Kurukshetra University, Kurukshetra

(Established by the State Legislature Act XII of 1956)

('A+' Grade, NAAC Accredited)

Scheme of Examination

B.Sc. (General)
Subject: Geology

Under

Choice Based Credit System (CBCS-LOCF)
w.e.f. session 2020-21 (in phased manner)

CBCS CURRICULUM (2020-21)

Program Name: B. Sc. with Geology

(For the Batches Admitted From 2020-2021)

VISION

Be globally acknowledged as a distinguished centre of academic excellence.

MISSION

To prepare a class of proficient scholars and professionals with ingrained human values and commitment to expand the frontiers of knowledge for the advancement of society.

DEPARTMENT VISION AND MISSION

VISION

- To become a model department which imparts quality education, research with innovation and recognition at National and International level for serving the society.

MISSION

- **M1:** To provide quality education to aspiring young minds for improving their skills, inculcating values, creating leadership qualities and enhancing research with innovative methods.
- **M2:** To produce young geologists who would contribute in the areas of higher education, regional and national planning, development, environment, ethics and sustainable environment development.
- **M3:** To develop Teaching-Learning methods which can produce socially committed professionals who contribute effectively in nation building.

Mapping of University Vision and Mission to Department Vision and Mission

Acclaimed as modal Centre of Learning and Research by

University Vision and Mission	**Department Vision and Mission**
High quality knowledge delivery through state of art infrastructure and ethical values to the students	**Yes**
Students excellence will make them professionals and innovators emerging as national and global leaders	**Yes**
Research and development will help in furtherance of faculty knowledge	**Yes**

Program Outcomes (PO) with Graduate Attributes

Programme outcomes are attributes of the graduates from the programme that are indicative of the graduates' ability and competence to work after being a qualified Geologist upon graduation. Program outcomes are statements that describe what students are expected to know or do by the time of graduation, they must relate to knowledge and skills that the students acquire from the programme. The achievement of all outcomes indicates that the student is well prepared to achieve the program educational objectives down the road. The department of geology has the following eleven PO's. The course syllabi and the overall curriculum have been designed to achieve these outcomes:

Program Outcomes (PO) for Under Graduate Programs (CBCS) in the Faculty of Sciences, Kurukshetra University, Kurukshetra

PO1	Knowledge	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study
PO2	Communication	Ability to communicate effectively on general and scientific topics with the scientific community and with society at large
PO3	Problem Solving	Capability of applying knowledge to solve scientific and other problems
PO4	Individual and Team Work	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.
PO5	Investigation of Problems	Ability of critical thinking, analytical reasoning and research-based knowledge including design of experiments, analysis and interpretation of data to provide conclusions
PO6	Modern Tool usage	Ability to use and learn techniques, skills and modern tools for scientific practices
PO7	Science and Society	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices
PO8	Life-Long Learning	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout the life
PO9	Environment and Sustainability	Ability to design and develop modern systems which are environmentally sensitive and to understand the importance of sustainable development.
PO10	Ethics	Apply ethical principles and professional responsibilities in

		scientific practices
PO11	Project Management	Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects

Program Specific Outcomes (PSO's):

- **PSO1:** Basic understanding of fundamental concepts of geology and applying it on the various natural processes occurring on and inside the earth as a whole system.
- **PSO2:** Clearly formulate and solve real life challenges with respect to human environment interactions.
- **PSO3:** Applications of fundamental principles of geology in finding out various minerals and other natural resources for the betterment of human society.
- **PSO4:** Acquisition of skills to effectively communicate the knowledge of geology to the society for safeguarding the physical environment.

Scheme of Examination, B.Sc. (General)

Under (CBCS-LOCF) w.e.f. session 2020-21 (in phased manner)

Subject: Geology

Semester	Course	Paper(s)		Credits	Workload/ hours per week	Internal marks	External Marks	Total	Exam Duration
I	CC- **Geology-I**	B-GGY-101		3	3	15	60	75	3 hrs.
		B-GGY -102		3	3	15	60	75	3 hrs.
		B-GGY -103 (Practical)		2	4	10	40	50	3 hrs.
II	CC- **Geology-II**	B-GGY -201		3	3	15	60	75	3 hrs.
		B-GGY -202		3	3	15	60	75	3 hrs.
		B-GGY -203 (Practical)		2	4	10	40	50	3 hrs.
III	CC- **Geology-III**	B-GGY -301		3	3	15	60	75	3 hrs.
		B-GGY -302		3	3	15	60	75	3 hrs.
		B-GGY -303 (Practical)		2	4	10	40	50	3hrs.
IV	CC- **Geology-IV**	B-GGY -401		3	3	15	60	75	3 hrs.
		B-GGY -402		3	3	15	60	75	3 hrs.
		B-GGY -403 (Practical)		2	4	10	40	50	3 hrs.
	SEC- **Geology**	B-GGY-404		2	2	15	60	75	3 hrs.
V	DSE-I **Geology Opt either 501, 502,503 or 504, 505, 506**	B-GGY -501	B-GGY - 504	2	2	15	60	75	3 hrs.
		B-GGY -502	B-GGY -505	2	2	15	60	75	3 hrs.
		B-GGY-503 (Practical)	B-GGY-506 (Practical)	2	4	10	40	50	3 hrs.
VI	DSE-II **Geology-II Opt either 601, 602,603 or 604, 605, 606**	B-GGY-601	B-GGY- 604	2	2	15	60	75	3 hrs.
		B-GGY-602	B-GGY-605	2	2	15	60	75	3 hrs.
		B-GGY-603 (Practical)	B-GGY- 606 (Practical)	2	4	10	40	50	3 hrs.

