its age, Internal Structure of the Earth. Concept of Geological Time Scale	15	25
Unit-2	Elementary knowledge of Lithosphere, biosphere, Hydrosphere and Atmosphere. Oceanic current system and effect of Coriolis force; Land air-sea interaction. Atmospheric circulation, Weather and climatic changes. Endogenetic and exogenetic processes of the Earth-weathering and erosion; Soil: formation, types, soil profile and soil types of India	15	25
Unit-3	Fundamental Concept of plate tectonics and continental drift. Wilson's Cycle; Concept of Sea-floor spreading ; Mid Oceanic Ridges, trenches; Origin of oceans and continents; Earthquake and earthquake belts; Volcanoes- types and their distribution	15	25
Unit-4 (Practical)	Study of contours: Patterns of contours to indicate various topographical features; interpretation of topographic maps; Drawing of profile and study of geomorphological features from topographic maps; Exercises on major ocean currents of the World. Study of soil profile of any specific area.	15 (Each class of two hours duration)	25

SUGGESTED READINGS:

1. Duff, P.M.D., & Duff, D.(Eds). (1993). Holmes' Principles of Physical Geology. Taylor & Francis.
2. Emiliani, C. (1992). Planet Earth: Cosmology, Geology, and the Evolution of Life & Environment. Cambridge University Press
3. Alan P. Trujillo and Harold B. Thurman, Essentials of Oceanography, Prentice Hall
4. Summerfield M.A.(1991), Global Geomorphology-an introduction to the Study of Landforms, Prentice Hall
5. Bloom A.L.(1998), Geomorphology: A Systematic Analysis of Late Cenozoic Landforms. Pearson Education
6. Anderson S. R. and Anderson Suzanne P.(2010), Geomorphology-the mechanics and Chemistry of Landscapes, Cambridge University Press, U.K.
7. J.T.Jenkins , A Text book of Oceanography, Constable and Co. Ltd., London

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology(MAJOR-2)
3. Semester: Second Semester
4. Course Name: Crystallography and Mineralogy
5. Paper code: MAJ-GLG-2.1
6. Course level: 100
7. Credit:4(Th-3, Pract-1)

Course Outcome: *This course provides integrated understanding of the crystallization and crystal growth, unit cell, space groups and point groups and study of various crystal systems. Students will learn about crystal intergrowth and twinning, twin law and types of twinning. They will be able to learn about the crystallographic projections of different crystal systems. This course includes basic concepts of X-Ray crystallography and different physical properties of the minerals. This course provides a detailed optical mineralogy to identify the mineralogical composition of geological materials in order to help reveal their origin and evolution.*

Study and identification of different minerals is a very important part of mineralogy and in the practical classes the students will get sufficient knowledge to identify the minerals.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Crystallography** Crystal and its characteristic features; crystallization and crystal growth; crystallographic axis, axial ratio, crystal symmetry, Interfacial angle, Parameters, Indices, crystal habits, crystal systems, 32 point groups, space-lattice, Bravais lattices, Symmetry notations of Hermann-Mauguin to different crystal system, crystal intergrowth, twinning-twin element, twin laws, types of twin law in different systems, twinning in feldspars, Crystal projections of Tetragonal, orthorhombic and monoclinic systems, Determination of axial ratio. Basic concepts of XRD.	15	25

Unit-2	**Physical Mineralogy** Definition of Minerals; Physical properties of mineral, Relationship of physical properties with atomic structure; Classification of minerals; Silicate Structures, CCD and HCP structures, structures of NaCl, F, Diamond. Study of physical and optical properties, atomic structure and chemistry of the following group of minerals- Olivine, Garnet, Pyroxene, Amphibole, Mica, Feldspar, Clay minerals.	15	25
Unit-3	**Optical Mineralogy** Nature of light; Reflection and Refraction of rays; R.I.; Dispersion of light; Polarization of light; plane polarization by doubly refracting crystals (Nicol Prism), by differential absorption (Polaroid) and by reflection (Bretoster's Law), Pleochroism, Interference Colour, Extinction, types of extinction and extinction angle. Isotropic and Anisotropic (Uniaxial and Biaxial) positive minerals; Optical axis, Optical Indicatrix. Interference figure; determination of optic sign Measurements of optic axial angle.	15	25

Unit 4	**Practical** Study of the forms and symmetry element of the holohedral class (Normal) of Isometric, Tetragonal, Hexagonal, Monoclinic and Triclinic systems; Study of twinning with the help of crystals models with reference to composition plane, twin plane, twin axis, twin law. Stereographic projection of holohedral class (Normal) of Isometric, Tetragonal, Orthorhombic, Monoclinic. Determination of axial ratio of Tetragonal and Orthorhombic. Study of physical properties of minerals in hand specimen: Quartz, Orthoclase, Olivine, Garnet, Sillimanite, Kyanite, Staurolite, Beryl, Tourmaline, Augite, Hypersthene, Hornblende, Biotite, Muscovite, Microcline, Plagioclase. Study of minerals in thin sections- Quartz, Orthoclase, Olivine, Garnet, Augite, Hypersthene, Hornblende, Biotite, Muscovite, Microcline, Plagioclase. Determination of the composition of Plagioclase by Michael- Levey Chart. Determination of optic sign from centered/ off centre uniaxial interference figures and centered acute bisectrix and centered optic biaxial interference figures by the use of accessory plates	30	25

SUGGESTED READINGS:

1. Klein, C., Dutrow, B., Dwight, J., & Klein, C. (2007). The 23rd Edition of the Manual of Mineral Science (after James D. Dana). J. Wiley & Sons.
2. Kerr, P. F. (1959). Optical Mineralogy. McGraw-Hill.
3. Verma, P. K. (2010). Optical Mineralogy (Four Colour). Ane Books Pvt Ltd.
4. Deer, W. A., Howie, R. A., &Zussman, J. (1992). An introduction to the rock-forming minerals (Vol. 696). London: Longman.

