माँ शाकुम्भरी विश्वविद्यालय, सहारनपुर
Maa Shakumbhari University, Saharanpur

Under-Graduation in Geology

For

School of Science-Geology

Maa Shakumbhari University, Saharanpur

2022-23

Members, Board of Studies (Geology)

S.No.	Name	Designation	College/University	Signature
1.	Prof.Poonam Khare	Convener	J.V.Jain College Saharanpur	Poonam Khare
2.	Prof. A.K. Biyani	External Expert	D.B.S. College, Dehradun	Presented ONLINE
3.	Prof. R. Krishnamurti	External Expert	I.I.T. Roorkee	

Semester-wise Titles of the papers in B.Sc. Geology

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
1	I	B090101T	Physical and Structural Geology	Theory	4
1	I	B090102P	Practical: Structural Geology	Practical	2
1	II	B090201T	Mineralogy and Crystallography	Theory	4
1	II	B090202P	Practical: Mineralogy and Crystallography	Practical	2
2	III	B090301T	Palaeontology	Theory	4
2	III	B090302P	Practical: Palaeontology	Practical	2
2	IV	B090401T	Petrology	Theory	4
2	IV	B090402P	Practical: Petrology	Practical	2
3	V	B090501T	Applied Geology and Global Tectonics	Theory	4
3	V	B090502T	Stratigraphy	Theory	4
3	V	B090503R	Field Work	Field Work	2
3	VI	B090601T	Remote Sensing and Environmental Geology	Theory	4
3	VI	B090602T	Economic Geology and Groundwater	Theory	4
3	VI	B090603P	Practical: Economic Geology	Practical	2

Subject prerequisites:

To study this subject, a student must have had the subject(s) ...**Physics/ Mathematics/ Chemistry/ Biological Sciences** .... in class/12th.

- **Programme outcomes (POs)**

The Bachelor of Science program in the Department of Geology, J.V. Jain College, Saharanpur(Maa Shakumbhari, University, Saharanpur) is designed with the objective of educating students for success as a geo-scientist having employability in government sector, public sector, private sector, research institutes, or further qualifying JAM or other national examinations so as to pursue further study.

- **Programme specific outcomes (PSOs):**

Geological excursions would be important components of the B.Sc. Program in Geology for laying a robust foundation to the budding geologists. Students will get exposure to actual rocks during Geological excursion. Students will learn the data collection, measurements and interpretations.

Semester-wise Titles of the Papers in B.Sc. (Geology)

Year	Year	Course Code	Theory/ Practical	Compulsory/ Elective	Course Title	Credits	Teaching Hours
	I	B090101T	Theory	Compulsory	*Physical and Structural Geology*	04	60
		B090102P	Theory	Compulsory	*Practical: Structural Geology*	02	60
		B090201T	Theory	Compulsory	*Mineralogy and Crystallography*	04	60
		B090202P	Practical	Compulsory	*Practical: Mineralogy and Crystallography*	02	60
	II	B090301T	Theory	Compulsory	*Palaeontology*	04	60
		B090402P	Practical	Compulsory	*Practical: Palaeontology*	02	60
		B090401T	Theory	Compulsory	*Petrology*	04	60
		B090402P	Theory	*Compulsory*	*Practical: Petrology*	02	60
	III	B090501T	Theory	Compulsory	*Stratigraphy*	04	60
		B090502T	Theory	Compulsory	*Applied Geology and Global Tectonics*	04	60
		B090503R	Practical	Compulsory	*Field Work*	02	60
		B090601T	Theory	Compulsory	*Remote Sensing and Environmental Geology*	04	60
		B090602T	Theory	Compulsory	*Economic Geology and Ground water*	04	60
		B090603P	Practical	Compulsory	*Practical: Economic Geology*	02	60

List of All Papers in All Six Semesters

Programme/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **Geology**		
Course Code: **B090101T**	Course Title: **Physical and Structural Geology**	

Course outcomes:
After completing the course, student should be able to

- learn origin of solar system and Earth
- understand internal structure of Earth
- understand interpretation stress-strain imprinted in earth
- learn the Interpretation of deformed structure
- understand role of weathering agents