Nomenclature of Papers B.Sc. (General)

Subject: Geology

Semester	Course	Paper(s)	Nomenclature of Paper(s)
I	CC- **Geology-I**	B-GGY-101	Physical Geology and Geomorphology
		B-GGY -102	Structural Geology
		B-GGY -103	Geology Practical Based on B-GGY-101 & B-GGY-102
II	CC- **Geology-II**	B-GGY -201	Crystallography & Mineral Optics
		B-GGY -202	Mineralogy
		B-GGY -203	Geology Practical Based on B-GGY-201 & B-GGY-202
III	CC- **Geology-III**	B-GGY -301	Palaeontology
		B-GGY -302	Stratigraphy
		B-GGY -303	Geology Practical Based on B-GGY-301 & B-GGY-302
IV	CC- **Geology-IV**	B-GGY -401	Igneous and Metamorphic Petrology
		B-GGY -402	Sedimentology
		B-GGY -403	Geology Practical Based on B-GGY-401 & B-GGY-402
	SEC-**Geology**	B-GGY-404	Field Techniques in Geology
V	DSE-I **Geology**	B-GGY- 501	Economic Geology
		B-GGY-502	Exploration Geology & Remote Sensing
		B-GGY-503	Geology Practical Based on B-GGY-501 & B-GGY-502
		OR	
	DSE-I **Geology**	B-GGY- 504	Natural Hazards
		B-GGY-505	Environmental Geology
		B-GGY- 506	Geology Practical Based on B-GGY-501 & B-GGY-502
VI	DSE-II **Geology**	B-GGY- 601	Engineering Geology & Mining Geology
		B-GGY- 602	Hydrogeology
		B-GGY- 603	Geology Practical Based on B-GGY-601 & B-GGY-602
		OR	
	DSE-II **Geology**	B-GGY- 604	Oceanography
		B-GGY- 605	Climatology
		B-GGY- 606	Geology Practical Based on B-GGY-604 & B-GGY-605

B.Sc. with GEOLOGY I SEMESTER

B-GGY-101
Physical Geology & Geomorphology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-101.1: Provides understanding about various geological aspects and its relation with mankind.
B-GGY-101.2: Understanding about the processes taking place inside the earth**.**
B-GGY-101.3: Understanding of the surface geological processes and their effect on mankind and environment.
B-GGY-101.4: Enhancement of knowledge about changes on the earth's surface by knowing various geomorphological processes.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Significance of Geology to mankind; Geology and its branches - their interrelationship; solar system, theories of origin of earth, shape and size of earth, its relief features, interior of earth, meteorites and age of earth.
Unit II
Volcanoes - their types, products and causes; earthquakes - seismic waves, intensity scale, damage to life and property, causes; continental drift - Wegner's concept, continental fit and evidence. Elementary ideas about sea floor spreading and plate tectonics.
Unit III
Basic concepts of geomorphology; weathering - physical, chemical and biological; soil profile and soil formation; mass wasting and drainage patterns.
Unit IV
Erosional and depositional features of fluvial, arid and glacial geomorphic cycles; cycle concept in geomorphology, peneplanation, uplift and rejuvenation.

BOOKS RECOMMENDED
Principles of Physical Geology- A. Holmes
Principles of Geomorphology- W.D. Thornbury
Geomorphology- V.K. Sharma
Plate Tectonics and Crustal Evolution- K.C. Condie
Aspects of Tectonics- K.S. Valdiya
Essentials of Earth Science- Kelvin

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-101.1	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-101.2	3.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-101.3	3.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-101.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	3.0	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-101.1	3.0	3.0	2.0	3.0
B-GGY-101.2	3.0	3.0	2.0	2.0
B-GGY-101.3	3.0	3.0	3.0	2.0
B-GGY-101.4	3.0	3.0	3.0	3.0
Average	3.0	3.0	2.5	2.5

B-GGY - 102
Structural Geology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-102.1: Provides understanding about basics of structural geology.
B-GGY-102.2: Understanding about the processes of folding of the strata and their identification in the field.
B-GGY-102.3: Understanding the mechanism of faulting of strata and their identification in the field.
B-GGY-102.4: Understanding the mechanism of joints on the earth's features and their identification in the field.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Elements of structural geology-attitude of beds, strike and dip; deformation of rocks - force, stress, strain and rupture; elastic and plastic deformations.
Unit II
Folds, their morphology, genetic and geometric classification, recognition of folds on maps and in the field.
Unit III
Faults, their geometric and genetic classification, recognition of faults on maps and in the field.
Unit IV
Joints and their classification; unconformity, its types and recognition in the field & maps.