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-3)
3. Semester: Third Semester
4. Course Name: Structural Geology and Geotectonics
5. Paper code: MAJ-GLG-3.1
6. Course level: 200
7. Credit:4(Th-3, Pract-1)

Course Outcome:*This course combines study and identification of different minerals is a very important part of mineralogy and in the practical classes the students will get sufficient knowledge to identify the mineralsStructural Geology and Geotectonics, after successful completion of this course student will be able to know accurate geometric description of the structures observed in natural deformed rocks. Moreover this course provides the knowledge of the classifications of folds, faults, fractures etc. This course also provides understanding of the tectonic history of the earth. After completion of the course the students will be able to know about the mechanism of deformations at their consequences.*

In the practical classes the students will be able to learn how to use the stereographic projection to plot planar and linear data, determine angular relationships, solve rotational problems, and analyze complex structural data in areas involving folding and faulting.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Structural Geology:** Definition and Scope Of Structural Geology; Primary, Secondary, Penecontemporaneous Structures Diastrophic and Non-Diastrophic Structures; Concept of Strike and Dip; **Stress and Strain:** Concept of stress; Types of stress; Stress at a point; Mohr diagram and its use in presentation of two-dimensional stress, Concept of Strain**;** stain in two and three dimensions. Types of strain; relation of stress and strain ellipsoids and their geological significance; Flinn and Ramsay diagram of presentation of strain; Concept of deformation in rocks: Brittle and ductile deformations; progressive deformation. **Unconformity:** Types of unconformity and their recognition in the field	15	25

Unit-2	**Folds:** Morphology, Geometric and Genetic classifications of folds; Mechanics of folding and their recognition in the field; Ramsay Classification of folds. **Boudinage and Boudins:** Pinch-and-swell structure and boudins; geometry of boudins; types of boudins; use of boudinage structures as kinematic indicators. **Fracture and Joint:** Different types of fractures; feature on fracture surface; relationships of fractures to other structures. **Faults:** Basic idea of fault and fault zone; geometric and genetic classification of faults; Anderson's dynamic analysis of faulting; criteria of recognition of faults; mechanics of faulting; distinguishing characteristics of fault and unconformity in the field. **Foliation and Lineation:** Classification and origin of lineation and foliation; tectonic significance of lineation and foliation; relationships of foliation and lineation with the major structures.	15	25
Unit-3	**Geotectonics:** Tectonic plates, evolution of the theory of plate tectonics, plate tectonics and seismicity; Seismic belts, sea floor spreading and mid oceanic ridges, ring of fire; Mantle plume and hotspot. Tectonics of NE India with special emphasis on eastern Himalaya, Assam and Assam-Arakan folded belt.	15	25
Unit-4	**Practical:** Stereographic projection of planes and lines; determination of true dip and apparent dips; 3-point problems; determination of pitch and plunge of folded structure. Megascopic study of planer, linear and deformed structures. Study of geological maps with unconformity, fold/fault/intrusive body and drawing of geological cross section and interpretation.	30	25

SUGGESTED READINGS:

1) Billings, M. P. (1987). Structural Geology, 4th edition. Prentice-Hall.
2) Davis, G.R. (1984). Structural Geology of Rocks and Region. John Wiley
3) Fossen, H. (2010). Structural Geology. Cambridge University Press.
4) Ghosh, S.K. (1993) Fundamentals and Modern Development of Structural Geology. Pergamon Press. v) Marshak, S. and Mitra, G. (1988). Basic Methods in Structural Geology. Prentice Hall.
5) Pollard, D.D. (2005) Fundamental of Structural Geology. Cambridge University Press.

6) Ragan, D.M. (2009). Structural Geology: an introduction to geometrical techniques (4th Ed). Cambridge University Press (For Practical).
7) Ramsay, J.G. (1967). Folding and Fracturing of Rocks. Mc-Graw Hill, New York.
8) Twiss, R.J. and Moores, E.M. (2007) Structural Geology. Second Edition. W. H. Freeman and Company.
9) Stephen M. Tomecek, (2009). Plate Tectonics, Science Foundations.
10) Kent C. Condie(1997).Plate Tectonics and Crustal Evolution, Butterworth Heinemann,

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-4)
3. Semester: Third Semester
4. Course Name: Petrology I
5. Paper code: MAJ-GLG-3.2
6. Course level: 200
7. Credit:4(Th-3, Pract-1)

Course Outcome:*Petrology combines concept of igneous, sedimentary and metamorphic rocks. Study of igneous rock is a key component of geology curriculum because these rocks are the abundant rock throughout the crust of the earth and their formations are related to crustal and upper mental environments. This course provides understanding of magma generation and crystallization mechanism that will help to understand the evolution of diverse rock types and their link to tectonic settings.*

In this course the students will learn about the mode of formation, occurrence, textures, structures, classifications and the interrelationships of the three rock types.

The practical course helps students to identify various types of igneous, sedimentary and metamorphic rocks in hand specimen. Moreover in the geological field work the students will get through knowledge about the different types of rock exposures and associated structures.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Rocks:** Definitions and types, Rock cycle, Distinguishing features of three major rock types. **Igneous rocks:** Mode of occurrence, Textures and structures, classification of igneous rocks on (IUGS classification), chemical & quasi-chemical (C.I.P.W. classification) criteria. Petrography of- Granite, Rhyolite, Gabbro, Dolerite, Basalt, Syenite and Diorite.	15	25
Unit-2	**Sedimentary rocks:** Abundance of common sediments; Processes of formation of sedimentary rocks- weathering, transportation, deposition, lithification and diagenesis. Textures and structures of sedimentary rocks. Petrography of – Sandstone, Limestone, Shale, Conglomerate and Breccia	15	25
Unit-3	**Metamorphic Rocks:** Definition; Factors or agents of Metamorphism; Types of metamorphism; Depth zones of metamorphism; Textures and structures of metamorphic rocks. Petrography of – Slate, Phyllite, Schist, Gneiss, Quartzite and Marble.	15	25
Unit-4	**Practical:** Identification of the following rocks in the hand specimen: Granite, Rhyolite, Gabbro, Dolerite, Basalt, Syenite and Diorite. Sandstone, Limestone, Shale, Conglomerate and Breccia Slate, Phyllite, Schist, Gneiss, Quartzite and Marble. Identification of textures and structures of igneous, sedimentary and metamorphic rocks in hand specimen. Geological field work	20 15	15 10