Credits: 4	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0

Unit	Topics	No. of Lectures
I	Introduction to Geology and its scope, Earth and Solar system: origin, size etc., Age of Earth, Components of Earth, Internal Structure and composition of Earth, Volcanoes and Earthquakes, Biography of renowned Indian Geologists and their contribution in Indian Geology.	7
II	Weathering and erosion: factor, types, Geological work of wind: Erosion, transportation, deposition and their related landforms	8
III	Geological work of river and glaciers: Erosion, transportation and deposition by rivers and glaciers, and their related landforms;	8
IV	Introduction to structural geology: contours, topographic and geological maps, elementary idea of dip, strike and outcrop. Basic concepts of stress and strain; Study of outcrop; Identification of bedding; Forms of igneous bodies (concordant and discordant)	8
V	Simple deformational structures: Fold morphology, their geometric and genetic classification, Top and Bottom of Beds	7

VI	Geometric and genetic classification of Faults (Normal, reverse and strike-slip faults); Recognition of faults in the field; Effects of faults on folded beds.	7
VII	Unconformities: their classification, recognition and geological significance, on lap and off lap; Joint and its classification, Lineation and Foliation: basic introduction.	8
VIII	Sea-floor Spreading, Continental drift ,Basic Concepts of Plate Tectonics	7

Suggested Readings:

1. The Blue Planet: An Introduction to Earth System Science – B.J. Skinner and S.C. Porter. 1995, John Wiley & Sons, Inc. 493p.
2. Introduction to Physical Geology – G.R. Thompson and J. Turk. 1998, Saunders College Publishers, Fort Worth. 371p.
3. Processes that Shape the Earth – D.M. Thompson. 2007, InfoBase Publishing, NY. 116p.
4. Physical Geology – L.D. Leets, S. Judson and M.E. Kauffman, (1982). Prentice-Hall Inc. 629p.
5. Holmes's Principles of Physical Geology – P.MvL. D. Duff, Fourth Edition (1993). Stanley Thrones (Publishers) Ltd.
6. Bailey, B., 1992. Mechanics in Structural Geology, Springer.
7. Davis, G. H. and Reynolds, S. J., 1996. Structural Geology of rocks and regions, John Wiley. and Sons.
8. Ghosh, S. K., 1993. Structural Geology: Fundamentals, and modern developments, Pergamon Press.
9. Monrow, James S. (1986): Physical Geology: Exploring the Earth, Booke Cole, Australia
10. Leyson, P: R. and Lisle, R. J., 1996. Stereographic projection techniques in structural geology, Cambridge University Press.
11. Passhier, C. and Trouw, R. A. J, 2005. Micro tectonics. Springer, Berlin.
12. Pollard, D. D. and Fletcher, R. C., 2005. Fundamentals of structural geology, Cambridge University Press.
13. Rowland, S. M., Duebendorier, E. and Schiefelbein, I. M., 2007. Structural analysis and synthesis: a laboratory course in structural geology, Balckwell pub.
14. Van der Pluijm, B. A. and Marshak, S., 2004. Earth structure: an introduction to structural Geology.
15. Billings, M.P. (1972): Structural Geology, Prentice Hall.
16. Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.
17. Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.
18. Mallory, B.F and Cargo, D.N. (1979): Physical Geology, McGraw Hill.
19. http://egyankosh.ac.in/handle/123456789/36575
20. http://egyankosh.ac.in/handle/123456789/53574
21. http://egyankosh.ac.in/handle/123456789/53280

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods: **Continuous Internal evaluation through internal tests, quies and presentation**
Course prerequisites: To study this course, a student must have had the subject … **Physics/ Mathematics/ Chemistry/ Biological Sciences** ….. in class/12th ……
Suggested equivalent online courses: ……

Programme/Class: **Certificate**	Year: **First**	Semester: **First**
Subject: **Geology**		
Course Code: **B090102P**	Course Title: **Practical: Structural Geology**	

Course outcomes:
After completing the course. student should be able to

- interpret the geological maps
- measure the geological data from field
- Interpret geological structures

Credits: 2	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2

Unit	Topics	No. of Lectures
	Structural problems on dip and strike: Contour maps and completion of outcrops: Study and interpretation of topographical maps; Use of Clinometer compass. Calculation of Apparent Dip Simple Lithological boundary tracing Determination of Thickness of bed. Identification of fold on geological maps through wooden models Identification of fault on geological maps through wooden models Identification of Unconformities on geological maps through wooden models Simple geological maps	60

Suggested Readings:

1. F. H. T. Rhodes, geological maps, the commonwealth and international library.
2. G. M. Bennison,1992, an introduction to geological structures and maps, Edward arnold
3. Richard j. Lisle,1988. Geological structures, and maps, a practical guide, Amsterdam
4. K. R. McClay, 1991. The mapping of geological structures, geological society of London handbook
5. http://egyankosh.ac.in/handle/123456789/53580