BOOKS RECOMMENDED
Structural Geology -M.P. Billing
Foundation of Structural Geology -R.G. Park
Principles of Structural Geology -G.M. Mevin
Theory of Structural Geology- N.W. Gokhale
The Techniques of Modern Structural Geology-John G. Ramsay

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-102.1	3.0	3.0	2.0	2.0	3.0	1.0	3.0	3.0	2.0	2.0	2.0
B-GGY-102.2	3.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	3.0
B-GGY-102.3	3.0	2.0	2.0	2.0	3.0	1.0	2.0	3.0	3.0	1.0	3.0
B-GGY-102.4	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	2.5	2.5	2.0	3.0	1.8	2.5	3.0	2.8	1.5	2.8

Mapping of Course Outcomes to Program Specific Outco mes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-102.1	3.0	2.0	2.0	3.0
B-GGY-102.2	3.0	3.0	2.0	2.0
B-GGY-102.3	3.0	3.0	3.0	2.0
B-GGY-102.4	3.0	3.0	3.0	2.0
Average	3.0	2.8	2.5	2.8

B.Sc. with GEOLOGY I SEMESTER

B-GGY – 103 Practical

Credits: 2
Total Marks: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination Time: 3h

Practical exercises based on B-GGY- 101 (Physical Geology and Geomorphology) and B-GGY- 102 (Structural Geology).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08

B.Sc. with GEOLOGY II SEMESTER
B-GGY - 201
Crystallography and Mineral optics

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-201.1: Understanding of the crystal systems.
B-GGY-201.2: Applying the crystal knowledge on various minerals found on the earth.
B-GGY-201.3: Understanding of crystal optics.
B-GGY-201.4: Studying optical properties of various minerals, hence using the above information for better identification of minerals

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Crystals - definition, forms, faces, edges, solid angles; elements of symmetry - axes, planes & center; parameter system of Weiss, Index system of Miller.
Unit II
Study of crystal forms of normal classes of all seven crystal systems; twinning - its types and examples.
Unit III
Principles of optics, reflection, refraction, pleochroism, polarization of light, nicol prism, construction and working of petrological microscopes.
Unit IV
Optical properties of common rock forming minerals; extinction angle; use of optical accessories - mica plate, gypsum plates and quartz wedge.

BOOKS RECOMMENDED
Rutley's Elements of Mineralogy- H.H. Read
Dana’s TextBook of Mineralogy- W.E. Ford
Mineralogy Berry & Mason Mineralogy for Students- M.I. Batty
Optical Mineralogy- E.E. Wahlstrom
Optical Mineralogy- P.F. Kerr
Elements of Optical Mineralogy- A.N. Winchell

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-201.1	3.0	2.0	2.0	1.0	3.0	1.0	3.0	3.0	2.0	1.0	2.0
B-GGY-201.2	3.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	2.0	2.0
B-GGY-201.3	3.0	2.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-201.4	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	2.0	2.5	1.8	3.0	1.8	2.5	3.0	2.5	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-201.1	3.0	2.0	3.0	3.0
B-GGY-201.2	3.0	2.0	3.0	2.0
B-GGY-201.3	3.0	3.0	3.0	2.0
B-GGY-201.4	3.0	3.0	3.0	3.0
Average	3.0	2.5	3.0	2.5

B.Sc. with GEOLOGY II SEMESTER

B-GGY – 202 Mineralogy

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-202.1: Learning about minerals
B-GGY-202.2: Understanding various properties of silica minerals and their economic importance
B-GGY-202.3: Application of properties and economic uses of various mafic minerals.
B-GGY-202.4: Application of properties and economic uses of various clay minerals.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Mineral - definition; types of bonding, isomorphism, polymorphism, pseudomorphism; classification of minerals; physical and chemical properties of minerals.
Unit II
Study of physical, chemical and optical properties of quartz and feldspar group of minerals.
Unit III
Study of physical, chemical and optical properties of amphibole, pyroxene and mica group of minerals.
Unit IV
Study of physical, chemical and optical properties of kyanite, sillimanite, epidote, fluorite, tourmaline, beryl, zircon, corundum and diamond.

BOOKS RECOMMENDED
Rutley's Elements of Mineralogy- H.H. Read
Dana's Textbook of Mineralogy-W.E. Ford
Mineralogy- Berry & Mason
Mineralogy for students- M.I. Batty
Optical Mineralogy- E.E. Wahlstrom
Optical Mineralogy- P.F. Kerr
Elements of Optical Mineralogy- A.N. Winchell

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-202.1	3.0	2.0	2.0	1.0	3.0	1.0	3.0	3.0	2.0	2.0	2.0
B-GGY-202.2	3.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-202.3	3.0	2.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-202.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	2.5	2.5	1.8	3.0	1.8	2.5	3.0	2.5	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-202.1	3.0	3.0	3.0	3.0
B-GGY-202.2	3.0	2.0	3.0	2.0
B-GGY-202.3	3.0	3.0	3.0	2.0
B-GGY-202.4	3.0	2.0	3.0	3.0
Average	3.0	2.5	3.0	2.5

B.Sc. with GEOLOGY II SEMESTER

B-GGY – 203 Practical

Credits: 2
Total Marks: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination: 3h

Practical exercises based on B-GGY- 201 (Crystallography and Mineral optics) and B-GGY- 202 (Mineralogy).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08

B.Sc. with GEOLOGY III SEMESTER
B-GGY 301 PALAEONTOLOGY

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-301.1: Understanding the concept of evolution by learning fossils.
B-GGY-301.2: Understanding the morphology of various important fossils
B-GGY-301.3: Understanding the vertebrate life.
B-GGY-301.4: Elementary idea about micropalaeontology and its application in the hydrocarbon industry.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Fossil, mode of preservation of fossils, condition of fossilization; organic evolution, theories of evolution – Lamarkism and Darwanism.
Unit II
Brief Introduction and Morphology to brachiopod, Trilobite and Mollusca (gastropod, cephalopod and pelecypod) and graptoloidea.
Unit III
Elementary idea of vertebrate life; evolution of horse and man; classification of plant kingdom and Gondwana flora; Morphology of Echinoids and their environmental significance.
Unit IV
Elementary idea of micropalaeontology and its scopes; Morphology of foraminifers and ostracodes; fossil spores and pollen.