SUGGESTED READINGS:

1) John D. Winter, .D. (2001). An Introduction to Igneous and Metamorphic Petrology. Prentice Hall Inc
2) Loren A. Raymond (2002). Petrology: The study of Igneous, Sedimentary and Metamorphic rocks. McGraw Hill .New York
3) Bose M.K. (1997). Igneous Petrology. World Press
4) Cox, K.G. Bel, J.D. and Pankthrust, R.J. (2002). The interpretation of Igneous rocks. Allen and Unwin, London
5) Pankthrust, (2000). Igneous and Metamorphic rocks. Prentice Hall.
6) Phillpots, A.R., and Ague, S.J., (2009). Principles of igneous and metamorphic petrology (2nd Edn.) Cambridge.
7) Hugh Rollinson (2007) Using geochemical data – evaluation, presentation and interpretation.

2nd Edition. Publisher Longman Scientific & Technical.
8) Tucker, M. E. (2006). Sedimentary Petrology, Blackwell Publishing. Collinson, J. D. & Thompson, D. B. (1988). Sedimentary structures, UnwinHyman,London.
9) Nichols, G. (2009). Sedimentology and Stratigraphy Second Edition. Wiley Blackwell
10) Sengupta S. (1996). Introduction to Sedimentology, Oxford & IBH Publishing Co.
11) Sam Boggs, Jr. (2009). Petrology of Sedimentary Rocks, Cambridge Univ. Press v) Applied Sedimentology, by Richard C. Selley, Academic Press, 521pp.

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology(MAJOR-5)
3. Semester: Fourth Semester
4. Course Name: Petrology-II-Igneous
5. Paper code: MAJ-GLG-4.1
6. Course level: 200
7. Credit:4(Th-3, Pract-1)

Course Outcome:*This course provides integrated understanding of the advanced petrology of igneous rocks. The students will able to learn about different phase diagrams, tectonic settings and petrogenesis of igneous rocks. This will provides magma generation in crust and mantle and their emplacement and evolution.*

The practical course helps students to identify the different types of igneous rocks under petrological microscope.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Igneous Petrology:** Magma: Composition, origin & types; Nature of primary magma; Crystallization of magma; Bowen's Reaction Principle; Magmatic differentiation; Assimilation; Role of volatile constituents in Magmatic differentiation.	15	25
Unit-2	**Thermodynamics of magmatic crystallization:** Concepts of system phase and components; mineralogical phase rule; Phase equilibria in Igneous rocks- 1, 2 and 3 component systems; experimental observations of the two components (Binary) and three components (ternary) systems and their petrogenetic significance.	15	25
Unit-3	**Magmatism in different tectonic settings:** Magmatism in the oceanic domains (MORB, OIB); Magmatism along the plate margins **Petrogenesis of Igneous rocks:** Petrogenesis of Komatites, Granitoides; Alkaline rocks, kimberlites, lamproites, Anorthosite and Carbonatite.	15	25
Unit-4	**Practical:** Mineralogical and petrogenetic study of the following rocks in thin sections: Granite, Granodiorite, Diorite, Gabbro, Anorthosites, Ultramafic Rocks, Basalts, Andesites, Trachyte, Rhyolite, Dolerite, Syenite; Study of the following micro-textures:	30	25

SUGGESTED READINGS:

1) John D. Winter, .D. (2001). An Introduction to Igneous and Metamorphic Petrology. Prentice Hall Inc

2) Loren A. Raymond (2002). Petrology: The study of Igneous, Sedimentary and Metamorphic rocks. McGraw Hill .New York
3) Bose M.K. 1997. Igneous Petrology. World Press
4) Cox, K.G. Bel, J.D. and Pankthrust, R.J. 2002. The interpretation of Igneous rocks. Allen and Unwin, London
5) Pankthrust, (2000). Igneous and Metamorphic rocks. Prentice Hall.
6) Phillpots, A.R., and Ague, S.J., (2009). Principles of igneous and metamorphic petrology (2nd Edn.) Cambridge.
7) Hugh Rollinson (2007) Using geochemical data – evaluation, presentation and interpretation. 2 ndEdition. Publisher Longman Scientific & Technical.

FOUR YEAR UNDERGRADUATE PROGRAMMES (FYUGP)
IN GEOLOGY FOR AFFILIATED COLLEGES UNDER RABINDRANATH TAGORE UNIVERSITY
AS PER NEP-2020

1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-6)
3. Semester: Fourth Semester
4. Course Name: Petrology-II-Sedimentary
5. Paper code: MAJ-GLG-4.2
6. Course level: 200
7. Credit:4(Th-3, Pract-1)

Course Outcome:*This course includes study of textures and structures of sedimentary rocks and hence to analyze transportational history and environment of deposition which will provide knowledge about palaeocurrent for different sedimentary environmentsand sedimentary facies.*

In practical course studentswill learn about petrographic and petrogenesis of sedimentary rocks under petrological microscope. Here the students will also get a clear idea about particle size distribution and statistical parameters of the sediments.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Sedimentary Petrology:** Nature and Origin of sediments: weathering and sediment transport; Diagenesis and lithification. Mineralogical composition of sedimentary rocks; heavy minerals and their significance in provenance determination. Textures of sedimentary rocks, granulometric analysis and interpretation.	15	25
Unit-2	Classification of sedimentary rocks: sandstone and limestone Preliminary concept about sedimentary environments and sedimentary facies. Paleocurrent analysis for different sedimentary enviroment.	15	25
Unit-3	**Sedimentary Basin and plate tectonics:** Concept of sedimentary basins and sedimentary basins of India; sedimentation as a geochemical process. **Sedimentary structures:** Study of different sedimentary structures- Primary (Pre-Syn-Post Depositional); Secondary (Stylolites, Concretionary structures, oolitic structures, pisolitic structures, Geode, Stalactites, stalagmites)	15	25
Unit-4	**Practical:** Particle size distribution and statistical treatment, Study of sedimentary structures, Palaeocurrent analysis. Mineralogical and petrogenetic study of the following rocks in thin sections: Sandstone, Limestone,	30	25

SUGGESTED READINGS:

1) Tucker, M. E. (2006). Sedimentary Petrology, Blackwell Publishing. Collinson, J. D. & Thompson, D. B. (1988). Sedimentary structures, UnwinHyman,London
2) Nichols, G. (2009). Sedimentology and Stratigraphy Second Edition. Wiley Blackwell

3) Sengupta S., Introduction to Sedimentology, Oxford & IBH Publishing Co.
4) Sam Boggs, Jr. (2009). Petrology of Sedimentary Rocks, Cambridge Univ. Press
5) Applied Sedimentology, by Richard C. Selley, Academic Press, 521pp.