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: To study this course, a student must have had the subject … **Physics/ Mathematics/ Chemistry/ Biological Sciences** ….. in class/12th

Programme/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **Geology**		
Course Code: **B090201T**	Course Title: **Crystallography and Mineralogy**	

Course outcomes:
After completing the course, student should be able to

- learn the mineral and it types
- understand the crystal formation, form and occurrence
- learn formation of mineral groups and resource

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0

Unit	Topics	No. of Lectures
I	Basic idea about crystal, crystal growth and crystallisation; Laws of crystallography; Crystal morphology; Crystallographic axes; Elements of symmetry; Crystallographic notations	7
II	Crystal forms; Habit and classification; Crystal aggregate: Twinning and common twin Laws	7

III	Symmetry and forms of Hexagonal (beryl type and calcite type), Orthorhombic (Barytes type), Monoclinic (Gypsum type), and Triclinic (Axinite type) Crystal Systems	8
IV	Symmetry and forms of Cubic (Galena type, Pyrite type and Tetrahedrite type), and Tetragonal (Zircon type) Crystal Systems	8
V	Definition of mineral: Atomic bonding; Physical properties of minerals: colour, lustre, form, hardness, fracture, cleavage, specific gravity, and characters based on heat, electricity and magnetism. Isomorphism, pseudomorphism and polymorphism. Structural classification of silicates.	8
VI	Physical properties, chemical composition, occurrences, and uses of minerals belonging to the quartz and feldspar, carbonate, zeolite and felspathoid families, and clay minerals	7
VII	Physical properties; chemical composition, occurrences, and uses of pyroxene, olivine, mica garnet and amphibole families	6
VIII	Polarizing microscope: components and its functions. Optically isotropic and anisotropic minerals; Polarisation of light; Optical properties of minerals under polarised light and crossed polars: refractive index, pleochroism, relief, twinkling, birefringence, interference colours, extinction and twinning; Optical properties of common rock forming minerals.	9

Suggested Readings:

1. Putnis A. 1992. Introduction to Mineral Sciences, Cambridge publication.
2. Cornelis Klein and Barbara Dutrow, 2007, The manual of Mineral Science, Wiley Publication
3. Mason, B .,1986. Principles of Geochemistry. 3 rd Edition, Wiley New York.
4. Rollinson H. 2007 Using geochemical data-evaluation. Presentation and interpretation. 2 nd Edition. Publisher Longman Scientific & Technical.
5. Walther John, V., 2009 Essentials of Geochemistry, student edition. Jones and Bartlett Publishers.
6. Albarede, F. 2003. An introduction to geochemistry. Cambridge University Press.
7. http://egyankosh.ac.in/handle/123456789/58908
8. http://egyankosh.ac.in/handle/123456789/58985

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: To study this course, a student must have had the subject … **Physics/ Mathematics/ Chemistry/ Biological Sciences** ….. in class/12th
Suggested equivalent online courses: ……
Further Suggestions: ……

Programme/Class: **Certificate**	Year: **First**	Semester: **Second**
Subject: **Geology**		
Course Code: **B090202P**	Course Title: Practical **Mineralogy and Crystallography**	
Course outcomes: After completing the course, student should be able to ➢ Learn to identify crystal symmetry elements ➢ Learn to identify minerals under polarizing microscope ➢ learn to identify the mineral in hand specimens		
Credits: 2	Core: **Compulsory**	
Max. Marks: 25+75	Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		

Unit	**Topics**	**No. of Lectures**

	Graphical construction of crystallographic axes of Cubic system; Study of symmetry elements and forms of normal class of cubic tetrahederon, tetragonal . orthorhombic, hexagonal , trigonal, monoclinic and triclinic. Drawing of common crystals of Cube, Rhomb dodecahedron, Tetra hexahedron, Trapezohedron, Pyritohedron, Tetrahedron, Zircon, Calcite Determination of physical properties of important rock forming minerals: (Quartz, orthoclase, Plagioclase, Microcline, Nepheline, Chlorite, Epidote, Calcite, Olivine, Garnet, Augite, Hypersthene, Hornblende, Muscovite, Biotite, Kyanite, talc, gypsum and kaolinite). Determination of optical properties of important rock forming minerals (Quartz, Orthoclase, Plagioclase, Microcline, Muscovite, Biotite, Garnet, Calcite).	60

Suggested Readings:

