BANGAMATA SHEIKH FOJILATUNNESA MUJIB

SCIENCE & TECHNOLOGY UNIVERSITY

Department of Geology

Faculty of Earth Science

Course Curriculum

B.Sc.(Hons) in Geology

Session: 2022–2023

1. Duration of Course and Course Structure

1.1 The Bachelor of Science (Honours) abbreviated as B.Sc. (Hons) Programs shall extend over a period of four academic years, each of a normal duration of one calendar year, divided into two Semesters called 1st semester and 2nd semester. The four academic years of study have been designated as 1st year class, 2nd year class, 3rd year class and 4th year class in succeeding higher levels of study. Students shall be admitted into the 1st year class.

1.2 The Academic Council will form an Admission Committee in each academic session for admission into 1st year class. Students will be admitted to the department as per university rules.

1.3 The curriculum of the B.Sc. (Hons) Degree in the different departments shall be proposed by the Committee of Courses and approved by the Syndicate on the recommendation of the Academic Council.

1.4 The Committee of Courses shall review the curricula at least once in every Academic Year and recommend changes and revision, if any, to the Faculty, and then the Faculty will recommend to the Academic Council.

1.5 Teaching of the courses is reckoned in terms of credits and the credits allotted to various courses will be determined by the Committee of Courses under the following guidelines;

Nature of Course	**Contact Hour/ Credit (in a semester)**
Theoretical Lecture	: 1 hour/week
Laboratory/Design	: 1.5hours/week
Project/Thesis	: 2 - 3 hours/week
FieldWork/Industrial Attachment	: 2 hours/weeks

1.6 **Contact Hours/week:** The total contact hours for the regular students including lecture, tutorial and laboratory shall be at least 24 periods per week, each period being 60 minutes in duration.

1.7 **Course Coordinator:** One of the teachers nominated by the Academic Committee shall act as Course coordinator for each academic year. With the approval of Academic Committee, Course coordinator will prepare the class routine, showing details of the lectures, course plan etc. at the beginning of each semester.

2. Course Designation and Numbering System

Each course is designated by a two to four letter word usually identifying the course offering department followed by a four-digit number with the following criteria without any space between letters and numerical.

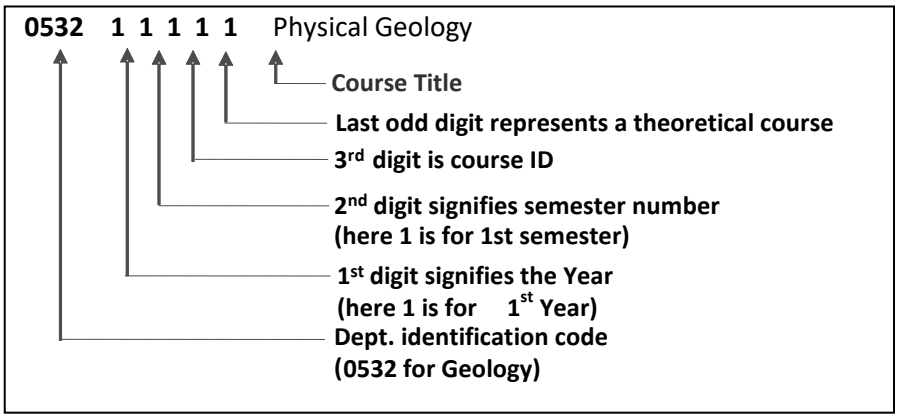
(a) The first digit will correspond to the Year in which the course is normally taken by the students.

(b) The second digit will correspond the semester (1 for 1st and 2 for 2nd) in which the course is normally taken by the students.

(c) The third digit will be reserved for departmental use for such things as to identify different areas within a department.

(d) The last digit will be odd for theoretical, even for laboratory courses and '0' for Board Viva voce.

The course designation system is illustrated by the following example.



3. Duration of Examination

Duration of Theoretical examination of different courses at the end of semester shall be as follows:

Courses greater than or equal to 2 credits but less than or equal to 3 credits	3 Hours	5 set questions to be answered out of 7 set questions. Each set carries 14 marks.

4. Academic Calendar

4.1 The academic year shall be divided into two semesters each having duration of not less than 11 teaching weeks.

4.2 There shall be final examinations at the end of each semester conducted by the respective Examination Committee of the Departments.

4.3 An academic schedule for the academic year shall be announced for general notification before the start of the academic year, on the approval of the Academic Committee. The schedule may be prepared according to the following guidelines:

Semester-1st (22 weeks)	**Number of Weeks**
Teaching	14 (70 working days)
Preparatory Leave	2
Examination Period	3
Result Publication	2
Inter Semester Recess	1
Total Weeks	**22**

Semester-2nd (22 weeks)

Teaching	14 (70 working days)
Preparatory Leave	2
Examination Period	3
Result Publication	2
Inter Semester Recess	1
Total Weeks	**22**
Vacation (Summer, Ramadan, and Others)	8
Total:	**52**

5. Attendance

In order to be eligible to appear, as a regular candidate, at the semester final examinations, a student shall be required to have attended at least 70% of the total number of periods of lectures/tutorials/laboratory classes offered during the semester in every course. A student whose attendance falls short of 70% but not below 60% in any course may be allowed to appear at the final examinations as non-collegiate student and he/she shall not be eligible for the award of any scholarship or stipend. A student, appearing the examination under the benefit of this provision shall have to pay Tk. 1000.00 (One thousand) in addition to the fees, the requisite fee prescribed by the syndicate for the purpose. Student having less than 60% attendance in any course will not be allowed to appear in the final examinations of the semester. An attendance report of the students will be prepared by the concerned course teacher and posted for information of the students. The basis of awarding marks for class participation and attendance is shown in the following Table.

Table-1: Distribution of Marks in Attendance

Attendance	Marks (%)	Remarks
90% and above	100	**Regular**
85% to less than 90%	90	
80% to less than 85%	80	
75% to less than 80%	70	
70% to less than 75%	60	
65% to less than 70%	50	**Non-collegiate**
60% to less than 65%	40	
less than 60%	0	**Dis-collegiate**

6. Class Test

6.1 For theoretical courses of less than or equal to 2 credits there shall be at least 2 class tests and at least 3 class tests for greater than 2 credits in a semester. Previous class test marks will remain valid for the reported/ course improvement student if he/she is unable to appear at class test.

6.2 The course teacher must submit the detailed class test marks and their average in percentage to the Chairman of the Examination Committee in a sealed envelope. A copy will be also sent to the controller of the examination. If a course is conducted by more than one course teacher, class test marks will be processed by the examination committee.

7. The Grading System

The letter grade system shall be used to assess the performance of the students as shown in the following Table:

Table-2: Grading System

Marks	Letter Grade (LG)	Grade Point (GP)
80% or above	A+	4.0
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.5
65 to less than 70%	B+	3.25
60% to less than 65%	B	3.0
55% to less than 60%	B-	2.75
50 to less than 55%	C+	2.5
45% to less than 50%	C	2.25
40 to less than 45%	D	2.0
less than 40%	F	0.0

Absence of a candidate in an examination of a course in which he/she ought to have been present will be considered as if the candidate obtained zero marks ('F' grade) in that course.

A **Grade Point Average (GPA)** shall be calculated for each semester as follows:

$$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \qquad \text{(i)}$$

where, n is the number of courses offered during the semester, C_i is the number of credits allotted to a particular course and G_i is the grade point earned for that course.

A **Yearly Grade Point Average (YGPA)** shall be calculated for each academic year as follows:

$$YGPA = \frac{\sum_{j=1}^{2} C_j G_j}{\sum_{j=1}^{2} C_j} \qquad \text{(ii)}$$

Where 2 is the number of semesters, C_j is the number of credits allotted to the jth semester and G_j is the GPA earned for that semester.

The **Cumulative Grade Point Average (CGPA)** gives the cumulative performance of the students from the first year up to the end of the year to which it refers, and will be calculated as follows:

$$CGPA = \frac{\sum_{k=1}^{m} C_k G_k}{\sum_{k=1}^{m} C_k} \qquad \text{(iii)}$$

where, m is the total number of years being considered, C_k is the total number of credits registered during the kth year and G_k is the YGPA earned in that particular year.

A Cumulative Grade Point Average (CGPA) shall be calculated at the end of each academic year and to be communicated to the students along with the YGPAs. The individual grades of courses obtained by them for the semesters of the academic year will, however, be communicated at the end of individual semester by the Chairman of the Examination Committee.

CGPA will be recorded upto 2nd digit following the rounding rule. If the third digit is less than 5, it will be immediately truncated, but if the third digit is greater than or equal to 5, the second digit will be added by 1 and only the first two digits after decimal will be kept for record. The YGPA will be rounded to the third place of decimal while CGPA is rounded to the second place for reporting. **For instance, YGPA=2.2125 shall be rounded as YGPA=2.212, while CGPA=2.215 shall be rounded as CGPA=2.22.**

Illustration: Suppose a student obtained following grade in 1st year 1st semester:

1st Year 1st Semester	Credit	Letter Grade	Grade Point
0532 1111	3	B+	3.25
0532 1122	1.5	A+	4
0532 1131	3	C	2.25
0532 1142	0.75	A-	3.5
0541 1151	3	A+	4
0533 1161	3	F	0
0533 1172	0.75	A-	3.5
0531 1181	3	A-	3.5
0531 1182	1.5	A	3.75

Therefore, GPA in the 1st semester is =

$$\frac{3(3.25)+1.5(4)+3(2.25)+0.75(3.5)+3(4)+3(0)+0.75(3.5)+3(3.5)+1.5(3.75)}{3+1.5+3+0.75+3+3+0.75+3+1.5} = 2.9038 \approx 2.904$$

And let's assume that his/her GPA in 1st year 2nd Semester is = 3.25

Therefore, YGPA of **1st Year** examination is = $\frac{19.5(2.904)+19(3.25)}{19.5+19}$

$= 3.0747 \approx 3.075$

Similarly assume that, the student's YGPA for the other 3 Years are the followings.

Year	Credit	YGPA
2nd	41.25	3.470
3rd	43	3.35
4th	37.25	3.334

Then his/her **CGPA** of four academic years is

$$= \frac{38.5(3.075)+41.25(3.470)+43(3.35)+37.25(3.334)}{160} = 3.311 \approx 3.31$$

8. Evaluation Strategy

8.1 Distribution of marks for Theoretical Part:

a. Class Attendance
   10%
b. Continuous Assessment (Class test, Performance, Assignment, Presentation, etc.)
   20%
c. Semester Final Exam 70%

Total **100%**

8.2 Distribution of marks for Laboratory Part:

a. Lab Attendance
   10%
b. Continuous Assessment (Lab Report, Class Performance, Quiz etc.)
   30%
c. Lab Final Test and Lab Viva Voce 60%

Total **100%**

8.3 Project Work/Thesis/Field Work/Professional Training/Seminar:

a.	Internal Evaluation	20%
b.	Report	50%
c.	Presentation and Oral Examination	30%
	Total	**100%**

Bachelor of Science (Honours) in Geology

B.Sc. (Hons)program in Geology

- Degree Award: B.Sc. (Hons)
- Total Credit: 148
- Duration: 4 Academic Years with 8 Semesters

SEMESTER-WISE DISTRIBUTION OF COURSES

1st Year 1st Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 1111	Physical Geology	2	2	0
0532 1121	Historical Geology	2	2	0
0532 1131	Mineralogy & Crystallography	3	3	0
0533 1141	Physics *1*: Properties of Matter & Mechanics	3	3	0
0541 1151	Mathematics *1*: Matrix & Linear Algebra	2	2	0
0222 1161	Bangladesh Studies	2	2	0
0532 1132	Mineralogy &Crystallography lab	2	0	3
0532 1170	Viva Voce	1	0	0
	Total	**17**	**14**	**3**

1st Year 2nd Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 1211	Elementary Petrology	2	2	0
0532 1221	Introduction to Structural Geology	2	2	0
0232-1231	English	2	2	0
0531 1241	Chemistry *1*: Physical Chemistry	2	2	0
0611 1251	Computer Fundamentals & Programming	2	2	0
0532 1212	Petrology Lab	2	0	3
0532 1222	Surveying, Map Preparation & Map Reading Lab	2	0	3
0611 1252	Computer Fundamentals & Programming lab	2	0	3
0532 1262	Geological Field Mapping	2	0	4
0532 1270	Viva Voce	1	0	0
	Total	**19**	**10**	**13**

2nd Year 1st Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 2111	Principles of Stratigraphy	2	2	0
0532 2121	Optical Mineralogy	2	2	0
0532 2131	Sedimentology	2	2	0
0532 2141	Paleontology & Micropaleontology	2	2	0
0531 2151	Chemistry*II*: Organic & Inorganic Chemistry	2	2	0
0532 2122	Optical Mineralogy Lab	2	0	3
0532 2132	Sedimentology Lab	2	0	3
05322142	Paleontology & Micropaleontology lab	2	0	3
05312152	Chemistry Lab	2	0	3
0532 2160	Viva Voce	1	0	0
	Total	**19**	**10**	**12**

2nd Year 2nd Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 2211	Geomechanics	2	2	0
0532 2221	Quaternary Geology	2	2	0
0532 2231	Geochemistry	2	2	0
0532 2241	Hydrology	2	2	0
0533 2251	Physics *II*: Electricity & Magnetism	2	2	0
0541 2261	Mathematics *II*: Calculus	3	3	0
0542 2271	Statistics	2	2	0
0533 2252	Physics lab: Electricity & Magnetism lab	2	0	3
0532 2272	Geological Field Mapping	2	0	4
0532 2280	Viva Voce	1	0	0
	Total	**20**	**15**	**7**

3rd Year 1st Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 3111	Igneous & Metamorphic Petrology	2	2	0
0532 3121	Hydrogeology	2	2	0
0532 3131	Introduction to Geophysics	2	2	0
0532 3141	Economic Geology	2	2	0
0532 3151	Oceanography, Marine Geology & Blue Economy	2	2	0
0532 3161	Introduction to Remote Sensing & GIS	2	2	0
0532 3112	Igneous & Metamorphic Petrology Lab	2	0	3
0532 3122	Hydrogeology lab	2	0	3
0532 3162	Remote Sensing & GIS Lab	2	0	3
0532 3170	Viva Voce	1	0	0
	Total	**19**	**12**	**9**

3rd Year 2nd Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 3211	Advanced Structural Geology & Tectonics	2	2	0
0532 3221	Applied Geophysics	2	2	0
0532 3231	Principles of Petroleum Geology	2	2	0
0532 3241	Regional Geology	2	2	0
0532 3251	Geology of Bengal Basin	2	2	0
0532 3212	Advanced Structural & Geological Map Lab	2	0	3
0532 3222	Applied Geophysics Lab	2	0	3
0532 3262	Geological Field Mapping	2	0	4
0532 3270	Viva Voce	1	0	0
	Total	**17**	**10**	**10**

4th Year 1st Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 4111	Engineering Geology	2	2	0
0532 4121	Petroleum Geology, Drilling & Well Logging	2	2	0
0532 4131	Advanced Sedimentology & Sequence Stratigraphy	2	2	0
0532 4141	Environmental Geology	2	2	0
0532 4151	Geo-Resources of Bangladesh & Subcontinent	2	2	0
0532 4161	Mining Geology	2	2	0
0532 4112	Engineering Geology Lab	2	0	3
0532 4122	Petroleum Geology Lab	2	0	3
0532 4170	Viva Voce	1	0	0
	Total	**17**	**12**	**6**

4th Year 2nd Semester

Course Code	Course Title	Credit	Hours/ Week	
			Theory	Sessional
0532 4211	Planetary Geology	2	2	0
0532 4221	Sustainable Energy & Resource Management	2	2	0
0532 4231	Mine Design & application	2	2	0
0532 4241	Geomorphology & Coastal Geology	2	2	0
0532 4251	Geotechnical Engineering	2	2	0
0532 4261	Geo-hazards & Waste Management	2	2	0
0532 4271	Research Methodology & Scientific Writing	2	2	0
0532 4212	Project Work	2	0	3
0532 4282	Geological Field Mapping	2	0	4
0532 4290	Viva Voce	1	0	0
	Total	**19**	**14**	**7**

DETAILS OF THE OFFERED COURSES

1st Year 1st Semester

0532-1111**:** Physical Geology

Credits: 2, Contact Hours/ Week: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Physical geology is a branch of geology that focuses on the study of Earth's physical processes and the materials that make up the planet's surface. It explores the forces that shape the Earth's landscape, the processes that lead to the formation of various landforms, and the interactions between Earths' interior, surface, atmosphere, and hydrosphere.

Intended Learning Outcomes(ILO):

After completing this particular course, students will get to learn about the followings-

1. Understanding earth's structure,
2. studying plate tectonics,
3. investigating earthquakes and volcanoes,
4. examining rock formation and deformation,
5. understanding surface processes,
6. analyzing natural resources,
7. studying climate and climate change,
8. exploring geological time,
9. applying geophysical techniques,
10. contributing to environmental and engineering applications.

Overall, the objectives of physical geology are to deepen our knowledge of the Earth's physical processes, history, and materials, which has implications for a wide range of scientific, practical, and societal endeavors.

Course Contents

1. Introduction to geological sciences and historical development.
2. Dimension and constitution of the earth.
3. The outer zones of the earth: atmosphere, hydrosphere, biosphere.
4. The inner zones of the earth: methods of investigation; crust, litho-sphere, asthenosphere, mantle, core.
5. The theory of continental drift; sea-floor spreading; plate tectonics, mechanism of plate tectonics.
6. Earthquakes: causes, intensity and magnitude, effects, distribution.
7. Volcanism: magma and lava, external and internal volcanism, effects, distribution, types of volcanoes.
8. Isostasy: theories, isostatic adjustment.
9. Major surface features of the earth: ocean basins, continental margins, continents.
10. Deformation of the earth's crust: orogenic, epeiorogenic, recent movements.
11. Processes of changing the surface of the earth: weathering, soil formation, denudation and erosion, slope instability, mass movement, subsidence, collapse.
12. Geological work of wind, streams and glaciers.

Reference books:

1. Giluly, J., Woodford, A.Q. Judson, S., 1974, Physical and Historical Geology: W.H.Freeman Co., San Francisco.
2. Holmes, D.L., 1978, Holmes Principles of Physical Geology; ELBS and Thomas Nelson Sons Ltd., Nairobi.
3. Judson, S. and Kauffman, M. E.; 1990 Physical Geology. Prentice-Hall Inc., New Jersey.
4. Leet, L.D. Judson, S. Kauffman, M.E., 1978, Physical Geology; Prentice-Hall, Inc., NewJersey.
5. Press, F. Siever, R., 1974, Earth; W.H. Freeman Co., San Francisco.
6. Spencer, E.W., 1977, Introduction to the Structure of the Earth; McGraw-Hill Book Co., NewYork.
7. Spencer, E.W., 1983, Physical Geology; Addison-Wesley Publishing Co., Inc., California.
8. Yakushova, A.F., 1986, Geology with the Elements of Geomorphology; Mir Publishers,Moscow.
9. Jain, S., 2014, Fundamental of Physical Geology, Springer, New Delhi, India.
10. Carlson, D.H., Plummer, C.C. and McGeary, D., 2008, The Physical Geology: EarthRevealed (7th edition), McGraw-Hill, New York.

0532- 1121**:** Historical Geology

Credits: 2, Contact Hours/ Week: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General Concept: The course gives a friendly glimpse into the fascinating world of historical geology, which explores geologic time, fossils, stratigraphic principles and the complete geologic history of our beautiful planet. This opens the door to studying the laws of Historical Geology, Geological Time, and the Geological Time Scale, the origins of life, and major physical and biological events that have shaped our world.

IntendedLearning Outcomes (ILO): A student who successfully completes this course should be able to:

1. respond to inquiries regarding fossil documentation for all the major geological periods and epochs.
2. justify the evidence supporting the theory of evolution
3. observe and utilize the geologic time scale for various purposes
4. analyze how relative and absolute dating has been used to construct and refine the geological time scale
5. integrate an understanding fossil characterization and classification to infer the past environments
6. assess the contributions of historical geology to our evolving understanding of global change and sustainability.

Course Contents:

1. Overview of the geologic history of Earth; Plate tectonics.
2. Fundamental geological laws and geological concepts; relative and absolute age dating and their principles, Radiometric age dating, Geological time scale, unconformities and their types.
3. Stratigraphy: Time unit, rock unit, time-rock unit, Lithostratigraphy, Biostratigraphy and Chronostratigraphy.

4. Precambrian Time: Divisions of Precambrian, Formation of earth, atmosphere, origin of life; Origin of continents,Precambrian rocks (Shield & Craton), Precambrian ice ages, Precambrian Lagerstatten, Banded Iron Formations.
5. Paleozoic Era: Paleozoic divisions, Orogenesis, Assembly of Pangea, Cambrian Explosion, Index fossils and their uses, Paleozoic reefs, Great Permian Extinction.
6. Mesozoic Era: Divisions of Mesozoic, Orogenesis, Breakup of Pangea, Cretaceous transgression, Reptiles and their dominance, Birds and mammals, K-T Extinction.
7. Cenozoic Era: Division of Cenozoic, Alpine- Himalayan Belt, Colorado Plateau, Basin and Range, Pleistocene ice ages, Rise of Mammals, Origin of human.

Reference books:

1. Kummel, B., 1960, History of the Earth; Eurasia Publishing House Private Ltd., New Delhi.
2. Mintz, L.W., 1972, Historical Geology; Charles E. Merrill Publishing Co., Columbus (Ohio).
3. MacDougall, J. D., A Short History of Planet Earth, Wiley, New York.
4. Margulis, L. and L. Olendzenski (eds), 1992. Environmental Evolution: Effects of the Originand Evolution of Life on Planet Earth, MIT Press, Cambridge.
5. Read, H.H. Watson, J., 1975; Earth History, part 1: Early Stages of Earth History. TheMacmillan Press Ltd., London.
6. Steven M. Stanley, 2005, Earth System History, 2nd edition Freeman.
7. Stokes, W.L., 1977, Essentials of Earth History; Prentice-Hall International, Inc., New Jersey.
8. Vorontsov-Vel'yaminov, B.A., 1985; Essays about the Universe. Mir Publishers, Moscow.
9. Wicander and Monroe, (2016) Historical Geology: Evolution of Life and Earth Through Time, Seven edition Brooks, Cole.

0532-1131**:** Mineralogy & Crystallography

Credits: 3, Contact Hours/ Week: 3

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept (Mineralogy): Mineralogy is the scientific study of minerals, which are naturally occurring inorganic substances with a specific chemical composition and a characteristic crystalline structure. Minerals are the building blocks of rocks and are essential components of the Earth's crust. Mineralogy involves the identification, classification, and characterization of minerals, as well as the study of their properties, occurrences, and relationships.

Mineralogists, scientists who specialize in mineralogy, examine various aspects of minerals, including their physical and optical properties, crystal structures, formation processes, and geological occurrences. They often use techniques such as X-ray diffraction, microscopy, spectroscopy, and mineral analysis to study and identify minerals.

Mineralogy is closely related to other disciplines such as crystallography, which focuses on the study of crystal structures, and petrology, which deals with the origin, composition, and classification of rocks.

General Concept (Crystallography): Crystallography is a scientific discipline that focuses on the study of crystals and the arrangement of atoms or molecules within them. It plays a crucial role in understanding the structure and properties of materials at the atomic and molecular level. Crystallography

provides insights into the symmetry, geometry, and physical properties of crystals, which has applications in various fields such as chemistry, physics, materials science, biology, and more.

Intended Learning Outcomes (ILO):

On completion of the course the student should have the following learning outcomes defined in terms of knowledge:

1. explain how the properties of chemical elements and their bonds determine the structure and composition of minerals (e.g. close-packing, coordination numbers);
2. demonstrate how the internal structure of minerals affects the external structure and physical properties of a mineral (e.g. crystal symmetry, crystal habit);
3. explain the mineralogical concepts of polymorphism, isomorphism, solid solution and exsolution;
4. recognize and describe the basic properties and chemistry of common rock-forming minerals;
5. describe crystal planes and directions using Miller indices;
6. identify and describe the common rock-forming minerals in hand specimen;

Course Contents

1. Formation of crystals; crystalline and non-crystalline substances.
2. Regular arrangement of points in space; characteristics of crystals; crystal notations; crystal projections; twinned crystals.
3. Description of the normal classes of different crystal systems; crystal system and classes.
4. X-ray crystallography (in outline): definition, Bragg's equation, methods, data interpretation, Xray diffractometer.
5. Physical and chemical properties of minerals: optical properties, cleavage and fracture, hardness, magnetic properties, electrical properties, surface properties, radio activity.
6. Chemistry of minerals: bonding of atoms, compositional variation in minerals radius ratio, coupled ionic substitution, solid solution, isomorphism, polymorphism, pseudomorphism.
7. The systematics of mineralogy; the species concept and classification of minerals.
8. Silicates: classification, description of different physical properties, diagnostic properties, origin, occurrence and uses.
9. A brief description of mineral groups - native elements, sulfides, oxides and hydroxides, halides, carbonates, nitrates, borates, sulfates, chromates, molybdates, tungstates, phosphates, arsenates, vanadates.

Reference books:

1. Berry, L.G. Mason, B., 1967, Elements of Mineralogy; W.H. Freeman & Co., SanFrancisco.
2. Dana, J.D., 1959, Manual of Mineralogy; John Wiley & Sons, Inc., New York.
3. Deer, W.A., Howie, R.A. Zussman, J., 1989, An Introduction to the Rock FormingMinerals;
4. Milovsky, A.V. Kononov, O.V., 1985, Mineralogy; Mir Publishers, Moscow.
5. Phillips, F.C., 1949, An Introduction of Crystallography; Longmans, Green & Co., Essex.
6. Read, H.H., 1962, Elements of Mineralogy; Thomas Murby& Co., London.

0533-1141**: Physics I:** Properties of Matter & Mechanics

Credits: 3, Contact Hours/ Week: 3

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General Concept: This course will offer students an opportunity to understand the basic problems related to gravitational field, surface tension of liquid, viscosity of liquid and gas and fluid dynamics.

IntendedLearning Outcomes (ILO): Upon completion of this course students will be able to:

1. understand Newton's law of gravitation and its application,
2. understand surface tension of liquid and its effects on liquid.
3. understand the viscosity of liquid and gaseous state of matter.
4. understand the problems related to streamline flow of liquid.
5. apply Newton's law of gravitation to study the gravitational field and potential and also learn about the escape velocity and Kepler's planetary laws of motion.
6. understand the origin of surface tension and the role of surface tension in forming the different types of liquid surface.
7. learn to calculate the surface tension of water by capillary rise method and the surface tension of mercury by sessile drop method.
8. learn to calculate the coefficient of viscosity of liquid for streamline flow using Poiseuille's formula.
9. understand the difference between streamline flow and turbulent flow and the physical significance of Reynold's number

Course Contents:

1. Conservation of Energy and Linear Momentum: Conservative and Non-Conservative Forces and Systems; Conservation of Energy and Momentum; Center of Mass; Collision Problem.
2. Rotational Motions: Rotational Variable; Rotation with Constant Angular Acceleration; Torque on a Particle; Angular Momentum of Particle; Kinetic Energy of Rotation and Moment of Inertia; Combined Translational and Rotational Motion of a Rigid Body; Conservation of Angular Momentum.
3. Oscillatory Motions: Vibration; Simple Harmonic Motion; Combination of Harmonic Motions; Damped Harmonic Motion; Forced Oscillation and Resonance.
4. Gravitation: Center of Gravity of Extended Bodies; Gravitational Field and Potential - Their Calculations; Determination of Gravitational Constant and Acceleration due to Gravity; Pendulums; Motion of Planets and Satellites; Escape Velocity
5. Surface Tension: Surface Tension as a Molecular Phenomenon; Surface Tension and Surface Energy; Capillary Rise or Fall of Liquids; Determination of Surface Tension of Water and Mercury; Effect of Temperature.
6. Elasticity: Hook's Law and Modulii of Elasticity, Poisson's Ratios; Relation Between Elastic Constants and their Determination; Cantilever.
7. Fluid Dynamics: Viscosity and Coefficient of Viscosity, Posseulle's Equation; Determination of the Coefficient of Viscosity of Liquid by Stoke's Method. Bernoulli's Theorem and its Applications.

Reference books:

1. Spiegel, M., 1974, Vector Analysis McGraw-Hill Book Co. New York.
2. Alouso, M. Finn, E.J., 1967-68, Fundamental University Physics; Addison-WesleyPublishingCo. Cambridge.
3. Mathur, D.S., 1984, Elements of Properties of Matter; Shyamlal Trust, Ram Nagar, NewDelhi.
4. Resnick, R. Haliday, D., 1966, Physics Part-I; John Wiley & Sons, Inc., New York.
5. Brijlal and Subrahmanyam N., 1999, Properties of Matter, Eurasia Publishing House (Pvt.)Ltd, Ram Nagar, New Delhi.

0541-1151**: Mathematics I:**Matrix & Linear Algebra

Credits: 3, Contact Hours/ Week: 3

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General Concept:

Matrices and Determinants; System of Linear Equations; Vector Spaces; Linear transformations

Intended Learning outcomes (ILO): Upon completion of this course, students will be able to:

1. determine if a system of equations is consistent and find its general solution.
2. apply solution methods of linear system
3. interpret vectors in two and three-dimensional space both algebraically and geometrically.
4. perform linear transformation and find the standard matrix representations.
5. prescribe Learn Cayley Hamilton theorem and its Applications to Matrix algebra.
6. apply linear algebra to various real-world phenomena
7. analyze determinants, cofactors and operations on matrix.
8. recognize and apply various laws and theorems of Matrix algebra to solve problems.
9. identify a linear system of equations in matrix form.
10. compute the solution of the linear system by row operation and analyze the nature of various solutions.
11. apply different solution methods to solve network analysis and chemical balancing problems.

Course Contents

1. Matrices and Determinants
2. Application of matrices and determinants
3. Introduction to the system of linear equations and their solutions
4. Applications of linear systems
5. Vector space axioms
6. Linear Independence, Span, Basis and dimension, Rank, Nullity
7. Linear Transformation
8. A first look at eigenvalues and eigenvectors. Similarity and diagonalizability, Cayley-Hamilton theorem

Reference books:

1. Elementary Linear Algebra (By H Anton and C. Rorres; 9th edition, 2010)
2. Calculus (By H. Anton; 9th edition, 2009)
3. Differential Equations (By Dennis G. Zill; 7th edition)
4. Linear Algebra (Schaum's Outlines; 3rd edition)

5. Differential Equations with Applications(By Mustafa K. Chowdhury).

0222-1161**:** Bangladesh Studies Credits: 2, Contact Hours/ Week: 2 Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: "Bangladesh Studies" generally refers to the academic and interdisciplinary field that focuses on the study of Bangladesh as a country, encompassing its history, culture, society, politics, economy, and other relevant aspects. It involves the systematic analysis and exploration of various factors that shape the identity and development of Bangladesh as a nation.

Bangladesh is a country located in South Asia, bordered by India to the west, north, and east, Myanmar (Burma) to the southeast, and the Bay of Bengal to the south.

Intended Learning outcomes (ILO):

After completing this Bangladesh studies course, students will get a clear and rigid idea of ourmotherland.

Course Contents:

1. Geography and Demographics: Bangladesh and its adjoining areas, weather; population.
2. History: History of Bangladesh, the great liberation war in 1971 and the contribution to it by our father of the nation, Bangabandhu Sheikh Mujibur Rahman.
3. Language and Culture: Our language movement in 1952 and the beautiful culture of Bangladesh.
4. Economy: Bangladesh economy and its future planning.
5. Politics, Government and its organs: Political ideology, history and the governing body's organs t run the nation.
6. Religion: Diversity of beautiful religious community and their different festivals.
7. International Relations: The key basic of our international relationship and mutual boding.

0532-1132**:** Mineralogy & Crystallography lab Credits: 3, Contact Hours/ Week: 4 Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General Concept: This course is created to explore the characteristics and recognize significant mineral varieties of diverse categories in hand specimens with a specific focus on rock forming minerals; derivation of symmetry theory; lattices, point groups, space groups, and their properties; use of symmetry in tensor representation of crystal properties, including anisotropy and representation surfaces.

IntendedLearning Outcomes (ILO):
At the end of the course the learners will be able to-

1. study the physical properties of a mineral in hand specimen;
2. determine the characteristic properties by simple physical and chemical tests;
3. know the systematic procedure for mineral identification and
4. identify the common rock forming and economically important minerals in hand specimens.
5. identify the relation between crystal symmetry and mineral properties.
6. explain miller indices.
7. apply crystal orientation rules.

Course Contents

1. Study and identification of common models of different crystal systems and projections (in brief).
2. Study and identification of common rock forming and ore minerals in hand specimens.
3. Study and identification of common igneous, sedimentary and metamorphic rocks in hand specimen.

Reference books:

1. Berry, L.G. Mason, B., 1967, Elements of Mineralogy; W.H. Freeman Co., SanFrancisco.
2. Dana, J.D., 1959, Manual of Mineralogy; John Wiley Sons, Inc., New York.
3. Deer, W.A., Howie, R.A. Zussman, J., 1989, An Introduction to the Rock FormingMinerals
4. Milovsky, A.V. Kononov, O.V., 1985, Mineralogy; Mir Publishers, Moscow.
5. Phillips, F.C., 1949, An Introduction of Crystallography; Longmans, Green Co., Essex.
6. Read, H.H., 1962, Rutley, Elements of Mineralogy; Thomas Murby Co., London.

0532-1170**:** Viva Voce

Credits: 1, Contact Hours/ Week: 0

Marks: 100 [Exam: 70%]

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.

1st Year 2nd Semester

0532-1211: Elementary Petrology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Petrology is a branch of geology that focuses on the study of rocks and the conditions under which they form. This field is crucial for understanding the Earth's history, processes that shape its interior and surface, and the formation of mineral resources. Petrologists examine the origin, composition, structure, and texture of rocks to decipher their history and the environments in which they formed.

Intended Learning Outcomes (ILO):

1. Students will gain basic knowledge on the formation of igneous, sedimentary and metamorphic rock,
2. structure and texture of different rock types.

In summary, the objectives of petrology encompass understanding the composition, origin, formation processes, and geological significance of rocks, which contributes to broader knowledge about Earth's structure, history, resources, and environmental interactions.

Class contents:

1. The science of petrology: The earth zones; composition of the earth shells; chemical composition of the crust; rocks and their composition; minerals; principle rock types and their relationship.
2. Igneous rocks: Forms of igneous rocks; intrusive and extrusive rocks; structure and texture of igneous rocks.
3. Formation of igneous rocks: Magma and its composition; pyrogenetic minerals, physio-chemical constituents of magmas, glass and crystals; minerals of low and high silication; crystallization of unicomponent, bicomponent and ternary magma, the reaction relation.
4. Classification of igneous rocks.
5. Sedimentary rocks: Formation of sediments and sedimentary rocks; cementing materials of sedimentary rocks; mineralogical.
6. Textural and structural characters of sedimentary rocks.
7. Classification of sedimentary rocks.
8. Metamorphic rocks: Metamorphism, agents of metamorphism; different types of metamorphism.
9. Texture and structure of metamorphic rocks; metamorphic zones; facies and grades.

Reference books:

1. Ehlers, E.G. and Blatt, H., 1992. Petrology, Igneous, Sedimentary and Metamorphic. CBS Publishers and Distributors, Delhi, India.
2. Huang, W.T., 1962, Petrology; McGraw-Hill Book Co., New York.
3. Pettijohn, H.J., 1975, Sedimentary Petrology; Harper & Row Publishers, New York.
4. Turner, R.J. &Verhoogen, J., 1960, Igneous and Metamorphic Petrology; McGraw-Hill Book Co., New York.
5. Tyrell, G.W., 1979, The Principles of Petrology; Chapman and Hall Ltd., New York.

0532-1221: Introduction to Structural Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This course aims to provide an introduction to the core principles of structural geology, encompassing the utilization of external forces on geological substances and the subsequent formation of geological structures as a result of such deformation.

The curriculum has been specifically formulated with the objective of comprehending the importance of structural geology; the relationship between structural geology and other branches of geology; aims and objectives; the concept of scale and the different stages of deformation. This course examines the physical properties of rocks in relation to mechanical principles; common types of structures such as folds, faults, joints, unconformities, cleavage &schistosity and lineation. Students will develop the skills to identify and classify geological structures associated with folding, fracturing, and lithospheric processes.

Intended Learning Outcomes (ILO):

By the culmination of the course students will-

1. possess the capacity to comprehend the importance of structural geology in the study of geology.
2. acquire an understanding of both primary and secondary structures.
3. acquire knowledge regarding the concepts of brittle and ductile deformation, as well as the forces accountable for generating various types of structures.
4. attain an understanding of the influence exerted by different external factors on rock deformation.
5. acquire the ability to determine the attitude of structural elements and plot them on a map.
6. be able to identify and categorize different types of folds, faults, and joints.
7. be capable of elucidating the causes of both tectonic and non-tectonic processes of folding.
8. be able to identify various kinds of unconformities and comprehend their relation to geological processes.
9. be able to recognize folds, faults, joints, and unconformities in the field and plot them on a map.
10. possess knowledge of the different types of rock cleavage and lineation (foliation).
11. develop a sound understanding of the fundamental principles of structural geology, enabling them to comprehend the deformation process in advanced structural geology courses.

Course Content:

1. Introduction to Structural Geology; definition of common types of structures, Identification of structures from photographs/sketches, objectives, scope.
2. Mechanical principles – force, pressure, stress & strain, physical properties of rocks, stress-strain diagram, factors controlling rock behavior.
3. Fold – definition, description and geometry, basic nomenclature, attitude of planar and linear structures, classification of fold & causes of folding

4. Fault- definition, description, types of faults, movements along fault plane, fault terminology, fault classification, criteria of faulting.
5. Joint – definition, description, classification and origin
6. Unconformity– definition, descriptions and types, field recognition, distinguishing from faults
7. Cleavage and Schistosity –definition, descriptions& classification
8. Lineation – definition, description, types& origin

Reference Books:

1. Billings, M. P. 1972. Structural geology. Prentice Hall College Div.
2. Bose, N, and Mukherjee, S., 2017. Map Interpretation for Structural Geologist. 1st Edition, Elsevier Inc.
3. Fossen, H., 2016. Structural Geology. 2nd Edition, Cambridge University Press Ltd.
4. Ragan DM. *Structural Geology: An Introduction to Geometrical Techniques*. 4th ed. Cambridge: Cambridge University Press; 2009.

0232-1231: English

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This course introduces students to various facets of proficient communication, encompassing both verbal and written forms. The primary focus shall be on facilitating their acquisition of fundamental skills, with particular emphasis on the mastery of the English language in both written and spoken form.

Intended Learning Outcomes (ILO): Upon achieving successful completion of the course, students will-

1. acquire the ability to augment their vocabulary through the comprehension of synonyms, antonyms, verbs, proverbs, and other linguistic elements
2. become proficient in composing, elucidating, and rectifying diverse English compositions, particularly geological reports, in an effective manner.

Course Content:

1. An Overview of the Structure and Composition of Grammar
2. Thorough Exposition and Development of Elaborate Concepts
3. Basic English Pertaining to the Authorship of Geological Reports

Reference Books:

1. Turabian, K.L. (2009), A Manual for Writers of Term Papers, Theses, and Dissertations, 7th Edition, Modern Language Association of America
2. Nesfield, J.C. (2014), Manual of English Grammar and Composition, Kindle Edition, Davidson Press
3. Murphy, R. (2004), English Grammar in Use, 3rd Edition, Cambridge University Press

0531-1241: Chemistry I: Physical Chemistry

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: General chemistry is a foundational branch of chemistry that provides an introduction to the fundamental principles governing matter and its interactions.

Intended Learning Outcomes (ILO): After the completion of the course, student will be able to-

1. use dimensional analysis in solving various types of problems
2. describe matter in terms of states, properties, and comparison
3. understand and apply basic gas laws
4. explain behaviours of matter using kinetic molecular theory
5. identify oxidizing and reducing agents in redox reactions
6. explain the ionic bonds, covalent bonds, valance bond theory, molecular orbital theory
7. identify acids and bases using modern concept
8. understand the chemistry of saturated and unsaturated hydrocarbons
9. outline the preparations of hydrocarbons, alcohols, aldehyde and ketone
10. explain the different types of chemical reaction.

Course contents:

1. The states of aggregation of matter; the gaseous state: the gas laws, kinetic theory of gases,derivation of kinetic equation, PV = 1/3 mnc2; deduction of gas laws from kinetic equation,molecular velocities, average velocity and R.M.S. velocity; mean free path, behaviour of realgases, Amagat's curves, modification of the ideal gas equation: van der Waal's equation,significance and limitations of van der Waal's equation, Andrew's experiments with CO2, criticalconstants, liquefaction of gases: principles and methods, Joule-Thomson effect.
2. The solid state: properties of solids, crystal systems, Bragg equation, X-ray diffraction,conductors, insulators and semiconductors.
3. Electrochemistry: electrolytic conduction' Faraday's laws of electrolysis, significance of the laws,measurement of the quantity of electricity, conductance of electrolytic solution, specific andequivalent conductance, determination of conductance.
4. The chemical bonds; the electronic concept of chemical bonds; types of bonds; ionic bond andproperties;covalent bonds and properties; hybridisation of atomic orbital; preliminarytreatment of valence bond theory and molecular orbital theory; metallic bond; hydrogen bond.
5. Oxidation and reduction; the electronic concept; oxidation state and oxidation number;assignment of oxidation number; writing equations involving oxidation-reduction reactions.
6. Modern concepts of acids and bases.

Reference books:

1. General Chemistry, Darrell D. Ebbing, Boston, 1996.
2. Chemistry, 10th Edition; Raymond Chang, Williams College; The McGraw Hill Companies.
3. Brown, T.L., 1963, General Chemistry; Charles E. Merrill Books, Inc., Columbus.
4. Fergusson, J.E., 1982, Inorganic Chemistry and the Earth; Pergamon Press, Oxford.

5. Glassrone, S. & Lewis, D., 1964, Elements of Physical Chemistry; McMillan & Co. Ltd., London.
6. Haider, S.Z., 1964; Introduction to Modern Inorganic Chemistry. Friends International, Dhaka.
7. Huque, M. M. and Mollah, M. Y. A., 2009; Principles of Physical Chemistry; Fully Revised Edition; Brothers' Publications, Dhaka.
8. Morrison, R.H. & Boyd, R.N., 1983, Organic Chemistry; Prentice-Hall, New York.
9. Essential of Physical Chemistry, Multicolour Edition; Arun Bahl, B. S. Bahl and G. D. Tuli; S. Chand.
10. Systematic Identification of Organic Compounds, R. L. Shriner, R. C. Fuson and D. Y. Curtin, John Wiley Sons, Inc. New York, London, Sydney.
11. Text Book of Practical Organic Chemistry, Vogel's 5th Edition, ELBS with Longman.
12. Vogel's Text book of Quantitative Chemical Analysis, J. Bassett, R. C. Dinney, G. H. Jeffery and J. Mendham, Longman Scientific & Technical.

0611-1251: Computer Fundamentals & Programming

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: By incorporating computer study into their curriculum, geoscience students can enhance their analytical skills, improve research efficiency, and contribute to innovative advancements in the field of earth sciences. Additionally, interdisciplinary collaboration between computer scientists and geoscientists can foster a deeper understanding of complex geological processes and facilitate sustainable resource management practices.

Intended learning outcomes: (ILO)

The integration of computer science and programming in geology-

1. aims to enhance data analysis capabilities, facilitate geological modeling, 2.
2. improve spatial visualization, support predictive modeling,
3. manage geological databases efficiently, enable field data collection,
4. promote collaboration, and provide essential skills for geologists in the modern era.

Course contents:

1. Introduction to Computer Science: Introduction to Computers, Number Systems and Logic Gates, Computer Architecture, Primary Memory, Secondary Storage, Input Devices, Output Devices, Computer Program, Computer Languages, Computer Software, Operating System (OS), Windows, Linux/Unix, Data Communication and Computer Networks, Database Fundamentals, The Internet Basics, Multimedia, etc.
2.MS - Windows and MS – Office: Working with MS – Windows (Operating System) , MS-Word (Word Processing Software), MS – Excel (Spreadsheet Software), MS – PowerPoint (Presentation Software) etc.
3. Programming: Preliminary Concepts of Structured and Object-Oriented Programming (OOP), Programming and Problem Solving with MATLAB, Overview of C++/Visual Basic Programming
4. Web Programming Basics: Basics of HTML, CSS, JavaScript, PHP, CMS, DBMS (e.g. MySQL), etc.

Reference books:

1. Alan Forbes, The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications with PHP and mySQL, 1st edition, CreateSpace Independent Publishing Platform, 2012.

2. Anita Goel, Computer Fundamentals, 1st edition, Pearson, 2010.
3. Arnold Robbins, Unix in a Nutshell, 4th edition, O'Reilly Media, 2005.
4. Craig S. Lent, Learning to Program with MATLAB: Building GUI Tools, 1st edition, Wiley, 2013.
5. Greg Perry, Dean Miller, C Programming Absolute Beginner's Guide, 3rd edition, Que Publishing, 2013.
6. James Foxall, Sams Teach Yourself Visual Basic 2012 in 24 Hours, Complete Starter Kit, 1st edition, Sams Publishing, 2012.
7. Jason Cannon, Linux for Beginners: An Introduction to the Linux Operating System and Command Line, 1st edition, CreateSpace Independent Publishing Platform, 2014.
8. Lisa A. Bucki, Walkenbach, Michael Alexander, Dick Kusleika, &FaitheWempen, Office 2013 Bible: The Comprehensive Tutorial Resource, 4th edition, Wiley, 2013.
9. Mike McGrath, C++ Programming in Easy Steps, 4th Edition, In Easy Steps Limited, 2011.
10. Martin H. Trauth, MATLAB® Recipes for Earth Sciences (Springer Textbooks in Earth Sciences, Geography and Environment), 5th edition, 2011.
11. SemmyPurewal, Learning Web App Development, 1st edition, O'Reilly, 2014.
12.Tris Hussey, WordPress Absolute Beginner's Guide, 1st edition, Que Publishing, 2014. 11. NenadJukic, Susan Vrbsky, &SvetlozarNestorov, Database Systems: Introduction to Databases and Data Warehouses, 1st edition, Prentice Hall, 2013.

0532-1212: Petrology Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: The course deals with the description and identification of igneous,metamorphic and sedimentary rock samples in hand specimen. The course is designed to impartpractical knowledge to describe physical characters, structure, texture, mineral composition and originof the rocks in hand specimen and thereby different types of igneous, metamorphic and sedimentaryrocks are identified and classified.

Intended Learning Outcomes (ILO):

By the end of the course, the learners will be able to –

a. identify and classify different types of igneous, metamorphic and sedimentary rocks in hand specimen
b. describe physical characters, structure, texture mineral composition and origin of all three types of rocks
c. identify granite, syenite, gabbro, basalt, rhyolite, trachyte, obsidian, pitchstone etc.
d. identify and classify clastic and non-clastic sedimentary rocks such as sandstone, shale, conglomerate, breccia, limestone etc.
e. identify mica-schists, hornblende-schist, chlorite-schist, talc-schist, gneiss, quartzite, marble etc.

Course contents:

1. Description and identification of acid, intermediate, basic and ultra-basicigneous rocks in hand specimen based on physical characters, structure, texture,mineral composition and origin.
2. Identification of clastic (sandstone, shale, conglomerate etc.) and nonclastic(limestone) rocks in hand specimen based on physical characters, structure, texture, mineral composition and origin

3. Study and identification of metamorphic rocks in hand specimen such asgneiss, mica-schists, hornblende-schist, chlorite-schist, talc-schist, quartzite,marble etc. on the basis of their physical characters, structure, texture, mineralcomposition and origin.

Reference books:

1. Tyrrell, G.W. (1973) The Principles of Petrology, John Wiley and Sons.

0532-1222: Surveying, Map Preparation & Map Reading Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: This course has been designed in accordance with the theory course "Elementary Structural Geology". The laboratory exercises in this course will involve practicing map scale computation and conversion, reproducing maps, determining bearings, azimuths, and locations, constructing contour maps and topographic profiles, determining dip and strike, plotting structural data on maps, constructing geological cross-sections based on representative geological map exercises, and interpreting SOB topographic maps.

IntendedLearning Outcomes (ILO): By the end of the course, students will be able to-

1. Understand the concept of map projections, datum plane and map scale.
2. prepare a base map for geological fieldwork and plot data on it.
3. locate position and objects on the map
4. determine bearing/azimuth of the objects/features and measure distance of the objects from reference point.
5. construct a contour map from spot heights and identify the geomorphic features.
6. understand 3-dimensional orientation of linear and planar structures.
7. explain the relation of outcrop patterns with topography and attitude of the geological structures.
7. recognize and classify geologic structures associated with folding and fracturing of the lithosphere.
8. develop good background on landforms and its relations to subsurface geology.

Course Content:

1. Introduction to map projection and datum, maps and map scales, computation and conversion of scales.
2. Map enlargement and reduction; bearing, azimuth, grid location
3. Construction of contours from spot heights, identification of geomorphic features and measurement of slope angle from contour map
4. Dip and strike determination and plotting
5. Geological maps: Structural interpretation and constructing geological cross section along with stratigraphic successions of representative geological maps including horizontal, homoclines, folds, faults and unconformity

6. Topo sheet interpretation: Interpretation of topographic maps including geological and structural interpretation, cultural interpretation, drainage pattern identification and regional development interpretation.

Reference Books:

1. Beninson, G.M. (1990) An Introduction to Geological Structures and Map (5th Edition). Edward Arnold Publishers.
2. Billings, M. P. 1972. Structural geology. Prentice Hall College Div.
3. Borradaile, G. (2014) Understanding geology through maps. Elsevier.
4.Lisle, R.J. (2004) Geological Structures and Maps - A Practical Guide (3rd Edition). Elsevier
5. Maltman, A. (1990) Geological maps: An introduction. Open University Press.

0611-1252: Computer fundamentals and Programming lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

This course deals with the laboratory part of the theory course named " Computer Fundamentals & Programming".

0532-1262: Geological Field Mapping

Credits: 2

General concept: A seven days long field trip in the hill tracts region in Bangladesh where there are extensive exposure of Mio-Pliocene sedimentary strata. Emphasis will be on understanding and mapping large-scale geological structures such as folds, faults, and unconformity. The students will learn how to measure bed attitude at the outcrop scale, plot them on a map and deduce geological structure on the map. They are required to understand the structure of their map area in three-dimensions and to establish a geological history of their map area. Additionally, students will also learn to identify various sedimentary rocks in the field.

Intended Learning Outcomes (ILO):

By completing this course students will be able to –
1. Locate and map geological exposure
2. measure bed attitude.
3. map bed attitude data and deduce geological structure
4. create a traverse map
5. identify and differentiate various rock types.

Course Content:

1. Preparation for field work- Expectations and reality in the field; list of field equipment, and base maps; code of conduct in the field; formation of various field committees.

2. During the field work- Visit selected areas to view the general geology and to learn field observation, documentation, and mapping skills; Mapping exercise on a microscopic scale; standards and technique for taking field notes; summarize and plot field data on the map at the end of daily field trip work.
3. After the Field, laboratory analysis of field data, completion of the geological map, and construction of geological cross section showing large-scale geological structure; writing field report.

Reference:

1. K. R. McClay, The mapping of geological structure, 2013.
2. Tucker, M.E.; Sedimentary Rocks in the field,2003.

0532-1270: Viva Voce

Credits: 1

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.

2nd Year 1st Semester

0532-2111: Principles of stratigraphy

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Stratigraphy is the discipline within the field of geology that is concerned with the examination and analysis of the creation, constitution, succession, and association of layered rocks. While stratigraphy encompasses all categories of rocks, including sedimentary, igneous, and metamorphic, it predominantly concentrates on the assessment of sedimentary rock layers.The primary focus is placed on comprehending the fundamental principles of Stratigraphy, specifically the Laws of Superposition, Faunal (Floral) Succession, Lateral Continuity, Horizontality, and Cross-cutting (discordant) Relationships.

IntendedLearning Outcomes (ILO):

The student shall acquire knowledge-

1. pertaining to fundamental principles of stratigraphy and acquire the skill of establishing correlation between distinct layers of rocks.

2. the capacity to acquire proficiency in diverse methods of dating various categories of rocks that are advantageous in determining the age of earth materials.

Course Content:

1. Definition of stratigraphy; scope of stratigraphy.
2. Sedimentary processes: sources of sediments; transportation; deposition; lithification, and diagenesis.
3. Basic stratigraphic relations - vertical and lateral variations; stratification; breaks in the record
4. Walther's Law; Cyclic successions
5. Facies- Facies change, facies association(s), relations and facies sequences
6.Depositional sedimentary environments- concepts, elements and factors, classification, individual description, recognition in ancient successions
6. Stratigraphic paleontology; guide and index fossils.
7. Principles of geochronology; isotopic age determination methods; isotopic time-scale.
8. Principles of magnetostratigraphy and cyclostratigraphy.

Reference Books:

1. Boggs, S., Jr. (2014) Principles of sedimentology and stratigraphy. 5 edn., Pearson
2. Reineck, H.E. and Singh, I.B. (2012) Depositional sedimentary environments: with reference to terrigenous clastics. Springer Science & Business Media.
3. Nichols, G. (2009) Sedimentology and stratigraphy. Wiley.

0532-2121: Optical mineralogy

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Optical mineralogy is a branch of geology that deals with the study of minerals and rocks through the use of optical properties. By observing how minerals interact with polarized light under a microscope, geologists can identify and characterize minerals based on their optical properties.

Intended learning outcomes (ILO):

Optical mineralogy is a fundamental discipline within geology and other earth sciences and after the completion of this course-

1.providing valuable insights into mineral identification, rock formation, exploration and mining
2. geological mapping, environmental management, and Earth history
3.our understanding of the Earth's composition, history, and processes.

Course contents:

1. Introduction: Definition, scope and principles of optical mineralogy; nature of light: theories of light, wave nomenclature, electromagnetic radiation, wave front, wave normal, phase andinterference)
2. Polarizing Microscope: General features, optical system; parts of microscope, illuminationsystem, accessory plates, adjustments, observations, field of view, care of the microscope; thinsection preparations for microscopic study.
3. Reflection and Refraction: The index of refraction, Snell's Law, critical angle and total reflection, polarization of light; explanation of white light effect.
4. Optical Properties of Minerals Using Polarized Light: Ordinary and polarized light; method ofpolarisation; polarizing devices; ordinary and extra-ordinary rays, birefringence; doublerefraction, optic axes; optical indicatrix, uniaxial and biaxial Indicatrix; polarization through amineral plate; polarization through analyzer; fast and slow rays, procedure of determination offast and slow rays; Color, form and habit, Cleavage, pleochroism, refractive index, relief;application of colour chart in the study of minerals.
5. Optical Properties of Minerals Using Crossed Nicols: Isotropic and anisotropic minerals,Interference colors, extinction, elongation sign, Twinning, Zoning.
6. Optical Properties of Minerals Using Convergent Polarized Light: Means of obtaining convergent polarized light; polarizing devices, formation of interference figures, uniaxial and biaxial interference figures; optic sign determination for the uniaxial and biaxial crystals, importance of interference figures; optic axis figures.
7. Optical Properties of the Rock Forming Minerals: Systematic study of the characteristic optical properties of the main mineral groups (silica group, alkali feldspars, plagioclase feldspars, mica group, amphibole group, pyroxene and olivine groups, metamorphic silicates, accessory silicates, non-silicate minerals and Carbonates, halides and sulphate).

Reference books:

1. Nesse, W.D., 2014. Introduction to Optical Mineralogy; Oxford University Press, 348 pp.
2. Dyar, M.D., Gunter, M.E. and Tasa, D., 2008. Mineralogy and Optical Mineralogy; Mineralogical Society of America, 708 pp, ISBN 978-0-939950-81-2.
3. Gribble, C.D and Hall, A.J., 1992. Optical Mineralogy: Principles and Practice; UCL Press, London.
4. Kerr, P.F., 1977. Optical Mineralogy; McGraw-Hill Book Co., New York.
5. Berry, L.G. & Mason, B., 1967. Elements of Mineralogy; W.H. Freeman & Co., San Francisco.
6. Blackburn, W.H., Dennen, W.H. (1988). Principles of Mineralogy. (1st edition), Wm.C. BrownPublishers, ISBN 069715078X, Dubuque, Iowa.
7. Deer, W.A., Howie, R.A., Zussman, J. (1992). An Introduction to the Rock Forming Minerals (2nd edition), ISBN 0-582-30094-0, Longman Publishing Co, London.
8. Velde, B., 1995. Origin and Mineralogy of clays, Springer.
9. Klein, C and Dutrow, B., 2007. Manual of Mineral Science (23rd edition); John Wiley & Sons,New York.
10. MacKenzie, W.S. and Adams, A.E., 1994. A Colour Atlas of Rocks and Minerals in Thin Section, Manson Publ., 192pp.

0532-2131: Sedimentology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Sedimentary petrology is a branch of geology that focuses on the study of sedimentary rocks and the processes by which they form, accumulate, and are subsequently altered. These rocks are formed from the accumulation and lithification (compaction and cementation) of sediments, which are derived from the weathering and erosion of pre-existing rocks or organic materials.

Intended learning Outcomes (ILO):

At the end of the course, the students will have knowledge about the-

1.texture, structure and origin of sedimentary rocks,

2.chemical and mineral composition the sedimentary rocks,

3.used to infer source area characteristics.

Course contents:

1. Introduction and Development of Concepts in Sedimentary Petrology: The context ofsedimentary petrology; weathering, erosion, transportation and rock cycle; origin of sediments,total volume of sediment, relative abundance of common sedimentary rocks.

2. Textural Properties of Sediments and Sedimentary Rock: Grain size and scale, grain sizedistributions; porosity and permeability; grain orientation and fabric.

3. Fluid Flow and Sediment Transport: Basic principles of sediment entrapment, transportationand deposition: physical implications of sediment transport, flow separation, setting ofparticles; fluid gravity flows: classification, velocity distribution in turbulent flows; Sedimenttransport under unidirectional flows; bedforms and structures under unidirectional flow: flowregime concept and bedform stability diagrams.

4. Sedimentary Structure: Description and origin of primary structures and their directionalsignificance; Bedding plane markings, biogenic sedimentary structures; penecontemporaneousdeformation structures.

5. Petrography of Siliciclastic Sedimentary Socks: Mineralogical and chemical composition,classification, origin and occurrences of siliciclastic sedimentary rocks: sandstones, mud rocks(shales) and conglomerates.

6. Siliciclastic Diagenesis: Major diagenetic processes and responses: compaction andcementation, anthogenesis, recrystallization and replacement; Diagenesis and porosity;diagenetic environment.

7. Carbonate Sedimentary Rocks: Composition, texture, classification of limestone and dolomites;carbonate diagenesis.

8. Other Non-clastic Sedimentary Rocks: Carbonaceous sedimentary rocks (coal), evaporates,cherts, other siliceous and iron-bearing sediments.

9. Provenance: Significance of sandstones and mud rocks mineralogical and geochemicalapproach.

10. Clay minerals: Principal clay mineral groups and sub-groups and their properties; origin,composition and mineralogy of clay minerals; method of clay sample preparation (orientedmount) and tools of identifying of clay mineral; clays in the environment.

Reference books:

1. Allan, J. R. L., 1992, Principles of Physical Sedimentology. Chapman and Hall, New York.

2. Blatt, J.D., Middleton, G. & Murray, R., 1980, Origin of Sedimentary Rocks; Princeton-Hall, Inc., New Jersey.
3. Boggs, JR. G, 2012, Petrology of Sedimentary Rocks; Cambridge University Press, UK
4. Boggs, JR. G, 2006, Principles of Sedimentology and Stratigraphy; Prentice-Hall, Inc., New Jersey.
5. Bundiey, G.W. & Brown, G, 1990. Crystal Structures of clay minerals and their X-ray identification, Mineral, Soc., London, Monograph 5, 495 pp.
6. Chamley, H., 1989, Clay sedimentology 623 pp, springer-Verlag.
7. Collinson, J.D. & Thompson, D.B., 1982, Sedimentary Structures; George Allen & Unwin, London.
8. Friedman, G.F. & Sanders, J.E., 1978, Principles of Sedimentology; John Wiley & Sons, Inc., New York.
9. Lindholm, R.C., 1987, A Practical Approach to Sedimentology, 276 pp, CBS Publishers, Delhi.
10. Moore, D.M. & Reynold, R.C., 1997, X-ray diffraction and the identification and analyses of clay minerals, 378 pp, Oxford.
11. Nichols, G. 2009, Sedimentology and Stratigraphy, 2nd Edition, 419 pp, Wiley-Blackwell
12. Pettijohn, F.J., 1975, Sedimentary Rocks; Harper & Row, New York.
13. Prothero, D.R. and Schwab, F., 2014. Sedimentary Geology; W.H. Freeman and Company, New York.
14. Reineck, H.E. & Singh, I.B., 1980, Depositional Sedimentary Environments; Springer-Verlag, Heidelberg.
15. Thorez, J., 1976, Practical identification of clay minerals, G. Leelortte (ed.), 90 pp, Belgique.
16. Tucker, M.E., 2003, Sedimentary Petrology, 262 pp, Blackwell Publishing 17. Velde, B., 1995. Origin and Mineralogy of clays, Springer.

0532-2141: Paleontology and micropaleontology

Credits: 3, contact hours/weeks: 3

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: The course has been developed with the purpose of acquiring knowledge pertaining to the diverse types of fossils along with their respective significance. This will enable the students to comprehend the various morphological attributes of fossils, encompassing their classification, identification and distribution throughout geologic time. The course will primarily focus on pivotal aspects such as evolution, palaeoecology, as well as the extinction of the principal invertebrate and vertebrate organisms. Micropaleontology covers all the major marine microfossil groups - foraminifera, coccolithophores, dinoflagellates and ostracoda – as well as terrestrial pollen and spore communities.

IntendedLearning Outcomes (ILO): Upon completing this course, the student will have the ability to-

1. Reconstruct long-term patterns of macroevolution.
2. Understand the perturbations in short-term ecosystems and the relationship between climate, environments, and life.
3. Comprehend Palaeoceanography and Palaeoclimatology as well as the evolution of the biosphere.

4. Recognize the importance of fossils, their use in biostratigraphy, identification of paleo environments and knowledge of evolution and extinction patterns throughout the Paleozoic, Mesozoic, and Cenozoic eras.
5. Discuss the morphology, taxonomy, mode of life, environments, and stratigraphic distribution of various microfossil groups of botanical and zoological origin.
6. Emphasize the significance of certain geological groups by explaining their application in dating, correlation, and interpretation of sedimentary successions.
7. Gain a deeper understanding of Tertiary and Quaternary microfossils in Bangladesh through this course.
8. Describe the world's past biodiversity;

Course Content:

1. Fossilization and fossil record, Nature and importance of fossil record; Fossilization processes and modes of preservation
2. Taxonomy and Species concept with special reference to paleontology, Taxonomic hierarchy, Theory of organic evolution interpreted from fossil record.
3. Invertebrates brief introduction to important invertebrate groups (Phylum- Mollusca, Brachiopoda, Coelentrata, Arthopoda)
4. Significance of ammonites in Mesozoic biostratigraphy and their paleobiogeographic implications & Functional adaptation in trilobites and ammonoids.
5. Application of fossils in Stratigraphy -Biozones, index fossils, correlation; Role of fossils in sequence stratigraphy, Fossils and paleoenvironmental analysis; Fossils and paleobiogeography, biogeographic provinces.
6. Origin of life, Archean life: Earth's oldest life, Transition from Archean to Proterozoic.
7. Precambrian macrofossils – The garden of Ediacara, The Snow Ball Earth Hypothesis.
8. Paleozoic Life- The Cambrian Explosion. Biomineralization and skeletalization Origin of vertebrates.
9. Mesozoic Life- Life after the largest (P/T) mass extinction, life in the Jurassic, Rise and fall of dinosaurs, Origin of birds; and spread of flowering plants; Origin of mammals
10. Cenozoic Life- Aftermath of Cretaceous mass extinction.
11. Vertebrates in biostratigraphy and the relevance of time to phylogenetic reconstruction of Plate tectonics and vertebrate biogeography, Vertebrate diversity, disparity, and extinction.
12. Introduction to Microfossils
13. Inorganic Walled Microfossils-Foraminifera, Ostracoda, Coccolithophore
14. (Calcareous Nannoplankton), Pteropods, Radiolarians, Diatoms (Siliceous), Silicoflagellates, Conodonts (Phosphatic) Organic Walled Microfossils-Acritarch and Chitinozoa, Dinoflagellates,
15. Environmental application of Micropaleontology; Foraminiferal biofacies and their relationship to sea level change;
16. Microfossils and sequence stratigraphy; Thanatotopes; Indicator of environmental changes; Toxicology and pollution identification.
17. Paleoceanography; Determination of environmental conditions using foraminifers
18. Palynology: History of palynology; Maceration Techniques
19. Morphology of spore-pollen; Palynostratigraphic zonation of Tertiary succession of Bangladesh;

20. Palynodebris and evaluation of hydrocarbon generation potential.

Reference Books:

1. Benton, M. (2014) Vertebrate palaeontology (4th Edition). Wiley-Blackwell
2. Armstrong, H. &Brasier, M. (2005) Microfossils. Wiley.
3. Cushman, J.A. (2013) Foraminifera: Their Classification and Economic Use, 4th Revised and Enlarged Edition. Harvard University Press

0531-2151: Chemistry *II*: Organic& Inorganic Chemistry

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Introduce the physical and chemical properties, uses of aliphatic and aromatic hydrocarbons, ethers, epoxides, alcohols, phenols and conformation of alicyclic compounds

Synthesize new aliphatic/aromatic compounds through this preliminary idea.

Intended Learning Outcomes (ILO):

By the end of the course, learners will be able to- Understand the principles of chemical calculations, data treatment and represent data scientifically. Describe thermodynamics and interactions of gas molecules, liquification principle and methods of real gasses. Use knowledge in optimizing gas liquification methods and refrigeration. Predict the surface and frictional properties and liquids and liquid mixtures. Determine the molecular structure of molecules from physical data.

Course Contents:

1. Organic Compounds: Purification and detection of elements inorganic compounds.
2. General study of the following classes of compounds: (nomenclature,preparation, reactions and uses)

   a) Aliphatic and Alicyclic: Aliphatic hydrocarbons, e.g. paraffin,olefins and acetylenes, petroleum and natural gas, alkyl halides andgrignard reagents, alcohols, aldehydes and ketones, monocarboxylicacids and their derivatives (acid halides, anhydrides, amides andesters), alkyl amines, alicyclic compounds, their stability in the light ofBayer strain theory.

   b) Aromatic: Aromatic compounds and their sources, aromatichydrocarbons, benzene, toluene and xylene, structure of benzene,resonance, aromaticity, electrophilic aromatic substitution reaction,

mechanism, activation and deactivation of aromatic disubstitutionreactions, substitution products of aromatic hydrocarbons, such ashalogen, nitro and amino diazonium salts-their synthetic applications,sulphonic acids, phenols, aldehydes and ketones, polycyclichydrocarbon, naphthalene and anthracene.

3. Heterocyclic Compounds: Preparation and aromatic character offuran, pyrrole, thiophene and pyridine with their chemical reactions.
4. Carbohydrates: Nomenclature, classification and properties ofcarbohydrates, structure, configuration and ring size of glucose andfructose including their inter conversions.
5. Preliminary Concept of Stereoisomerism: Brief idea of opticalisomerism of simple compounds having asymmetric carbon,geometrical isomerism of simple organic compounds.

Reference Books:

1. Ebbing, D.D., General Chemistry
2. Bahl, B.S. and Bahl A., Advanced Organic Chemistry

3. Morrison, R.T. and Boyed, R.N., Organic Chemistry

0532-2122: Optical mineralogy lab

(based on the theory course)

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: Optical mineralogy lab studies provide valuable insights into the identification, characterization, and understanding of minerals based on their optical properties. By combining microscopy techniques with knowledge of mineralogy, researchers and students can gain a deeper understanding of Earth's materials and their geological significance.

Intended Learning Outcomes (ILO):

Optical mineralogy lab study is crucial for geoscience students as-

1. It provides them with essential knowledge, skills, and practical experience needed for careers in various sectors of geology, including mineral exploration, environmental geology, petroleum geology, academic research, and geological consulting,
2. by mastering the techniques and principles of optical mineralogy, students can make meaningful contributions to the field of geoscience and address real-world challenges related to Earth's resources, environment, and sustainability.

Course contents:

1. Systematic identification of common rock-forming minerals of sedimentary rocks from in thin sections and grain slides.
2. Systematic identification of heavy minerals occurred in the sedimentary rocks from grain slides.
3. Systematic identification of common rock-forming minerals of igneous and metamorphic rocks in thin sections.

Reference:

1. Nesse, W.D., 2014. Introduction to Optical Mineralogy; Oxford University Press, 348 pp.
2. Dyar, M.D., Gunter, M.E. and Tasa, D., 2008. Mineralogy and Optical Mineralogy; Mineralogical Society of America, 708 pp, ISBN 978-0-939950-81-2.
3. Gribble, C.D and Hall, A.J., 1992. Optical Mineralogy: Principles and Practice; UCL Press, London.
4. Kerr, P.F., 1977. Optical Mineralogy; McGraw-Hill Book Co., New York.
5. Berry, L.G. & Mason, B., 1967. Elements of Mineralogy; W.H. Freeman & Co., San Francisco.
6. Blackburn, W.H., Dennen, W.H. (1988). Principles of Mineralogy. (1st edition), Wm.C. Brown

Publishers, ISBN 069715078X, Dubuque, Iowa.
7. Deer, W.A., Howie, R.A., Zussman, J. (1992). An Introduction to the Rock Forming Minerals (2nd edition), ISBN 0-582-30094-0, Longman Publishing Co, London.
8. Velde, B., 1995. Origin and Mineralogy of clays, Springer.
9. Klein, C and Dutrow, B., 2007. Manual of Mineral Science (23rd edition); John Wiley & Sons, New York.
10. MacKenzie, W.S. and Adams, A.E., 1994. A Colour Atlas of Rocks and Minerals in Thin Section, Manson Publ., 192pp.

0532-2132: Sedimentology Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: This Course is for studying in detail the properties and attributes of sedimentary rocks, viz., clastics and nonclastics, in hand specimen and under the microscope

Intended Learning Outcomes (ILO):

At the end of the course student should be able to:
a. Explain / describe laboratory analytical techniques including sample-preparation procedures, dry- and wet-sieve methods, pipette analysis, graphical presentation and statistical analysis of grain-size parameters, heavy-mineral separation, microscopic study and interpretation of sedimentary rocks.
b. Determine / explain properties and attributes of sediment and sedimentary rocks, e.g., texture, fabric, and other attributes of clastic and nonclastic rocks in hand-specimen and under microscope (grain slides and thin-sections).
c. Characterize / identify the composition of the framework grains (minerals, lithic fragments), matrices, and cement of the rock specimen / sample supplied; identify fossil content and biogenic structures; name, classify, and suggest their origin. d. Interpret the depositional environment of rock(s) under investigation

Course contents:

1. Study and identification of common sedimentary rock.
2. Study and identification of common sedimentary rock under microscope.

Reference books:

1. Berry, L.G. & Mason, B., 1967, Elements of Mineralogy; W.H. Freeman & Co., San Francisco.
2. Dana, J.D., 1959, Manual of Mineralogy; John Wiley & Sons, Inc., New York.
3. Deer, W.A., Howie, R.A. &Zussman, J., 1989, An Introduction to the Rock Forming Minerals; ELBS/Longman, Essex.
4. Kerr. PF., Optical Mineralogy, 1959.
5. Milovsky, A.V. &Kononov, O.V., 1985, Mineralogy; Mir Publishers, Moscow.
6. Phillips, F.C., 1949, An Introduction of Crystallography; Longmans, Green & Co., Essex.

7. Read, H.H., 1962, Rutley's Elements of Mineralogy; Thomas Murby& Co., London.

0532-2142: Paleontology and micropaleontology lab

(based on the theory course)

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: The primary focus of this course is to analyze the diverse and interdisciplinary utilization and implementation of microfossils within paleontological research. The scope encompasses the examination of microfossils that are categorized as both animal invertebrates and vertebrates. Particular attention is given to the study of the structure and classification of various significant groups, such as foraminifers and ostracodes.

IntendedLearning Outcomes (ILO): After completion of the course, a learner will be able to-

a. explain how and why fossils were formed
b. classify the different types of fossils based on their distinguished morphology
c. identify different morphological features of vertebrate & microfossils
d. explain a depositional environment based on the presence of specific fossil.

Course Content:

1. Identification of fossil in hand specimen.
2. Identification of microfossils under microscope

Reference Books:

1. Benton, M. (2014) Vertebrate palaeontology (4th Edition). Wiley-Blackwell. 2. Clarkson, E.N.K. (1998)
2. Invertebrate palaeontology and evolution (4th Edition).
3. Armstrong, H. &Brasier, M. (2005) Microfossils. Wiley.
4. Traverse, A. (2007) Paleopalynology (2nd Edition). Springer.

0531-2152: Chemistry Lab

(based on the theory course)

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: Organic chemistry and inorganic chemistry are two main branches of chemistry that focus on different types of compounds based on the presence or absence of carbon atoms.

Intended Learning Outcomes (ILO):

After successful completion of the lab-
1.students will be able to: Prepare different chemical solution using different methods,
2. determine different parameters of physical chemistry, Estimate volumetrically different metals using different methods.

Course Content:

1. Scientific notations, significant figures, rounding off numbers, plotting of data and finding of slope and intercept of a line.
2. Determination of the molar volume of H 2 gas at STP and evaluation of gas constant R.
3. Determination of the molar mass of a solute by Rast's method.
4. Determination of the solubility product constant and study of common ion effect by titration method.
5. Determination of specific rotation and finding out unknown concentration of an optically active organic compound.
6. Determination of the heat capacity of calorimeter and finding out heat of NaOH solution in water and heat of neutralization of HCI with solid NaOH and with NaOH solution.
7. Kinetic study of an acid catalyzed hydrolysis of an ester by titrimetric and polarimetric method.
8. Conductometric titration of an acid by a base.
9. Verification of the Beer Lambert law and finding out concentration of a solution.
10. Preparation of standard Na 2 CO 3 solution and standardization of supplied HCl and NaOH solutions.
11. Preparation of standard K 2 Cr 2 O 7 solution and standardization of supplied Na 2 S 2 O 3 solution.
12. Preparation of standard sodium oxalate (Na 2 C 2 O 4) solution and standardization of supplied permanganate (MnO 4-) solution.
13. Volumetric estimation of (a) copper iodometrically, (b) iron with permanganate and dichromate, (c) iron, copper, nickel, zinc, by complexometric titration with EDTA.

Reference:

1. Fergusson, J.E., 1982, Inorganic Chemistry and the Earth; Pergamon Press, Oxford.
2. Haider, S.Z., 1964; Introduction to Modern Inorganic Chemistry. Friends International, Dhaka.
3. Morrison, R.H. & Boyd, R.N., 1983, Organic Chemistry; Prentice-Hall, New York.
4. Systematic Identification of Organic Compounds, R. L. Shriner, R. C. Fuson and D. Y. Curtin, JohnWiley Sons, Inc. New York, London, Sydney.
5. Text Book of Practical Organic Chemistry, Vogel's 5th Edition, ELBS with Longman.
6. Vogel's Text book of Quantitative Chemical Analysis, J. Bassett, R. C. Dinney, G. H. Jeffery and J.

Mendham, Longman Scientific & Technical.

0532-2160: Viva Voce

Credits: 1

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.

2nd Year 2nd Semester

0532-2211: Geomechanics

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Geomechanics is a multidisciplinary field of study that focuses on the behavior of geological materials, such as soils and rocks, under various physical and environmental conditions. A student can get idea that, geomechanics is a vital field that integrates principles of geology, physics, and engineering to understand and predict the behavior of geological materials under various conditions.

Intended Learning Outcomes (ILO):

The primary objective of geomechanics is to understand how these materials respond to external forces, including stresses, strains, and deformations, and how they interact with engineered structures.

1. To develop knowledge about characterization, identification, sample preparation, determination of engineering properties and their interpretation.
2. To understand three phases of soil classification for engineering purposes,
3. Engineering soil classification system
4. To encourage the geo-engineering community to understand the fundamentals of soil test report, its content and presentation.
5. To understand shear strength properties of the soil.

At the end of the course the students will be able to know the fundamentals of engineering soil testing, phase relationship. Engineering soil classifications, shear strength properties determination, to understand the fundamentals of soil testing for design purposes and governmental works. The skills developed at the end of the course will help the students to prepare soil test reports for engineering purposes. The students will be able to gain knowledge about sample preparation, analyses and interpretation and will be able to contribute to the national development.

Course contents:

1. Clay structures, Engineering description of soils and rocks, basic engineering tests, moisture content, Atterberg consistency limits, shrinkage limit, volumetric shrinkage, specific gravity, methods of calculation all basic parameters, engineering soil classification system, three phase relationship, preparation of engineering soil classification chart according to BS 5930 (1990) and ASTM.(1974).
2. General on geomechanics. Multidisciplinary approach of geomechanics to control landforms and environments, Geomechanics and urban development, Fundamentals of Urban Engineering Geology & Geotechnics.
3. Changes caused by Engineering works, Possible effects of engineering and natural processes, loading the ground, withdrawal of support, changes of fluid level.

4. Geomechanics in soils: Basic characteristics of soil, moisture content, particle size, density, specific gravity, unit weight, void ratio, phase relationship, porosity, permeability, degree of saturation, Atterberg consistency limits, shrinkage limits and mathematical derivation of basic soil properties.
5. Strength, definition, types, methods of determining strengths, Stress and strain: General, normal stress, shear stress, effective stress principle, stress ratio, stress paths, deviator stress, axial strain, volumetric strain, shear strain, pore water pressure, stiffness, Shear strength tests, Mohr-coulomb failure criterion, Shear strength of clays and sands. Moh'scolumb equation, shear strength problems, Moh's strength envelope
6. Geomechanics in rocks: Engineering classification of rocks, rock strength, uniaxial compressive strength, shear and tensile strength, elastic module, poissons ratio, rock quality designation (RQD).Index tests on rocks, point load tests, Schmidt hammer tests, CBR tests, Los Angeles abrasion tests, slake durability tests.

Reference books:

1. Atkinson, J.H., 1993. The mechanics of soils and foundations, McGraw and Hill book Company, England.
2. Atkinson, J.H. &Bransby, P.L., 1978. The mechanics of soils, McGraw and Hill book company Ltd. England.
3. Craig, R.P., 1990, Soil Mechanics, Van Nostrand, London.
4. Gillott, J.E., 1987. Clay in Engineering Geology. Elsevier Science Publishers B.V. The Netherlands
5. Grim, R.E. 1962. Applied Clay Mineralogy. McGraw Hill, New York.
6. Lambe, T.W. & Whitman, R.V., 1969. Soil Mechanics. John Wiley & Sons, New York.
7. Proceedings of the 2nd international conference on Geomechanics, Vol.2, edited by Balkema, Rotterdam.
8. Smith, G.N., 1990, Elements of Soil Methods, BSP, London.

0532-2221: Quaternary Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Quaternary geology provides essential insights into Earth's recent geological history, including climatic variations, glacial dynamics, sea-level changes, and landscape evolution. By studying the geological record of the Quaternary Period, students can better understand the processes shaping our planet's surface and the interplay between geological, climatic, and biological systems.

Intended Learning Outcomes (ILO):

Upon completion of the course, the students should know:

1. To make the students familiar with the climate change events during the Quaternary and the causes of climate changes.
2. To extend student's knowledge on the physiographic classification of Bangladesh and Quaternary stratigraphy and landform of Bangladesh.
3. To extend systematic knowledge on sea level change during the Quaternary and their impacts. 4. To promote student's knowledge on the Quaternary landform evolution of the Bengal Basin and Bangladesh in particular.
5. The Quaternary landforms and neotectonic activities within and adjacent Bengal Basin.

Course contents:

1. Introduction to Quaternary Geology – Plio-Pleistocene boundary; Worldwide geological events during Quaternary Period, climatic evolution.
2. Methods of dating and correlation of Quaternary deposits; rhythmic phenomena, paleomagnetic methods, radiometric methods, Luminescence dating methods; other methods.
3. Atmospheric circulation during Quaternary.
4. Quaternary Glaciation: Global climate models during Quaternary; evidences of glaciation; causes of ice-sheet growth and decay.
5. Quaternary sea-level change: causes and timing of sea-level fluctuation; recent and historic changes in sea level. Evidences of sea-level fluctuation; temperature, salinity and ocean circulation during Quaternary.
6. Quaternary geology of the Bengal Basin: Distribution of the Quaternary deposits; stratigraphy, sedimentology, depositional environment and paleoclimate. 7. Neotectonics within Bengal Basin.

Reference books:

1. Bowen, D.Q., 1978, Quaternary Geology; Pergamon Press, Oxford.
2. Bradley, R.S., 2015, Paleoclimatology: reconstructing climate of the Quaternary; Elsevier Inc. 3. Flint, R.F., 1971, Glacial and Quaternary Geology; John Wiley & Sons, Inc., New York.
4. Hossain, M.S., Khan, M.S.H., Chowdhury, K.R., and Abdullah, R., 2018. Synthesis of the Tectonic and Structural Elements of the Bengal Basin. In: Mukherjee, S. (eds.) Tectonics and Structural Geology: Indian Context. 1 st edition, Springer.
5. Lowe, J. J., & Walker, M. J. C., 1997, Reconstructing Quaternary Environments (2nd Edition); Longman, England.
6. Mansur, H. 1995; An Introduction to the Quaternary Geology of Bangladesh; City Library, Dhaka.
7. Mathur, U. B., 2005, Quaternary Geology Indian Perspective; Geological Society of India, Bangalore.
8. Nilson, T., 1989, The Pleistocene; D. Reidel Publishing Co., Drodrecht.
9. Ruddiman, W.F., 2008, Earth's Climate: Past and Future; W. H. Freeman and Company, New York.
10. Williams, M. A. J., Dunkerley, D. L., Deckker, P. D., Kershaw, A. P., and Stokes, T. J., 1996, Quaternary Environments; Arnold, London.
11. Selected Publications.

0532-2231: Geochemistry

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: The course explores the birth and development of the universe, the solar system, and materials from beyond Earth. It examines the prevalence, categorization, dispersion, and movement of chemical elements in the Earth's lithosphere, hydrosphere, and atmosphere, as well as the biogeochemical cycles and ecological concerns related to these elements.

Intended Learning Outcomes (ILO):

At the end of the course the students will be able to-

1. Relate important elements to their occurrence in the Earth's crust
2. Understand the fundamentals of geochemistry and its relevance in earth processes.
3. Understand how inorganic and organic chemical processes are involved in the formation of carbonate sediments, silica sediments, iron sediments, manganese sediments and phosphate sediments.
4. Understand the origin of carbon in rocks, origin of petroleum, origin of coal, organic matter in black shale
5. Account for simple weathering processes in aqueous conditions
6. Envisage the procedures of geochemical sampling and different methods of analysis

Course Content:

1. Introduction – Scope; abundances and theories of origin, and processes of formation of chemical elements.
2. Geochemical classifications of elements.
3. Geochemical differentiation of the Earth's core, mantle, crust (igneous, sedimentary and metamorphic rocks).
4. Distribution and migration of elements in lithosphere, hydrosphere and atmosphere; factors of migration
5. Chemistry of aqueous solutions; transport of solute in aqueous systems; mineral solubility and equilibria;
6. Geochemical reactions in aqueous systems; stability fields of water and dissolved chemical species.
7. Carbonate system and chemical weathering.
8. Isotopes and types of isotopes; isotope fractionation; applications of isotopes in geology and geochronology.
9. Environmental Geochemistry and Biogeochemical cycles of chemical elements.
10. Environmental pollution, toxic pollutants and their impact on environmental health and ecology.

Reference Books:

1. Faure, G. (1992) Principles and Application of Inorganic Geochemistry (2nd Edition). Prentice Hall.
2. Hoefs, J. (2015) Stable Isotope Geochemistry (7th Edition). Springer.
3. W.M. White (2013) Geochemistry. Wiley-Blackwell.
4. Albarede, F. (2003) Geochemistry: An Introduction. Cambridge University of Press.

0532-2241: Hydrology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Hydrology is the scientific study of the distribution, movement, and properties of water on Earth and other planets, including the water cycle, water resources, and environmental watershed sustainability. It encompasses the occurrence, distribution, movement, and properties of water in the atmosphere, on the Earth's surface, and within the Earth's crust.

Intended Learning Outcomes of hydrology (ILO):

After the completion of this course, students will be-
1. Able to explain the occurrence, distribution, movement and properties of the waters of a basin or any unit area;
2. estimate precipitation, evapotranspiration and surface runoff using different mathematical and field methods;
3. describe different methods to prepare a water budget for the basin area;
4. able to predict the flood level of a river downstream, based on an observed flood discharge, or high-precipitation event on upstream;
In summary, the key objectives of hydrology revolve around understanding, assessing, managing, and protecting water resources to ensure their sustainable use for various purposes while considering environmental, social, and economic aspects.

Class contents:

1. Hydrologic cycle, importance of hydrology.
2. Precipitation, types and forms, causes, measurements of different types of precipitation, precipitation analysis.
3. Evaporation, factors affecting evaporation, measurements of potential evaporation and transpiration, calculation of evaporation. Evapotranspiration and its measurement.
4. Infiltration, water in soil, soil water retention, methods of measurements.
5. Run-off, sources, factors affecting run-off, river regimes, hydrographs, flow frequency, flood frequency, flood probability, flood prediction.
6. Drainage basin, development, morphometry and hydrology, run-off generation, initiation of channels and the drainage network; basin hydrology, basin denudation.

Reference books:

1. Fetter, G. W., 1980, Applied Hydrogeology; Charles E. Merrill Publishing Co., Toronto.
2. Shaw, E.M., 1988, Hydrology in Practice (2nd Edition). Chapman Hall, London.
3. Ven Te Chow, 1964. Handbook of Applied Hydrology. McGraw-Hill Book Co., New York.
4. Watson, I., & Burnett, A.D., 1995. Hydrology, An Environmental Approach, Lewis Publishers, CRC Press LLC, Florida.
5. Wisler, C.O. &Breter, E.F.; 1959. Hydrology, Jhon Wiley and Sons Inc.; New York.

0533-2251: PhysicsII: Electricity & Magnetism

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This course describes the basic phenomena of electricity and magnetism. It is designed for Geology undergraduate students who have the concepts of intermediate level Vector Algebra, Calculus and General Physics. It may consolidate the understanding of fundamental concepts of Electricity and Magnetism more rigorously as needed for further studies in Physics, Geophysics, Engineering and Technology.

Intended Learning Outcomes (ILO): Completion of this course enables the successful students to demonstrate knowledge and understandings of

1. The use of Coulomb's law and Gauss' law for the electrostatic force
2. The relationship between electrostatic field and electrostatic potential
3. The use of the Lorentz force law for the magnetic force
4. The use of Ampere's law to calculate magnetic fields hence learning how an electric current can produce magnetic field and that a changing magnetic field can produce an electric current.
5. The use of Kirchoff's laws to work with simple electric circuits and calculate the current, potential difference, and resistance in it.
6. The use of Faraday's law in induction problems
7. The difference between alternating and direct current hence the basics of an a.c. generator
8. The basic laws that underlie the properties of electric circuit elements

Course Content:

1. Electrostatics: Electric Charge, Electric Field and Electric Potential, Electric Dipole, Gauss's Law, Density of Charge in a Polarized Dielectric, Gauss's Law for Charges in a Dielectric, Capacitance and Co-efficient of Potential, Capacitance and Induction Energy of Charged Systems, Electrical Images.
2. Magnetostatics: Gauss's Law for Magnetism, Magnetic Dipole, Energy in a Magnetic Field.

3. Direct Current: Current and Electromotive Force, Ohm's Law, Drift Speed, Resistance and Resistivity, Combination of Resistances in Series and Parallel, Kirchoff's Laws, Wheatstone Bridge.
4. Electromagnetism: Magnetic Field of a Current, Ampere's Law, Biot- Savart Law, Magnetic Field of Simple Circuits, Galvanometers, Lorentz Force, CRT.
5. Electromagnetic Induction: Faraday's Law, Self-Inductance and Mutual Inductance.
6. Alternating Current (AC): Generation of AC, RMS Value, Power Factor, CR and LR circuits, Gain, Decibel (dB)

Reference Books:

1. Fundamentals of Physics, Robert Resnick, David Halliday and Jearl Walker, John Wiley and Sons.
2. Physics, Robert Resnick, David Halliday and Krane, John Wiley and Sons.
3. Foundations of Electromagnetic Theory, J. Reitz, F. Milford and R. Christy, Addison Wesley.
4. Electromagnetic Fields and Waves, P. Lorrain and D. Corson, W.H. Freeman and Co. Ltd.
5. Concepts of Electricity and Magnetism, M.S. Huq, A.K. Rafiqullah and A.K. Roy, Students' Publications.
6. Principles of Electricity, L. Page and N.I. Adams, S. Chand and Company.

0541-2261: Mathematics *II*: Calculus

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Functions, graphs, limits of functions , derivatives, differentiation, applications of derivatives, different theorems, functions of several variables, indefinite and definite integrals, applications of integrations.

Intended Learning outcomes (ILO): By the end of the course, students will be able to-

1. Introduce with basic concept of calculus
2. Describe different types of functions and their graphs
3. Differentiate different types of functions
4. Use derivative for practical problems of maxima and minima, rates, for calculating small Increments
5. differentiate partially functions of two or more variables integrate simple and complicated functions
6. Use reduction formulas for integration
7. Apply definite integration for practical purposes, such as, for finding arc length, areas, volumes and surfaces of solids of revolution.

Course Contents:

1. Functions and their graphs (polynomial) and rational functions, logarithmic and exponential functions, trigonometric functions and their inverses, hyperbolic functions and their inverses, combination of such functions).
2. Limits of functions: Definition. Basic limit theorems (without proofs). Limit at infinity and infinite limits. Continuous functions. Properties of continuous functions on closed and bounded intervals (no proof required)
3. Differentiation: Tangent lines and rates of change. Definition of derivative. One-sided derivatives. Rules of differentiation (with applications). Related rates, linear approximations and differentials. Taylor's series. Successive differentiation
4. Leibnitz theorem. Rolle's Theorem: Lagrange's Mean Value Theorems. Extrema of functions, problems involving maxima and minima.
5. Functions of two or more variables. Partial differentiation.
6.Integrals: Antiderivatives and indefinite integrals. Techniques of integration. Definite integration using antiderivatives.
7. Definite Integrals: Integration as a limit of a sum. The fundamental theorem of calculus. Integration by reduction.
8. Application of integration: Plane areas. Volumes of solids of revolution. Volumes by cylindrical shells. Volumes by cross-sections. Arc length and surface of revolution.

Reference Books:

1.Anton, H., Bivens, I., David, S. : Calculus with Analytic Geometry (10th Edition). Wiley.
2.Lang, S. (1998) A First Course in Calculus (5th Edition). Springer.
3.Swokowski, E.W. (1983) Calculus with Analytic Geometry (2nd Edition). Brooks/Cole.
4.Bers,L.&Karal, P. (1976) Calculus. Holt, Rinehart & Winston of Canada Ltd.
5.Thomas & Finney. Calculus

0542-2271: Statistics

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This course serves as an introductory exploration into the field of spatial statistics, specifically designed for students who possess no prior understanding of statistical principles. The initial segment of the course delves into classical statistics, encompassing a multitude of topics that encompass both descriptive and inferential statistics. Particular attention is placed on the exploration of simple linear regression analysis, the concept of probability distribution, and the practice of hypothesis testing. The subsequent portion of the course delves into the realm of spatial statistics, delving into an array of techniques utilized in the analysis of spatial data. These techniques include Geovisualization, Point Pattern Analysis, Spatial Interpolation (specifically the Inverse Distance Method and Kriging), Spatial Regression, and Stochastic Simulations. Additionally, students will be introduced to fundamental features and applications of several statistical and geostatistical software, such as SPSS, Matlab, Surfer, ArcGIS Spatial Analyst, Rockware, R-programme, and SGeMS.

Intended Learning Outcomes (ILO): By successfully completing this course, students will acquire the ability to:

1. Conduct fundamental statistical computations and graphical analyses.
2. Identify and employ several commonly used probability distributions, while assessing the plausibility of the underlying assumptions for each distribution.
3. Examine research inquiries based on statistical data, arrive at relevant conclusions, and demonstrate familiarity with the limitations of specific statistical methods.
4. Discern spatial patterns within data.
5. Compare and contrast different spatial estimation techniques.
6. Construct statistical models for uncomplicated spatial phenomena.

Course Content:

1. Introduction to statistics, data, variables, population, samples etc.
2. Summarizing Data – graphical and numerical methods (central tendency and dispersion).
3. Probability and Probability Distribution: basic concepts and rules of probability; binomial distribution, geometric distribution, hypergeometric distribution, Poisson distribution, T-distribution, and normal distribution.
4. Estimation and Hypothesis testing: Estimation of population parameter from sampling distribution, Hypothesis Testing (t-test and Chi-square test).
5. Regression analysis: Detail of simple linear regression analysis and basics of multiple regression analysis.
6. Spatial statistics: Introduction, Scopes and Applications of Geostatistics; Exploratory Data Analysis
7. Spatial Data Analysis: Geovisualization, Point Pattern Analysis, spatial autocorrelation
8. Spatial Interpolation: Proximity polygons, Nearest Neighbour, Inverse Distance Weighted Method, Kriging, and Splines.
9. Introduction to Spatial Regression and Stochastic Simulations.
10. Geostatistical Software: Basic features and applications of the following softwares – SPSS, Matlab, Surfer, ArcGIS Spatial Analyst, Rockware, R-programme, SGeMS.

Reference Books:

1. Mann, P. S. (2013). Introductory statistics (8th Edition). John Wiley & Sons
2. O'sullivan, David, and David Unwin (2014). Geographic information analysis (2nd Edition). John Wiley & Sons.
3. Montgomery, D. C., Peck, E. A., & Vining, G. G. (2015) Introduction to linear regression analysis. John Wiley & Sons.

0533-2252: Physics Lab: Electricity & Magnetism Lab

Credits: 2

Lectures: 25

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

This lab is based on the theory course: Electricity & Magnetism. Students will apply their theoretical knowledge to solve practical problems.

0532-2272: Geological Field Mapping

Credits: 2

General concept: A seven days long field trip in the hill tracts region in Bangladesh where there are extensive exposure of Mio-Pliocene sedimentary strata. Emphasis will be on understanding and mapping large-scale geological structures such as folds, faults, and unconformity, identification and mapping of various stratigraphic formations, identification and interpretation of sedimentary structures, and deduction of processes producing those sedimentary structures.

Intended Learning Outcomes (ILO): By completing this course students will be able to –

1. Locate and map geological exposure,
2. measure bed attitude,
3. map bed attitude data and deduce geological structure,
4. construct geological sections at exposure scale and correlate them,
5. prepare a complete geological map showing various structures, and stratigraphic formations,
6. identify and differentiate between various sedimentary structures,
7. interpret the processes responsible for producing various sedimentary structures.

Course Content:

1. Preparation for field work- Expectations and reality in the field; list of field equipment, and base maps; code of conduct in the field; formation of various field committees.
2. During the field work- Visit selected areas to view the general geology and to learn field observation, documentation, and mapping skills; Mapping exercise on a microscopic scale; standards and technique for taking field notes; summarize and plot field data on the map at the end of daily field trip work.
3. After the Field, laboratory analysis of field data, completion of the geological map, and construction of geological cross section showing large-scale geological structure; writing field report.

0532-2280

Viva Voce

Credits: 1

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.

3rd Year 1st Semester

0532-3111: Igneous & Metamorphic Petrology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: A course on igneous and metamorphic rocks provides students with a comprehensive understanding of the processes, properties, and significance of these rock types in the Earth sciences.

Intended Learning Outcomes (ILO):

Students will be able to

1. identify and interpret the igneous and metamorphic materials of the earth;
2. relate the chemical signature of the magmatic and metamorphic rocks to their source and tectonic setting;
3. apply the knowledge to decipher the relationship between magmatism, deformation and metamorphism.

Course contents:

1. Geological occurrences of igneous rocks and Classification of igneous rocks.
2. Origin of Magma, Tectonic setting of magma generation.
3. Magmatic processes: Magma generation, magma differentiation, cooling and solidification etc.
4. Texture, structure, composition of igneous rocks.
5. Petrogenesis of igneous rocks: Petrogenesis refers to the origin and formation of rocks, and when it comes to igneous rocks, it involves the processes that lead to the creation of these rocks from molten magma.

6. Ophiolite: Ophiolites are sections of oceanic lithosphere that have been uplifted and exposed above sea level due to tectonic processes. They are composed of various rock types, including serpentine, basalt, and gabbro.
7. Migmatites: Composition, formation and distribution.
8. Metamorphism Metamorphic rocks, Agents of metamorphism
9. Metamorphic processes: Regional metamorphism, contact metamorphism.
10. Texture and structure (fabric) of metamorphic rocks.
11. Classification of metamorphism, contact and regional metamorphism,
12. Contact metamorphic facies: Hornfels facies, Pyroxene-Hornfels facies.
13. Regional metamorphic facies: There are several recognized regional metamorphic facies, each associated with distinct pressure-temperature (P-T) conditions.
14. Precambrian basement and other crystalline rocks of Bangladesh.

Reference books:

1. Best, M. J., 2003. Igneous and Metamorphic Petrology. Blackwell.
2. Huang, W.T., 1962. Petrology; McGraw-Hill Book Co., New York.
3. Hyndman, E.W., 1972. Petrology of Igneous and Metamorphic Rocks; McGraw-Hill Book Co., New York.
4. Philpotts, A. and Ague, J., 2009. Principles of Igneous and Metamorphic Petrology. Cambridge University Press. ISBN-13: 978-0521880060.
5. Raymond, L.A., 1995. Petrology: The study of Igneous, Sedimentary and metamorphic Rocks; Wm. C. Brown, Dubuque.
6. Vernon, R. H., and Clarke, G. L., 2008. Principles of Metamorphic Petrology. Cambridge University Press. ISBN-13: 978-0521871785.
7. Wilson, M., 1989. Igneous Petrogenesis; Unwin Hyman, London.
8. Winter, J. D., 2014. Principles of Igneous and Metamorphic Petrology. Pearson Education Limited. ISBN-13: 9781292021539.

0532-3121: Hydrogeology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: It is very important to know thatabout 1.7 percent of all of Earth's water is groundwater and about 30.1 percent of freshwater on Earth occurs as groundwater. The main focus of hydrogeology knowledge is essential for managing groundwater resources sustainably, protecting water quality, and addressing various environmental challenges related to water resources.

Intended learning outcomes (ILO):

At the end of the course the students will be able to understand-
1. Characteristics of groundwater flow in porous aquifers, recharge, flow and discharge.

2. Aquifer properties and their effect on groundwater flow.
3. Physically-based equations that describe groundwater flow under natural conditions, and around a pumping well.
4. Design and construction of tube-wells.
5. Chemical properties of groundwater.
6. Hydro-geology and groundwater potentiality of Bangladesh.

Course contents:

1. Hydrogeology and related sciences; origin and occurrence of groundwater; geological formations as aquifer; types of aquifers, Groundwater exploration
2. Groundwater movement; Darcy's law, permeability, transmissibility, tracing of groundwater movement; groundwater flow lines and contours.
3. Fundamentals of well hydraulics; steady and unsteady flows; equilibrium and non-equilibrium equations; well interference, partially penetrating well, aquifer performance test.
4. Water wells; drilling techniques, well design and construction, screen selection and gravel pack, well development.
5. Groundwater chemistry: physical and chemical properties of groundwater; geochemical analysis and interpretation; groundwater pollution.
6. Groundwater flow theory, physical and mathematical description of groundwater problems, recharge and discharge, solving groundwater flow equations.
7. Development of groundwater; safe yield, recharge estimation; artificial recharge, groundwater management, conjunctive use of groundwater and surface water.
8. Sea-water intrusion in coastal aquifers.
9. Groundwater resources of Bangladesh.

Reference books:

1. Abdel-Aziz, I.K., 1986; Groundwater Engineering. McGraw-Hill Book Co., New York.
2. Brandon, T.W., 1986; Groundwater: Occurrence, Development and Protection. The Institute of Water Engineers and Scientists, London.
3. Domenico, P.A. & Schwartz, F.W., 1990, Physical and Chemical Hydrogeology; John Wiley & Sons, New York.
4. Drever, J.I., 1982; The Geochemistry of Natural Water (2nd edition). Prentice Hall, Englewood Cliffs, New Jersey.
5. Driscoll, F.G., 1986; Groundwater and Wells (2nd edition). Johnson Division, St. Paul, Minnesota, USA.
6. Fetter, G.W., 1980, Applied Hydrogeology; Charles E. Merrill Publishing Co., Toronto.
7. Fetter, C.W., 2001, Applied Hydrogeology; 4th edition, Pearson, ISBN-13: 9780130882394.
8. Freeze, A.R. and Cherry, J.A., 1979; Groundwater. Prentice Hall, Englewood Cliffs. New Jersey.
9. Kruseman, G.P. & De Ridders, N.A., 1990, Analysis and Evaluation of Pumping Test Data; ILRI Publication, The Netherlands.
10. Lloyd, J.W. & Heathcote, J.A., 1985, Natural Inorganic Hydrochemistry in relation to Ground Water: An Introduction; Claredon Press.
11. Raghunath, H.M., 1983, Ground Water; Wiley Eastern Ltd., New Delhi.
12. UNITED NATIONS, 1982, The Hydrogeological Condition of Bangladesh; United Nations Ground Water Survey Technical Report, New York.

13. Todd, D.K., 1980, Ground Water Hydrology; John Wiley & Sons, New York.

0532-3131: Introduction to Geophysics

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Applied geophysicsfocuses on the practical applications of geophysical methods to study the Earth's subsurface. The primary goal is to obtain information about the Earth's structure, composition, and properties by measuring various physical properties of the subsurface materials.

Intended Learning Outcomes (ILO):

Upon successful completion of the course, students will be able to:
1. Calculate the gravity and magnetic effects of subsurface sources.
2. Develop an understanding of basic concepts of processing and interpretation of gravity and magnetic data.
3. Show how gravity and magnetics relate to, and are useful in, geology.
4. Radioactive methods provide essential tools for understanding Earth's evolution, processes, and resources.
5. Gain knowledge on the curve matching technique of resistivity data interpretation and the ambiguity in interpretation.

Course contents:

1. Introduction: branches of applied geophysics; the use of geophysics in oil, mining exploration and environmental sciences.
2. Magnetic methods: fundamentals of magnetic effects of various shapes; brief account of (the processing and interpretation of magnetic data) magnetic data processing, qualitative and quantitative interpretation of magnetic data; applications of magnetic surveying.
3. Gravity methods: fundamentals of gravitational effects of buried bodies having discrete shapes; an outline of (the processing and interpretation of gravity data) gravity data processing, qualitative and quantitative interpretation of gravity data; typical anomalies for geological features.
6. Radioactivity method: principles of radioactivity - Radioactive Decay Processes and equilibrium, radioactivity of rocks and minerals; interpretation of radioactivity data.

Reference books:

1. Clayton, C.G.; (Ed) 1983; Nuclear Geophysics. Pergamon Press, Oxford.
2. Dentith M. and Mudge S.T. 2014. Geophysics for the Mineral Exploration Geoscientist. Cambridge University Press. 3. Dobrin, M.B. and Savit, C.H. 1988; Introduction to Geophysical Prospecting. McGraw-Hill Book Co.; New York.
4. Kearey, P., Brooks, M. and Hill I., 2002, An Introduction to Geophysical Exploration (3rd ed.). Blackwell Scientific, Oxford.

5. Keller, G.V. and Frischknecht, F.C., 1966, Electrical Methods in Geophysical Prospecting; Pergamon Press, London.
6. Reynolds, J.M., 2011, An Introduction to Applied and Environmental Geophysics, John Wiley & Sons.
7. Robinson, E.S. and Coruh, C., 1988, Basic Exploration Geophysics; John Wiley & Sons, New York.
8. Sharma, P.V., 1986, Geophysical Methods in Geology; Elsevier Scientific Publishing Co., Amsterdam.
9. Sharma P.V., 1997, Environmental and engineering geophysics. Camb. Univ. Press.
10. Sheriff, R.E. and Geldart, L.P., 1995, Exploration Seismology. 2nd edition. Cambridge University Press, Cambridge.
11. Telford, W.M.; Geldart, L.P. and Sheriff, R.E., 1990, Applied Geophysics. 2nd edition. Cambridge University Press, Cambridge.
12. Selected publications.

0532-3141: Economic Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This particular course has been developed with the intention of comprehending the fundamental principles and processes that are responsible for the emergence of diverse kinds of Economic mineral deposits. The course also delves into the matters of their localization, classification, conservation, mining, and uses. Furthermore, the course encompasses the advancement of scientific knowledge and skills in the domain of Economic Geology, thereby enabling the recognition of the significance of mineral resources in the construction of roads, buildings, bridges, industries, power plants, ports, and other crucial infrastructures. The significance of petroleum and coal as fossil fuels shall also be duly acknowledged.

IntendedLearning Outcomes (ILO): By the end of the course, students will be able to –

1. Introduce to the scope and importance of mineral resource
2. Describe the formation of mineral deposits
3. Explain the modes of occurrences, stratigraphy, reserves, classification and localization of economic mineral resources
4. Describe the processes of formation of magmatic, contact metasomatic, hydrothermal, metamorphic, sedimentary and volcanogenic mineral deposits
5. Explain origin, localization, stratigraphy and reserves of coal, petroleum, placer, residual and supergene enrichment deposits.
6. Understand the utilization, conservation and economic importance of mineral deposits to infrastructure development in a modern society

Course Content:

1. Introduction and scope of Economic Geology
2. Modes of occurrences of mineral deposits
3. Classification of mineral deposits
4. Ore localization and its controls

5. Magmatic mineral deposits, their classification and processes of formation
6. Contact metasomatic process and resulting mineral deposits
7. Origin of hydrothermal solution and resulting mineral deposits
8. Cavity-filling and metasomatic replacement deposits
9. Origin, mode of occurrence, ranks, chemical analysis and uses of coal
10. Residual, placer, supergene enrichment and sedimentary deposits

Reference Books:

1. Pohl, W.L. (2011) Economic Geology: Principles and Practice. Wiley-Blackwell
2. Imam, B., 1996; Mineral Resources of Bangladesh. Bangla Academy Press, Dhaka.
3. Jensen, M.L. & Bateman, A.M., 1982, Economic Mineral Deposits; John Wiley & Sons, Inc., New York.

0532-3151: Oceanography, Marine Geology& Blue Economy

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This course offers an introductory exploration of the world's oceans, aiming to establish a fundamental comprehension of their physical, chemical, and biological aspects, as well as the various geological processes occurring within them. The curriculum encompasses a wide range of topics, including the study of the world ocean, physical, chemical, and biological oceanography, the physiography of global oceans, plate tectonics in relation to oceans, ophiolite complexes, coastal processes, deep sea sediments, mineralization within the oceans, and methods utilized for ocean floor sampling.

Key Learning Outcomes (ILO): Upon successful completion of this course, the student will possess the capability to:

1. Comprehend the distinct classifications of the world's oceans and their fundamental characteristics
2. classify and explain the physiographic provinces of the oceans;
3. understand the physical and other geological processes going on in the world oceans;
4. understanding of data acquisition methods in marine environments
5. interpret the various types of data that have been acquired in marine environments
6. use the data to manage the coastal environments.

Course Content:

1. Introduction to Oceanography: Scope; Origin and Distribution of Oceans.

2. Ocean Morphology-Physical Features of Deep-ocean Floor (Ocean Ridges, Rises, and Trenches; Submarine Canyons)
3. Physical and Chemical Properties of Ocean Water; SMOW.
4. Ocean Circulation and Ocean Currents; Wind-stressed Currents.
5. Waves and Tides.
6. Coastal Morphology and Major Coastal Processes; Coastal, Nearshore, Shelf, Slope and Abyssal-plain Sedimentation; Mineral Resources of the Oceans.
7. Oceanic Crust; Rifting and Sea-floor Spreading.
8. Major Tectonic Features and Evolution of the Oceans.
9. Mid-ocean Ridges and Volcanism; Eustasy and Relative Sea-level Changes
10. Bay of Bengal- Evolution; Major Morphometric Features; Bengal Deep-Sea Fan.
11. Law of the seas, History, Marine Spatial Planning, Blue economy.
12. Satellite oceanography-Sensors, Progress, Implications.

Reference Books:

1. Kennett, U.P. (1982) Marine Geology. Prentice-Hall.
2. Bird. E. 2008. Coastal geomorphology. Second Edition. John Wiley & Sons Ltd. 411p
3. Open University. 2004. Ocean circulation. Second Edition. Butterworth-Heinemann. 286p.
4. Open University. 2004. Seawater its composition. Second Edition. Butterworth-Heinemann. 168p.
5. Open University. 2003. The sedimentary record of sea level changes. Cambridge University Press. 279p.
6. Open University. 2004. The ocean basins. Second Edition. Butterworth-Heinemann. 185p.

0532-3161: Introduction to Remote Sensing & GIS

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This course includes the fundamentals of remote sensing, the features of remote sensors, and the utilization of remote sensing in academic fields and professional sectors. Moreover, this course aims to provide knowledge about the fundamentals of geographic information systems (GIS). Additionally, the course explores the diverse methods through which GIS and remote sensing have been combined and employed to analyze various geological phenomena.

Key Learning Outcomes (ILO): By the end of this course, learners will be able to-

1. explain the principles of remote sensing.
2. describe remote sensing applications and history.
3. evaluate the methods of digital image processing.
4. analyze and explain remote sensing purposes, advantages, and limitations.
5. construct geographical information by processing digital remotely sensed data.
6. justify the opportunities and available methods for integrating remote sensing and GIS.
7. understand the basic concepts and application of GIS.
8. analyze different spatial problems in GIS environment

Course Content:

Remote Sensing:

1. Introduction and Scope, Classification of Remote Sensing
2. Air and Space-borne Remote Sensing
3. Data Acquisition
4. Aerial Photograph
5. Fundamentals of Photo Interpretations
6. Satellite Remote Sensing - Satellites and Sensor Characteristics
7. Multispectral Remote sensing
8. Application of Remote Sensing

GIS:

9. Introduction and Scope
10. Fundamentals of GIS
11. Maps and Map Projections
12. Spatial Data Models
13. Raster and Vector Data Structures
14. Data Sources and Data Quality
15. Spatial Data Input
16. Digitizing and Editing

17. Data Base, Database Management and Relational Databases
18. Attribute Data and Basic GIS Analyses

Reference Books:

1. Jensen, J.R. (2014) Remote Sensing of the Environment: An Earth Resource Perspective (Pearson New International Edition). Pearson.
2. Longley, P.A., Goodchild, M.F., Maguire, D.J., Rhind, D.W. (2015) Geographic Information Science & System (4th Ediiton). Wiley.
3. Kennedy, M. (2013) Introducing Geographic Information Systems with ArcGIS. A Workbook Approach to Learning GIS (3rd Edition). Wiley.
4. Heywood, I., Cornelius, S., Carver, S. (2006) An Introduction to Geographical Information Systems (3rd Edition). Pearson Prentice Hall.
5. Jensen, J.R. (2004) Introductory Digital Image Processing: A Remote Sensing Perspective (3rd Edition). Prentice Hall.
6. Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2004) Remote Sensing and Image Interpretation (5th Edition). John Wiley and Sons

0532-3112: Igneous & Metamorphic Petrology Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: The course is designed to study the properties and identify common Igneous and Metamorphic rocksin hand specimen and in thin section under petrographic microscope.

Intended learning outcomes (ILO): At the end of the course the learners will be able to

a. Study the properties of Igneous and Metamorphic rocks in hand specimen and in thin section under petrographic microscope;

b. Distinguish between the properties of Igneous and Metamorphic rocks;

c. Identify the common Igneous and Metamorphic rocks in hand Specimen as well as under petrographic microscope.

d. Know the limitations and advantages of rock identification in hand specimen and under petrographic microscope

Course Contents:

1. Study the properties and identification of common Igneous rocks in hand specimen.
2. Study the properties and identification of common Igneous rocks in thin section under petrographic microscope.
3. Study and properties and identification of common Metamorphic rocks in hand specimen.

4. Study the properties and identification of common Metamorphic rocks in thin section under petrographic microscope.

Reference Books:

1. Best, M.G. (2002) Igneous and Metamorphic Petrology (2nd Edition). Wiley-Blackwell.
2. Winker, H.G.F. (2013) Petrogenesis of Metamorphic Rocks (4th Edition). Springer Science & Business Media.
3. Philpotts, A. (2003) Petrography of Igneous and Metamorphic Rocks. Waveland Press.
4. Hyndman, D.W. (1985) Petrology of Igneous and Metamorphic Rocks (2nd Edition). McGraw-Hill internationalseries in the earth and planetary sciences.

0532-3122: Hydrogeology Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: This course is a practical approach to the study of surface water and groundwater with emphasis on underground flow, pumping, water quality and construction of tube-wells.

Intended learning outcomes (ILO):

At the end of the hydrogeology practical course the students will be able to understand-
1. The relationship among the components of the hydrologic cycle, hydrologic data sources, and techniques for analyzing these data.
2. Analyzing groundwater level data and development hydro-stratigraphic sequence of any area from borelog analysis.
3. Distinguish between confined & unconfined aquifers from the analysis of data;
4. Draw groundwater flow-nets to scale from provided data;
5. Use and interpret pumping data for groundwater flow applications;
6. Design and construction of water well in an area, determination of well performance and selection of pump capacity and also
7. Interpretation of water chemistry data, plot and interpret Ternary, Piper, Stiff, Durov, Schoeller and Ion-Balance Diagrams for water quality analysis.

Course contents:

1. Climatic data interpretation and analysis.
2. Construction and interpretation of hydrograph, groundwater table contour maps and flow net.
3. Bore log analysis and subsurface cross-section, aquifer facies map.
4. Well designing, water balance and recharge estimation

5. Analysis and interpretation of pumping test data, determination of aquifer characteristics. 6. Step drawdown test data analysis and interpretation.
7. Hydro-chemical data analysis and interpretation: conversion of data, quality of analytical data, graphical representation of data – bar diagram, xy-plot, trilinear plots.

Reference Books:

1. Fetter, C.W. (2014) Applied Hydrogeology (4th International Edition). Pearson.
2. Kruseman, G. P., Ridder, N. A. (1990) Analysis and evaluation of pumping test data (2nd Edition). IILRI.
3. Hounslow, A. (2018) Water quality data: analysis and interpretation. CRC press

0532-3162: Remote Sensing & GIS Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: This course focuses on the basics of Erdas Imagine software, different image processing techniques, supervised and unsupervised classification of satellite images, geocoding and other tools to clear the idea taught in theory. This course is also designed for understanding the layout of geographic information systems (GIS) software. The course also looks for the various GIS operations such as: georeferencing, geoprocessing, topology and other important techniques.

Key Learning Outcomes (ILO): By the end of this course, learners will be able to-

1. To understand the applications of geographical information systems and sciences.
2. To provide learning experiences with real world problems.
3. To develop technical skills and competence in data and information acquisition, extraction, management and analysis.
4. To describe how geographical information is used, managed, and marketed globally.
5. Analyze different spatial problems in GIS environment

Course Content:

Remote-Sensing:

1. Introduction to Software layout
2. Data entry, data query, extracting information from satellite images.
3. Geocoding viz. image to image registration
4. Supervised classification
5. Unsupervised classification
6. Image correction
7. Image enhancement

GIS:

1. Introduction to Software layout, data entry and data creation
2. Georeferencing
3. Geoprocessing
4. Layout preparation

Reference Books:

1. Jensen, J.R. (2014) Remote Sensing of the Environment: An Earth Resource Perspective (Pearson New International Edition). Pearson.
2. Longley, P.A., Goodchild, M.F., Maguire, D.J., Rhind, D.W. (2015) Geographic Information Science & System (4th Ediiton). Wiley.

0532-3170: Viva Voce

Credits: 1

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.

3rd Year 2nd Semester

0532-3211: Advanced structural Geology and Tectonics

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: In this course, we will introduce the fundamental concepts and theories of tectonics. We will explore the macroscopic structure of the Earth, including the oceanic and continental crust, lithosphere, and asthenosphere, and compare their characteristics. Additionally, the course will delve into the concepts of rifting and ocean formation, as well as subduction and mantle plumes. We will provide a comprehensive description of orogenesis processes. The main objective of this course is to foster an advanced comprehension of deformation processes and structures resulting from displacement and deformation in the Earth's lithosphere, encompassing various scales from microscopic to tectonic. Moreover, the course will cover planar and linear elements and their structural coding, tectonites and fabric, criteria for determining the direction of younging, application of minor structures to major structures, mechanics of deformation in extensional, strike-slip, and contractional tectonic regimes,

stereographic projection and interpretation, stress and strain analysis, lineaments, and determination of principal stress axes through petrofabric study.

Key Learning Outcomes (ILO): By the culmination of the course, learners will-

1. possess the capacity to quantitatively assess the deformation of the earth's crust
2. entail the acquisition of skills necessary to identify and map the superimposed structures
3. develop an understanding of the significance associated with determining the face of a bed in relation to interpretation.
4. attain a comprehensive understanding of stereographic plotting and the interpretation of structural data
5. be able to provide a thorough explanation of the stress-strain relationship as it pertains to rock deformation.
6. be able to effectively describe the tectonic processes that occur at plate boundaries and the resulting effects on the interior of the plates.
7. have the ability to elucidate the primary forces that impact the Earth's surface and subsurface,
8. be able to provide a detailed description of models pertaining to the lithosphere and asthenosphere, encompassing their respective physical properties.
9. be able to apply their knowledge of tectonic processes in order to explain regional tectonic features.

Course Content:

1. Introduction to tectonics, basic concepts of tectonics and tectonic movements, tectonic theories and their evolution.
2. Crustal Types and Crustal Provinces
3. Mantle-plume Generation Mechanisms; Rifting and Drifting; Triple Junction and Hot Spots
4. Basin Formation and Subsidence Mechanism
5. Classification and Characteristics of Plate Margins; Plate Reconstruction
6. Tectonics and Magma Association; Ophiolites and Tectono-Stratigraphy.
7. Plate-tectonic Evolution of the Bay of Bengal, Indo-Burman Ranges, Bengal Basin and the Himalayas
8. concept of structural elements and its grouping, coding of structural elements, penetrative and non-penetrative structures, tectonites, fabric.
9. Top and bottom criteria
10. Minor structures (drag folds; cleavage &schistosity and lineation) and their relation to major structures
11. Mechanics of folding, relations of thrust fault with folding, stereographic projection-its principle, analysis and interpretation
12. Stress & Strain analysis
13. Lineaments
14. Petrofabric study.

Reference Books:

1. Billings, M. P. 1972. Structural geology. Prentice Hall College Div.
2. Fossen, H. 2016. Structural Geology. Prentice Hall College Division.

3. Condie, K.C. (1997) Plate Tectonics and Crustal Evolution (4th Edition). Butterworth-Heinemann
4. Schettino, A. (2015) Quantitative Plate Tectonics Physics of the Earth - Plate Kinematics – Geodynamics. Springer.
5. Kearey, P., Klepeis, K.A., Vine, F.J. (2009) Global Tectonics (3rd Edition). Wiley-Blackwell.

0532-3221: Applied Geophysics

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Students will have a better understanding that Seismic and electrical methods are geophysical techniques used to investigate subsurface structures and properties of the Earth. Both methods provide valuable information about the composition, geometry, and physical properties of the subsurface, aiding in various applications like mineral exploration, hydrocarbon exploration, engineering studies, and environmental assessments.

Intended learning outcomes (ILO):

Upon successful completion of the course, students will be able to:

1. Develop an ability to understand the principal mathematical operations of seismic data processing
2. Develop skills for geological interpretation of 2D/3D reflection data
3. Be familiar with refraction interpretation methods
4. Interpret SP, resistivity, IP and electromagnetic data

Course contents:

1. Seismic methods: An outline of seismic data processing; structural and stratigraphicinterpretation of reflection data; 2D and 3-D interpretation; refraction data reduction andprocessing; principal refraction interpretation methods; outline of MASW data analysis;specialized techniques including VSP and tomography; specialized applications of seismicsurveying.
2. Electrical methods: SP method - Interpretation of SP data; resistivity method - effects ofinhomogeneous ground, interpretation of resistivity survey data – VES and ERT; inducedpolarisation (IP) method – data interpretation; brief account of electromagnetic datainterpretation, outline of the GPR data processing and interpretation.

Reference books:

1. Clayton, C.G.; (Ed) 1983; Nuclear Geophysics. Pergamon Press, Oxford.
2. Dentith M. and Mudge S.T. 2014. Geophysics for the Mineral Exploration Geoscientist. Cambridge University Press.
3. Dobrin, M.B. and Savit, C.H. 1988; Introduction to Geophysical Prospecting. McGraw-Hill Book Co.; New York.

4. Kearey, P., Brooks, M. and Hill I., 2002, An Introduction to Geophysical Exploration (3rd ed.). Blackwell Scientific, Oxford.
5. Keller, G.V. and Frischknecht, F.C., 1966, Electrical Methods in Geophysical Prospecting; Pergamon Press, London.
6. Reynolds, J.M., 2011, An Introduction to Applied and Environmental Geophysics, John Wiley & Sons.
7. Robinson, E.S. and Coruh, C., 1988, Basic Exploration Geophysics; John Wiley & Sons, New York.
8. Sharma, P.V., 1986, Geophysical Methods in Geology; Elsevier Scientific Publishing Co., Amsterdam.
9. Sharma P.V., 1997, Environmental and engineering geophysics. Camb. Univ. Press.
10. Sheriff, R.E. and Geldart, L.P., 1995, Exploration Seismology. 2nd edition. Cambridge University Press, Cambridge.
11. Telford, W.M.; Geldart, L.P. and Sheriff, R.E., 1990, Applied Geophysics. 2nd edition. Cambridge University Press, Cambridge.
12. Selected publications.

0532-3231: Principles of Petroleum Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: The main focus of petroleum geology is that it integrates various disciplines like geophysics, geochemistry, and engineering to understand the origin, accumulation, and extraction of oil and gas resources.

Intended Learning Outcomes (ILO):

At the end of the course, the students will have knowledge about:
1. Composition and classification of petroleum
2. Formation of source rocks by accumulation and preservation of organic matter in sediments
3. Petroleum generation by maturation of source rocks
4. Petroleum migration and trapping
5. Classification of traps and how are they formed
6. Petrophysical properties of reservoir rocks and what control these properties
7. Petroleum systems of the Bengal Basin.

Course contents:

1. Introduction to petroleum geology: historical overview; occurrence of petroleum, geographical distribution, general age distribution of reservoir rocks, detailed facts world petroleum reserve,

and the importance of this course.
2. Composition of oil and gas: physical and chemical properties of petroleum compounds, distillation of crude oils, their products and applications of these fractions; classification of petroleum.
3. The subsurface environments: subsurface temperatures, basic principles of geothermal gradient; subsurface pressures: normal pressure gradient; subnormal and abnormal pressures; overpressure occurrences and implications for petroleum geology; subsurface fluid dynamics. Various types of maps and usage; isopach, isotherm, isolith, isocore, clastic ratio, palaeo-geologic etc.
4. Petroleum system: elements and processes of petroleum system, temporal and spatial aspects.
5. Source rocks: types of source rocks; production and accumulation of organic matters in sedimentary basins; diagenesis, catagenesis, and metagenesis of organic matter; maturation of organic matters and hydrocarbon formation
6. Migration of petroleum: general principles; primary migrations and secondary migration; phases and mechanisms.
7. Reservoir rocks: properties of reservoir rocks and their controlling factors; types of reservoir Rocks.
8. Traps: trapping mechanism; structural, stratigraphic and combination traps; types of seal rocks; timing of trap formation.
9. Petroleum system of Bengal Basin: tectonic settings and stratigraphy of the Bengal Basin; source and reservoir rocks; prospects of petroleum in Bangladesh; brief description of different petroleum bearing structures of Bangladesh; future challenges.

Reference books:

1. Tissot, B.P. &Welte, D.H., 1978, Petroleum Formation and Occurrence; Springer-Verlag, Heidelberg, New York.
2. Selley, R.C., 1998. Elements of Petroleum Geology (2nd ed.), Academic Press, California.
3. Bjørlykke, K., 2010. Petroleum Geoscience: From Sedimentary Environments to Rock Physics, Springer.
4. Waples, D.W., 1985. Geochemistry in Petroleum Exploration, D. Reidel Publishing Co.
5. Magoon, L.B., and Dow, W.G. (ed.), 1994. The petroleum system – from source to trap, AAPG Memoir 60.
6. North, F.K, 1990, Petroleum Geology, Unwin Hyman Inc. Winchester, USA.
7. Killops, S., Killops, V., 2005. Introduction to Organic Geochemistry (2nd Ed.). Blackwell Publishing.
8. Harries, N.B. (ed.), 2005. The deposition of organic-carbon-rich sediments: models, mechanisms, and consequences. SEPM Special Publication
9.Imam, B., 2005, Energy Resources of Bangladesh, University Grants Commission of Bangladesh, Dhaka.

0532-3241: Regional Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: from this course, regional stratigraphy gives us the view of the spatial distribution and relationships of rock strata within a region, geologists can unravel the geological history and evolution of that area over millions to billions of years.

Intended Learning Outcomes (ILO):

Upon completion of the course, the students should know
1. The major structures of the subcontinent and their tectonic settings.
2. Stratigraphic records of the subcontinent throughout the geologic history.
3. The knowledge to explain the geologic evolution of the Bengal Basin.

Course contents:

1. Tectonic setting and stratigraphy of the subcontinent in outline; Archaeozoic, Proterozoic, Mesozoic and Cenozoic stratigraphy.
2. The evolution, structure and stratigraphy of the Bengal Basin in brief.
3. A systematic study of the stratigraphy of the adjoining areas of the Bengal Basin; Assam-Meghalaya, West Bengal, Bihar, Myanmar (Burma), and Bay of Bengal.

Reference books:

1. Gansser, A., 1964, Geology of the Himalayas; International Science Publishers, London.
2. Hossain, M.S., Khan, M.S.H., Chowdhury, K.R., and Abdullah, R., 2018. Synthesis of the Tectonicand Structural Elements of the Bengal Basin. In: Mukherjee, S. (eds.) Tectonics and Structural Geology: Indian Context. 1st edition, Springer.
3. Khan, F.H., 1991, Geology of Bangladesh; The University Press Ltd., Dhaka.
4. Krishnan, M.S., 1982, Geology of India and Burma; CSB Publishers & Distributors, Delhi.
5. Kazmi, A. H. and Qasim, M,.J., 1997, Geology and Tectonics of Pakistan; Graphic Publishers, Karachi, Pakistan.
6. Kumar, R., 1986, Fundamentals of Historical Geology and Stratigraphy of India; Wiley Eastern Ltd., New Delhi.
7. Reimann, K.U., 1993, Geology of Bangladesh; GebruederBorntraeger, Berlin.
8. Wadia, D.N., 1984, Geology of India; Tata McGraw-Hill Publishing Co, Ltd., New Delhi.
9. Selected Articles.

0532-3251: Geology of Bengal Basin

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Bangladesh, located in South Asia, has a geology that is primarily characterized by its alluvial plains, deltaic formations, and sedimentary basins. The geology of Bangladesh is predominantly characterized by its alluvial plains, deltaic formations, sedimentary basins, and the influence of tectonic processes. The Ganges-Brahmaputra Delta and the associated sedimentary deposits play a crucial role in shaping the country's landscape, hydrology, and socio-economic conditions.

Intended Learning Outcomes (ILO):

Students should have good understanding on the geology of the Bengal Basin and will be able to
1. apply this knowledge in finding new discoveries of petroleum, water and Mineral resources.

Course contents:

1. Geographical and geological position of the Bengal Basin.
2. Physiography and hydrography of the Bengal Basin - major subdivisions.
3. The development of the Bengal Delta through time.
4. Stratigraphy, structure, and geological history of the Bengal Basin.
5. Relationship of the Bengal Basin with its neighbouring sedimentary basins.
6. Economic minerals and rocks of the Bengal Basin and their utilization.

Reference books:

1. Curray, J.R. & Moore, D.G., 1974, Sedimentary and Tectonic Processes in the Bengal Deep-Sea Fan and Geosyncline; In: Burke, C.A. & Drake, C.L. (eds.), The Geology of the Continental Margins, Springer-Verlag, Heidelberg, New York, p. 617-627.
2. Evans, P., 1932, Tertiary succession in Assam; Trans. Min. Geol. Inst., India, vol. 27, p. 155-260.
3. Evans, P., 1934, The Tectonic Framework of Assam; Geol. Society of India Journal, vol. 5, p. 80-86.
4. Hossain, M.S., Khan, M.S.H., Chowdhury, K.R., and Abdullah, R., 2018. Synthesis of the Tectonicand Structural Elements of the Bengal Basin. In: Mukherjee, S. (eds.) Tectonics and Structural Geology: Indian Context. 1st edition, Springer.
5. Khan, F.H., 1991, Geology of Bangladesh; The University Press Ltd., Dhaka.
6. Krishnan, M.S., 1982, Geology of India and Burma; CSB Publishers & Distributors, Delhi.
7. Reimann, K.U., 1993, Geology of Bangladesh; GebruederBorntraeger, Berlin.
8. Wadia, D.N., 1984, Geology of India; Tata McGraw-Hill Publishing Co, Ltd., New Delhi.

0532-3212: Advanced Structural &Geological map Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: This course will establish a solid foundation for the geological field mapping course. To achieve this, laboratory exercises will be employed for the purpose of quantifying and elucidating geological structures. These exercises will encompass numerical problems, calculations pertaining to thickness and depth, as well as structural analysis utilizing stereonet. Furthermore, the course will also delve into the study of tectonics and plate tectonic predicaments.

Key Learning Outcomes (ILO): By the end of the course, students will be able to-

1. Understand the 3-dimensional aspect of structural elements in complex geological set up.
2. Solve different structural and tectonic problems.
3. Determine the stratigraphic thickness and depth of the stratum in different field conditions.
4. Apply knowledge in field geology.
5. Explain the deformation process and determination of principal stress axes.
6. Recognize and classify geologic structures associated with folding and fracturing of the lithosphere.

Course Content:

1. Numerical problems
2. Thickness and Depth calculation
3. Structural analyses with stereonet
4. Problems related to tectonics, plate tectonics and Euler pole

Reference Books:

1. Billings, M. P. 1972. Structural geology. Prentice Hall College Div.
2. Ragan, D.M. 2009. Structural Geology and Introduction to Geometrical Techniques. Blackwell.
3. Rowland, S.M; Duebendorfer, E.M. and Schiefelbein, I.M. (2007) Structural Analysis and Synnthesis: A Laboratory Course in Structural mGeology (3rd Edition). Elsevier

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0532-3222: Applied Geophysics Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%]

General concept: This course has been specifically crafted to provide practical exposure to the analysis of wireline log data with the purpose of identifying lithology and estimating petrophysical characteristics. Additionally, students will be expected to interpret seismic and other geophysical data in relation to petroleum, groundwater exploration, and other mineral deposits. Furthermore, they will be required to integrate these data sets with log data in order to calculate the volumes in place.

Intended Learning Outcomes (ILO):

By the end of the course, students will be able to-

1. Perform petrophysical analysis
2. Perform log correlation, facies analysis and demarcate lithological boundaries
3. Interpret 2D/3D seismic data
4. Interpret Resistivity Profiling and Resistivity Sounding Data
5. Perform qualitative and quantitative analysis of SP, IP, EM data
6. Prepare gravity anomaly and magnetic map

Course Content:

1. Petrophysical analysis
2. Log correlation, Facies analysis
3. Seismic interpretation
4. Interpretation of resistivity data
5. Interpretation of SP, IP and EM data
6. Interpretation of gravity and magnetic data

Reference Books:

1. Badeley, M.E. (1985) Practical Seismic Interpretation. Intl Red Cross
2. Rider, M.H. & Kennedy, M. (2011) The geological interpretation of well logs (3rd Edition). Rider-French.
3. Gadallah, M.R. & Ray, F. (2009) Exploration Geophysics (1st Edition). Springer.
4. Krygowski, D. et al. (2004) Basic Well log analysis for Geologists (2nd edition). AAPG memoir 4.

0532-3262: Geological Field Mapping

Credits: 2

General concept: A seven days long field trip in the hill tracts region in Bangladesh where there are extensive exposure of Mio-Pliocene sedimentary strata. Emphasis will be on understanding and mapping large-scale geological structures such as folds, faults, and unconformity, identification and mapping of various stratigraphic formations, identification and interpretation of sedimentary structures, and deduction of processes producing those sedimentary structures.

IntendedLearning Outcomes (ILO):

By completing this course students will be a able to –

1. Locate and map geological exposure.
2. Measure bed attitude.
3. Map bed attitude data and deduce geological structure.
4. Construct geological sections at exposure scale and correlate them.
5. Prepare a complete geological map showing various structures, and stratigraphic formations.
6. Identify and differentiate between various sedimentary structures.
7. Interpret the processes responsible for producing various sedimentary structures

Course Content:

1. Preparation for field work- Expectations and reality in the field; list of field equipment, and base maps; code of conduct in the field; formation of various field committees.
2. During the field work- Visit selected areas to view the general geology and to learn field observation, documentation, and mapping skills; Mapping exercise on a microscopic scale; standards and technique for taking field notes; summarize and plot field data on the map at the end of daily field trip work.
3. After the Field, laboratory analysis of field data, completion of the geological map, and construction of geological cross section showing large-scale geological structure; writing field report.

0532-3270: Viva Voce

Credits: 1

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.

4th Year 1st Semester

0532-4111: Engineering Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This course aims to provide an introduction to the principles and concepts of Soil and Rock Mechanics. It will cover topics such as Surface and Subsurface Investigation, including methods for sampling and sampling techniques. Additionally, the course will delve into Field and Laboratory Tests used in this field of study. Furthermore, the course will explore the Geological Criteria that are essential for Site Selection in various engineering projects. These projects include Foundation Engineering, Construction Materials, River Training, Bank Protection, and Flood Control. Additionally, the course will address the Geological Considerations and Constructions that are involved in the development of Dams, Reservoirs, Tunnels, Roads, Highways, Bridges, and other Critical Facilities.

Intended Learning Outcomes (ILO): By the end of the course, students will be able to-

1. Explain Soil and Rock Mechanics
2. Discuss Surface and Subsurface Investigation
3. Describe Sampling and Sampling Methods
4. Differentiate Field and Laboratory Tests
5. Describe the Geological Criteria for Site Selection
6. Explain the Basic Principles of Foundation Engineering
7. Describe selection of Construction Materials
8. Describe River Training, Bank Protection and Flood Control
9. Explain Geological Considerations and Constructions of Dams and Reservoirs
10. Explain Tunnel, Roads, Highways, Bridge, and other Critical Facilities
11. Geologic Hazards in Engineering

Course Content:

1. Soil and Rock Mechanics
2. Surface and Subsurface Investigation
3. Sampling and Sampling Methods
4. Field and Laboratory Tests
5. Geological Criteria for Site Selection
6. Basic Principles of Foundation Engineering
7. Selection of Construction Materials
8. River Training, Bank Protection and Flood Control
9. Geological Considerations and Constructions of Dams and Reservoirs
10. Tunnel, Roads, Highways, Bridge, and other Critical Facilities

11. Geologic Hazards in Engineering

Reference Books:

1. Das (1983) Introduction to Soil Mechanics.
2. Bowles, J.E. (1988) Foundation Analysis and Design (4th Ed.) McGraw Hill, N.Y.
3. Blyth, F.G.H. & De Freites, M.H., 1974, Geology for Engineers; Edward Arnold, London

0532-4121: Petroleum Geology, Drilling and well logging

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This field of study involves the application of geological principles and techniques to locate, evaluate, and manage hydrocarbon deposits.Drilling and well logging are fundamental activities in the field of geology, especially in the exploration and production of hydrocarbons (oil and gas). As a geology student, understanding these concepts and techniques will be essential if you plan to work in the energy sector or related fields.

Key learning outcomes: (ILO)

This course provides a well understanding of basic concepts of-

1. Petroleum system and petroleum fields are on the verge of an energy crisis situation around the world.
2. Source rock, seal rock and trap to design a real life petroleum field.
3. Conventional and unconventional resources, resources management.
4. Petroleum recovery in an economically viable way.
5. Meaningful contributions to the energy industry, environmental stewardship, technological innovation, and global economic development.
6. Bangladesh petroleum system and future petroleum extraction.
7. Well-positioned to address current and future challenges, shaping the future of the oil and gas sector and related industries.
8. drilling process, technology, drilling tools and methodology of drilling for complete a well as well as the basic layout of well logs and their principal's and uses,
9. role of borehole measurements in the search for and evaluation of hydrocarbon reservoirs and a number of measurement methods,
10. overall drilling processes and to make simple interpretations of the more common log measurements that are made in a borehole.
11. able to determine the main lithologies and estimates of porosity, saturation and permeability, and which fluid types, water, oil or gas, are present in the formations.

Course contents:

1. Introduction (petroleum generation, migration and accumulation)
2. Source rock evaluation

3. Reservoir characterization
4. Petroleum production methods and enhanced recovery
5. Petroleum alteration
6. Petroleum resources
7. Prospects evaluation
8. Nonconventional petroleum resources
9. Introduction to well drilling: Overview of drilling, types of drilling, drilling equipment.
10. Rotary drilling: Methods, process, equipment.
11. Drilling fluids: Types, uses.
12. Mud logging: Introduction, tools.
13. Directional drilling: Process and uses.
14. Cementation and casing: Methods and equipment.
15. Formation pore pressure and fracture resistance.
16. Introduction to well logging: Types, petroleum and water location, types and their uses.
17. Logging environment: Pressure environment, temperature environment and tool capabilities.
18. Well logs: Theoretical considerations, tools, log characteristics and uses of caliper, temperature, self-potential, resistivity, natural gamma, sonic, density, neutron and image castel log, logs, principle of NMR log.

Reference books:

1. Tissot, B.P. &Welte, D.H., 1978, Petroleum Formation and Occurrence; Springer-Verlag,Heidelberg, New York.
2. Selley, R.C., 1998. Elements of Petroleum Geology (2nd ed.), Academic Press, California.
3. Bjørlykke, K., 2010. Petroleum Geoscience: From Sedimentary Environments to Rock Physics, Springer.
4. Waples, D.W., 1985. Geochemistry in Petroleum Exploration, D. Reidel Publishing Co.
5.Adam, T., Chenevert, M. E., Millheim, K. K. and Young Jr, F. S. 1991; Applied Drilling Engineering; SPE Textbook Series, Vol.2, USA.
6. Asquith, G. and Gibson, C., 1982, Basic Well Log Analysis for Geologists; Methods in Exploration Series 216, American Association of Petroleum Geologists, Tulsa, Oklahoma.
7. George Asquith, G. and Rygowski, D., 2006. Basic Well Log Analysis (2nd ed.), AAPG Methods in Exploration Series, No. 16
8. Rider Malcolm. 1996. The geological interpretation of well logs. Second edition, Whittles Publishing, Caithness.
9. Schlumberger, 1972, Log Interpretation, I Principles; Schlumberger Publications.
10. Schlumberger, 1974, Log Interpretation, II Application; Schlumberger Publications.
11.Selly, R. C., 1998; Elements of Petroleum Geology; Academic Press, London.
12. Western Atlas, 1995; Introduction to wire line log analysis, Texas, USA

0532-4131: Advanced Sedimentology& Sequence Stratigraphy

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: This particular course focuses on the study of sediments (particles that accumulate on the Earth's surface) and the processes that lead to their deposition and subsequent transformation into sedimentary rocks.

Intended Learning Outcomes (ILO):

The main course objective is to understand process sedimentology and depositional environments in continental to marine settings. Students should develop an understanding for sedimentary processes responsible for the deposition of sediments and sedimentary rocks in various sedimentary environments based on sedimentary facies and sedimentary genetic sequences.

Course contents:

1. Introduction: Historical developments and applications.
2. Origin of sediments: Overview.
3. Depositional processes and environments. Concept of sedimentary facies and facies associations. Interpretation of facies successions and development of facies models.
4. Sedimentary processes, facies characterization and economic significance of siliciclastic depositional environments; alluvial fans, rivers, deltas, estuaries, lakes, shallow marine shelves, marines, deserts.
5. Biological, chemical and physical controls on carbonate deposition; composition and classification of carbonate sediments, facies architecture and development of carbonate rimmed shelves, ramps and reefs.
6. Description and interpretation of sedimentary materials and rocks in outcrop and under the microscope.
7. Sedimentary Basins.
8. Sequence stratigraphy.

Reference books:

1. Boggs, S.JR. 2004, Principles of Sedimentology and Stratigraphy; Prentice Hall, New Jersey.
2. Emery, D. & Myers, K., 1996, Sequence Stratigraphy; Blackwell Science, London.
3. Friedman, G.M. & Sanders, J.E., 1978, Principles of Sedimentology; John Wiley & Sons, Inc., New York.
4. Leeder, M.R., 1982, Sedimentology, Process and Product; Blackwell, London.
5. Miall, A.D. 1990; Principles of Sedimentary Basin Analysis; Springer-Verlag, London.
6. Miall, A.D., 1997. The Geology of stratigraphic Sequences; Springer-Verlag, Berlin.
7. Nicols, G., 1999, Sedimentology and Stratigraphy; Princeton Hall.
8. Pettijohn, Potter &Siever, 1987, Sands and Sandstones; Springer-Verlag.
9. Prothero, D. R. and Schwab, F., 2014. Sedimentary Geology: An introduction to sedimentary

rocks and stratigraphy, 3rd Edition, W. H. Freeman and Company
10. Reading, H.G., 1996, Sedimentary Environments: Process, Facies and Stratigraphy; Blackwell Scientific Publication, Oxford.
11. Reineck, H.E. & Singh, T.B., 1980, Depositional Sedimentary Environment; Springer-Verlag, Heidelberg, New York.
12. Shelly, R.C., 2000, Applied Sedimentology; Academic Press, London.
13. Tucker, 1988, Techniques in Sedimentology.
14. Tucker, M.E., 2003, Sedimentary Petrology; Blackwell Publishing.
15. Walker, R.G. & James, N.P. 1992; Facies Models: Response to sea-level Change; Geological Association of Canada.

0532-4141: Environmental Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Through the completion of this course, individuals who have obtained a degree will be equipped with the necessary skills to pursue various employment opportunities that pertain to the examination of the environmental consequences resulting from geological phenomena and human actions on our planet. These employment prospects may involve the analysis and resolution of concerns related to the management of environmental and natural resources, adherence to regulatory agency guidelines, the identification and mitigation of hazards, as well as the undertaking of fundamental scientific inquiries that possess the potential to inform policies regarding natural resource utilization and facilitate the implementation of responsible Earth resource.

Key Learning Outcomes (ILO): At the culmination of the course, the students will-

1. acquire a comprehensive understanding of the foundational principles underlying the environment, encompassing the concepts of environmental systems and the constituent elements thereof.
2. familiarize themselves with the intricacies of environmental pollution, the techniques employed for its control, and the management strategies required for its amelioration.
3. gain insight into the various environmental problems.
4. study the methods to prevent, mitigate, and regulate environmental issues.
5. equip with the necessary skills to prepare an assessment report on environmental problems, enabling them to effectively disseminate their knowledge to policymakers and contribute to the advancement of the nation.

Course Content:

1. Introduction to Environmental Geology
2. Hazardous Earth Processes and their Characteristics- Flood; Landslide; Earthquake; Volcanism; Coastal Hazards.
3. Hazard Mitigation and Management
4. Environmental Pollution and management

5. Waste Disposal and management
6. Geological Aspects of Environmental Health.
7. Environmental Impacts assessment;
8. Land use and Planning
9. Environmental Laws
10. Environmental Conservation

Reference Books:

1. Montgomery, C.W. (1992) Environmental Geology (3rd Edition). W. C. Brown Publisher.
2. Keller, E.A. (1992) Environmental Geology (6th Edition). C.E. Merrill Publication Co.
3. Patniaik, L.N. (1990) Environmental Impacts of Industrial and Mining Activities. Ashish Publishing House.
4. Howard, Arthur D, &Remson, I. (1978) Geology in Environmental Planning. McGrow Hill Inc.

0532-4151: Geo-Resources of Bangladesh & subcontinent

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%

General concept: This course has been developed with the intention of providing scientific and technical expertise regarding the distribution, occurrence, stratigraphy, reserves, exploration, and production/mining of various mineral and energy resources found in Bangladesh and the Subcontinent. The primary objective of this course is to familiarize students with the utilization of petroleum, coal, ore deposits, placer, hard rock glass sand, limestone, china clay, and other economically valuable mineral deposits within the industries and infrastructure development of Bangladesh and the Subcontinent.

Intended Learning Outcomes (ILO):

By the conclusion of the course, the participants will-

1. possess the capability to introduce and acquaint themselves with the mineral and energy resources of Bangladesh and the subcontinent.
2. Elucidate the disparities between non-renewable and renewable energy sources.
3. Elaborate upon the instances, distribution, stratigraphic correlation, reserves, and applications of mineral deposits.
4. Comprehend the geological aspects and reserves of gas, oil, and coal fields, as well as their potential in ameliorating the energy predicament of Bangladesh and the subcontinent.

Course Content:

1. Introduction to mineral and energy resources of Bangladesh and Subcontinent
2. Petroleum resources of Bangladesh and subcontinents
3. Coal deposits of Bangladesh and subcontinents
4. Solar, wind, biomass and water resources in Bangladesh
5. Hard rock, Limestone, placer, china clay and glass sand deposits in Bangladesh
6. Iron, Aluminium and Copper ore deposits of India.

Reference Books:

1. Imam, B (2005) Energy Resources of Bangladesh - Natural Gas, Oil and Coal. University Grants Commission of Bangladesh.
2. Racey, A. &Ridd, M.F. (2015) Petroleum Geology of Myanmar. Geological Society of London.
3. Tyner, W.E. (2012) Energy resources and economic development in India. Springer Science & Business Media.

0532-4161: Mining geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Mining is a fundamental concept within the realm of geology, and it's essential for geology students to grasp its basic principles. Geology students studying mining gain insights into Earth's resources, exploration techniques, extraction methods, and the broader implications of mineral extraction on society and the environment.

Intended Learning Outcomes (ILO):

The course is intended to introduce the students with the-

1. Various geological, geophysical and geochemical surveys & techniques applied for prospecting,
2. Exploration and discovery of mineral and ore deposits; classification of mineral deposits based on exploration results; evidences / signatures of surface and subsurface ore bodies;
3. Sampling techniques, drilling and logging; surface and
4. Underground mining methods, mining and its consequences in particular coal mining;
5. Mine development, mine anatomy and mine safety.
6. They would also learn about the mining methods and how to select the suitable mining method to extract and develop mineral resources.

Course contents:

1. Search for mineral deposits: geological backgrounds; prospecting criteria and guides; search for minerals.
2. Procedures employed in prospecting and exploration works: Prospecting and exploration, Coal exploration, objectives of prospecting, feasibility study.
3. Sampling: sampling methods.
4. Estimation of reserves; grouping of deposits.
5. Prospecting and exploration techniques; drilling equipment for exploration.
6. General information: Historical background of mining. Mining in Bangladesh.

7. Open-cut and underground mining: workable reserve for mining; conditions for open-cut and underground mining; types of open-cut mining machinery; bench mining.
8. Opening up of mineral deposits; mine entry; choice of shaft site; shaft sinking; shaft sinking by freezing; sinking vertical shafts by grouting; driving roadways; mine machinery.
9. Rock pressure; physical and mechanical properties of rocks; rock pressure in horizontal roadway and vertical shafts; effects of underground works on the surface; support for underground working.
10. Methods of mining coal seams; Longwall mining; Room method; Room and Pillar method; working thick coal seams.
11. Methods of working ore deposits; general classification of metal mining methods; stopping; use of explosives in mining; Firing methods; charging and firing holes etc.
12. Mine ventilation; mine air; underground ventilation; mine safety issues; environmental impacts of mining.
13. Mine in Bangladesh- Barapukuria coal mine and Madhyapara hard rock mine.

Reference books:

1. Beavis, F.C., 1993; Engineering Geology. Blackwell Scientific Publications, London.
2. Bell, F.G., 1969; Engineering Geology. Blackwell Scientific Publications, London.
3. Berkman, D.A., 1995. Field Geologist's Manual, Australian Institute of Mining and Metallurgy.
4. Boky, B.; 1980; Mining. Mir Publisher; Moscow.
5. Evans, A. M., 1993. Ore Geology and Industrial Minerals, an Introduction; Blackwell Science, Third Edition.
6. Kreiter, V.M., 1968, Geological Prospecting and Exploration; Mir Publishers, Moscow.
7. Maximov, A., Miloserdina, G &Eremin, N., 1973, Short Course of Geological Prospecting and Exploration; Mir Publishers, Moscow.
8. Moririott, R.D.; 1986; Coal Exploration Mine Planning and Development. Noyes Publications, New Jersey, USA.
9. Peele, R., 1969; Mining Engineer's Handbook. Wiley Eastern Pvt. Ltd. New Delhi.
10. Peters, 1996, Exploration and Mining Geology; John Wiley and Sons, 2nd Ed.
11. Hartman, H. L. and Mutmansky, J. M., 2002; Wiley India, 2nd Ed.

0532-4112: Engineering Geology Lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%

General concept: This laboratory course serves as a supplementary component to the study of Engineering Geology. The utilization of geologic data and principles, in conjunction with engineering principles and techniques, enables the examination and manipulation of rock and soil surface materials, as well as groundwater. This aspect is crucial for the appropriate identification, planning, design, construction, operation, and maintenance of engineered structures.

Intended Learning Outcomes(ILO):

By completing this course students will be a able to –

1. Calculate the bulk properties of rocks and unconsolidated sediments such as density, void ratio, water contents, and unit weights.
2. Perform a grain-size analysis, determine plastic and liquid limits, and classify soils using the Unified Soil Classification System
3. Calculate soil consolidation magnitudes and rates under induced stress conditions
4. Determine soil strength parameters from in situ tests.

Course Content:

1. Calculation of the bulk properties of rocks and unconsolidated sediments such as density, void ratio, water contents, and unit weights
2. Grain-size analysis, determine plastic and liquid limits, and classify soils using the Unified Soil Classification System
3. Calculation of soil consolidation magnitudes and rates under induced stress conditions
4. Determination of soil strength parameters from in situ tests.

Reference Books:

1. Bell, F.G. (2007) Engineering Geology (2nd Edition). Butterworth-Heinemann.
2. Graig R.F. (2004) Soil Mechanics (7th Edition). CRC Press.
3. Bowles, J.E. (1988) Foundation Analysis and Design (4th Edition). McGraw Hill.

0532-4122: Petroleum geology lab

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 30%, Exam: 60%

General concept: For exploration and production of petroleum from subsurface, it is necessary to apply both theoretical and practical knowledge. Very simple techniques and exercises are helpful in discovering the petroleum reservoir as well as in successful production of petroleum. Thus this course is designed to learn how tools of petroleum geology with structural geology, sedimentology and stratigraphy can be applied to identify the traps, reservoir rocks and their petrophysical properties, timing of petroleum migration and maturation level of source rocks.

Intended Learning Outcomes (ILO):

After completion of the course, the student will able to:
1. Construct burial graphs and perform maturity calculations.
2. Evaluate the porosity and permeability of reservoir rocks based on core and microscope analysis of thin sections.
3. Identify the petroleum system, play and prospect of a sedimentary basin.

4. Evaluate the petroleum accumulations at prospect and play levels and calculate the petroleum reserves before production and also at different levels of production.

Course contents:

1. Basin mapping methods: stratigraphic cross sections, fence diagram, various types of maps (isopach, isotherm, isolith, isocore, clastic ratio, palaeo-geologic etc).
2. Predicting thermal maturity: burial history curve, temperature history curve, time-temperature index (TTI).
3. Petrophysical properties of reservoir rocks: porosity and permeability measurements from core, thin sections and wireline logs.
4. Petroleum reserve calculations: volumetric, material balance, and decline curve analysis.
5. Determination and interpretation of composition of crude oils from chromatogram.
6. Interpretation of geophysical well logs: gamma ray log, porosity logs (sonic, density, neutron and combination neutron-density logs).
7. Construction of subsurface contour maps and interpretation.
8. Preparation of stratigraphic cross sections, panel diagram. Structure contour maps; isopach maps; facies maps; palaeo-geographic maps from geophysical and drilling data.
9. Problems related to petroleum geology.
10. Chemical analysis of limestone, coal and peat.
11. Geochemical data analysis.

0532-4170: Viva Voce

Credits: 1

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.

4th Year 2nd Semester

0532-4211: Planetary Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: For geology students, understanding planetary geology can provide insights into the evolution of planets and moons, the processes that shape their surfaces, and the potential for past or present geological activity.

Intended Learning Outcomes (ILO):

After completing this particular course, students of geology will make a clear understanding on-
1. A fascinating exploration of the geologic processes, features, and histories of celestial bodies beyond Earth.
2. A broader perspective on the principles of geology and the unique challenges and discoveries associated with planetary exploration.
3. A natural and physical phenomenon observed on and from the Earth such as tides, eclipses, the aurora, and meteorites.
4. A natural and physical phenomenon as pertinent to the orbital motion and characteristics of planets and moons in our solar system.
5. Scientific methods and processes applied in the field of planetary astronomy.

Course contents:

1. The Universe: suns, galaxies and the origin of the elements: stellar evolution and the origin of the chemical elements; the origin of galaxies; large-scale structure in the universe; birth, life and death of the stars.
2. The planets: jovian and terrestrial planets.
3. Evolution, constitution and geology of terrestrial planets; Earth, Mercury, Venus, Mars and their Moons.
4. Other objects in the universe.
5. Occurrence of life in the universe.
6. Exploration in space: observatory, optical telescope, spacecraft, satellites.

Reference books:

1. Buti, B., 1988; Cometary and Solar Plasma Physics. World Scientific, Singapore.
2. Chaisson, E. and McMillan, S., 2014. Astronomy Today: The Solar System. 8th ed. Pearson Addison-Wesley.
3. Encrenaz, T. &Bibring, J.-P., 1995. The solar system; Springer-Verlag, Heidelberg.
4. Gore, P., 2014. Historical Geology Lab Manual, Wiley & Sons, Inc.

5. Gornitz, V., 1979; Geology of the Planet Mars. Dowen, Hutchinson & Ross Inc. Stroudsburg, Pennsylvania.
6. Kennel, C.F., Lanzerotti, L.J. & Parker, E.N., 1979; Solar Plasma Physics (vol. I); Solar and Solar Wind Plasma Physics (vol. II): Magnetospheres. North Holland Publishing Company, Amsterdam.
7. King, E.A., 1976, Space Geology: An Introduction; John Wiley & Sons, Inc., New York.
8. Skinners, B.J., 1981; The Solar System and Its Strange Objects. Willian Kaufmann Inc. Los Altos, California.
9. Vita-Finzi, and Fortes, D., 2013, Planetary Geology: An Introduction, Dunedin, London.
10. Vorontsov-Vel'yaminov, B.A., 1985; Essays about the Universe. Mir Publishers, Moscow.
11. Planetary Geology- An Introduction, Claudio and A. Dominic Fortes. Second edition Edinburgh, London.

0532-4221: Sustainable Energy & Resource management

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%]

General concept: Sustainable Resource Management addresses the safeguarding of all natural resources. By enrolling in this course, students will acquire knowledge about diverse natural resources, the challenges in managing them, and the optimal strategies to conserve and protect these resources. Discussions will encompass multiple sectors that contribute to the exploitation and preservation of natural resources, such as the influence of social systems on the environment, the interaction between individuals and organizations with natural resources, the impact of values on people's perception of the environment, and the variations in societies' treatment of it. In this course, students will learn about the Bangladesh Delta Plan (BDP) 2100 which is a long term integrated techno-economic mega plan that integrates all delta-related sector plans and policies, enveloping a Delta Vision and strategies that make it possible to integrate sector plans and policies for the long term and to present actionable interventions with a roadmap for realization.

Intended Learning Outcomes (ILO):

By completing this course students will be a able to -

1. Describe issues concerning the availability and sustainability of resources
2. Recognise theories, paradigms, concepts, and principles in resources management
3. Recognise the moral and ethical issues of investigations and appreciating the need for professional codes of conduct
4. Plan and conduct environmental investigations including the use of secondary data and and reporting the results of such investigation
5. Collect, record and analyze data using appropriate techniques in the field and in the laboratory.
6. Learn plans to protect the country from flooding, mitigate the impact of extreme weather events, and secure supplies of freshwater.

Course Content:

1. Natural Resources - Traits, Management and Theory of Sustainability
2. Principles of natural Resource Conservation and Management
3. Environmental and natural resource economics & Policy
4. Renewable energy Technologies
5. Sustainability Solutions: Urbanization and Land Management; Problems and Management of - Mineral, Energy, Soil, Water; Climate Changes and Natural Resources Management.
6. Bangladesh Delta Plan 2100- Analytical framework, opportunities, challenges

Reference Books:

1. ChaudheryMustansar Hussain, Juan F. Velasco-Munoz, Sustainable Resource Management Modern Approaches and Contexts,1st Edition - June 20, 2021
2. Selected Journal articles.

0532-4231: Mine design & Application

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%

General concept: For geology students, understanding the concepts and applications of mine design provides valuable insights into the practical aspects of mineral exploration and extraction. Mine design is a multidisciplinary field that integrates geological knowledge with engineering principles to ensure efficient, safe, and environmentally sustainable mining operations.

Intended Learning Outcomes (ILO):

After this course, students of geology will get a clear concept on-
1. Understanding the principles and applications of mine design is essential as it bridges the gap between geological exploration and practical mining operations.
2. A holistic learning experience that integrates theoretical knowledge with practical skills, preparing them for careers in the mining industry or further academic pursuits in related fields.
3. Evaluation and incorporating environmental considerations into their mine design, such as waste management, water management, and reclamation plans.
4. Economic evaluations of mining projects, including cost estimation, financial modeling, risk assessment, and feasibility analysis.
5. Understand the importance of safety in mining operations and learn how to identify, assess, and manage risks associated with mining activities.

Course contents:

1. Introduction to Mining Engineering
2. Mineral Deposits and Exploration
3. Mine Planning and Design Fundamentals
4. Geotechnical Considerations

5. Mine Ventilation and Safety
6. Surface and Underground Mine Design
7. Mineral Processing and Extraction Methods
8. Mine Economics and Financial Analysis
9. Case Studies and Real-world Applications

Reference books:

1. Beavis, F.C., 1993; Engineering Geology. Blackwell Scientific Publications, London.
2. Bell, F.G., 1969; Engineering Geology. Blackwell Scientific Publications, London.
3. Berkman, D.A., 1995. Field Geologist's Manual, Australian Institute of Mining and Metallurgy.
4. Boky, B.; 1980; Mining. Mir Publisher; Moscow.
5. Evans, A. M., 1993. Ore Geology and Industrial Minerals, an Introduction; Blackwell Science, Third Edition.
6. Kreiter, V.M., 1968, Geological Prospecting and Exploration; Mir Publishers, Moscow.
7. Maximov, A., Miloserdina, G &Eremin, N., 1973, Short Course of Geological Prospecting and Exploration; Mir Publishers, Moscow.
8. Moririott, R.D.; 1986; Coal Exploration Mine Planning and Development. Noyes Publications, New Jersey, USA.
9. Peele, R., 1969; Mining Engineer's Handbook. Wiley Eastern Pvt. Ltd. New Delhi.
10. Peters, 1996, Exploration and Mining Geology; John Wiley and Sons, 2nd Ed.
11. Hartman, H. L. and Mutmansky, J. M., 2002; Wiley India, 2nd Ed.

0532-4241: Geomorphologyand Coastal Geology

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%

General concept: This course is dedicated to quantitative inquiries into the genesis and development of coastal landforms, as well as the physical mechanisms accountable for their formation and alteration. The subsequent subject matters will be addressed: categorization of coastal land features based on their geomorphology, characterization and examination of sediments, fluctuations in sea levels during the Quaternary period, coastal assets, risks associated with coastal areas, and management of coastal zones.

Intended Learning Outcomes (ILO):

Upon successful completion of this course, students will acquire the ability to:

a. Articulate the characteristics of coastal morphology and coastal zonation.

b. Identify and comprehend the impact of coastal processes on the formation of coastal landforms.

c. Calculate the sediment budget and measure erosion and accretion rates in the coastal regions of Bangladesh.

d. Examine and comprehend the influence of fluctuations in sea level on coastal morphology.

e. Assess and effectively manage the hazards associated with coastal resources in Bangladesh.

Course Content:

1. Coastal zone of Bangladesh.
2. Estuaries: Physicochemical characteristics and processes
3. Coastal processes
4. Understanding the past and current sea level changes- climate change and sea level rise in Bangladesh; Quaternary sea-level changes along the Coastal Belt of the Bay of Bengal development of Bangladesh coastline.
5. Coastal resources of Bangladesh: mineral resources; fisheries; tourism; forestry.
6. Coastal Hazards and pollution in Bangladesh: natural hazards (cyclone, storm surges, coastal erosion, subsidence and flooding, sea water encroachment), anthropogenic hazards & pollution; vulnerability of Bangladesh coastal area to global warming and sea level rise.
7. Coastal zone management: Conservation, management and adaptation to coastal environment (structural and non-structural measures); coastal zone policy; Assessment and Management Coastal Ecosystem; Land Use Change and Coastal Management; Guidelines for coast development and management, Coast protection– multi structure, beach nourishment, groans, coastal embankment etc, their problems and remedies.

Reference Books:

1. Paul, B. & Rashid, H. (2016) Climatic Hazards in Coastal Bangladesh: Non-Structural and Structural Solutions. Elsevier.
2. Masselink, G., Hughes, M. G. and Knight, J. (2014) Introduction to Coastal Processes and Geomorphology. Routledge.
3. Ramanathan, A. L., Bhattacharya, P., Dittmar, T., Bala Krishna Prasad, M., Neupane, B. R. (Eds.) (2010)
4. Management and Sustainable Development of Coastal Zone Environments. Springer Science

0532-4251: Geotechnical Engineering

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%

General concept: For geology students, understanding geotechnical engineering offers a practical application of geological principles in civil engineering projects. While geologists focus on understanding Earth's materials, history, and processes, geotechnical engineers apply this knowledge to design safe and sustainable infrastructure.

Intended Learning outcomes (ILO):

Finally, this course will help students understand on-

1. Knowledge about the classification, physical properties, and behavior of soils and rocks, including their strength, compressibility, permeability, and other engineering properties.
2. How investigation methods are applied to assess subsurface conditions and geological hazards.
3. Principles behind designing foundations for structures based on soil and rock properties.
4. Factors influencing slope stability, methods for analyzing slope stability, and measures for stabilizing slopes against failures like landslides.
5. Assessing natural hazards such as earthquakes, floods, and tsunamis.
6. Evaluating and managing geotechnical risks associated with engineering projects.
7. Importance of interdisciplinary teamwork and communication in addressing complex geotechnical challenges.

Course contents:

1. Description & Classification of soil and rock samples for engineering purposes, weathering description and classification of soils and rocks.
2. Subsurface investigation methods: Boring and different sampling techniques, boring and different prospecting tools, logging soils on sites, ground water information, undisturbed and reconstituted sample collection and preparation for engineering and environmental works.
3. Consolidation: General, theory of consolidation, one dimensional and isotropic consolidation, consolidation parameters, preconsolidation pressures and over consolidation ratio.
4. Mechanical behavior of soils: Undrained mechanical behavior of soils, stress strain, stress paths, pore water pressure change in normally consolidated and over consolidated soils, drained mechanical behavior of soils; stress strain, stress paths, volumetric strain in normally and over consolidated soils.
5. Mechanical behavior of rocks: Stress strain, modulus of rigidity, poisson's ratio.
6.Basics of unsaturated soil mechanics. Tropical soil engineering: General, classification, weathering and bonding in tropical soils, engineering implications of bonding.
7.Applications of geology in engineering works: Geological investigations on a Dam: Definition, types and geological investigations. Tunnels: Definition, methods of tunneling, geological investigation of tunnel sites.
8. Slopes: Stability of slope, slope failures in soils, methods of slope stability analysis, factor of safety and calculation using different methods.

Reference books:

1. Abdel-Aziz, I.K., 1986, Groundwater Engineering. McGraw-Hill Book Co.
2. Atkinson, J.H., 1993, The mechanics of soils and foundations, McGraw and Hill book Company, England.
3. Atkinson, J.H. &Bransby, P.L., 1978. The mechanics of soils, McGraw and Hill book company Ltd. England.
4. Blyth, F.G.H. & De Freites, M.H., 1974, Geology for Engineers; Edward Arnold, London.
5. Capper, P.L., Cassie, W.F. and Geddes, J.D., 1980, Problems in Engineering Soils. E and F. N. Spon. Ltd., London, New York.
6. Craig, R.F., 1990; Soil Mechanics. Van Nostrand, London.
7. GEOTECHNICAL CONTROL OFFICE, 1980; Guide to Site Investigation. Geoguide, Hong Kong.
8. Griffith, D.H. and King, R.F., 1981; Applied Geophysics for Engineers and Geologists. Pergamon Press, London.
9. Johnson, R.B., 1988; Principles of Engineering Geology. John Wiley and Sons Inc. New York.

10. Lambe, T.W. & Whitman, R.V. 1969 & 2000. Soil Mechanics, John Wiley & Sons, New York.
11. Mitchell, J.K., 1979; Fundamentals of Soil Behavior. John Wiley and Sons Inc. New York.
12. Quarterly Journal of Engineering Geology, 1988; Engineering Geophysics. Geological Society Engineering Group Working Party Report. Vol. 21, London.
13. Schultz, J.R. & Cleaves, A.S., 1974, Geology in Engineering; John Wiley & Sons, Inc., New York.
14. Smith, G.N., 1990; Elements of Soil Mechanics. BSP, London.
15. Teraghi, K. and Peck, R.B., 1967; Soil Mechanics in Engineering Practice. John Wiley & Sons Inc. New York.

0532-4261: Geohazards and waste management

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%

General Concept: Geohazards refer to natural processes or phenomena that have the potential to cause harm or damage to human life, property, and the environment. These hazards can include earthquakes, volcanic eruptions, landslides, tsunamis, floods, and sinkholes, among others.Effective waste management is crucial for minimizing environmental pollution, protecting public health, and conserving natural resources. It involves the collection, transportation, processing, recycling, and disposal of waste materials in a way that is environmentally sustainable and socially responsible.

In the context of geohazards, waste management becomes even more critical because improper disposal of waste can exacerbate the impacts of natural disasters. For example, poorly managed landfills can contaminate groundwater and increase the risk of landslides during heavy rainfall. Similarly, hazardous materials stored in inadequate facilities can pose significant risks during earthquakes or other geohazard events.

Key Learning Outcome (ILO): The candidate can:

1. Identify sources of uncertainties in a given geotechnical problem, define relevant and critical failure modes or unwanted events
2. Assess probability of occurrence
3. Plan and perform reliability/risk analyses
4. Calculate/predict consequences
5. Make decisions based on reliability analyses
6. Recommend actions for risk reduction and/or risk mitigation.

Course content:

1. Terminology used in risk assessment
2. A brief insight into various geohazards landslide types, debris flow, rock fall, flood, tsunamis, earthquake, mass wasting
3. Identification of sources and types of uncertainties in problems related to geohazards
4. Methods for prevention and mitigation of geohazards
5. Land subsidence
6. Waste management: nuclear waste, brick field waste, coal based power plant waste, medical waste, petrochemical waste, ship breaking waste etc.

0532-4271: Research Methodology & Scientific Writing

Credits: 2, contact hours/weeks: 2

Marks: 100 [Attendance: 10%, Continuous Assessment: 20%, Exam: 70%

General concept: This course is comprised of two components. The initial component will serve to acquaint students with the notion of research and prevalent research methodologies across various domains within the field of earth sciences. Students will be tasked with crafting research projects, identifying necessary data, and devising methodologies for the collection, analysis, and interpretation of said data. In the subsequent component, the course will place a strong emphasis on the process of composing research articles, scientific reports, and theses. Deliberations will also be held regarding research ethics and the issue of plagiarism.

Key Learning Outcomes (ILO): By completing this course students will be a able to -

1. Describe and compare the major quantitative and qualitative research methods in earth sciences
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner
6. Write a research article & report

Course Content:

1. Introduction to research and research methodology.
2. Survey and Designing the Sample: Planning of survey, Survey methods, Survey guidelines, Reducing Sources of Error in Sampling and Data Collection, Data Coding, Data-File Construction, Reliability and validity
3. Data analysis and interpretation
4. Introduction to the formats of scientific articles, reports, and thesis
5. Literature review techniques and procedure
6. Ethical issues related to publishing, Plagiarism and Self-Plagiarism; Software for detection of Plagiarism
7. Writing a literature based scientific article

Reference Books:

1. Cargill, M. & O'Connor, P. (2009) Writing Scientific Research Articles: Strategy and Steps. Wiley.
2. Walliman, N. (2011) Research Methods - The Basics. Routledge.
3. Kumar R. (2010) Research Methodology: A Step-by-Step Guide for Beginners (3rd Edition). SAGE Publications Ltd.
4. Kothari, C R (2004) Research Methodology: Methods and Techniques (2nd Edition). New Age International.
5. Katz M.Z. (2006) From research to manuscript: A guide to scientific writing. Springer.

6. Day, R.A. &Gastel, B. (2006) How to write and publish a scientific paper. Cambridge University Press.

0532-4212: Project work

Credits: 2

Marks: 100 [Internal evaluation: 20%, Report: 50%, Presentation & Oral Examination: 30%]

The internship is an activity that allows students to acquire the credits required in the program's study Plan and is also an opportunity to gain practical skills as well as encourage their first experience in the working world from various geological organizations such as: BAPEX, GSB, BORI, AEC etc.

0532-4282: Geological Field Mapping

Credits: 2

General concept: 14 days long field trip in the hill tracts region in Bangladesh where there are extensive exposure of Mio-Pliocene sedimentary strata. Emphasis will be on understanding and mapping large-scale geological structures such as folds, faults, and unconformity, identification and mapping of various stratigraphic formations, identification and interpretation of sedimentary structures, and deduction of processes producing those sedimentary structures.

Intended Learning Outcomes (ILO):

By completing this course students will be a able to –

1. Locate and map geological exposure.
2. Measure bed attitude.
3. Map bed attitude data and deduce geological structure.
4. Construct geological sections at exposure scale and correlate them.
5. Prepare a complete geological map showing various structures, and stratigraphic formations.
6. Identify and differentiate between various sedimentary structures.
7. Interpret the processes responsible for producing various sedimentary structures

Course Content:

1. Preparation for field work- Expectations and reality in the field; list of field equipment, and base maps; code of conduct in the field; formation of various field committees.
2. During the field work- Visit selected areas to view the general geology and to learn field observation, documentation, and mapping skills; Mapping exercise on a microscopic scale; standards and technique for taking field notes; summarize and plot field data on the map at the end of daily field trip work.
3. After the Field, laboratory analysis of field data, completion of the geological map, and construction of geological cross section showing large-scale geological structure; writing field report.

0532-4290: Viva Voce

Credits: 1

An oral examination will take place at the end of the semester, encompassing the entire syllabus. This will evaluate the student's comprehension and awareness throughout the program. The primary aim of this course is to equip students with the necessary skills to confidently approach interviews in both academic and professional settings.