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-7)
3. Semester: Fourth Semester
4. Course Name: Petrology-II-Metamorphic
5. Paper code: MAJ-GLG-4.3
6. Course level: 200
7. Credit: 4(Th-3, Pract-1)

Course Outcome:*This course includes study of metamorphic rocks, types of metamorphism and depth zones of metamorphism. This course will provide knowledge of metamorphic facies, facies series, textures, structures, phase diagrams and different metamorphic reactions.*

In practical course students will able to identify different metamorphic rocks under microscope. The laboratory exercises in graphic plots for petro-chemistry and interpretation of assemblages will provide a thorough knowledge of metamorphic petrology.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	Concept of chemical equilibrium in metamorphism; Phase rule; Application of the Phase rule to natural rocks; Metamorphic Phase Diagrams; Metamorphic reactions and its types; Prograde and Retrograde metamorphism; Textural and chemical equilibrium in regional metamorphism; solid-solid reaction; continuous and discontinuous metamorphic reaction; metamorphic zones	15	25
Unit-2	Concept of metamorphic facies and facies series; contact metamorphism and its assemblages. Mineral assemblagesand their graphical representation: ACF, AKF, AFM and composition phase diagrams; Relationship between metamorphism and deformation	15	25
Unit-3	Basic Concept of Thermodynamics Geothermobarometry; Metamorphism of mafic rocks, ultramafic rocks, pelitic sediments and calcareous rocks and the metamorphic reactions involved. Metasomatism and role of fluids in metamorphism. Petrographic description of Charnockite, Khondalite, Gondite, Kodurite, Eclogite and Khasi Greenstone.	15	25
Unit-4	**Practical:** Mineralogical and petrogenetic study of the following rocks in thin sections: Schists, Gneisses, Marble, Quartzite, Amphibolite,Charnockite, Khondalite, Gondite, Kodurite, Eclogite and Khasi Greenstone. Laboratory exercises in graphic plots (ACF, AKF and AFM) for petro-chemistry and interpretation of assemblages. PT estimation in metamorphic assemblages.	30	25

SUGGESTED READINGS:

1) Yardley, B W D. (1990). An introduction to metamorphic petrology. ELBS publication.
2) Bucher K. and Martin F. 2002. Petrogenesis of Metamorphic rocks. Springer-Verlag Publication.
3) Best, M.G. (2002). Igneous and metamorphic petrology. Wiley publication.
4) Vernon R. H. and Clarke G. L. 2008. Principles of metamorphic Petrology. Cambridge publication.
5) Spears F. (1993). Metamorphic Phase Equilibria and Pressure-Temperature-Time Paths. AGU publication
6) Winter, J.D. (2001). An Introduction to Igneous and Metamorphic Petrology. Prentice Hall Inc.
7) Bucher, K. and Martin, F. (2002): Petrogenesis of Metamorphic Rocks (7Rev. Ed.), Springer–Verlag.

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-8)
3. Semester: Fifth Semester
4. Course Name: Palaeontology
5. Paper code: MAJ-GLG-5.1
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome: *This course intends to give the students a basic idea about Palaeontology which includes modes of preservation and importance of fossil in various aspects of geological studies.*
They will learn the morphological characteristics and geological distribution and functional adaptation of various classes for e.g. Foraminifera, Brachipoda, Lamilibranchia, Gastropoda, Cephalopoda, Trilobita, Echinoidea, Graptoloidea.They will get a general idea of the plant fossils of India with special reference to Gondwana Flora and their palaeogeographicsignificance.They will study evolutionary trend of Man, Equidae and Proboscideafrom the study of vertebrate fossils.
Microplaeontology, the science of microfossils has become very important due to its significance in determining thepaleoclimate and its use in oceanographic studies. In this course students will study microfossil and their importance in oil exploration.

In practical course students will able to identify different genera of fossils by their external morphology and stratigraphic ranges.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Introduction to Palaeontology:** Definition; different branches of palaeontology and scope; types of fossils; modes of preservation of fossils; importance of fossils: chronological, palaeogeographical, palaeoecological, biostratigraphical, evolutionary and economic studies, Ichno fossils and their significance; index fossil, important index fossil from India.	15	25
Unit-2	**Descriptive palaeontology:** Species concept and speciation; taxonomic hierarchy. Study of the morphological characters, geological distribution and biostratigraphic significance of the following phyla/classes: Foraminifera, Brachiopods, Lamellibranchia, Gastropoda, Cephalopoda, Trilobita, Echinoidea. Gondwana Flora and their palaeogeographic and palaeoclimatic significance. Vertebrate fossils and Major steps in vertebrate evolution; mesozoic reptiles their importance in palaeontology and stratigraphy; A short discussion on the evolutionary trend of Man, and Equidae.	15	25
Unit-3	**Applied Palaeontology:** Application of microfossils in paleoenvironment analysis; role of foraminifera and palenofossil in hydrocarbon exploration. Correlation method and role of index fossils in demarketing Stratigraphic boundaries viz., Pc-C, P-T, K-P-g boundaries with special reference to India; fossils in sequence stratigraphy.	15	25
Unit-4	**Practical:** Study of different mode of preservation of fossils. Study of morphological characters, systematic position, stratigraphic position and age of various invertebrate, vertebrate and plant fossils. Interpretation and determination of stratigraphic range from the fossil assemblage from Triassic of Spiti, Jurassic of Kutch (Kachchh), Cretaceous of Tiruchchirappalli and NE-India	30	25