1. Putnis A. 1992. Introduction to Mineral Sciences, Cambridge publication.
2. Cornelis Klein and Barbara Dutrow, 2007, The manual of Mineral Science, Wiley Publication
3. Phillips, F.C., 1963. An introduction to crystallography. Wiley, New York
4. Nesse, D.W., 1986. Optical Mineralogy. McGraw Hill.
5. Kerr, B.F., 1995. Optical Mineralogy 5th Ed. Mc Graw Hill, New York.
6. http://egyankosh.ac.in/handle/123456789/58895

This course can be opted as an elective by the students of following subjects: **No**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Programme/Class: **Diploma**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code: **B090301T**	Course Title: **PALAEONTOLOGY**	

Course outcomes:
After completing the course, student should be able to

- know the palaeo-life of earth
- know the reconstruction the earth based on fossils
- be able to determine the age of rock formation-based fossils
- be able to locate the resources based on fossils

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Unit	Topics	No. of Lectures
I	Introduction to palaeontology: processes of fossilisation: Preliminary idea of the origin of life: Basic idea of trace fossils and their uses	7
II	Morphology and geological history of Bivalvia, Brachiopoda	8
III	Morphology and geological history of Gastropoda, Cephalopoda	8
IV	Morphology and geological history of Echinoidea and Anthozoa.	8
V	Morphology and geological history of Trilobita and Graptolithina	8
IV	Introduction to Palaeobotany: Important Lower and Upper Gondwana plant fossils	7
VII	Brief idea of concept of species; Classification of organisms; Principles of marine Ecology, Palaeoecology;	7
VIII	Principles of sequence Stratigraphy; Microplaeontology and its use	7

Suggested Readings:

1. Cowen, R. (2000) History of Life, Blackwell Science.
2. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science
3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press
4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing
5. Patrick Wyse Jackson, (2019) Introducing Palaeontology: A Guide to Ancient Life, Dunedin Academic Press Ltd.
6. Raymond Enay (2012) Palaeontology of Invertebrates, Springer-Verlag.
7. Peter Doyle, Understanding Fossils: An Introduction to Invertebrate Palaeontology.
8. Morley Davies (2008) An Introduction to Palaeontology, Read Books.
9. Sreepat Jain (2017) Fundamentals of Invertebrate Palaeontology: Macrofossils, Springer India
10. Roland Goldring, (2014) Field Palaeontology, Routledge
11. Johansson, C. Z., Underwood, M. Richter, (2019) Evolution and development of Fishes, Cambridge University Press.
12. Pratul Kumar Saraswati, M.S. Srinivasan, (2016) Micropaleontology: Principles and Applications, Springer International Publishing Switzerland.
13. Michael Benton, David A. T. Harper, (2009) Introduction to Paleobiology and the Fossil Record, Wiley-Blackwell.
14. Colbert, E.H. and Minkoff, Eli C. (2001) Evolution of vertebrates, Wiley Liss
15. Wadia, D., 1973. Geology of India. Mc Graw Hill Book co.
16. Krishnan, M.S., 1982. Geology of India and Burma, 6th Edition. CBS Publ.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**
Suggested Continuous Evaluation Methods: **Continuous Internal evaluation through internal tests, quies and presentation**
Course prerequisites: To study this course, a student must have had the subject **Certificate in Geology**
Suggested equivalent online courses: ....
Further Suggestions: .....

Programme/Class: **Diploma**	Year: **Second**	Semester: **Third**
Subject: **Geology**		
Course Code: **B090302P**	Course Title: Practical: PALAEONTOLOGY	
Course outcomes: After completing the course, student		
Credits: 2	Core: **Compulsory**	
Max. Marks: 25+75	Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		

Unit	Topics	No. of Lectures

	Study of the morphology of representative fossil invertebrates of Mollusca (Bivalvia, Gastropoda and Cephalopoda), Brachiopoda, Echinodermata (Echinoidea) and Cnidaria (Anthozoa): Study of important Gondwana plant fossils Preparation of lithostratigraphic maps of India showing distribution of important geological formations	60

Suggested Readings:

1. Cowen, R. (2000) History of Life, Blackwell Science.
2. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science
3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press
4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: To study this course, a student must have had the subject **Certificate in Geology**

Suggested equivalent online courses:
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Programme/Class: **Diploma**	Year: **Second**	Semester: **Fourth**
Subject: **Geology**		
Course Code: **B090401T**	Course Title: **PETROLOGY**	