Books recommended
1. Invertebrate palaeontology- H. Wood
2. Principles of Invertebrate Palaeontology- Shrock and Twenhoffel
3. Invertebrate fossils. Moore- Lalicker and Fisher
4. Evolution of vertebrates- E. A. Colbert
5. Microfossils- Brasier

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-301.1	3.0	1.0	2.0	3.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-301.2	3.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	2.0	2.0	2.0
B-GGY-301.3	3.0	2.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	2.0	3.0
B-GGY-301.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	2.25	2.5	2.8	3.0	1.8	2.5	3.0	2.5	2.0	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-301.1	3.0	3.0	2.0	3.0
B-GGY-301.2	3.0	2.0	3.0	2.0
B-GGY-301.3	3.0	3.0	3.0	2.0
B-GGY-301.4	3.0	2.0	3.0	3.0
Average	3.0	2.5	2.8	2.5

B.Sc. II with GEOLOGY III SEMESTER
B-GGY 302 STRATIGRAPHY

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-302.1: Elementary idea of stratigraphy and correlation.
B-GGY-302.2: Understanding Precambrian stratigraphy and significance of depositional sequences.
B-GGY-302.3: Understanding Paleozoic stratigraphy and significance of depositional sequences.
B-GGY-302.4: Understanding Mesozoic stratigraphy and significance of depositional sequences.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Definition of stratigraphy, principles of stratigraphy, stratigraphic nomenclature– lithostratigraphic, biostratigraphic and chronostratigraphic classifications; geological time scale; principles of correlation.
Unit II
Precambrian stratigraphy: Dharwar, Sighbhum, Eastern Ghats, Aravalli, Cuddapah and Vindhyans.
Unit III
Paleozoic stratigraphy of India with emphasis to Spiti basin, Gondwana sequence, Deccan traps
Unit IV
Mesozoic stratigraphy of India– Spiti, Rajasthan, Kutch and Tamil Nadu; Palaeogene, Neogene and Quaternary stratigraphic successions of India.

Books Recommended
1. Geology of India- D.N. Wadia
2. Geology of India and Burma- M.S. Krishnan
3. Fundamentals of Historical Geology and Stratigraphic of India- Ravindra Kumar
4. Principles of Stratigraphy- Dunbar and Rogers
5. Geology and Evolution of Indian Plate- S.M. Naqvi

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-302.1	3.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0	1.0	2.0	2.0
B-GGY-302.2	3.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-302.3	3.0	1.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	2.0	3.0
B-GGY-302.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	1.75	2.5	1.8	3.0	1.8	2.5	3.0	2.25	1.75	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-302.1	3.0	1.0	2.0	2.0
B-GGY-302.2	3.0	3.0	2.0	2.0
B-GGY-302.3	3.0	2.0	3.0	2.0
B-GGY-302.4	3.0	2.0	3.0	3.0
Average	3.0	2.0	2.5	2.25

B.Sc. with GEOLOGY III SEMESTER

B-GGY – 303 Practical

Credits :2
Total Marks: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination Time: 3h

Practical exercises based on B-GGY- 301 (PALAEONTOLOGY) and B-GGY- 302 STRATIGRAPHY).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08

B.Sc. with GEOLOGY IV SEMESTER

B-GGY-401 IGNEOUS AND METAMORPHIC PETROLOGY

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-401.1: Elementary idea about Magma and its composition, differentiation and Physical properties.
B-GGY-401.2: Learning about Phase rules, component systems and various igneous rocks.
B-GGY-401.3: Understanding about formation of various igneous rocks.
B-GGY-401.4: Getting the elementary idea of metamorphism and metamorphic rocks

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Composition and types of magma; Physical properties of magma: temperature, viscosity and density; magmatic differentiation and assimilation; Bowen reaction series.
Unit II
Phase diagram and their uses in igneous and metamorphic petrology; Phase rule; one component system; two component systems: Congruent melting and Incongruent melting; Solid solution; Basics of ternary systems.
Unit III
Igneous Rocks- common igneous minerals, method of emplacement of igneous rocks, classification and texture of igneous rocks; Physical, petrographical and chemical properties of igneous rocks: Granite, Rhyolite, Pegmatite, Syenite, Diorite, Basalt and Dolerite.
Unit IV
Metamorphism– definition, scope, agents and types; Concept of grade, zone and facies of metamorphism; Structure and texture of metamorphic rocks; metamorphic differentiation.

Books recommended:
1. Principles of Petrology- G.W. Tyrrell
2. Petrology- Ehlers and Blatt
3. Petrology of Igneous and Metamorphic Rocks- Best
4. Igneous and Metamorphic Petrology- Turner and Verhoogen
5. Petrology of Igneous Rocks- Hatch, Wells and Wells
6. Petrology of Igneous and Metamorphic Rocks of India- Chatterjee
7. Petrography Williams- Turner and Gilbert
8. The Studies of Rocks in Thin Section- Moor House

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-401.1	1.0	2.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-401.2	3.0	1.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-401.3	2.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-401.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	2.25	2.25	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-401.1	3.0	1.0	2.0	3.0
B-GGY-401.2	2.0	3.0	3.0	3.0
B-GGY-401.3	3.0	3.0	3.0	2.0
B-GGY-401.4	3.0	2.0	3.0	3.0
Average	2.8	2.25	2.75	2.75

B.Sc. with GEOLOGY IV SEMESTER
B-GGY-402 SEDIMENTOLOGY

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-402.1: Understanding the concept of sedimentation, origin of sedimentary rocks and their grain size relations.
B-GGY-402.2: Understanding of properties of sedimentary rocks, their structures and various types of sands.
B-GGY-402.3: Studying types of sedimentary rocks, their classification and significance.
B-GGY-402.4: Understanding Heavy minerals and their role in various research aspects.

Note for Paper Setters: Question 1 is compulsory comprising six sub parts spread over the entire syllabus (two marks for each sub part), to be answered in 15-20 words. There will be eight long questions, two from each unit. The candidate has to answer four long questions, at least one question from each unit. All questions carry equal marks.

Unit I
Origin of sediments and sedimentary rocks; concept of size of sediments, descriptive size terms, size classification; shape and roundness of sediment grains; packing of grains.
Unit II
Porosity, permeability, oolites, sperulites. Bedding - its significance. Sedimentary structures - primary, secondary and organic. Shoestring sands, wedge shaped sands, sheet sands, sedimentary dykes and sills, reefs and mud mounds.
Unit III
Gravels, Conglomerates - their classification and significance; Sandstones -their mineralogy and classification into arenites, wackes and mudstones. Matrix -its types; greensands, placer sands.
Unit IV
Shales, marls and limestones; Heavy minerals - definition, methods of separation and their significance, provenance of sediments; lithification and diagenesis of sediments.

Books recommended:
1. Sedimentary Rocks - F.J. Pettijohn
2. Petrology of Sedimentary Rocks- J. T. Greensmith
3. Sedimentary Rocks - Prothero and Schwab
4. Sedimentology and Stratigraphy - Gary Nichols
5. Principles of Sedimentology and Stratigraphy - Sam Boggs
6. Sedimentology - McLane

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-402.1	3.0	2.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-402.2	3.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	2.0	2.0
B-GGY-402.3	2.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	1.0
B-GGY-402.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	2.8	2.8	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.75	1.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-402.1	3.0	3.0	2.0	3.0
B-GGY-402.2	3.0	3.0	2.0	2.0
B-GGY-402.3	3.0	3.0	3.0	2.0
B-GGY-402.4	3.0	3.0	3.0	3.0
Average	3.0	3.0	2.5	2.5

B.Sc. with GEOLOGY IV SEMESTER

B-GGY – 403 Practical

Credits: 2
Total Marks: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination Time: 3h

Practical exercises based on B-GGY- 401 (IGNEOUS AND METAMORPHIC PETROLOGY) and B-GGY- 402 (SEDIMENTOLOGY).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08

B.Sc. with GEOLOGY IV SEMESTER
B-GGY-404 Field Techniques in Geology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-402.1: Learning of basic idea of field equipment.
B-GGY-402.2: Elementary Idea about field work
B-GGY-402.3: Studying types of out crops present in the field
B-GGY-402.4: Learning about drawing of a geological section.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit I
Field equipment and their uses: Topographic maps, contour Maps, compass, Hammer, Altimeter, Measuring Tape, Field notebook.
Unit II
Methods of field work: Preliminary survey, geological mapping, sample collection, laboratory work, writing a report.
Unit III
Field outcrop patterns and geologic structures: Horizontal ground, undulating ground: Horizontal beds, inclined beds, Vertical beds.
Unit IV
Drawing the geological cross sections: contour lines, structural attitude of data, Thickness of each formation; determination of dip and Strike.

Books recommended:
1. A Guide To Field Geology- N.W. Gokhale
2. Field Geology-F.H. Lahee
3. Guide to Field Geology- S.M. Mathur
4. Manual of Field Geology- Robert R. Compton

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-402.1	3.0	2.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-402.2	3.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	2.0	2.0
B-GGY-402.3	2.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	1.0
B-GGY-402.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	2.8	2.8	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.75	1.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-402.1	3.0	3.0	2.0	3.0
B-GGY-402.2	3.0	3.0	2.0	2.0
B-GGY-402.3	3.0	3.0	3.0	2.0
B-GGY-402.4	3.0	3.0	3.0	3.0
Average	3.0	3.0	2.5	2.5

B.Sc. with GEOLOGY V SEMESTER
B- GEO-501 Economic Geology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-501.1: Elementary idea of ore forming processes.
B-GGY-501.2: learning about economically important base metals
B-GGY-501.3: Learning about occurrence and origin of petroleum
B-GGY-501.4: Learning about occurrence and origin of coal.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Elementary concept of the following ore forming processes: magmatic, hydrothermal, sedimentary, residual and mechanical concentration, oxidation and supergene enrichment.
Unit -II
The study of physical properties and uses of the ores of the following with reference to Indian occurrences: Iron, manganese, aluminum, copper, lead, zinc, tin, tungsten, molybdenum, uranium thorium, chromium, nickel, cobalt, antimony, gold, silver and platinum.
Unit-III
Petroleum: composition, origin, migration (primary and secondary), accumulation of petroleum and geological occurrences in India.
Unit-IV
Coal: Formation of coal, types of coal, gasification, liquefaction, uses of coal and geological occurrences in India.

Books recommended:
1. India's Mineral Resources- S. Krishnaswami
2. Industrial Mineral and Rocks of India- S. Deb
3. Economic Mineral Deposits- A.M. Bateman
4. Ore Deposits of India- Gokhale and Rao
5. Geology and Mineral Deposits- Smirnov

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-501.1	3.0	2.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-501.2	1.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-501.3	2.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-501.4	3.0	1.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	2.25	2.25	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-501.1	3.0	3.0	2.0	3.0
B-GGY-501.2	2.0	1.0	2.0	2.0
B-GGY-501.3	3.0	3.0	3.0	2.0
B-GGY-501.4	3.0	1.0	3.0	3.0
Average	2.75	2.0	2.5	2.5

B.Sc. with GEOLOGY V SEMESTER
B-GGY-502 Exploration Geology & Remote Sensing

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-502.1: Learning about indications of economic minerals ore deposits.
B-GGY-502.2: Elementary idea of sampling
B-GGY-502.3: Learning basics of Remote sensing.
B-GGY-502.4: Learning Remote Sensing characteristics, aerial photographs and their uses in Geology.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Surface expression and indications of economic deposits; old working, gossans and cap rocks; geobotanical guides.
Unit-II
Techniques of surface and subsurface sampling (pitting, trenching, drilling) and delineation of anomalies with typical examples. Elementary idea of geophysical investigation - resistivity surveys, Schlumberger and Wenner configuration.
Unit-III
Remote sensing - concept; sources of remote sensing information; electromagnetic energy and spectrum; remote sensing platforms; Atmospheric effects - absorption bands; scale, brightness and tone, contrast ratio, spatial resolution and resolving power; detectability, recognizability, signature, texture and interpretation key.
Unit-IV
Atmospheric scattering; ground resolution; photographic scale; relief displacement, vertical exaggeration, Aerial photographs - their types and uses.

Books recommended:
1. Mining Geology- R.M. Arogyaswamy
2. Practical Manual of Exploration and Prospecting- S.K. Babu
3. Principles and Practical of Mineral Exploration- D.K. Sinha
4. Elements of Prospecting and Bagchi Exploration- Sen Gupta and Rao
5. Remote sensing - Principles and interpretation - Floyd F. Sabins
6. Remote Sensing Geology - R.P. Gupta

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-502.1	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	3.0
B-GGY-502.2	3.0	3.0	3.0	2.0	3.0	1.0	2.0	3.0	3.0	1.0	2.0
B-GGY-502.3	3.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	2.0	1.0	3.0
B-GGY-502.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0
Average	3.0	3.0	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-502.1	3.0	3.0	2.0	3.0
B-GGY-502.2	3.0	3.0	2.0	3.0
B-GGY-502.3	3.0	2.0	3.0	2.0
B-GGY-502.4	3.0	3.0	3.0	3.0
Average	3.0	2.8	2.5	2.8

B.Sc. with GEOLOGY V SEMESTER

B-GGY – 503 Practical

Credits: 2
Total Marks: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination Time: 3h

Practical exercises based on B-GGY- 501 (Economic Geology) and B-GGY- 502 (Exploration Geology & Remote Sensing).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08

B.Sc. with GEOLOGY V SEMESTER
B-GGY-504 Natural Hazards

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-504.1: Elementary idea about natural hazards, their impact on the society and economy and disaster management.
B-GGY-504.2: Knowledge about Earthquakes and their management plan.
B-GGY-504.3: Knowledge about Landslides, Coastal Hazards, their mitigation and action plan.
B-GGY-504.4: Knowledge about Floods, Droughts, prevention and action plan.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Introduction to Hazards and Disasters; Types of Hazards: Natural and Manmade; Socio-economic impact of natural hazards. Disaster management: introduction and principles; Elements of disaster management.
Unit-II
Earthquakes: Introduction, Causes, Intensity scales; Actions to be taken before, during and after Earthquake.
Unit-III
Landslides: definition, types, causes and prevention; Do's and don'ts in case of slope failure; Coastal Hazards: types, causes and remedies.
Unit-IV
Floods: Introduction, Causes and mitigation; Actions to be taken before, during and after Floods; Drought: characteristics, causes and prevention.

Books recommended:

1. Engineering Geology- Krynine and Judd WR
2. Applied Geomorphology- Thornbury
3. Environmental geosciences- Keller, EA
4. Natural Hazard Risk Assessment and Public Policy- WJ Petak and Atkinsson.
5. Natural Disasters and Mitigation- P.S Roy, C.J Van Western, V.J. Jha.

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-504.1	3.0	3.0	2.0	2.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-504.2	2.0	3.0	3.0	2.0	3.0	1.0	2.0	3.0	3.0	1.0	2.0
B-GGY-504.3	3.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-504.4	1.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	2.25	3.0	2.5	2.0	3.0	1.5	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-504.1	3.0	3.0	3.0	3.0
B-GGY-504.2	3.0	3.0	1.0	3.0
B-GGY-504.3	2.0	3.0	3.0	2.0
B-GGY-504.4	3.0	3.0	3.0	2.0
Average	2.8	3.0	2.5	2.5

B-GGY-505 Environmental Geology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-505.1: Elementary idea about environmental geology.
B-GGY-505.2: Learning of impact of hazards and anthropogenic activity on mining, and energy resources..
B-GGY-505.3: Idea about various geological cycles and climate change.
B-GGY-505.4: Learning about various pollution and their causes.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Introduction to environmental geology, its fundamental concepts, and scope; Environmental ethics; Concepts ecosystem on earth (atmosphere, hydrosphere, lithosphere and biosphere)
Unit-II
Soil erosion; land resources vs natural hazards; depletion of water resources: causes and impact; Renewable and non- renewable sources of energy.
Unit-III
Concepts of geological cycles: hydrological cycle, carbon cycle; increasing CO2 trend and greenhouse gases; concept of climate change. Impact of mining on the environment.
Unit-IV
Pollution: Water and Land; Waste: introduction, types and their disposal. Role of geology in waste disposal. Environmental laws.

Books recommended:

1. Environmental Geology- L. Lindgrein
2. Introduction to Environmental Geology - Edward A. Keller
3. Environmental Geology - James W. Lamoreaux.

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-505.1	3.0	3.0	2.0	1.0	3.0	2.0	3.0	3.0	3.0	2.0	2.0
B-GGY-505.2	2.0	2.0	3.0	2.0	3.0	1.0	2.0	3.0	3.0	1.0	2.0
B-GGY-505.3	1.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	2.0	1.0	3.0
B-GGY-505.4	2.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	2.0	2.8	2.5	1.8	3.0	2.0	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-505.1	2.0	2.0	3.0	3.0
B-GGY-505.2	3.0	3.0	2.0	2.0
B-GGY-505.3	2.0	3.0	3.0	2.0
B-GGY-505.4	3.0	3.0	3.0	3.0
Average	2.5	2.8	2.8	2.5

B-GGY – 506 Practical

Credit: 2
Total Marks: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination Time: 3h

Practical exercises based on B-GGY- 503 (Natural Hazards) and B-GGY- 504 (Environmental Geology).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08

B.Sc. with GEOLOGY VI SEMESTER
B-GGY-601 Engineering Geology & Mining Geology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-601.1: Knowledge of engineering properties of rock and their use as construction material.
B-GGY-601.2: To know about various engineering structures, their site selection, evaluation and impact of natural hazards on engineering structures, and slope management and flood control.
B-GGY-601.3: Elementary idea about mining and methods of mining
B-GGY-601.4: Elementary idea about role of geologists in mining, environmental issues in mining and mine safety

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Introduction to Engineering Geology; Geology vs. Engineering; Engineering properties of rocks; rocks as building and construction materials and basis of their selection and use; concept of stress and strain; Young's modulus, void ratio, poisson's ratio; Soil classification; Rock mass rating and Tunneling quality index.
Unit-II
Engineering structures: dams, tunnels, buildings, highways and bridges; Techniques for selection and evaluation of sites for various engineering structures; impact of earthquakes and landslides on engineering structures; Role of geologists in civil engineering projects; Geology in river improvement; slope management; flood control.
Unit-III
Mining: definition & terminology; Assay width; cut off grade; Types of mines: open cast and underground; mining methods: alluvial mining, opencast mining (Loading by hand, loading by machines, glory hole), underground mining (pillar and chamber, sbu-level method, cross cut method, block caving); sampling: channel, chip and coning and quartering.
Unit-IV
Role of geologists in mines; mine cross-section; mine plan; mineral concession: reconnaissance permit (RP), prospecting lease (PL), mining lease (ML); explosives; mining safety; mines' environmental safeguards; mines legislation.

Books recommended:
1. Mining and Environment in India- S.C. Joshi and G. Bhattarcharya
2. Mining Geology- R.M. Arogyaswamy
3. Engineering Geology- Krynine and Judd
4. Engineering Geology- Blyth
5. Soil Mechanics- T.W. Lambe and R. Whitman

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-601.1	1.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-601.2	3.0	3.0	3.0	2.0	2.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-601.3	2.0	2.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-601.4	2.0	3.0	3.0	2.0	1.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	1.5	2.8	2.5	1.8	2.75	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-601.1	3.0	2.0	2.0	3.0
B-GGY-601.2	3.0	2.0	2.0	1.0
B-GGY-601.3	3.0	1.0	3.0	3.0
B-GGY-601.4	3.0	3.0	3.0	3.0
Average	3.0	1.5	2.5	2.5

B-GGY-602 Hydrogeology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-602.1: Knowledge of groundwater quality and its occurrence.
B-GGY-602.2: Understanding about water bearing formations, their hydrogeological parameters and groundwater flow.
B-GGY-602.3: Elementary idea about components of hydrometeorology.
B-GGY-602.4: Elementary idea about exploration, evaluation, management and recharge of groundwater, problems related to groundwater, water laws.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Basic concept, scope of hydrogeology and its relevance to the society; Introduction to hydrometeorological parameters: precipitation, evaporation, evapotranspiration, infiltration, runoff; hydrologic cycle; distribution of water on earth.

Unit-II
Occurrence of groundwater; water bearing formations: classification and their characteristics; classification of aquifers; Springs; artesian well; hydrogeological parameters: porosity, permeability, storage coefficient and transmissivity; Darcy's law; flow direction.

Unit-III
Pumping test and tracer test for evaluation of hydrogeological parameters; water wells: dug wells, bored wells, driven wells and jetted wells; water well drilling methods; groundwater quality criteria for different uses; contamination of groundwater.

Unit-IV
Conjunctive use and groundwater management; water-logging and relative problems; exploration and evaluation of groundwater potential; rain water harvesting; artificial recharge of groundwater; Water laws.

Books recommended

1. Groundwater Hydrology- D.K. Toad
2. Groundwater- Cheery and Greeze
3. Hydrogeology -S.N Davis, and R.J.M. Dewiest
4. Groundwater Resources Evolution- W.C Walton
5. Hydrology- C. Meinzier
6. Handbook of Applied Hydrology- Chow

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-602.1	1.0	3.0	2.0	2.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-602.2	3.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-602.3	2.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-602.4	3.0	1.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	2.8	2.75	2.5	2.0	3.0	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-602.1	3.0	3.0	2.0	3.0
B-GGY-602.2	3.0	3.0	2.0	2.0
B-GGY-602.3	3.0	3.0	2.0	3.0
B-GGY-602.4	3.0	3.0	3.0	3.0
Average	3.0	3.0	2.75	2.8

B-GGY – 603 Practical

Credits: 2
Total Mark: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination Time: 3h

Practical exercises based on B-GGY- 601 (Engineering Geology & Mining geology) and B-GGY- 602 (Hydrogeology).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08

B.Sc. with GEOLOGY VI SEMESTER

B-GGY-604 Oceanography

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-604.1: Knowledge of Basics of oceanography.
B-GGY-604.2: Learning about Ocean bottom features and their importance
B-GGY-604.3: Learning about Ocean waves and their importance.
B-GGY-604.4: Learning about Ocean currents and their importance.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Introduction to Oceanography; distribution of oceans: boundaries and names of the oceans, importance of oceans; physical and chemical characteristics of ocean water.
Unit-II
Hypsographic or hypsometric curve; morphology of ocean basin: continental shelf, continental slope, deep sea plains and oceanic deeps.
Unit-II
Introduction to ocean waves: origin and characteristics of ocean waves; Types of waves: deep water wave, shallow water waves, transitional waves; wave breakers and types.
Unit-IV
Ocean currents - causes and types of ocean currents; warm ocean currents and fishing grounds; coriolis force.

Name of Books/Authors

1. Oceanography - D.S. Lal
2. Physical Geography - Savinder Singh
3. Essentials of Oceanography - Harlod V. Thurman

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-604.1	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-604.2	3.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-604.3	3.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-604.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	3.0	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-604.1	3.0	3.0	2.0	3.0
B-GGY-604.2	3.0	3.0	2.0	2.0
B-GGY-604.3	3.0	3.0	3.0	2.0
B-GGY-604.4	3.0	3.0	3.0	3.0
Average	3.0	3.0	2.5	2.5

B-GGY-605 Climatology

Credits: 3
Total Marks: 75
External Marks: 60
Examination Time: 3h

Course Outcomes (COs):

B-GGY-605.1: Knowledge of fundamental concept of Climatology.
B-GGY-605.2: Learning about Basics of Atmosphere.
B-GGY-605.3: Elementary idea about Clouds.
B-GGY-605.4: Basic idea of insolation and heat budget.

Note for Paper Setters: Question 1 is compulsory comprising short answer questions spread over the entire syllabus, to be answered in 15-20 words. In addition to Question No. 1, there will be eight questions, two from each unit. A candidate has to answer four questions, selecting at least one question from each unit. All questions carry equal marks.

Unit-I
Introduction to climatology; definition and its scope, aims and objectives of climatology. Climate and human affairs, climate and civilization. Weather elements and climate records.
Unit-II
Origin of Atmosphere, composition of atmosphere, structure of atmosphere, layered structure of the atmosphere.
Unit-III
Clouds - classification, reporting of clouds, clouds as an aid to weather forecasting. Cyclones, tornadoes and hurricanes. Cloud bursts.
Unit-IV
Insolation and heat budget; distribution of insolation, atmospheric depletion of solar radiation, heat budget, latitudinal heat balance.

Name of Books and Authors

1. Climatology - D.S. Lal
2. Physical Geography - Savinder Singh
3. Understanding Climatology - Salvador Poole

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
B-GGY-605.1	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
B-GGY-605.2	3.0	3.0	3.0	2.0	3.0	2.0	2.0	3.0	3.0	1.0	2.0
B-GGY-605.3	3.0	3.0	2.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0
B-GGY-605.4	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0
Average	3.0	3.0	2.5	1.8	3.0	1.8	2.5	3.0	2.8	1.5	2.5

Mapping of Course Outcomes to Program Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4
B-GGY-605.1	2.0	3.0	2.0	3.0
B-GGY-605.2	3.0	3.0	3.0	2.0
B-GGY-605.3	1.0	3.0	3.0	2.0
B-GGY-605.4	3.0	3.0	3.0	3.0
Average	2.75	3.0	2.8	2.5

B-GGY – 606 Practical

Credits: 2
Total Marks: 50
External Assessment Marks: 40
Internal Assessment Marks: 10
Examination Time: 3h

Practical exercises based on B-GGY- 604 (Oceanography) and B-GGY- 605 (Climatology).

Distribution of Marks for Evaluation

Exercise = 24
File Record = 08
Viva-voce = 08