SUGGESTED READINGS:

1) Raup, D. M., Stanley, S. M., Freeman, W. H. (1971). Principles of Paleontology
2) Clarkson, E. N. K. (2012). Invertebrate paleontology and evolution, 4th Edition by Blackwell Publishing.
3) Benton, M. (2009). Vertebrate paleontology. John Wiley & Sons.
4) Shukla, A. C., &Misra, S. P. (1975). Essentials of paleobotany. Vikas Publisher
5) Armstrong, H. A., &Brasier, M.D. (2005). Microfossils. Blackwell Publishing
6) Cowe, R. 1994. History of life. Blackwell Scientific Publications
7) Jones, R.W. 2006. Applied palaeontology. Cambridge : Cambridge University Press
8) Jain P.C. and Anantharaman M.S. 2022-23 Palaeontology (Palaeobiology) Evolution & Animal Distribution), Vishal Publishing Co.

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AS PER NEP-2020

1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology(DSC-9)
3. Semester: Fifth Semester
4. Course Name: Principles of Stratigraphy and Indian Stratigraphy
5. Paper code: MAJ-GLG-5.2
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome: *The students will be able to learn the stratigraphic principles and nomenclature, major stratigraphic units, methods of stratigraphic correlation. The students will able to know standard Geological time scale; Concepts of Stratotypes, Global Stratotype Section and Point (GSSP), Facies concept in stratigraphy. In this paper the students will learn the Indian stratigraphy of Precambrian, Paleozoic, Mesozoic, and Cenozoic Eras.*

In practical course students will learn about important rocks from known stratigraphic horizons. Here the students will also get a clear idea about facies maps; structure contour map isopach map and their interpretation for basin configuration.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks

Unit-1	**Principles to Stratigraphy:** Law of Superposition of strata, Uniformitarianism and law of faunal succession; Geological time scale, concept of relative and absolute chronology; Codes of stratigraphic nomenclature in India. Concepts of Stratotypes. Global Stratotype Section and Point (GSSP), Vertical and lateral stratigraphic relationship; Unconformity and their types, cyclic successions; Concept of sedimentary facies, Walther's Law Nomenclature, classification and correlation of lithostratigraphic, biostratigraphic, chronostratigraphic, and magnetostratigraphic units; concept of sequence stratigraphy.	15	25
Unit-2	**Precambrian Stratigraphy of India:** Cratons and Mobile Belts of the Indian Sub-continent. Description of litho-stratigraphy, age, structure and metamorphism in the Dharwar Province, Singhbhum-Orissa Province. **Proterozoic Basins of India**: Brief idea about their distribution, lithological and structural characteristics. Lithostratigraphic, structural and tectonic evolution of the Cuddapah, Vindhyan and Shillong Basins	15	25
Unit-3	.**Phanerozoic Stratigraphy of India:** Palaeozoics of Kashmir and Spiti-Zanskarbasin. Marine Palaeozoics in Peninsular India – their distribution, litho-stratigraphic characteristics and fossil content. Distribuition, lithology and the fossil content with special reference to Triassic of Spiti, Jurassic of Kutch and Cretaceous of Cauvery Basin and North east India. Gondwana deposits of Indian Subcontinent - sedimentation, marine intercalation, palaeoclimate and economic importance. The Deccan Traps, Rajmahal Traps and Sylhet Traps. Stratigraphy and economic importance of Assam Arakan Basin, stratigraphy and vertebrate palaeontology of Siwalik Basin.	15	25
Unit-4	**Practical:** Study of geological map of India and identification of major stratigraphic units. Study of characteristics rocks from known stratigraphic horizons in hand specimen, thin section and their diagnostic features. Preparation of facies maps (sand - shale ratio map; carbonate – sand - shale ratio map); structure contour map, isopach map and their interpretation for basin configuration.	30	25

SUGGESTED READINGS:

1) Stratigraphic Principles and Practices – JW. Weller, Universal Book Stall, Delhi
2) Principles of Sedimentology and stratigraphy – Sam Boggs Jr. Pearson Prentice Hall
3) Principle of sedimentary basin analysis – A.D. Miall, Springer
4) Geology of India and Burma – M. S. Krishnan, CBS Publisher & Distributor
5) Precambrian Geology of India – S. M. Naqvi& J. J. W. Rogers, Oxford University Press
6) Geology of India Vol.-1 and Vol.-2 by Ramakrishnan and Vaidyanadhan. Geological
7) Society of India, Bangalore.
8) Fundamentals of Historical Geology and Stratigraphy of India – R. Kumar, New Age
9) International Publishers
10) Indian Precambrian – B.S. Paliwal, Scientific Publications (India) Jodhpur

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-10)
3. Semester: Fifth Semester
4. Course Name: Economic Geology
5. Paper code: MAJ-GLG-5.3
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome: *In this course they will get a detailed concept about the process of formation of economic mineral deposit, mode of formation of ore deposit and classification of economic mineral deposit. They will study about structure, physics, chemical and stratigraphic control of ore localization. The students will learn about the Metallogenic provinces and epochs, important deposits of India including atomic minerals, non-metallic and industrial rocks and minerals in India.They will study about the principles of reserve estimation, geostatistical and statistical methods of reserve estimation, computer application in ore reserve estimation.*

In practical course students will be able to identify ore minerals, to estimate reserve,Study of genetic interpretation of ore minerals from their textures and structures in hand specimens and ore reserve estimation.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Introduction to economic geology:** Ore, gangue, grade, tonnage, Clarke's value, resource and reserve, Metallogenic provinces and epochs. Geological Processes and Mineral Deposit Formation:Magmatic processes and ore genesis**,** Hydrothermal processes and ore deposits**,** Sedimentary processes (placer deposits, evaporites)**,** Weathering and supergene processes, Metamorphic processes and mineral deposits**.**	15	25
Unit-2	**Ore Geology:** Ore textures and paragenesis: stockwork, stratiform and stratabound ores, syngenetic and epigenetic ore, and controls of ore localization. **Types of ore deposits:**Vein and lode deposits**,** Disseminated ore bodies**,** Skarn deposits**,** VMS deposits **Reserve estimation:** Methods of reserve estimation.	15	25
Unit-3	**Important mineral deposits of India:** Iron, copper, Manganese, Lead and Zinc,Aluminum, Chromium, Diamond, Gold, Silver, Platinum. Industrial rocks and minerals in India: limestone, sillimanite, mica, diamond, phosphates, magnesites Introduction to gemstones, atomic minerals, critical and essential minerals.	15	25
Unit-4	**Practical:** Identification of ore/industrial minerals in hand specimen and under microscope: chromite, galena, sphalerite, arsenopyrite, pyrite, pyrrhotite, chalcopyrite, covellite, chalcocite, bornite, pentlandite, magnetite, hematite, ilmenite, goethite. Genetic interpretation of ore minerals from their textures and structures in hand specimens. Ore reserve estimation.	30	25

SUGGESTED READINGS:

1) Guilbert, J.M. and Park Jr., C.F. (1986). The Geology of Ore deposits. Freeman & Co.
2) Bateman, A.M. and Jensen, M.L. (1990). Economic Mineral Deposits. John Wiley.
3) Evans, A.M. (1993). Ore Geology and Industrial minerals. Wiley
4) Laurence Robb. (2005). Introduction to ore forming processes. Wiley.
5) Gokhale, K.V.G.K. and Rao, T.C. (1978). Ore deposits of India their distribution and processing, Tata-McGraw Hill, New Delhi.

6) Deb S. (1980) Industrial minerals and rocks of India. Allied Publishers.
7) Sarkar, S.C. and Gupta, A. (2014) Crustal Evolution and Metallogeny in India.Cambridge Publications.

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology(MAJOR-11)
3. Semester: Fifth Semester
4. Course Name: Geomorphology and Hydrogeology
5. Paper code: MAJ-GLG-5.4
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome: *The students will be able to learn the Endogenic and Exogenic processes for landscape development. They will learn the basic concepts of hydrogeology, the occurrence of groundwater, water bearing properties of formations, aquifer types and aquifer parameters. They will also get the knowledge groundwater flow, well hydraulics and surface and subsurface investigation of ground water.*

In practical course students will learn about preparation of topographic profile, morphometry of drainage basin, identification of morphological features from the models, numerical problems on groundwater flow and aquifer properties. They will also learn about the preparation and interpretation of depth to water table map, piezometric surface map and estimation of ground water reserves.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks

Unit-1	**Introduction to Geomorphology:** Definition and scope of geomorphology Endogenic Processes: tectonics processes, mountain building (orogenesis), volcanic processes and seismic processes. Exogenic Processes: weathering, glacial, periglacial, fluvial, aeolian and coastal processes and associatedlandforms. Landforms associatedwith igneousactivities.	15	25
Unit-2	**Basic Concepts of Hydrogeology:** Definition of hydrology and hydrogeology; Hydrologic cycle - precipitation, evapotranspiration, run-off, infiltration and subsurface movement of water; Concept of Residence Time. Rock properties effecting groundwater; vertical distribution of subsurface water. Aquifers - their types and classification; aquiclude, aquitard and aquifuge; Groundwater Recharge and Discharge; Aquifer Parameters - occurrence of groundwater openings in rocks, porosity, types of porosity; permeability and void ratio; specific storage, transmissivity, storativity, specific yield and specific retention.	15	25
Unit-3	**Groundwater Flow and Well Hydraulics:** Ground Water movement; Darcy's law - its range of validity and limitation; hydraulic conductivity,basic principles of well hydraulicsdrawdown and cone of depression. Elementary concepts related to equilibrium and non-equilibrium conditions for water flow to a well in confined and unconfined aquifers. Surface and subsurface investigation of ground water.	15	25
Unit-4	**Practical:**Preparation of topographic profile, Morphometry of drainage basin, Identification of morphological features from the models. Numerical problems on groundwater flow and aquifer properties. Preparation and interpretation of depth to water table map, piezometric surface map. Estimation of ground water reserves	30	25

SUGGESTED READINGS:

1) Bloom A.L., (1998). Geomorphology: A Systematic Analysis of Late Cenozoic Landforms, Pearson Education.
2) Esterbrook D.J., (1992). Surface Processes and Landforms, MacMillan Publ.
3) Kale, V.S. and Gupta A. (2001). 1ntoduction to Geomorphology, Orient Longman Ltd.
4) Holmes' Principles of Physical Geology. 1992. Chapman & Hall.
5) Patwardhan, A. M., TheDynamic Earth System, PHI Learning.
6) Fetter, C.W. (2001) Applied Hydrogeology, 4th Edition, CBS Publishers and Distributors,New Delhi
7) Karanth K.R. (1987) Groundwater: Assessment, Development and Management, Tata McGraw-Hill Pub. Co. Ltd
8) Raghunath, H.M. (2007) Ground Water, 3rd Edition. New Age International Publishers
9) Todd, D.K. and Mays, L.W. (2005) Groundwater Hydrology, 3rd Edition. John Wiley &Sons
10) Todd, D. K. (2006) Groundwater Hydrology, 2nd Edition., John Wiley & Sons, NewYork

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology(MAJOR-12)
3. Semester: Sixth Semester
4. Course Name: Remote Sensing and GIS
5. Paper code: MAJ-GLG-6.1
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome: *This course includes study of remote sensing, how sensors work, about the geostationary satellites with special reference to Indian Satellites. They will learn about the application of remote sensing in geomorphological, structural and lithological mapping and natural hazard mitigation and basics of GIS and data analysis.*

They will learn Concepts of GPS, Integrating GPS data with GIS and Applications in earth system sciences.

They will get an idea of Digital Image Processing, Image Errors, rectification and restoration, FCC, Image Enhancement, Filtering, image Rationing, Image classification and accuracy assessment.

They will learn about GIS integration and Case studies- Indian Examples.