Course outcomes:
After completing the course, student should be able

- learn to identify rock types and their mineralogical composition.
- learn texture, structure found within the rock
- to understand the role of temperature and pressure in formation of rocks
- to understand the geo-thermometer
- to understand stratigraphy and sedimentation history of different sedimentary basins of India understand the process of sedimentation and rock formation

Credits: 3	Core: **Compulsory**

Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0

Unit	Topics	No. of Lectures
I	Brief introduction to rocks: Magma: definition, composition and origin; Bowen's reaction series: Magmatic differentiation and assimilation	8
II	IUGS classification of igneous rocks, Texture of Igneous rocks, Brief petrographic description of common igneous rocks.	6
III	PhaseRule, Laws of thermodynamics , Phase equilibria studies in Diopside-Anorthite, Albite-Anorthite, Leucite-Silica and Diopside-Albite Anorthite systems	6
IV	Definition, agents, types and grades of metamorphism; Metamorphic rocks: texture, structure and classification: Concept of index minerals, metamorphic facies;	8
V	Regional metamorphism of calcareous and basic rocks; anatexis; Brief description of common metamorphic rocks.	7
VI	Origin and classification of sedimentary rocks; Introduction to sedimentary rocks and their origin.	8
VII	Sediment characteristics, Diagenesis, Textures of sedimentary rocks; Sedimentary structures.	8
VIII	Classification of sedimentary rocks: clastic and non-clastic; Classification of sandstone and carbonates; Sedimentary basins in different tectonic settings	9

Suggested Readings:

1. Cox, K. G., Bell, J. D. and Pankhurst, R. J. 1979. Interpretations of igneous rocks. George Allen and Unwin, London.
2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman.
3. Anthony R. Philpotts and Ague, J. J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge.
4. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.
5. Gautam Sen, 2014. Petrology: Principles and Practice: Gautam Sen (Springer).
6. Best, M. G. 2013. Igneous and Metamorphic Petrology. Wiley Blackwell.

7. Don L. Anderson 2012 Theory of the Earth Blackwell Scientific Publications
8. Alexander R McBirney, 2006 Igneous Petrology, III edition: Alexander R McBirney
9. White, W. M. Isotope Geochemistry. Wiley Blackwell
10. Faure, G. and Mensing, T. M. 2009 Isotope principles and Applications.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: To study this course, a student must have had the subject
Certificate in Geology

Suggested equivalent online courses:
.....

Further Suggestions:
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Programme/Class: **Diploma**	Year: **Second**	Semester: **Fourth**
Subject: **Geology**		
Course Code: **B090402P**	Course Title: Practical Petrology	
Credits: 2	Core: **Compulsory**	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-3		

Unit	Topics	No. of Lectures
	Study of rock types in hand specimens and thin sections: Granite, Syenite, Diorite, Dolerite, Gabbro, Dunite, Rhyolite, Basalt, Quartzite, Marble, Schist and Charnockite. Study of rock types in hand specimens only: Pegmatite, Sandstone, Limestone, Conglomerate, Shale, Phyllite, Slate and Gneiss Study of sedimentary rock types in hand specimens and thin sections: Quartz arenite, Arkose, Glauconitic-sandstone, Oolitic limestone, Pellet limestone, Fossiliferous limestone. Study of sedimentary rock types in hand specimens only: Conglomerate, Breccia, Stromatolitic limestone, Siltstone and Shale. Study of sedimentary structures in hand specimens such as ripple marks, cross bedding, graded- bedding, mud cracks, salt pseudomorphs, rain prints etc.	60

Suggested Readings:

1. Cox, K. G., Bell, J. D. and Pankhurst, R. J. 1979. Interpretations of igneous rocks. George Allen and Unwin, London.
2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman.
3. Anthony R. Philpotts and Ague, J. J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge.
4. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.
5. Prothoreo and Schwab, 2004. Sedimentary Geology, Freerman
6. Collinson, J.D. and Thompson, D.B., 1988. Sedimentary Structures, UnwinHyman, London.
7. Sam Boggs, 1995. Principles of Sedimentology and Stratigraphy, PrinticeHall, New Jersey.

This course can be opted as an elective by the students of following subjects: **NO**

Suggested Continuous Evaluation Methods:
Continuous Internaal evaluation through internal tests, quies and presentation

Programme/Class: **Degree B.Sc.**	Year: **Third**	Semester: **Sixth**
Subject: **Geology**		
Course Code: **B090501T**	Course Title: **Applied Geology and Global Tectonics**	

Course outcomes:
After completing the course, student be able to

- understand the plate tectonic
- understand the processes related to rifting, volcanism, mountain building etc.
- understand the construction of dam, tunnel and safety of roads in hilly regions

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Concepts of Geophysical, Geochemical and Geobotanical mineral exploration; Concept of surface and subsurface mining	8
II	Engineering properties of rocks and Soils, Soil and Soil groups of India	9
III	Introduction to geotechnical properties of rocks; Geological consideration for geo-engineered structures;	8
IV	Tunnels: geology, structure, seepage problem and role of water table	8
V	Active and Passive continental margins; Wilson Cycle, Geomagnetic reversals;	8
VI	Tectonic events in the Himalaya: Suspect Terranes, Hot-spots and Mantle plumes; Triple junctions	9
VII	Environmental considerations for mining.	5
VIII	Dam, Types and their geological and environmental considerations; Geological problem of reservoirs	5

Suggested Readings:

1. Kent C. Condie, Plate Tectonics and Crustal Evolution, Butterworth-Heinemann
2. Philip Kearey, Keith A. Klepeis, Frederick J. Vine, Global Tectonics, John Wiley & Sons
3. L.D. Leet, S. Judson and M.E. Kauffman, (1982), Physical Geology . Prentice-Hall Inc. 629p.
4. Krynine D.P. and Judd W.R., 1957. Principles of Engineering Geology & Geotechnics. McGraw-Hill Book
5. Kesavulu, N.C., 2009. A text book of engineering geology. Macmillan P publishing India Ltd.
6. Crozier, M.J., 1989. Landslides: causes, consequences and environment. Academic Press.
7. Readman, J.H , 1979. Techniques in Mineral exploration. Applied Science Publishres.
8. Bell, F.G., 1983. Fundamentals of Engineering Geology. Butterworth and Co

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Programme/Class: **Degree B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Geology**		
Course Code: **B090502T**	Course Title: **STRATIGRAPHY**	

Course outcomes:

After completing the course, student be able to

- learn the presence of different types
- Understand the fundamentals of stratigraphy and its branches.
- be able to identify potential zone of earth resource

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Principles of Stratigraphy; History and Development of Stratigraphy; Concept of Lithofacies and Biofacies; Lithostratigraphic, Chronostratigraphic and Biostratigraphy units; Stratigraphic correlation; Event stratigraphy.Geological Time Scale	8
II	Physical and structural subdivisions of the Indian subcontinent and their characters; Brief idea about Archaean successions of Peninsular India with special reference to the Dharwar Supergroup	7
III	Unmetamorphosed Proterozoic successions of India with special reference to Cuddapah and Vindhyan Supergroups	8
IV	Gondwana Supergroup: Marine Palaeozoic sequences of the Himalaya and Peninsular India	7

V	Marine Triassic and Jurassic successions of India; Marine and non-marine Cretaceous successions of Trichinopoly	8
VI	Stratigraphy of the Deccan Traps and Intertrappean beds	7
VII	Cenozoic stratigraphy: Cenozoic formations of India	7
VIII	Rise of the Himalayas and development of Siwalik Group; Quaternary Period and Meghalayan Stage	8

Suggested Readings:

1. Doyle, P. and Bennett, M.R., 1996. Unlocking the Stratigraphic Record, John Willey.
2. Dunbar, C.O. and Rodgers, J., 1957. Principles of Stratigraphy. John Wiley & Sons.
3. Krishnan, M.S., 1982. Geology of India and Burma, C.B.S. Publishers, Delhi
4. Naqvi, S.M. 2005. Geology and Evolution of the Indian Plate: From Hadean to Holocene4 Ga to 4 Ka. Capital Pub., New Delhi.
5. Pascoe, E.H., 1968. A Manual of the Geology of India & Burma (Vols.IN), Govt. of India Press, Delhi.
6. Pomerol, C., 1982. The Cenozoic Era - Tertiary and Quaternary. Ellis Harwood Ltd., Halsted Press.
7. Schoch, R.M., 1989. Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.
8. R. Vaidyanathan & M.Ramakrishnan, 2008. Geology of India, Geological Society of India.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: To study this course, a student must have had the subject
Diploma in Geology

Suggested equivalent online courses:
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Further Suggestions:
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Programme/Class: **Degree B.Sc.**	Year: **Third**	Semester: **Sixth**

Subject: **Geology**	
Course Code: **B090503R**	Course Title: Field Work

Course outcomes:
After completing the course, student should be able to

- ➢ understand the plate tectonic
- ➢ understand the processes related to rifting, volcanism, mountain building etc.
- ➢ understand the construction of dam, tunnel and safety of roads in hilly regions