In practical course students will be able to learn Aerial Photo interpretation, identification of sedimentary, igneous and metamorphic rocks and various Aeolian, glacial, fluvial and marine landforms. They will get an elementary idea on DIP and GIS software, Digital Image Processing exercises including analysis of satellite data in different bands and interpretation of various objects on the basis of their spectral signatures creating a FCC from raw data, registration of satellite data with a toposheet of the area.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Photogeology:** Definition and concept; aerial photography: Types and acquisition of aerial photographs, types of camera, geometry of AP, stereoscopic vision and stereoscope; relief displacement, vertical exaggeration and distortion; Elements of air photo interpretation, Identification of rocks and various landforms.	15	25
Unit-2	**Remote Sensing:** Concepts in Remote Sensing, EMR, Sensors and Platforms, Satellites and their characteristics, Spectral Reflectance Curve., Microwave remote Sensing and Indian Remote Sensing satellites. Digital Image Processing: Data formats- Raster and Vector,Fundamental steps in image processing, Elements of pattern recognition, FCC, Image classification and accuracy assessment. Applications of Remote Sensing in geoscience; advantages and limitations of Remote Sensing.	15	25
Unit-3	**GIS and GPS:** Components, Datum, Coordinate systems and Projection systems, Spatial data models and data editing, Introduction to DEM analysis. GPS: Concepts of GPS, Integrating GPS data with GIS, Applications in earth system sciences.	15	25
Unit-4	**Practical:** Aerial Photo interpretation, identification of rocks and various landforms. Introduction to DIP and GIS softwares. Interpretation of Satellite image to extract geological and geomorphic information. Registration of Satellite data with reference to topographic maps.	30	25

SUGGESTED READINGS:

1) Demers, M.N. (1997). Fundamentals of Geographic Information System, John Wiley & sons. Inc.
2) Jensen, J.R. (1996). Introductory Digital Image Processing: A Remote Sensing Perspective, Springer- Verlag.
3) Lillesand, T. M. & Kiefer, R.W. (2007). Remote Sensing and Image Interpretation, Wiley.
4) Richards, J.A. and Jia, X. (1999). Remote Sensing Digital Image Analysis, Springer-Verlag.
5) S. N. Pandey (2001). Principles and Applications of Photogeology. New Age International (P) Limited, Publishers.

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1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-13)
3. Semester: Sixth Semester
4. Course Name: Fuel Geology
5. Paper code: MAJ-GLG-6.2
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome:*This course includes study of mechanism of hydrocarbon generation from organic material. The students will learn the relationship between temperature, pressure and other physical parameters and its effect on distribution and migration of hydrocarbons. The students will get a clear idea about the coal and oil fields of north east India, fundamentals of coal and coal forming sedimentary environments. The students will also learn about the lithotypes, microlithotypes, maceral concept and its classification, origin of macerals.*

In practical course students will be able to identify different types of coal; lithotypes in coal, determination of calorific value from results of proximate and ultimate analyses of coal, determination of kerogen types using Van Krevelen diagram, estimation of petroleum reserves.Students will learn about the section correlation and identification of hydrocarbon prospects and the Panel and Fence diagrams.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Coal:** Definition and origin of Coal; Classification of coal, grading and ranking. Chemical composition of coal: proximate analysis and ultimate analysis. Fundamentals of Coal petrology-macropetrographic constituents of Coal, lithotypes, microlithotypes, macerel and its classification, origin of macerals. Coal Bed Methane, underground Coal combustion, carbonization, gasification, liquefaction, distribution of coal in India with special reference to NE India.	15	25
Unit-2	**Petroleum:** Definition of source rocks; kerogen types, reservoir rocks, seal/cap rocks and their types; Processes associated with formation of petroleum reserves, oil window, petroleum traps and their types. Migration of oil-primary and secondary. Global distribution of Petroleum; petroliferous basins of India; occurrence of Petroleum in Assam-arakan basin.	15	25
Unit-3	**Other fuels:** Gas hydrates - its distribution, complexities associated with exploitation of gas hydrates, shale oil and gas - tight reservoirs, hydrofracturing and production of shale oil and gas. Nuclear fuels - types, geological distribution, exploration for nuclear fuels.	15	25
Unit-4	**Practical:** Study of hand specimens of coal; identification of lithotypes in coal; determination of calorific value from results of proximate and ultimate analyses of coal. Determination of kerogen types using Van Krevelen diagram; estimation of petroleum reserves; Section correlation and identification of hydrocarbon prospects. Panel and Fence diagrams.	30	25

SUGGESTED READINGS:

1) Thomas, L (2002). Coal Geology. Willey.
2) Chandra D. (2007). Chandra's Textbook on applied coal petrology. Jijnasa Publishing House.
3) Shelly R. C. and Sonnenbergm, S. A. (2022). Elements of Petroleum geology: 4th Edition, Academic Press.
4) Bjorlykke, K. (1989). Sedimentology and petroleum geology. Springer-Verlag.
5) Beaumont, E. A. and Foster, N. H. (2000). AAPG Treatise of Petroleum Geology: Exploring for Oil and Gas Traps. AAPG.
6) Bahardori, A. and Zendehboudi, S. (2016). Shale Oil and Gas Handbook: Theory, Technologies, and Challenges. Gulf Professional Publishing.
7) Thakur, P., Schatzel, S., Aminian, K., Rodvelt, G., Mosser, M. and D'Amico, J. (2020). Coal Bed Methane: theory and applications. Elsevier.

8) Aswathanarayana, U. (1986). Principles of Nuclear Geology. Balkema.