Credits: 2	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2

Unit	Topics	No. of Lectures
	Geological Field Excursion Every student shall be required to attend the field training and submit to the Head of the Department a record of field observations and specimens collected, properly labelled and arranged; and a Viva–Voce examination based on the field work. The marks assigned to the fieldwork shall be on the basis of the field records and collections.and performance in the field.	Geological field excurissio n in and around Saharanpu r (60 hours)

Programme/Class: **Degree B.Sc.**	Year: **Third**	Semester: **Sixth**
Subject: **Geology**		

Course Code: **B090601T**	Course Title: **Remote Sensing and Environmental Geology**

Course outcomes:
After completing the course, student should be able to

- state of art technology, being effectively used to monitor and assess the earth's resources will be able to develop skills of interpreting the visual and digital satellite data
- understand the interaction of humans with the geological environment

Credits: 3	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0

Unit	Topics	No. of Lectures
I	Elementary idea about photogeology: electro-magnetic spectrum, types & geometry of aerial photographs: factors affecting aerial photography and scale	8
II	Fundamentals of remote sensing; sensors; signatures of rocks, minerals and soils. Application of remote sensing in geoscience and geomorphological studies.	8
III	Types of Indian and Foreign Remote Sensing Satellites, Digital image processing, elements of pattern recognition and image classification	7
IV	Introduction to Geographic Information System (GIS); components of GIS: product generation in GIS: tools for map analysis: integration of GIS with remote sensing	7
V	Defination of Environment and Environmental geology, atmosphere, hydrosphere, lithosphere, biosphere	8
VI	Global environments: coastal, riverine, desertic, tropical, cold, polar; Concept of global warming and climate change	8
VII	Geoloigeal hazards: Earthquakes, volcanism, landslides, avalanches, floods, droughts: Hazard mitigation	7
VIII	Resource Management: Energy resources (Conventional and non-conventional), watershed management, landuse planning, management of water resources.	7

Suggested Readings:

1. T. M. Lillesand and P. W. Kiefer. 2016 Remote Sensing and Image Interpretation. Wiley
2. R. P. Gupta. 2016. Remote Sensing Geology. Springer
3. F. F. Sabins. 2007. Remote Sensing. Principal and Interpretation Waveland Pr Inc
4. P. R. Wolf and B. A. Dewitt. 2004. Elements of Photogrammetry with applications in GIS.
5. G. Joseph and C. Jeganathan. 2018. Fundamentals of Remote Sensing: Universities Press (India) Private Limited.
6. Bhatta, B., 2008. Remote Sensing and GIS. Oxford, New Delhi.
7. Verma, V.K., 1986. Geomorphology Earth surface processes and form. McGraw Hill.
8. Chorley, R. J., 1984. Geomorphology. Methuen.
9. Selby, M.J., 1996. Earths Changing Surface. Oxford University Press UK.
10. Thornbury W. D., 1997. Principles of Geomorphology Wiley Eastern Ltd., New Delhi.
11. Valdiya, K. S., 1987. Environmental Geology - Indian Context. Tata McGraw Hill New Delhi.
12. Keller, E. A., 2000. Environmental Geology. Shales E. Merril Publishing Co., Columbus. Ohio.
13. Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London.
14. Bird, Eric. 2000. Coastal Geomorphology: An Introduction. John Wiley & Sons. Ltd. Singapore.
15. Liu, B.C., 1981. Earthquake Risk and Damage, Westview.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: To study this course, a student must have had the subject
Diploma in Geology
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Suggested equivalent online courses:
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Further Suggestions:
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Programme/Class: **Degree B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Geology**		
Course Code: **B090602T**	Course Title: **Economic Geology and Groundwater**	

Course outcomes:
After completing the course, student should be able to

- identify the common ore minerals.
- understand the genetic controls exerted by physical and chemical processes on ore formation in various geologic settings,
- understand economic and policy issues related to minerals and their national importance

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Classification of mineral deposits: Processes of formation of ores: magmatic, hydrothermal, oxidation and supergene enrichment, Concept of critical minerals	8
II	Occurrence, origin and distribution of the important mineral deposits of India: Copper, Iron, Manganese,	7
III	Occurrence, origin and distribution of the important mineral deposits of India: Aluminium , Chromium, Lead and Zinc.	6
IV	Conventional energy resources: Coal, Petroleum,	8
V	Radioactive minerals (Uranium and Thorium) , essential and strategic minerals	8
VI	Non -conventional energy resources: Geothermal energy - hot springs; Non metallic minerals to refractory and cement industry	8