FOUR YEAR UNDERGRADUATE PROGRAMMES (FYUGP)
IN GEOLOGY FOR AFFILIATED COLLEGES UNDER RABINDRANATH TAGORE UNIVERSITY
AS PER NEP-2020

1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-14)
3. Semester: Sixth Semester
4. Course Name: Exploration and Mining
5. Paper code: MAJ-GLG-6.3
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome: *In this paper the students will get THE IDEA OF the Principles of mineral exploration, Prospecting and exploration conceptualization, methodology and stages. Students will be able to know about the evaluation of sampling data. In this paper the students will get the knowledge of Drilling and Logging techniques. The students will also be able to know importance of mining and methods of mining-Surface and Underground.*

In practical course students will be able to identify the geochemical anomalies. Also learn to solve the numerical based on Geophysical and Geochemical Data and well log interpretation.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Basic Concepts:** Principles and prospecting of mineral exploration; Selection of sites; Sampling, subsurface sampling including pitting, trenching and drilling, core and non-core drilling, Evaluation of sampling data; Mean, Mode, Median, Standard Deviation and Variance.	15	25
Unit-2	**Geological and Geochemical exploration:** Principles and methods of Geological and geochemical prospecting, pathfinders and indicator elements in rocks and soils, Mobility of elements, Primary and secondary dispersion patterns, geochemical anomalies and their interpretation.	15	25
Unit-3	**Geophysical exploration:** Introduction to geophysical methods of exploration and their applications. Principles of gravity, magnetic, resistivity, induced polarization, electromagnetic and seismic methods; data reduction, anomalies, geological interpretation. Well logging techniques – Resistivity, SP, Gamma, Sonic and their applications. Methods of mining- Surface and Underground mining.	15	25
Unit-4	**Practical:** Identification of anomaly (geochemical and geophysical); Numericals based problems on Geophysical and Geochemical Data, Well log interpretation and preparation of litho-logs.	30	25

SUGGESTED READINGS:

1) McKinstry, H.E. (1962). Mining Geology (2nd Ed.) Asia Publishing House.
2) Clark, G.B. (1967). Elements of Mining. 3rd Ed. John Wiley & Sons.
3) Arogyaswami, R.P.N. (1996). Courses in Mining Geology. 4th Ed. Oxford-IBH.
4) Moon, C.J., Whateley, M.K.G. and Evans, A.M. 2006. Introduction to mineral exploration, 2nd edition. Blackwell Publishing Ltd. Oxford.
5) Robinson, E.S. and Coruh, C. (1988). Basic Exploration Geophysics, John Wiley & Sons,
6) Peters, W.C. 1978. Exploration and mining geology. John Wiley & Sons, New York.
7) Rose, A.W., Hawkes, H.E. & Webb, J.S. (1979). Geochemistry in mineral exploration, Academic Press, London.
8) Levinson, A.A. (1974). Introduction to exploration geochemistry. Applied Publication Co., Calgary.
9) Dorbin, M.B. Introduction to geophysical prospecting.
10) RamachandraRao. Geophysical prospecting for geologists

FOUR YEAR UNDERGRADUATE PROGRAMMES (FYUGP)
IN GEOLOGY FOR AFFILIATED COLLEGES UNDER RABINDRANATH TAGORE UNIVERSITY
AS PER NEP-2020

1. Four Year Undergraduate Programmes (FYUGP)
2. Subject: Geology (MAJOR-15)
3. Semester: Sixth Semester
4. Course Name: Engineering Geology and Environmental Geology
5. Paper code: MAJ-GLG-6.4
6. Course level: 300
7. Credit: 4(Th-3, Pract-1)

Course Outcome: *In this paper the students will get the knowledge of physical and chemical characterization of earth materials. The students will also be able to learn about the rock mechanics, dams, tunnels and slope stability. This course will provide the understanding of Natural and Anthropogenic hazards, impacts of landslides, flood, earthquake and mining on environment, environmental issues and mitigations.*

In practical course students will be able to understand the geology of tunnel, dam and road, determin the moisture content, unit weight of soil, consistency limits of soil by different methods, Rock Quality Designation (RQD) in field outcrops or core-samples, Kinematic analysis of rock slope stability.

Syllabus showing each unit against class number and marks

Unit No.	Unit Content	Class hours	Credit/Marks
Unit-1	**Engineering Properties of materials:** Physical and chemical characterization of earth materials, Moisture content, void ratio, porosity, permeability, degree of saturation, unit weight, density, specific gravity, strength (compressive, shear, and tensile), deformability. Atterberg's Limits and consistency of soil, Indian Standard Soil Classification System. Elementary knowledge about soil compaction, compressibility and consolidation, Liquefaction.	15	25
Unit-2	**Geology and Engineering Structures:** Dams and Tunnels: Classification and terminologies. Geological and geophysical investigations associated with construction of dams and tunnels. Dam foundation, abutment and reservoir problems. Seepage and leakage. Methods of tunnel excavation. Introductory idea about slope stability analysis. Application of Remote Sensing in Engineering Geology.	15	25
Unit-3	**Rock mechanics:** Discontinuities, their types and characteristics (roughness, wall strength, aperture and infill, persistence, orientation, spacing, shear strength). Relation of rock strength with geological structures. Rock quality designation (RQD), Rock Mass Classification (RMR), **Environmental Geology:** Natural and Anthropogenic hazards: Impacts of landslides, flood, river erosion, earthquake and mining on environment. Environmental issues and mitigations. Environmental Ethics and Laws	15	25
Unit-4	**Practical:** Determination of moisture content and unit weight of soil. Determination of consistency limits of soil by Casagrande Method or Cone Penetration Method. Determination of Rock Quality Designation (RQD) in field outcrops or core-samples. Kinematic analysis of rock slope stability.	30	25

SUGGESTED READINGS:

1) Principles of Engineering Geology and Geotechnics by Krynine and Judd. CBS Publishers.
2) Engineering Geology by Duggal, Pandey and Rawal. McGraw Hill Education (India) Pvt. Ltd.
3) Geotechnical Engineering (Soil Mechanics) by Ramamurthy and Sitharam, S.Chand and Company.
4) Soil Mechanics and Foundations by Punmia, Jain and Jain. Laxmi Publications.
5) Basic and Applied Soil Mechanics by GopalRanjan and Rao. New Age International Publishers.
6) Modern Geotechnical Engineering by Alam Singh. CBS Publishers.
7) Rock Slope Engineering, Civil Applications by Duncan C. Wyllie. CRC Press.
8) Environmental Geology (Indian Context) – K.S. Valdiya; Tata McGraw-Hill Publishing Company Ltd.
9) Environmental Geology – B.W.Murck, B.J. Skinner & S.C. Porter; John Wiley and Sons, Inc.
10) Textbook in Environmental Sciences- V. Subramanium; Narosa International.