VII	Groundwater and its vertical distribution; Aquifers and the geological considerations: Water bearing properties of rocks - Porosity and Permeability; specific yield, specific retention	8
VIII	Rainwater harvesting: River and groundwater pollution	7

Suggested Readings:

1. Ridley, John. (2013). Ore deposit geology. Cambridge University Press.
2. Barnes, H.L.. 1979 Geochemistry of Hydrothermal Ore Deposits, John Wiley.
3. Mookherjee, A. 2000. Ore Genesis – A Holistic Approach. Allied Publisher.
4. Craig, J. R., and D. J. Vaughn. "Ore microscopy and ore mineralogy." (1994).
5. Pracejus, Bernhard. 2015The ore minerals under the microscope: an optical guide. Vol. 3. Elsevier.
6. Bateman, Alan Mara, and Mead L. Jensen. 1950. Economic mineral deposits. Vol. 259. New York: Wiley.

Programme/Class: **Degree B.Sc.**	Year: **Third**	Semester: **Fifth**
Subject: **Geology**		
Course Code: **B090603P**	Course Title: **Practical Economic Geology**	

Course outcomes.
After completing the course, student should be able to

- ➢ understand the plate tectonic
- ➢ understand the processes related to rifting, volcanism, mountain building etc.
- ➢ understand the construction of dam, tunnel and safety of roads in hilly regions

Credits: 2	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2

Unit	Topics	No. of Lectures
	Study of important economic minerals in hand specimens. Stereographic projection technique to solve dip and strike problem & other problems. Surveying Methods	60

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: To study this course, a student must have had the subject
Diploma in Geology

Suggested equivalent online courses:
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Further Suggestions:
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SUBJECT: MINOR

Course Code:	Course Title: **Introductory Geology**

Course outcomes:
After completing the course. student should be able to

- Know about basics of geology. earth and its internal structure.
- Understand of tectonic activities and various disaster on earth
- understand the relation of water and rock. Availability of water and its conservation
- Identify the mineral and rocks

Credits: 4	Core: **Compulsory**
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Introduction to Geology and its scope. origin and age of Earth. Branches of Geology and its scope. Physiographic divisions of India, Importance of Geology as a carrier.	8
II	Origin and internal Structure and composition of Earth, Renowned Indian geologists and their contribution in Indian Geology.	7
III	Tectonic activities on Earth, Basic Concepts of Plate Tectonics, Divergent. Convergent and Transform Plate boundaries. Earthquakes and Volcanoes	6
IV	Formation of minerals and Rocks-types of rocks, rock cycle. Process of weathering and erosion, elementary idea about economic mineral. Eg. Metallic and Non metallic, Precious, Refractory, Abrasive and cement minerals.	8
V	Hydrogeology, water table and water bearing properties of rocks. Conservation and Management of water, Artificial recharge, Concept of Rain water harvesting structures	8
VI	Applied Geology: Environmental geology, Engineering geology, Medical geology, Mining geology and Remote Sensing.	8

Suggested Readings:

1.The Blue Planet: An Introduction to Earth System Science – B.J. Skinner and S.C. Porter. 1995, John wiley & Sons, Inc. 493p.
2. Introduction to Physical Geology - G.R. Thompson and J. Turk. 1998. Saunders College Publishers, Fort Worth. 371p.
3. Processes that Shape the Earth – D.M. Thompson. 2007, Infobase Publishing, NY. 116p.
4. Physical Geology – L.D. Leet. S. Judson and M.E. Kauffman, (1982). Prentice-Hall Inc. 629p.
5. Holme's Principles of Physical Geology – P.MvL.D. Duff. Fourth Edition (1993). Stanley Thornes (Publishers) Ltd
6.Valdiya. K. S., 1987. Environmental Geology - Indian Context. Tata McGraw Hill New Delhi.
7.Keller, E. A., 2000. Environmental Geology. Shales E. Merril Publishing Co., Columbus, Ohio.
8.Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London
9. http://egyankosh.ac.in/handle/123456789/36575
10. http://egyankosh.ac.in/handle/123456789/53574
11. http://egyankosh.ac.in/handle/123456789/53280

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12th.**

Suggested Continuous Evaluation Methods:
Continuous Internal evaluation through internal tests, quies and presentation

Course prerequisites: