File Ref.No.72046/GA - IV - J3/2019/Admn

UNIVERSITY OF CALICUT

Abstract

General & Academic - CBCSS UG Regulations 2019 - Scheme and Syllabus of B.Sc Geology Programme w.e.f 2020 Admission onwards -Incorporating Outcome Based Education - Implemented - Subject to ratification of Academic Council - Orders Issued.

G & A - IV - J

U.O.No. 5497/2021/Admn Dated, Calicut University.P.O, 23.05.2021

Read:-1) U.O.No. 8892/2019/Admn, Dated 05.07.2019.
2) The minutes of the meeting of Board of Studies in Geology, Dated 24.03.2021.
3) Remarks of the Dean, Faculty of Science, Dated 17.05.2021.
4) Orders of the Vice Chancellor in the file of even no, Dated 20.05.2021.

ORDER

1. The scheme and syllabus of B.Sc Geology Programme under CBCSS UG Regulations 2019 of the University, w.e.f 2019 admission onwards has been implemented, vide paper read (1) above.
2. The Board of Studies in Geology has resolved to incorpate Outcome Based Education (OBE) in the scheme and syllabus of B.Sc Geology Programme, in tune with the new CBCSS UG Regulations 2019 with effect from 2020 Admission onwards, vide paper read (2) above.
3. The Dean, Faculty of Science, vide paper read (3) above, has approved to implement the scheme and syllabus of B.Sc Geology Programme (CBCSS-UG-2019) incorporating Outcome Based Education (OBE), in the syllabus forwarded by the Chairperson, Board of Studies in Geology, in tune with the new CBCSS UG Regulations 2019 with effect from 2020 Admission onwards.
4. Considering the urgency, the Vice Chancellor has accorded sanction to implement the scheme and syllabus of B.Sc Geology Programme incorporating Outcome Based Education (OBE), in the existing syllabus forwarded by the Chairperson, Board of Studies in Geology in tune with the new CBCSS UG Regulations 2019 of the University with effect from 2020 Admission onwards, subject to ratification by the Academic Council.
5. Scheme and syllabus of B.Sc Geology (CBCSS) programme incorporating Outcome Based Education (OBE) in the existing syllabus, in tune with CBCSS UG Regulations 2019, is therefore implemented with effect from 2020 Admission onwards, subject to ratification by the Academic Council.
6. Orders are issued accordingly.
7. U.O.No. 8892/2019/Admn Dated, 05.07.2019 is modified to this extend.(syllabus appended).

Arsad M

Assistant Registrar

To

Principals of all affiliated colleges
Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/DR, DOA/JCE I/JCE IV/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

Forwarded / By Order

Section Officer

Regulations, Scheme of Evaluation, and Syllabus for

B.Sc. Programme OBE based

in

Geology (Core)

with

Chemistry and Physics/Mathematics/Statistics/Remote Sensing & GIS (as Complementary Courses)

(2020 Admission onwards)

Under

Regulations for

Choice Based Credit and Semester System for Under Graduate (UG)

(CBCSSUG 2019)

UNIVERSITY OF CALICUT

Board of Studies in Geology (UG & PG)

University of Calicut

Scheme of Undergraduate (UG) Programme in Geology

Rules, Regulations, and Syllabus

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1. TITLE

These regulations shall be called "Regulations for Choice Based Credit and Semester System for Under Graduate Curriculum 2019" (CBCSSUG 2019).

2. SCOPE, APPLICATION & COMMENCEMENT

The regulations provided herein shall apply to all Regular UG programme in Geology under Faculty of Science conducted by the University of Calicut for the admissions commencing from 2019, with effect from the academic year 2019-2020.Every programme conducted under the Choice Based Credit and Semester System in a college shall be monitored by the College Council

3. ADMISSION

Registration and admission to the undergraduate programme in Geology will be as per the rules and regulations of the University. Minimum qualification for the admission is a pass in higher secondary (Pre-Degree or 10+2 Science scheme) or qualifications announced by the University from time to time.

The applicants for B.Sc. Geology Course will be ranked as follows:

Total marks obtained for Part III Optional at the Higher Secondary or equivalent level plus highest marks scored for any one of the subsidiaries among Physics/ Chemistry/Computer Science/Mathematics/Geology/Biology. In the case of a tie, preference shall be given as per the following order:

1) Candidates with Geology as optional subject
2) Marks for Geology
3) Marks for Chemistry
4) Marks for Physics
5) Marks for Mathematics
6) Marks for Computer Science
7) Alphabetical Order of the applicants

(U.O No. GAI/JI/4440/99(2) Dated 13-05-2004)

4. PROGRAMME STRUCTURE

Duration of the programme shall be six semesters distributed in a period of three years. Each semester consists of a minimum of 18weeks, (16 instructional weeks and two weeks for examination). The odd (1,3,5) semesters shall be from June to October and even (2,4,5) semesters shall be from November to March.

The programme shall include five types of courses, *viz,* Common Courses (Code A), Core courses (Code B), Complementary courses (Code C), Open Course (Code D) and Audit courses (Code E).

- Common Courses (10 theory) with 38 credits (22 for common English courses + 16 for common languages other than English)

- Core courses (11 Theory, 8 Practical, 1 Elective theory, and Project and Study tours) with 55 credits
- Open Course (one from other department) with 3 credits; and
- Complementary courses (4 Theory and 4 Practical Courses from Chemistry as compulsory complementary course and 4 theory courses of Physics/Mathematics/Statistics/Remote Sensing & GIS with 4 practical courses in Physics/Remote Sensing & GIS).
- Altogether, there shall be a total of 120 credits for Common, Core, Complementary, and Open courses.
- Ability Enhancement course/Audit course: These are courses which are mandatory for a programme but not counted for the calculation of SGPA or CGPA. There shall be one Audit course each in the first four semesters. These courses are not meant for class room study. The students can attain only pass (Grade P) for these courses. At the end of each semester there shall be examination conducted by the college from a pool of questions (Question Bank) set by the University. The students can also attain these credits through online courses like SWAYAM, MOOC etc (optional). The list of passed students must be sent to the University from the colleges at least before the fifth semester examination. The list of courses in each semester with credits are given below.

Course	Credit	Semester
Environment Studies	4	1
Disaster Management	4	2
*Human Rights/Intellectual Property Rights/ Consumer Protection	4	3
*Gender Studies/Gerontology	4	4

*Colleges can opt any one of the courses.

5. EVALUATION AND GRADING

There shall be University examinations at the end of each semester. 20% of marks are awarded through internal assessment. Mark system is followed instead of direct grading for each question. For each course in the semester letter grade and grade point are introduced in 10-point indirect grading system as per the University guidelines

(a) Distribution of Credits:

Sl. No.	Course		Credits
1.	Common	English	22
2.	Common	Additional Language	16
3.	Core	Geology	55
4.	Complementary Course I	Chemistry	12
5.	Complementary Course II	Physics/Mathematics/ Statistics/Remote Sensing & GIS	12
6.	Open Course	One theory course offered by any other department	3
7.	Audit Course	One theory course	16
8.	Extra Credits		4
		Total	**140**

(b) Ten point Indirect Grading System

Indirect grading System based on a 10-point scale is used to evaluate the performance of students. Each course is evaluated by assigning marks with a letter grade (O, A^+, A, B^+, B, C, P, F, I or Ab) to that course by the method of indirect grading. An aggregate of P grade (after external and internal put together) is required in each course for a pass and also for awarding a degree (A minimum of 20% marks in external evaluation is needed for a pass in a course. But no separate pass minimum is needed for internal evaluation). No separate grade/mark for internal and external will be displayed in the grade card; only an aggregate grade will be displayed. Also the aggregate mark of internal and external are not displayed in the grade card.

% of Marks (Both internal & External put together)	Grade	Interpretation	Grade Point Average (G)	Range of Grade points	Class
95 and above	O	Outstanding	10	9.50–10.00	First Class with distinction
85 to below 95	A^+	Excellent	9	8.50–9.49	
75 to below 85	A	Very Good	8	7.50–8.49	
65 to below 75	B^+	Good	7	6.50–7.49	First Class
55 to below 65	B	Satisfactory	6	5.50–6.49	
45 to below 55	C	Average	5	4.50–5.49	Second Class
35 to below 45	P	Pass	4	3.50–4.49	Third Class
Below 35	F	Failure	0	0	Fail
Incomplete	I	Incomplete	0	0	Fail
Absent	Ab	Absent	0	0	Fail

(c) Extra Credits:

The additional credit awarded to a student over and above the minimumcredits required in a programme, for achievements in co-curricular activities and social activitiesconducted outside the regular class hours, as decided by the University. Extra credits will be awarded to students who participate in activities like NCC, NSS and Swatch Bharath. Those students who could not join in any of the above activities have to undergo Calicut University Social Service Programme (CUSSP). For calculating SGPA and/or CGPA,extra credits will not be considered.

(d) Attendance:

A student shall be permitted to appear for the semester examination, only ifhe/she secures not less than 75% attendance in each semester. Attendance shall be maintained bythe Department concerned. Condonation of shortage of attendance to a maximum of 10% in the case of single condonation and 20% in the case of double condonation in a semester shall be granted by University remitting the required fee. Benefits of attendance may be granted to students who attend the approved activities of the college/university with the prior concurrence of the Head of the institution. Participation in such activities may be treated as presence in lieu of their absence on production of participation/attendance certificate (within two weeks) in curricular/extracurricular activities (maximum 9 days in a semester). Students can avail of condonation of shortage of attendance in a maximum of four semesters during the entire programme (Either four single condonations or one double condonation and two singlecondonations during the entire programme). If a student fails to get 65% attendance, he/she canmove to the next semester only if he/she acquires

50% attendance. In that case, a provisionalregistration is needed. Such students can appear for supplementary examination for suchsemesters after the completion of the programme.Less than 50% attendance requiresReadmission.Readmission is permitted only once during the entire programme.

(e) Grace Marks:

Grace marks may be awarded to a student for meritorious achievements in co-curricular activities (in Sports/Arts/NSS/NCC/Student Entrepreneurship) carried out besides the regular hours. Such a benefit is applicable and limited to a maximum of 8 courses in an academic year spreading over two semesters. In addition, maximum of 6 marks per semester can be awarded to the students of UG Programmes, for participating in the College Fitness Education Programme (COFE).

(f) Improvement course:

Improvement of a particular semester can be done only once. The student shall avail of the improvement chance in the succeeding year after the successful completion of the semester concerned. The students can improve a maximum of two courses in a particular semester. The internal marks already obtained will be carried forward to determine the new grade/mark in the improvement examination. If the candidate fails to appear for the improvement examination after registration, or if there is no change in the results of the improved examination, the mark/grade obtained in the first appearance will be retained. Improvement and supplementary examinations cannot be done simultaneously.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of astudent in that semester is calculated using the formula given below. For the successful completionof a semester, a student should pass all courses. However, a student is permitted to move to the nextsemester irrespective of SGPA obtained.

SGPA of the student in that semester is calculated using the formula:

$$SGPA = \frac{Sum\ of\ the\ credit\ points\ of\ all\ courses\ in\ a\ semester}{Total\ credits\ in\ that\ semester}$$

The Cumulative Grade Point Average (CGPA) of the student is calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students. CGPA can be calculated by the following formula:

$$CGPA = \frac{Total\ credit\ points\ obtained\ in\ six\ semesters}{Total\ credits\ acquired\ (120)}$$

CGPA determines the broad academic level of the student in a programme and is the index for ranking students (in terms of grade points). An overall letter grade (cumulative grade) for the entire programme shall be awarded to a student depending on her/his CGPA

6. CORE COURSE STRUCTURE

Sem	Course Type	Course Code	Course Title	Hrs per week	Credits	Max Marks		
						Internal	External	Total
I	Theory	GEO1B01	Essentials of Geology	3	3	15	60	75
	Practical*	GEO1B02(P)	Field Geology	1	0	-	-	-
II	Theory	GEO2B03	Dynamic Geology and Geoinformatics	3	3	15	60	75
	Practical*	GEO2B04(P)	Geoinformatics	1	0	-	-	-
III	Theory	GEO3B05	Crystallography and Mineralogy	3	3	15	60	75
	Practical*	GEO3B06(P)	Crystallography	2	0	-	-	-
IV	Theory	GEO4B07	Optical and Descriptive Mineralogy	3	3	15	60	75
	Practical*	GEO4B08(P)	Geoinformatics, Crystallography, and Mineralogy	2	4	20	80	100
V	Theory	GEO5B09	Structural Geology and Geotectonics	3	3	15	60	75
		GEO5B10	Stratigraphy and Sedimentology	3	3	15	60	75
		GEO5B11	Igneous Petrology	3	3	15	60	75
		GEO5B12	Metamorphic Petrology	3	3	15	60	75
	Practical±	GEO5B13(P)	Structural Geology	4	0	-	-	-
		GEO5B14(P)	Petrology	4	0	-	-	-
	Project±	GEO5B15(PR)	Project work	1	0	-	-	-
	Study Tour±	GEO5B16(ST)	Study Tour	1	0	-	-	-
VI	Theory	GEO6B17	Palaeontology	4	4	20	80	100
		GEO6B18	Indian Geology	4	4	20	80	100
		GEO6B19	Economic Geology	4	4	20	80	100
	Practical±	GEO6B20(P)	Structural and Economic Geology	4	4	20	80	100
		GEO6B21(P)	Petrology and Palaeontology	4	4	20	80	100
	Elective#	GEO6B22(E01)	Environmental Geology	3	3	15	60	75
		GEO6B22(E02)	Disaster Management					
		GEO6B22(E03)	Geo Exploration					
		GEO6B22(E04)	Geotechnical Engineering					
	Project±	GEO6B23(PR)	Project work	1	2	15	60	75
	Study Tour±	GEO6B24(ST)	Study Tour	1	2	20	80	100
			Total	**65**	**55**	**290**	**1160**	**145**

					0

*Exam will be held at the end of 4th semester
±Exam will be held at the end of 6th semester
#An institution can offer any one among these courses

6.1. Open Course*

Sem	Course	Course Code	Course Title	Hrs per week	Credits	Max Marks		
						Internal	External	Total
V	Open	GEO5D01	Understanding the Earth	3	3	15	60	75
		GEO5D02	Gemmology					
		GEO5D03	Ground Water Exploration and Management					

*Courses offered by the Faculty of Geology for other Stream students

7. COURSE EVALUATION:

The evaluation scheme for each course shall contain two parts:

(a) Internal assessment and (b) external evaluation

20% weight will be given to the internal assessment. The remaining 80% weight will be for the external evaluation. The colleges will send only the marks obtained for internal examination to the University.

7.1. Components of Internal Assessment

The internal assessment shall be based on a predetermined transparent system involving written tests, Class room participation based on attendance in respect of theory courses and lab involvement/ records attendance in respect of Practical Courses. There shall not be any chance for improvement for internal marks.

Components with percentage of marks of Internal Evaluation of Theory Courses:

- Test paper 40%
- Assignment 20%
- Seminar 20%
- Class room participation based on attendance 20%.

For the test paper marks, at least one test paper should be conducted. If more test papers are conducted, the mark of the best one should be taken.

For practical courses

- Record 60%
- Lab involvement 40%.

Marks awarded for the record of practical works shall be purely based on the number of practical workscarried out/specimens studied by the candidate.

If a fraction appears in internal marks, nearest whole number is to be taken.

(a) Split up of marks for Theory Test Paper

Range of Marks in Test	Out of 8	Out of 6

paper	(Max. internal mark is 20)	(Max. internal mark is 15)
Less than 35%	1	1
35% – 45%	2	2
45% – 55%	3	3
55% – 65%	4	4
65% – 85%	6	5
85% – 100%	8	6

(b) Split up of marks for Class room participation (CRP)

Range of CRP	Out of 4 (Max. internal mark is 20)	Out of 3 (Max. internal mark is 15)
50% ≤ CRP < 75%	1	1
75% ≤ CRP < 85%	2	2
85% and above	4	3

7.2. Components of External Evaluation

External evaluation carries 80% of marks. All question papers for theory shall be set by the University. The external question papers may be of uniform pattern with 80/60 marks. The courses with 2/3 credits will have an external examination of 2 hours duration with 60 marks and courses with 4/5 credits will have an external examination of 2.5 hours duration with 80 marks.

The external examination in theory courses is to be conducted by the University with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation and answer keys shall be provided by the University.

(a) Scheme of examination- Theory

Question paper type 1:

The external QP with 80 marks and Internal examination is of 20 marks. Duration of each external examination is 2.5 Hrs. The pattern of External Examination is as given in Annexure I. The students can answer all the questions in Sections A& B. But there shall be Ceiling in each section.

Question paper type 2:

The external QP with 60 marks and Internal examination is of 15 marks. Duration of each external examination is 2 Hrs. The pattern of External Examination is as given in Annexure II. The students can answer all the questions in Sections A& B. But there shall be Ceiling in each section.

(b) Scheme of examination - Practical

The external examination in practical courses shall be conducted by two examiners – one internal and an external, the latter appointed by the University. Only candidates with records of more than 75% of practical works prescribed in the syllabus and duly attested by the head of the department shall be allowed to appear for Practical examination.

(c) Core Course Project Work

Evaluation of the Project Report shall be done under Mark System. The evaluation of the project will be done at two stages:

a) Internal Assessment (supervising teachers will assess the project and award internal Marks)
b) External evaluation (external examiner appointed by the University)
c) Grade for the project will be awarded to candidates, combining the internal and external marks.

The internal to external components is to be taken in the ratio 1:4. Assessment ofdifferent components may be taken as below:

Components		Percentage of Marks
Internal	**External**	
Originality	Relevance of the Topic;Statement of Objectives	20
Methodology	Reference/Bibliography; Presentation; Quality of Analysis/Use of Statistical Tools.	20
Scheme/Organisation of Report	Findings andrecommendations	30
Viva–Voce	Viva–Voce	30

7.2.1. Study Tour/Field Work: Evaluation Scheme

Study tours for geological field work, including collection of minerals, rocks, and fossil specimens, training on the measurement and recording of structural attributes and geological information, are integral and mandatory component of the program. These study tours are to be scheduled as follows:

(1) Field work expanding for 8 to 12 days shall be conducted in the first four semesters with emphasis on Physical Geology, Geomorphology, Mineralogy, and Mineral Deposits within southern India. The field work in the first four semesters may be carried out either in a single stretch in any of the semesters or as two stretches initially at first or second semester and later one at the third or fourth semester.

(2) Extensive field work with emphasis on Stratigraphy, Structural Geology, Economic Geology, Palaeontology, and Petrology for 12 to 15 days in different parts of India shall be conducted in fifth or sixth semester of the programme.

The study tour should be organized in such a way that a major portion of the entire tour period is exclusively allocated for field-based studies, including visit to quarries, mines and locations of geological interest, and limited time slots may be reserved to visit Academic/Research institutions. During the field-based studies and training, the students shall be grouped with a maximum strength of 15 numbers in a group supervised by one faculty member for each group.

A detailed and collective report of these field works, certified by the teacher(s)-in-charge of the study tour(s) and also by the Head of the Department should be submitted in the Sixth Semester, and specimens collected during the field works should be displayed at the time of practical examination in Sixth Semester. The study tour report is compulsory for each student appearing for Sixth Semester practical examination.

(a) Internal Assessment

Sl. No.	Criteria	Marks
1.	Punctuality & Field Note	4
2.	Field work/Skill	4
3.	Specimen collection	6
4.	Viva-Voce	6
	Total	**20**

(b) External Evaluation

Sl. No.	Criteria	Marks
1.	Study Tour Report	20
2.	Specimen Display	20
3.	Presentation/Viva-Voce	40
	Total	**80**

CORE COURSE: GEOLOGY
THEORY SYLLABUS

Programme Outcomes

PO1. **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. **Problem Solving**: Understand and solve problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired from humanities/ sciences/mathematics/social sciences.

PO3. **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO6. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Programme Specific Outcomes

PSO1. Understand the nature and basic concepts of Physical geology, Geomorphology, and Historical Geology.

PSO2. Understand the physical, chemical and optical characteristics of rocks and minerals, their economic aspects and distribution.

PSO3. Understand the structural aspects of rock formations, global tectonics and earth dynamics.

PSO4. Understand the applications of geoscience in environmental planning and management.

GEO1B01 – ESSENTIALS OF GEOLOGY

Credit: 3 **Total Hours: 48**

Course Outcomes

CO 1. The student will be able to explain the origin and evolution of earth, various branches of Geology and elementary ideas of plate tectonics

CO 2. The student will be able to identify the various methods of age determination of earth and also about the time span represented by the Geological Time Scale.

CO 3. The student will be able to discuss about the nature of crystals, the role of minerals in making rocks and also about the rock cycle.

CO 4. The student will be able to describe in detail about earthquakes, volcanism, mass movements and marine processes.

Module 1:

- Definition, scope and branches of Geology.
- Elementary information on the Universe and the Solarsystem– TheEightPlanets;Meteorites;Comets;Asteroids.
- Origin of the Earth – Big-Bang theory; Nebular hypothesis; Planetesimal hypothesis.
- Layered structure of the earth and its major discontinuities.
- Concept of lithospheric plates and plate tectonics

Module 2:

- Age of the Earth – Determination of Earth's age, Relative and absolute dating. Non-radioactive methods and radioactive methods.
- Geological Time scale: Eons; Eras; Periods; and Epochs
- International stratigraphic time scale

Module 3:

- Nature of crystals; crystalline and amorphous materials; polycrystalline materials; a brief introduction to Crystal systems.
- Morphological characters of crystal – faces, forms, edges solid angles Interfacial angle.
- Building blocks of earth materials –Chemical elements and periodic table; Bonding of atoms – Metallic, Covalent, Ionic and Vander Walls Bonding in Minerals
- A brief introduction to minerals – Silicates – Carbonates – Sulphides –Phosphates.
- Rocks – Types of rocks - brief introduction to Igneous, sedimentary and metamorphic rocks; Concept of rock cycle

Module 4:

- Earthquakes – Properties of seismic waves; Magnitude and Intensity – Ritcher and Mercalli's Scales; Seismogram and Seismograph. Origin, distribution and prediction of earthquakes. Tsunami – Origin and effects.
- Study of Earth's interior by using seismic waves
- Mass movements – Types of mass wasting. Landslides – causes, effects and remedial measures.

Module 5:

- Volcanoes – Classification based on Lava Types; Styles of Eruptions – Products - Global Distribution; Causes; Effects; Prediction.
- Oceans and Seas: Waves, tides and currents; Geological work of oceans.
- Description of continental margins and ocean bottom topography – Continental shelf, Continental slope, submarine canyons, sea mount, Guyots, Midoceanic ridges, trenches.

Essential Reading:

1. Condie, K.C., 2015. *Earth as an Evolving Planetary System,* 3rd Edition, Academic Press, USA.
2. Hudson, T., 2012. *Living with Earth – An Introduction to Environmental Geology*. Pearson Education Inc., New Jersey, USA
3. Marshak, S., 2001. *Earth: Portrait of a Planet.* W.W. Norton & Co., Inc., USA
4. Wicander, R. and Monroe, J., 2006. *Essentials of Geology.* 4th Edition, Thomson Learning Inc., USA.
5. Tarbuck, E.J. and Lutgens, F.K., 2008. Earth: An Introduction to Physical Geology. 9th Edition, Pearson Education, Inc., New Jersey, USA

GEO2B03 – DYNAMIC GEOLOGY AND GEOINFORMATICS

Credit: 3 **Total Hours: 48**

Course Outcomes

CO 1. The student will be able to explain the work of various geological agents, the different processes involved and the resulting landforms

CO2. The student will be able to describe the fundamental concepts of GIS and its applications in geosciences.

CO 3. The student will be able to discuss the basics of remote sensing, different satellite data products, platforms and sensors.

Module 1:

- Weathering, erosion and soil – Types of weathering – Physical, Chemical and Biological; Products of weathering; Factors influencing weathering
- Geological work of wind: Erosional and depositional landforms – Loess, types of dunes, pediplanation, playas and inselbergs; Formation of desert landforms
- Glaciers – Formation of glaciers; Types; Accumulation and wastage; Movements;
- Erosional and depositional landforms; Glacial ages

Module 2:

- Running water as a geological agent: Development of a typical Stream-Drainage system; Consequent and subsequent streams; Drainage basin and Drainage patterns; Graded, Braided and Meandering streams
- Geological work of stream, erosional and depositional fluvial landforms
- Concept of base level, peneplanation, monadnocks, Stream terrace, Rejuvenation, Knick Point.

Module 3:

- Underground water: Occurrence, Zone of aeration and saturation; Water table – Perched water table; Porosity, Permeability,
- Aquifers – Confined and unconfined, aquicludes, aquitard and aquifuge. Artesian wells, Geysers and springs. Erosional and depositional landscapes produced by action of ground water; Origin of limestone caverns – Stalactite and stalagmites; Karst topography

Module 4:

- Geoinformatics – Definition.
- Geographic Information System (GIS) – The purpose of GIS; Maps; Components of GIS; GIS software. Types of Data – Raster and Vector.
- Spatial data input – Digitizing paper maps. Geo-referencing. Transformation and Projection. Spatial data analysis; Overlay functions.
- GIS Applications in Geosciences – Geology; Groundwater; Mineral Exploration.

Module 5:

- Remote sensing- basic principles.
- Satellite data products- panchromatic, multispectral, hyperspectral, super spectral.
- Sensors and platforms- type, sensor parameters- spatial, spectral, radiometric, temporal resolution.

Essential Reading:

1. Lo, C.P. and Yeung, A.K.W., 2007. Concepts and Techniques in Geographic Information Systems.
2. 2. Tarbuck, E.J. and Lutgens, F.K., 2008. Earth: An Introduction to Physical Geology. 9th Edition, Pearson Education, Inc., New Jersey, USA.
3. 3. Wicander, R. and Monroe, J., 2006. Essentials of Geology. 4th Edition, Thomson Learning Inc., USA

GEO3B05 – CRYSTALLOGRAPHY AND MINERALOGY

Credit: 3 **Total Hours: 48**

Course Outcomes

CO1. The student will be able to explain the different crystal systems, symmetry elements and classification of crystals

CO2. The student will be able to describe the symmetry elements and forms of the different classes of cubic, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic systems with special reference to the type minerals

CO3. The student will be able to discuss about twin crystals, effects of twinning and law

CO4 The student will be able to describe the physical and chemical properties of minerals

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Module 1:

- Crystallography – A brief introduction to scope and its applications.
- Symmetry elements – crystallographic axes, crystal notation, parameter system of Weiss and Miller indices, axial ratio.
- Laws of crystallography – law of constancy of symmetry, law of constancy of interfacial angles, law of rational indices.
- Classification of crystals into systems and classes – Holohedral, Hemihedral, Hemimorphic and Enantiomorphic forms in crystals.

Module 2:

- Study of the symmetry elements and forms of the Normal, pyritohedral , tetrahedral and plagiohedral classes of cubic system with special reference to well-developed crystals of Galena, Spinel, Garnet, Flourite, Diamond, Pyrite, Tetrahedrite, Boracite and cuprite.
- Study of symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Sphenoidal and Trapezphedral classes of Tetragonal system.
- Study of the symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Trapezohedral, Rhombohedral, Rhombohedral Hemimorphic and Trapezohedral classes of Hexagonal system.

Module 3:

- Study of the symmetry elements and forms of the Normal and Sphenoidal classes of Orthorhombic system.
- Study of the symmetry elements and forms of the Normal classes of the Monoclinic and Triclinic systems.
- Twin crystals – Definitions – Effects of Twinning – laws of twinning – composition plane, twinning plane and twinning axis, indices of twins – simple and repeated (polysynthetic twins), contact and penetration twins: secondary twins.

Module 4:

- Definition of Mineral and Mineraloid – Scope and aim of Mineralogy.
- Crystal Coordination - the making of minerals
- Classification and structural diversity of silicate minerals

Module 5:

- Compositional variation and coupled ionic substitution, Isomorphism, Polymorphism, Pseudomorphism, solid solution and ex- solution in minerals.
- Physical properties of minerals Form, colour, streak, luster, Hardness, Cleavage, Fracture, Specific Gravity, Tenacity, transparency, Electrical and Magnetic properties- pyro and piezo electricity, Ferri-, Para-, and Diamagnetism.

Essential Reading:

1. Borchardt-Ott, W., 2011. Crystallography– An Introduction. Springer Heidelberg, 355p.
2. Dana, F.S., 1955. A Text Book of Mineralogy. Asia publishing House, Wiley.
3. Klen, C., Hurlbut, C.S., 1985. Manual of Minerology, John Wiley & Sons
4. Perkins, D., 2015. Mineralogy. Pearson Education (3Ed), 568 p

GEO4B07 – OPTICAL AND DESCRIPTIVE MINERALOGY

Credit: 3 **Total Hours: 48**

Course Outcomes

CO1. The student will be able to explain double refraction, polarized light and the working of petrological microscope.

CO2. The student will be able to discuss about the optical classification of minerals and their various optical properties.

CO3. The student will be able to discuss about the different mineral groups and their properties

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Module 1:

- Nature of light – Ordinary and polarized light; Refraction and reflection; Refractive index, Critical angle and Total internal reflection.
- Double refraction – Plane Polarization by Reflection; Plane polarization by Refraction; Nicol Prism; Plane polarization by absorption.
- Petrological microscope and its parts
- Optical properties of isotropic and anisotropic minerals observed under parallel and crossed Nicols.

Module 2:

- Characters of Uniaxial and biaxial minerals – Optic axis and optic axial angle; Acute and Obtuse Bisectrix; Optic sign of Uniaxial and Biaxial minerals; Uniaxial and Biaxial Indicatrix; Sign of elongation.
- Extinction – Types, angles, determination, and applications in mineral identification.
- Optical accessories and uses – Quartz wedge (Determination of order of Interference Colour), Gypsum plate and Mica plate (Determination of Fast and Slow vibration directions).

Module 3:

- Structure, Chemistry, Optical and Physical properties, Modes of occurrence and uses of the following groups of minerals: Olivine, Garnet, Epidote ,Aluminium silicates, Pyroxene, and Amphibole.

Module 4:

- Structure, Chemistry, Optical and Physical properties, Modes of occurrence and uses of the following groups of minerals: Mica, Chlorite, Polymorph and varieties of Quartz, Feldspars, Feldspathoids and Spinel.

Module 5:

- Chemistry, Optical and Physical properties, Modes of occurrences and industrial uses of the following minerals: Scapolite, Cordierite, Talc, Serpentine, Steatite, Calcite, Dolomite, Topaz, Staurolite, Beryl, Tourmaline, Fluorite, Apatite, Zircon, Rutile, Sphene, Zeolites and Corundum.

Essential Reading:

1. Dyar, M.D., Gunter, M.E., 2007. Mineralogy and Optical Mineralogy. Min. Soc. America, 705p.
2. Demange, M., 2012. Mineralogy for Petrologists: Optics, Chemistry, and Occurrence of Rock Forming Minerals. CRC Press (Taylor & Francis Group), 182 p.
3. 3. Nesse, W.D., 2012. Introduction to Optical Mineralogy. Oxford University Press; 4 edition, 384p.
4. Pichler, H., Riegraf, C.S., 2011. Rock-forming Minerals in Thin Section. Springer, 220 p.
5. Deer, W.A., Howie, R.A., Zussman, J., 2013. Introduction to the Rock-forming Minerals. Mineralogical Society of Great Britain & Ireland, 510 p.

GEO5B09 – STRUCTURAL GEOLOGY AND GEOTECTONICS

Credit: 3 **Total Hours: 48**

CO1. The student will be able to describe the fundamental field techniques of structural geology using Brunton compass.

CO2. The student will be able to discuss rock deformation and various structural features such as folds, faults, joints and unconformities

CO3. The student will be able to explain the structure and characteristics of layers of the Earth

CO4. The student will be able to describe the concept of plate tectonics and the tectonic evolution of Indian subcontinent.

Module 1:

- Introduction to Structural Geology. Methods for representing relief features; contours, topographic and geologic maps- their preparation and uses, geological surface and their attitudes-Dip and strike- trend of outcrops - rules of 'V' – relation between true dip and apparent dip-width of outcrops; true thickness and vertical thickness and their mutual relation. Uses of clinometers and Brunton compass.
- Rock deformation-uniform pressure- differential pressure- stress and strain, types of stress-type of strain -stress strain diagram. Stages of deformation, mechanism of elastic, plastic and brittle deformation

Module 2:

- Folds: Geometry and elements of folded surface-classification- descriptive study of different types of folds- recognition in the field and on the maps.
- Shear Zones –Shear sense indicators– prominent shear zones of southern India
- Fault: Definition, terminology, classification, description and recognition in the field and on the map

Module 3:

- Joints: Definition, classification, descriptive study and geological significance of joints.
- Foliation and lineation- primary and secondary and their types.
- Unconformities: Definition, and types, significance and recognition in the field and on the maps. Overlaps and offlaps, outlier and inlier.
- Introduction to equal area and stereographic projections; methods of construction; Pie Diagram, contour diagram, Beta diagram.

Module 4:

- Structure and characteristics of layers of the Earth: Crust (Continental and Oceanic), Mantle (Lower and Upper), Core (Inner and Outer);
- Geophysical and petrochemical characteristics of Lithosphere and Asthenosphere
- Mantle petrology and chemical composition; Models of mantle convection
- Mantle plumes; Hot spots; Super swells

Module 5:

- Continental Drift; Seafloor spreading; Palaeomagnetism

- Plate tectonics: Basic concepts and definition. Types of plate margins.
- Features associated with divergent, convergent, and transform plate margins.
- Triple junctions, Benioff zones, Island arcs, rift valleys, transform faults

Essential Reading:

1. Frisch, W., Meschede, M., and Blakey, R., 2011. *Plate Tectonics – Continental Drift and Mountain Building,* Springer-Verlag, Berlin Heidelberg, 212p.
2. Kondie, K.C., 2011. *Earth as an Evolving Planetary System,* Academic Press, Oxford, UK, 574p.
3. Turcotte, D.L. and Schubert, G., 2014. *Geodynamics,* Cambridge University Press, 636p.
4. Twiss, R.J., Moores, E.M., 2007. Structural Geology. W.H. Freeman, 500p.
5. Twiss, R.J., Moores, E.M., 2007. Structural Geology. W.H. Freeman, 500p.

GEO5B10 – STRATIGRAPHY AND SEDIMENTOLOGY

Credit: 3 **Total Hours: 48**

Course Outcomes

CO1. The student will be able to explain the different types of stratigraphic classification.

CO2. The student will be able to explain the sedimentary processes, classification of sedimentary rocks and different types of sedimentary

CO3. The student will be able to describe the textures and structures of sedimentary rocks.

C 4. The student will be able to discuss the important and typical sedimentary rock types

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Module 1:

- Laws of Stratigraphy: Concept of uniformitarianism; Law of order of super position; Law of faunal succession; Law of original horizontality; Principle of Lateral Continuity; Principle of Inclusion; Law of cross cutting relationship
- Physical and biological criteria of correlation and homotaxis.
- Major events of Mass extinction

Module 2:

- Facies and facial changes-litho and bio facies- break in stratigraphic records- diastems.
- Stratigraphic classification
- BiostratigraphIc classification- Biozones, biohorizon, index fossil.
- Range zone- Taxon range zone concurrent range zone, interval zone, assemblage zone, Acme zone.
- Lithostratigraphic classification Group, Formation, Member, Bed.
- Chronostratigraphic classification- Eonothem, erathem, system, series, stage.

Module 3:

- Sedimentary process: disintegration & decomposition of rocks – transportation – deposition –diagenesis.
- A broad classification of sedimentary rocks
- Structures of sedimentary rocks-mechanical, chemical and organic structures.
- Textures of sedimentary rocks – clastic and non – clastic textures
- Brief introduction to Depositional environments – terrestrial, marine and transitional

Module 4:

- Mechanical deposits – rudaceous, arenaceous and argillaceous groups
- Chemical deposits – siliceous , carbonaceous, ferruginous and salt deposits
- Organic deposits – calcareous, siliceous, phosphatic, and carbonaceous deposits.
- Residual deposits – terra rossa, clay, laterite and bauxite and soils.

Module 5:

- A descriptive study of Conglomerate, Breccia, Sandstones and Shales
- Heavy minerals

- A brief study of Flint, Chert, Limestone, Dolomite, Gypsum, Rock Salt, Siderite
- A brief study of fossiliferous limestone, radiolarian chert, diatomaceous earth, Guano
- Descriptive study of different types of carbonaceous deposits.

Essential Reading:

1. Boggs, S., 2016. Principles of Sedimentology and Stratigraphy. Pearson Education. 568 p.
2. Brookfield, M.E., 2003. Principles of Stratigraphy. Wiley-Blackwell, 340 p.
3. Nichols, G., 2016. Sedimentology and Stratigraphy. Wiley-Blackwell, 419 p.
4. Prothero, D.R., Schwab, F., 2013. Sedimentary Geology. W.H. Freeman, 593 p

GEO5B11 – IGNEOUS PETROLOGY

Credit: 3 **Total Hours: 48**

Course Outcomes

CO1. The student will be able to explain the composition and constitution of magma and forms of intrusive igneous rocks

CO2. The student will be able to describe the textures and structures of igneous rocks

CO3. The student will be able to discuss the different classification schemes of igneous rocks.

CO4. The student will be able to explain the crystallization of unicomponent magma,crystallization and petrogenetic significance of Binary magmas

CO5. The student will be able to describe the various rock types giving their texture, mineralogy, classification, and modes of occurrence.

Module 1:

- Composition and constitution of magmas – Primary and Parental Magmas.
- Forms of Intrusive igneous rocks: Concordant forms - Sill, Laccolith, Lopolith and Phacolith, Discordant forms - Dykes, Cone Sheets, Volcanic neck, Ring dyke, Batholiths, Stocks, Bosses and bysmaliths.
- Forms of Extrusive igneous rocks: Lava flows, Pyroclastic deposits - Agglomerate, Lapilli, volcanic ash and volcanic froth.

Module 2:

- Structures vesicular and Amygdaloidal structures – block lava – Ropy lava – pillow structure – flow structure – sheet joints- mural jointing – columnar jointing – rift and grain.
- Textures: Definition and description - crystallinity: crystallites and microlites – Devitrification – Granularity – shapes of crystals, mutual relations – Equigranular textures: allotriomorphic hypidimorphic, Panidiomorphic. inequigranular Textures: porphyritic and Intergrowth texture – Trachytic texture – Intergrowth texture strctures orbicular structure Spherulitic structure – Perlitic fracture. , Directive textures, Overgrowth textures, Reaction textures - Micro Structures

Module 3:

- Classification: bases of classification – Genetic classification – classification based on colour index – based on the proportion of Alkali to plagioclase feldspars-based on silica saturation – based on alumina saturation –
- A short account of CIPW classification , Normative minerals, salic and femic groups – Merits and defects of CIPW classification
- Tyrrel's tabular classification- IUGS classification.

Module 4:

- Crystallization of Unicomponent magma

- Crystallization and petrogenetic significance of Binary magmas: Diopside – Anorthite Eutectic system, Albite – Anorthite Solid-Solution system, Forsterite – Silica incongruent melting system and Ternary system (Ab–An– Di).
- Reaction principle and Bowen's reaction series - Causes for the diversity of Igneous rocks – Magmatic Differentiation: Fractional Crystallization, Liquid immiscibility, Assimilation - Short notes on: Consanguinity, Variation diagrams and petrographic provinces.

Module 5:

- Study of Texture, Mineralogy, Classification, and Modes of occurrence of Granite, Granodiorite, Syenite, Diorite, Gabbro with their hypabyssal and volcanic equivalents.
- Petrographic characters and origin of Pegmatites, Lamprophyres, Alkaline rocks, Dunite, Peridotite and Anorthosites

Essential Reading:

1. Frost, B.R., Frost, C.D., 2014. Essentials of Igneous and Metamorphic Petrology. Cambridge University Pres. 318 p.

2. Raymond, L.A., 2002. Petrology: The Study of Igneous, Sedimentary and Metamorphic Rocks, 720p.

3. Winter, J.D., 2009. Principles of Igneous and Metamorphic Petrology. Pearson, 720 p.

GEO5B12 – METAMORPHIC PETROLOGY

Credit: 3 **Total Hours: 48**

Course Outcomes

CO1. The student will be able to describe the limits, variables and types of metamorphism.

CO2. The student will be able to explain the metamorphic structures, textures and mineral paragenesis.

CO3. The student will be able to explain metamorphic grade, metamorphic facies and the effects of metamorphism on various types of rocks.

CO4. The student will be able to discuss the petrography and origin of common metamorphic rocks, concepts of prograde and retrograde metamorphism.

CO5. The student will be able to explain UHP and UHT metamorphism; anatexis and migmatites; metamorphic differentiation, geothermometry and geobarometry; P-T-t paths and tectonic environments

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Module 1:

- Metamorphism – Definition; limits of metamorphism (low and high *T/P* limits and influence of water and bulk compositions on metamorphic limits).
- Variables of metamorphism – temperature, lithostatic pressure, deviatoric stress, fluids.
- Types of metamorphism – classification based on the principal agents (thermal, dynamic, dynamo-thermal, hydrothermal); based on geological setting – contact, shock, high-strain, regional (burial, ocean-ridge, orogenic); based on plate tectonic setting – metamorphism at convergent, divergent, and transform plate margins.
- Fault-zone and impact metamorphism

Module 2:

- Classification of metamorphic rocks: foliated and lineated; non-foliated and non-lineated; specific rock groups (Quartzite, Greenstone, Amphibolite, Serpentinite, Calc-silicate, Skarn)
- Metamorphic structures – fabric, layer, foliation, schistosity, cleavage, gneissosity, lineations.
- Metamorphic textures – augen, cataclastic, corona, decussate, epitaxial, flaser, granoblastic, lepidoblastic, megacrystic, nematoblastic, poikiloblastic, porphyroblastic, strain shadow, symplectite, and relict textures.
- Equilibrium mineral asemblages; Introduction to chemographic diagrams: ACF, AKF Diagrams

Module 3:

- Metamorphic grades and isograds; mineral zones and Barrowian sequence;
- Metamorphic facies – zeolite, prehnite-pumpellyite, greenschist, epidote-amphibolite, amphibolite, granulite, blueschist, eclogite, and contact metamorphic facies
- Facies series and plate tectonics – paired metamorphic belts.

Module 4:

- Metamorphic effects on – argillaceous (medium *P-T* Barrovian); calcareous (contact metamorphism); basic igneous (regional metamorphism) rocks
- Petrography and origin of slate, phyllite, chlorite schist, kyanite schist, biotite schist, biotite gneiss, bornblende gneiss, amphibolite, marble, charnockite, eclogite, and mylonite

Module 5:

- Prograde and retrograde metamorphism
- Nature of metamorphic fluids and metasomatism
- Introduction to UHP and UHT metamorphism; anatexis and migmatites; metamorphic differentiation

Essential Reading:

1. Barker, A.J., 1990. *Introduction to Metamorphic Textures and Microstructures.* Blackie, 162p.
2. Bucher, K. and Grapes, R., 2011. *Petrogenesis of Metamorphic Rocks*. Springer-Verlag, Berlin-Heidelberg, 428p.
3. Frost, C.D., Frost, B.R, 2013. *Essentials of Igneous and Metamorphic Petrology,* Cambridge University Press, 336p.
4. Kornprobst, J., 2012. *Metamorphic Rocks and Their Geodynamic Significance: A Petrological Handbook,* Springer, 206p.
5. Kretz, R., 1994. *Metamorphic Crystallization.* John Wiley & Sons, 507p.
6. Miyashiro, A., 1978. Metamorphism and Metamorphic Belts. 3rd Edition. George Allen & Unwin, London, 492p.
7. Raymond, L.A., 2002. *Petrology: The Study of Igneous, Sedimentary and Metamorphic Rocks*, 720p.
8. Spear, F.S. 1995. *Metamorphic Phase Equilibria and Pressure-Temperature-Time Paths.* Monograph, Mineralogical Society of America, 799p.
9. Vernon, R.H. and Clarke, G.L., 2008. *Principles of Metamorphic Petrology.* Cambridge University Press, 446p.
10. Winter, J.D., 2011. *Principles of Igneous and Metamorphic Petrology*, Prentice-Hall, 728p.

GEO6B17 – PALAEONTOLOGY

Credit: 4 **Total Hours: 64**

Course Outcomes

CO1. The student will be able to describe the fossils and their preservation and uses.

CO2. The student will be able to explain the general morphology, geological history,distribution and stratigraphic significance of the important phylums of organisms.

CO3. The student will be able to discuss a brief outline of the classification of vertebrates, general classification of plant kingdom and plant fossils from India.

Module 1:

- An outline of life through ages, its evolution and distribution
- Definition of Palaeontology – organic world – classification – Flora and Fauana – vertebrates and invertebrates
- Definition of fossils – nature and modes of preservation of fossils: Unaltered hard parts: Altered hard parts : Petrifaction, permineralisation, carbonisation, recrystallisation, silicification , mould, casts, tracks , trails, borings,
- Uses of fossils – stratigraphic indicators – climatic indicators- indicators of palaeogeography – indicators of evolution and migration of life forms – indicators of new deposits of coal and petroleum

Module 2:

- Phylum protozoa – Order: Foraminifera: General morphology – chitinous test – septa, arrangement of chambers, suture, aperture, dimorphism – classification, geological history and stratigraphic importance.
- Phylum coelenterata – class Anthozoa – zoological features – General morphology: corallum, corallite , theca , chambers, septa, fossula, columella, septal developments, classification – tabulate corals – Rugose corals evolution geological distribution – stratigraphic importance.
- Sub phylum Hemichordata – class Graptozoa: order Dendroidea and Graptoloidea – general morphology , rhabdosome, stipe , theca , common canal , nema , virgula , sicula , angle of divergence, central disc, uniserial, biserial, classification, geological distribution and stratigraphic importance

Module 3:

- Phylum mollusca: Class Pelecypoda:- General characters – umbo, Hinge line – ligament – lunule and escutcheon – adductor impressions, pallial line, pallial sinus, dental patterns, ornamentation, classification, geological history
- Class Gastropoda:- General morphology, shell forms, whorl, spire, spiral angle, suture, aperture, columella, umbilicus , peristome , aperture , (Holostomatus and siphonostomatus) – types of coiling – Dextral and sinistral – ornamentation , classification and geological history
- Class Cephalopoda:- General morphology , siphuncle, septa, septal necks, connecting ringes, chambers, suture lines, (Nautilitic , Goniotitic , Ceratitic and Ammonitic) – shell

forms – ornamentation – classification evolution, geological history- morphology of a Belemnite shell.

Module 4:

- Phylum Brachiopoda:- General morphology, umbo, hinge line , pedicle opening, delthyrium, deltidium pseudo deltidium – Brachial skeleton – morphometric details, ornamentation , classification , geological history.
- Phylum Echonodermata: - Class Echinoidea:- General morphology, periproct, apical system (Anus, ocular plates, Genetal plates, madriporic plates), corona (Ambulacra , inter ambulacra) – peristome – Regular and irregular echinoids – classification – geologicial history. Class crinoidea:- General morphology , calyx , dorsal cup, (Radicals , basals, intrabasals), arms, stem, classification, geological history. Class Blastoidea: - General morphology – calyx, dorsal cup (Basals, radials, deltoids, ambulacra). Brachioles, cicatrix, geological history

Module 5:

- Phylum Arthropoda:- Class – Trilobita- General morphology : Cephalon: glabella, facial suture, free cheek, fixed cheek, genal angle , genal spine , cranadium; thorax – pygidium – classification – geological history.
- Brief account of Siwalik vertebrate fossils
- General classification of plant kingdom – plant fossils from India – A brief account of the following plant fossils :- Glossopteris , Gangamopteris , Ptilophyllum , Calamites , Lepididendron and Sigillaria

Essential Readings:

1. Henry woods : Invertebrate palaeontolgy – Cambridge.
2. Romer , A.S.: Vertebrate palaeontology, Chicago press.
3. Arnold, C.A., An introduction to Palaeobotany., MC-Graw Hill.
4. B.U. Haq and A. Boersma (1978) Introduction to marine Micropalaeontology. Elsevier, Netherlands
5. Raup, D.M. and Stanely, M.S.: Principles of Palaeontology, CBS Publishers.
6. Moore , R.C., Laliker , C.G.&Fishcher, A.G.: Invertebrate Fossils , Harper brothers
7. Shrock. R.R. and Twenhofel , W.H – 1953 : Principles of invertebrate Palaeontology, Amold publication

GEO6B18 – INDIAN GEOLOGY

Credit: 4 **Total Hours: 64**

Course Outcomes

CO1. The student will be able to explain the Precambrian stratigraphy of India with particular reference to the important rock units.

CO2. The student will be able to explain the Palaeozoic stratigraphy of India with particular reference to the important rock units.

CO3. The student will be able to explain the Mesozoic stratigraphy of India with particular reference to the important rock units.

CO4. The student will be able to explain the Cenozoic stratigraphy of India with particular reference to the important rock units.

Module 1:

- Early Precambrian Stratigraphy: Sargursupracrustals; Granulite blocks of southern India; DharwarSupergroup; AravalliSupergroup
- Late Precambrian Stratigraphy: Delhi Supergroup, CudappahSupergroup, Vindhyan Super group. Brief study of Singhbhumcraton, Sausar and Sakoli group

Module 2:

- Paleozoic Stratigraphy**:** Distribution of Paleozoic rocks in India; Cambrian of Salt Range; Age of Saline Series; Upper Carboniferous and Permian rocks of Salt Range; Paleozoic rocks of Kashmir Valley; Paleozoic rocks of Spiti Valley; Paleozoic rocks of Peninsular India

Module 3:

- Mesozoic Stratigraphy: The Depositional Environment–distribution-life-classification and economic importance of Gondwana formations of India, Coastal Gondwana of India, Gondwana formations of Tamil Nadu, Triassic of Spiti – The Lilang System, Jurassic of Kutch, Cretaceous of Tiruchirapalli – Pondicherry – Bagh Beds, Deccan traps: distribution, structure, Lameta beds – infratrapean and intertrappean beds, age of the Deccan traps

Module 4:

- Cenozoic Stratigraphy:Comprehensive account ofthe geological events took place during Cenozoic Era in India, rise of Himalayas, stratigraphy of Siwalik system, fauna and flora of Siwaliks, Tertiary rocks of Assam, Karewa formation, Tertiary rocks of Tamil Nadu, Tertiary rocks of Kerala, Pleistocene Glaciation – Cenozoic oil bearing formations of India

Essential Reading:

1. Sharma, R.S., 2009. *Cratons and Fold Belts of India*. Springer.
2. Krishnan M.S. (2003)- Geology of India and Burma, 6th Edition, CBS.
3. Wadia D.N. (1953) – Geology of India, TATA McGraw – Hill.

4. Pascoe, E.H.(1968) - A manual of the Geology India and Burma, Govt of India Publications.
5. GSI publications, Bangalore. Geology of India Vol 1 &2, 2008

GEO6B19 – ECONOMIC GEOLOGY

Credit: 4 **Total Hours: 64**

Course Outcomes

CO1. The student will be able to explain the geochemical distribution of elements, materials of mineral deposits, metallogenic epochs and provinces, geologic thermometers.

CO2. The student will be able to describe the classification of mineral deposits.

CO3. The student will be able to explain the various processes of ore formation.

CO4. The student will be able to describe the diagnostic physical properties, chemical composition, uses, modes of occurrence and distribution in India of the important ore minerals.

CO5The student will be able to report the uses, classification, constitution, origin and distribution in India of fossil fuels.

Module 1:

- Historical development of economic Geology. Geochemical distribution of elements.
- Materials of mineral deposits – ore minerals, gangue minerals, tenor and grade of ores, ore shoots and bonanzas.
- Brief study of metallogenic epochs and provinces – geologic thermometers.
- Classification of mineral deposits. Outline of Lindgren's and Bateman's classification- Syngenetic and epigenetic deposits.
- Controls of ore localization – structural, stratigraphic, physical and chemical.

Module 2:

- Magmatic processes – mode of formation – Early magmatic processes and deposits, disseminations, segregations and injections – Late magmatic processes and deposits – Residual liquid segregation and injection – immiscible liquid segregation and injection – sublimation.
- Metamorphic processes – Formation of Graphite, Asbestos, Talc, Soapstone and Sillimanite group of minerals

Module 3:

- Contact Metasomatic processes – the process and effects – resulting mineral deposits. Hydrothermal processes – principles – Factors affecting deposition – wall rock alteration – minerals sequence – cavity filling deposits Fissure veins, shear – zone, stock-work, saddle reef, ladder vein, fold cracks, breccia filling, solution cavities, pore space and vesicular filling – replacement deposits- process and deposits – criteria of replacement.
- Sedimentary processes and cycles – principles involved in sedimentation – cycles of Iron and manganese, weathering processes – principles- Residual concentration process and deposits – mechanical concentration principles – eluvial, alluvial, beach and eolian

placers. Oxidation and supergene sulphide enrichment – solution and deposition in the zone of oxidation – secondary sulphide enrichment – Gossans and capping.

Module 4:

- Occurrence and distribution in India of metalliferous deposits - base metals, iron, manganese, aluminium, chromium, nickel, gold, silver, molybdenum.
- Indian deposits of non-metals – Diamond, mica, asbestos, barytes, gypsum, graphite, apatite and beryl. Gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint, ceramic and cement industries.

Module 5:

- Coal and its properties: Different varieties and ranks of coal. Origin of coal.Geology and coal petrography of different coalfields of India.
- Origin, migration and entrapment of natural hydrocarbons. Characters of source and reservoir rocks. Structural, stratigraphic and mixed traps. Geographical and geological distributions of onshore and offshore petroliferous basins of India.

Essential Reading:

1. Pohl, W.L., 2016. Economic Geology Principles and Practice. Wiley-Blackwell, 678 p.

2. Sarkar, S.C., Gupta, A., 2012. Crustal Evolution and Metallogeny in India. Cambridge

University Press, 912 p

CORE COURSE: GEOLOGY
PRACTICAL SYLLABUS

GEO1B02(P) – FIELDGEOLOGY

Credit: 0 **Total Hours: 16**

Course Outcomes

CO 1. The student will be able to carry out a geological field trip using toposheet and Brunton compass.

- Introduction to Gt Aide (Academy) learning tool / Software
- Toposheet search, UTM Zones, Coordinates and Latitude and Longitude converter etc, Interactive sessions and tasks to extract information on toposheets and UTM zones using Gt Aide (Academy) software.
- Study of conventional signs, symbols, physical and socio-cultural features in Survey of India toposheet.
- Study of marginal information.
- Instructional training on uses of Clinometer, Brunton compass and GPS.
- Field trip to understand the geomorphology and topography of an adjacent locality.
- Report preparation on field trip

GEO2B04(P) – GEOINFORMATICS

Credits: 0 **Total Hours: 16**

Course Outcomes

CO 1. The student will be able to work with a GIS software.

- Download and install QGIS software
- Scanning of paper maps / toposheets
- Georeferencing
- Digitisation of points, lines and polygons
- Adding attribute data
- Calculation of length and area of features
- Preparation of map layouts
- Record of the practical done

GEO3B06(P) – CRYSTALLOGRAPHY

Credits: 0 **Total Hours: 32**

Course Outcomes

CO 1. The student will be able to identify and classify the crystal models according to the symmetry elements

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- Study of axial disposition, axial relationship and axial analysis of crystal systems.
- Classification of normal classes of all systems by studying the symmetry elements.
- Identification and description of the following crystal models in normal classes only.
- Isometric system: Galena, garnet, Fluorite, Magnetite.
- Tetragonal System: Zircon, Cassiterite, Rutile, Octahedrite, Apophyllite.
- Hexagonal: Beryl, Calcite.
- Orthorhombic: Olivine, Topaz, Barite.
- Monoclinic: Gypsum, Orthoclase, Augite, Amphibole.
- Triclinic: Axinite, Albite, Kyanite.
- Study of simple twin models.
- Galena-Flourite-Pyrite-rutile-calcite-quartz-staurolite-Gypsum-augite-orthoclase-albite-Calamine
- Study of axial disposition, axial relationship and axial analysis of crystal systems.

GEO4B08(P) – CRYSTALLOGRAPHY, MINERALOGY& GEOINFORMATICS

Credits: 4 **Total Hours: 32**

Course Outcomes

CO1. The student will be able to identify and classify the mineral using its physical properties.

CO2. The student will be able to identify and classify the mineral using its optical properties.

CO3. To learn with the possibilities of GtAide software in the study of coordinates and toposheets

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Megascopic identification:

- Megascopic identification and description of the following: Quartz, smoky quartz, milky Quartz, Rosy quartz, Amethyst, Chalcedony, Agate, Flint, Jasper, Chert, Opal, Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Nepheline, Leucite, Sodalite, Enstatite, Bronzite, Hypersthene, Diopside, Augite, Spodumene, Acmite, Rhodonite, Wollastonite, Anthophyllite, Tremolite, Actinolite, Hornblende, Olivine, Serpentine, Muscovite, Biotite, Vermiculite, Phlogpite, Chlorite, Epidote, Garnet, Natrolite, Stilbite, Apophyllite, Talc, Steatite, Andalusite, Kyanite, Sillimanite, Staurolite, Cordierite, Apatite, Beryl, Topaz, Calcite, Dolomite, Tourmaline, Zircon, Fluorite.

Microscopic identification:

- Megascopic identification and description of the following: Quartz, smoky quartz, milky Quartz, Rosy quartz, Amethyst, Chalcedony, Agate, Flint, Jasper, Chert, Opal, Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Nepheline, Leucite, Sodalite, Enstatite, Bronzite, Hypersthene, Diopside, Augite, Spodumene, Acmite, Rhodonite, Wollastonite, Anthophyllite, Tremolite, Actinolite, Hornblende, Olivine, Serpentine, Muscovite, Biotite, Vermiculite, Phlogpite, Chlorite, Epidote, Garnet, Natrolite, Stilbite, Apophyllite, Talc, Steatite, Andalusite, Kyanite, Sillimanite, Staurolite, Cordierite, Apatite, Beryl, Topaz, Calcite, Dolomite, Tourmaline, Zircon, Fluorite.

GIS Practicals:

- Toposheet search, UTM Zones, Coordinates
- Lattitude and Longitude converter
- Georeferencing
- Digitisation of Point, Line and Polygon features
- Calculation of length and area
- Making of map layout

Record preparation

*This course will include the practical component of the courseGEO1B02(P) – Field Geology, GEO2B04(P) – Geoinformaticsand GL3B06(P) – Crystallography.

GEO5B13(P) – STRUCTURAL GEOLOGY

Credits: 0 **Total Hours: 64**

Course Outcomes

CO1. The student will be able to solve structural problems.

CO 2. The student will be able to work with a structural map in order to identify the structural features embedded with it.

Illustration with the help of neat diagrams of the following:

Attitude of beds, true and apparent dip, strike and dip symbols, rules of 'V', types of Folds, Faults, Joints and Unconformities. Maps with suitable sections and geological descriptions

- Simple horizontal beds – two maps.
- Study of effect of relief on 'V' of outcrops – four maps.
- Simple dipping beds – three maps.
- Simple dipping beds with intrusions – three maps.
- Tracing the outcrops –with three point problems- Three maps.
- Problems involving bore hole data, thickness, dip and apparent dip –three maps.
- Simple dipping beds with unconformity – five maps.
- Folded beds – five maps.
- Maps with different types of faults –five numbers.
- Combination of intrusions, unconformity, folds and faults –six maps.

Structural problems:

Problems involving true and apparent dip, true vertical thickness and width of outcrops. Three point problems.

GEO5B14(P) – PETROLOGY

Credits: 0 **Total Hours: 64**

Course Outcomes

CO1. The student will be able to identify and classify the rocks using its physical properties and mineralogy.

CO2. The student will be able to identify and classify the rocks using its optical properties and mineralogy

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Megascopic identification and description of the following rocks:

- Granite, Graphic granite, Pegmatite, Aplite, Granite Porphyry, Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite, Dolerite, Basalt, Rhyolite, Felsites, Obsidian, Pumice, Scoria.
- Slate, Phyllite, Schists, Gneisses, Quartzite, Marble, Amphibolite, Eclogite, Leptynite, Charnockite, Khondalite, Schorl rock, Banded Magnetite Quartzite
- Conglomerate, Breccia, Sandstone, Arkose, Shale, Limestone, Laterite, Chert, Grit, Lignite.

Microscopic identification and description of the following rocks:

- Mica Granite, Hornblende Granite, Graphic Granite, Syenite, NephelineSyenite, Diorite, Gabbro, Dunite, Peridotite, Granite porphyry, Diorite, Dolerite, Anorthosite, Basalt.
- Slate, Chlorite schist, Mica schist, Kyanite schist, Charnockite, Eclogite, Amphibolite, Khondalite, Augen Gneiss, Garnet Biotite Gneiss,
- Conglomerate, Breccia, Sandstone, Arkose, Shell limestone.

GEO6B20(P) – STRUCTURAL AND ECONOMIC GEOLOGY

Credits: 4 **Total Hours: 64**

Course Outcomes

CO1. The student will be able to solve structural problems.

CO2. The student will be able to megascopically identify and describe the minerals together with a description of their Indian occurrences & uses.

Megascopic identification and description of Indian occurrences & uses of the following ore and industrial Minerals: -

- Sulphides: Realgar, Orpiment, Stibnite, Molybdenite, Galena, Sphalerite, Chalcophyrite, Pyrite, Arsenopyrite, Marcasite.
- Sulphates: Barite, Celestite, Gypsum,
- Oxides: Cuprite, Corundum, Hematite, Ilmenite, Magnetite, Chromite, Cassiterite, Rutile, Pyrolusite, Psilomelane, Goethite, Limonite, Bauxite,
- Carbonates: Calcite, Dolomite, Magnesite, Siderite, Aragonite, Witherite, Strontianite, Cerussite, Azurite, Malachite.
- Industrial Minerals: Halite, Fluorite, Phosphatic Nodule, Monazite, Graphite, Coal and its varities, Asbestos.

Record preparation

*This course will include the practical component of the courseGEO5B13(P) – Structural Geology.

GEO6B21(P) – PETROLOGY AND PALAEONTOLOGY

Credits: 4 **Total Hours: 64**

Course Outcomes

CO1. The student will be able to identify and classify the rocks using its optical properties and mineralogy

CO2. The student will be able to identify and classify fossils according to their morphological features.

Megascopic identification and description of the following fossisls with neat diagrams:-

- **Anthozoa:**Calceola, Zaphrentis, Lithostrotion, Favosites, Halysites, Montlivaltia, Isastrea, Thecosmilia;
- **Brachiopoda**: Sprifer, Productus, Terebratula, Rhynchonella, Athyris, Orthis, Lingula
- **Echinoderma**: Cidaris, Hemicidaris, Micraster, Holaster, Hemiaster, Pentremites,
- **Mollusca-Lamellibranchia**: Arca, Cardium, Cardita, Pecten, Trigonia, Megaladon,
- Spondylus, Gryphaea, Exogyra, Ostrea, Inoceramus, Alectryonia, Hippurities, Venus
- **Mollusca-Gastropoda:**Natica, Turbo, Trochus, Turritella, Cerithium, Conus, Murex, Fusus, Physa, Bellerophon,
- **Mollusca-Cepalopoda**: Nautilus, Goniatites, Ceratites, Acanthoceras, Phylloceras, Scaphites, Baculites, Turrilites and Belemnites,
- **Trilobites**: Paradoxides, Calymene, Phacops, Olenus, Olenellus.
- **Graptolites**: Phyllograptus, Tetragraptus, Didymograptus, Diplograptus, Monograptus,
- **Plant fossils**: Glossopteris, Gangamopteris, Ptillophylum, Lepidodendron, Sigillaria, Calamites, Elatocladus, Vertibraria.

Record preparation.

*This course will include the practical component of the courseGEO5B14(P) – Petrology.

CORE COURSE: GEOLOGY
ELECTIVE

GEO6B22(E01) – ENVIRONMENTAL GEOLOGY

Credits: 3 **Total Hours: 48**

Course Outcomes

Environmental geology involves application of geological knowledge to the investigation of processes occurring at or near Earth's surface in order to mitigate natural hazards and minimize environmental degradation.

CO1. The student will be able to describe the scientific method as applied in the earth sciences; and explain the fundamental concepts and man as a geological agent

CO2. The interaction of man and environmental hazards; explain how earth processes create hazards to life and property

CO3. The interaction of man and Hydrosphere and the interaction of man and atmosphere

CO4. Learn about the global energy scenario and geology and waste management

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Module 1:

- Our place in the environment-humans as agents of geologic change-fundamental concepts of environmental geology. Man as a geologic agent- de forestation-human population explosion-urbanization

Module 2:

- Man and geologic hazards-mass wasting and its human impacts-factors that influence slope stability- earth quakes hazards and risks- prediction and control of earth quakes

Module 3:

- Man and hydrosphere- pollution of surface water-pollution of ground water-saline water intrusion- pollution in the marine environment

Module 4:

- Man and atmosphere- atmospheric change as a natural process-anthropogenic impacts on the atmosphere- depletion of ozone-global warming- green house effect

Module 5:

- The global energy scenario- energy from fossil fuels- energy alternatives-environmental impacts of mining-waste management

Essential Reading:

1. Donald R coates, Ed 1973 Environmental Geomorphology and Environmental geo science. Willey international
2. Donald R coates, 1981, Environmental geology, John wiley and sons
3. Peter T Elawan ,1970. Environmental geology, Harper & Raw

GEO6B22(E02) – DISASTER MANAGEMENT

Credits: 3 **Total Hours: 48**

Course Outcomes

CO1. Students learn about different types of disasters and the laws of regulations

CO2. Different categories of disasters and their causes, effects and remedial measures

CO3. Learn about the vulnerability and risk assessment factors

CO4. Disaster management and application of GIS in management

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Module 1:

- Introduction- Hazard and Disaster: Definition and terminologies - Classification. Concept of Disaster Management- Comprehensive Disaster Management Plan. Elements of Disaster Management Plan. Disaster Management Act, 2005. Institutional framework - Policy and Administrative frame work for DisasterManagement

Module 2:

- Natural Disasters - Earth quake, Land Slide, Avalanches, Volcanic eruptions - Their Case Studies. Heat and Cold waves. Coastal Disasters. Coastal Regulation Zone. Cyclone - Case Studies. Flood - Case Studies. Drought - Case Studies. Tsunami - Case studies

Module 3:

- Man-made Disasters. Rail, Road, Air and Sea accidents. Dams and Dam bursts. Environmental Planning and Design of Dams. Environmental Impact of Dam. Dam safety, failure and mitigation measures Nuclear Disasters, Chemical Disasters. Biological Disaster .Building fire, Coal fire/Forest fire and Oil fire. Air pollution, Water pollution, Industrial pollution: Types of Pollutants - Heavy metals Pesticides, Petroleum Hydro Carbons. Abatement, Mitigation and Management of Environmental pollution Hazards. De-forestation. Climate change: Global warming, sea level rise, Ozone Depletion- Causes and Effects

Module 4:

- Risk Assessment and Vulnerability Analysis- concepts and elements, Hazard, Risk and Vulnerability, Understanding risk, Risk Reduction.Vulnerability: Social and Economic Factors. Strategies for Survival. Vulnerability and Development

Module 5:

- Disaster Management. Prevention, Preparedness and Mitigation; Disaster Preparedness Plan. Application of Information Technology in Disaster

Preparedness. Applications of GIS in disaster management. Trauma and Stress Management. First Aid, and Emergency procedures, Warning Systems

Essential Reading:

1. Abbott .P.C (2002); Natural Disasters, Mcraw- Hill Publications-New Delhi
2. Coates D.R (1985) ; Geology and society chapman and hall publishers- New Delhi
3. Davisetal (1976) Environmental Geoscience Niley Eastern
4. Howard .A.D and Irwin Remson (1978); Geology in Environmental Planning, M.C Graw-hill publications
5. Keller. E.A (1976); Environmental Geology. Charles E.Merril Publishers, New Jerseys
6. Lundgren. L. (1986) Environmental Geology. Prentice-Hall publishers, New Jerseys
7. Strahler. N. and Strahler. A.H (1973); Environmental Geoscience; Willey eastern

GEO6B22(E03) – GEO EXPLORATION

Credits: 3 **Total Hours: 48**

Course Outcomes

- This course will help the students to learn the fundamentals of mapping and basic concepts of geological as well as geophysical methods of exploration.
- Understand the basic concept of topo sheet
- Learn the basic principles of Brunton Compass
- Know about various geological guides in geo exploration
- Understand the basic principles of geophysical exploration, resistivity survey and well logging survey
- Know the fundamentals of gravitational and geomagnetic aspects of geo exploration
- Learn about the application of seismic survey and radioactivity in geo exploration
- Understand the about the elemental abundance in the crust and about the geochemical exploration of economically important minerals.

Module 1:

- Geological exploration; marginal information of toposheets and working principles with Brunton compass. Principle of making pits and trenches. An introductory knowledge of different types of drilling. Stratigraphic, structural, mineralogical and geomorphological guides in ore search

Module 2:

- Geophysical exploration; scope and limitations of geophysical techniques. Principles involved in geoelectrical survey. A brief introduction about self potential and resistivity surveys. Basic principles of well logging surveys

Module 3:

- Geodectic aspects of earth. Newtons law of gravitation- gravity corrections-gravimeters- applications of gravity in exploration. Geomagnetic field of earth. Principles of magnetism, Hysterisis loop- magnetometers-interpretation magnetic data- application magnetic survey

Module 4:

- Elastic constants, properties of seismic waves-geophones-refraction path of seismic waves in simple, horizontal two layer case. Basic principles of seismic reflection, application of seismic survey. Principles of radioactivity and its utility in geo exploration

Module 5:

- Geochemical exploration; abundance and types of elements in earth crust, mobility of elements, the electronic structure of atoms and the periodic table, chemical bonds, Geochemical exploration for copper and gold, principles of bio geo exploration-indicator plants, interrelation between geo exploration techniques

Essential Reading:

1. Dohr.G.(1984) Applied geophysics- English Book Department
2. Dobrin.M.B (1981) Introduction to geophysical prospecting- McGraw Hill
3. Kearney .P and Brooks M(1984) An introduction to geo physical exploration- ELBS
4. Mckinstry.H.E (1960) mining geology. Asia publisher house
5. Mason.B.(1966) principles of geo chemistry-Willey Toppan
6. RamachandraRao.M.B (1975) out lines of geo physical prospecting- a manual for geologist university of mysore
7. Hawkes.H.E and Webh.V.S. (1962) geo chemistry in mineral exploration.

GEO6B22(E04) – GEOTECHNICAL ENGINEERING

Credits: 3 **Total Hours: 48**

Course Outcomes

- This course will help the students to learn the fundamentals of mapping and basic concepts of geological as well as geophysical methods of exploration.
- Know about various geological sampling methods and principles
- Understand the basic principles of geophysical exploration, resistivity survey and well logging survey
- Know the fundamentals of rock classification tests
- Learn about the application of seismic survey and radioactivity in geo exploration
- Understand the about the classification of soils

Module 1:

- Geo-technical engineering as a field science related to construction. Scope of geo-technical engineering. Ground investigations – Introduction, Types of ground investigation, Geological mapping for ground investigation

Module 2:

- Field investigations - Introduction, Excavations and boreholes - Shallow trial pits, Deep trial pits and shafts, Headings (adits), Hand auger boring, Light cable percussion drilling, Mechanical augers, Wash boring and other methods, Backfilling excavations and boreholes

Module 3:

- Sampling. Frequency of sampling. Sampling the ground - General principles, Sample quality. Disturbed samples from boring tools or from excavating equipments, Types of samplers - Open-tube samples and samplers, Stationary piston sampler, Continuous soil sampling, Sand samplers, Rotary core samplers, Window sampler, Block samples. Handling and labelling of samples
- Field and lab tests

  Field tests – Introduction, Tests in boreholes - Standard penetration test (SPT). Permeability test and Packer test. Pressuremeter test.Pumping tests.Geophysical surveying (Electrical resistivity, Gravity, Magnetic, Seismic methods.

- Laboratory tests on samples - Tests on soil - Classification tests - Moisture content/ water content determination, Liquid and plastic limits (Atterberg Limits), Particle size distribution (grading) by sieving. Soil strength tests - Triaxial compression test and Unconfined compression test. Compaction-related tests - Dry density (dry unit weight)

Module 4:

- Tests on rock
- Rock classification tests - Saturation moisture content (alteration index), Bulk density, Moisture content, Petrographic analysis, Hardness and abrasiveness, Carbonate test, Swelling test. Rock strength tests - Point load test, Uniaxial Compression, Direct tension test, Indirect tensile strength test (Brazil test).

Module 5:

- Logging - Description of soils and rocks
- Description of soils - Mass characteristics of soils. Material characteristics of soils – Colour, Particle shape, grading and composition.
- Description and classification of rocks - General description - Strength of rock material, Structure, Colour, Texture, Grain size, State of weathering, Rock name.
- Total core recovery (TCR), solid core recovery (SCR), Rock Quality Designation (RQD

Essential Reading:

1. Canadian Geotechnical Society, Canadian Foundation Engineering Manual. 3rd Ed.
2. Canadian Geotechnical Society, Technical Committee on Foundations, BiTech
3. Publishers Ltd., Richmond, British Columbia, 1992.
4. Nielsen, David M., (ed.). Practical Handbook Of Ground-Water Monitoring. Lewis
5. Publishers Inc., Chelsea, Michigan, 1991.
6. Coduto, D.P., Component: Geotechnical Engineering: Principles and Practices. Prentice
7. Hall, NJ, 1999.
8. Lambe, T.W., Soil Testing for Engineers. BiTech Publishers, Vancouver, 1991.
9. Hoek, Evert and John Bray, Rock Slope Engineering. London: Institution of Mining and
10. Metallurgy, 1981.
11. Hoek, Evert and Edwin T. Brown, Underground Excavations in Rock. London: Institution
12. of Mining and Metallurgy, 1982.

OPEN COURSE: GEOLOGY
(FOR OTHER STREAM)

GEO5D01 – UNDERSTANDING THE EARTH

Credits: 3 **Total Hours: 48**

Course Outcomes

- Students learn about the layers and of the earth and composition
- Fundamental concepts of plate tectonics
- Oceans, their geological work and ocean bottom topography
- Learn about the natural hazards like earthquakes and landslides

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Module 1:

- Earth – Structure and composition – Layers, discontinuities and their properties.
- Types of rocks - brief introduction to Igneous, sedimentary and metamorphic rocks; Concept of rock cycle.

Module 2:

- Continental drift; sea floor spreading and evolution of plate tectonic theory.
- Different kinds of plate margins; Convergent-divergent-transform;
- Evidences and significance plate motion.

Module 3:

- Oceans – their distribution.
- Ocean bottom topography- mid ocean ridges; guyots; seamount; trenches; submarine canyons; continental rise; continental slope; continental shelf.
- Coastal landforms. Geological work of Oceans

Module 4:

- Natural hazards – Earthquake- seismology; focus and epicenter; different kinds of seismic waves; intensity; magnitude; Ritcher scale; Seismograph and seismogram;
- Volcanoes – classification; eruption style; products;
- Seismic and volcanic belts of the world. Tsunami.
- Landslide – Mass wasting- types, causes and prevention

Module 5:

- Earth processes: Geological agents – wind; running water; glaciers and work – erosional and depositional features.
- Weathering and soil formation

Essential Reading:

1. Plumer, Carlson, Mc Geary(2003), Physical geology, published by McGraw -Hill
2. Bloom,A, Geomorphology,CBS, New Delhi
3. Ahamed, E. Coastal geomorphology of india. Orient long man, New Delhi, 1972
4. Thornbury .W.D Principles of geomorphology, Wiley 1968

GEO5D02 – GEMMOLOGY

Credits: 3 **Total Hours: 48**

Course Outcomes

CO1. Learn about types of gemstones , their qualities and occurrence within the Eart

CO2. Their physical chemical and optical properties factors of selection of gemstones

CO3. Their occurrence in India

Module 1:

- Gems and Jewelry. Navarathnas. Evolution of science of gemology. History of Gem industry In India- ancient and recent. Diamond cutting industry. Coloured stone industry. Gems in ayurvedha. Geological distribution

Module 2:

- Minerals and rocks. The formation of gemstones in the earth crust. Essential qualities of gem materials, organic and inorganic gems, gem testing. The major gem occurrences of the world

Module 3:

- Chemical composition of gemstones. The relationship between chemical composition and durability. Important Physical and optical properties of gemstones. Groups, species and varieties of gemstones with special reference to Ruby, Sapphire, Aquamarine, Alexandrite, Emerald, Opal, Topaz, Tourmaline and Diamonds

Module 4:

- Factors influencing the choice of a precious stone, definition of synthetic gem. Cutting and polishing of gemstones. Cutting with reference to diamonds, artificial colouring of synthetic gems, distinction between natural and synthetic gemstones

Module 5:

- Gemstone occurrences in India. Marketing values of gemstones

Essential Reading:

1. R.V. Karanth. Gems and Gem industry in India(2000)
2. Peter G.Readgemmology
3. Phlips.W.R. (1986); Optical Minerology-Giffen
4. Dana.F.S.(1955); A text book of Minerology Asia publishing House Willey

GEO5D03 – GROUND WATER EXPLORATION AND MANAGEMENT

Credits: 3 **Total Hours: 48**

Course Outcomes

CO1. The students learn about occurrence, distribution and movement of water and properties of rocks in relation to the conduct of water through them

CO2. Learn about the methods of groundwater exploration

Co3. Understand the well design techniques and water quality parametres

CO4. Groundwater Management techniques

Module 1:

- Origin- meteoritic, juvenile and connate waters. Hydrological cycle, occurrence; ground water occurrences in igneous, sedimentary and metamorphic rocks-vertical distribution of ground water, movement; classification and types of aquifers, definition of porosity, permeability, specific yield, specific retention, storage and transmissibility

Module 2:

- Groundwater detection; surface methods-geomorphological, structural and biological evidences. Surface geophysical methods; principles, field procedures, electrode arrangements, instruments and interpretations involved in electrical resistivity method of ground water exploration. Brief account of role of remote sensing in ground water targeting

Module 3:

- Well design and well development; brief introduction about dug wells, tube wells, jetted wells, infiltration galleries and collector wells, well screening and artificial packing. Well development through surging and acidizing. Methodology and need for pump test

Module 4:

- Water quality; Quality of water in various rock types, water quality parameters and their standards proposed by WHO and BIS. Physical parameters of water quality. Chemical parameters and determining methods. Diseases and virological aspects of ground water and remedial measures

Module 5:

- Ground water management; meaning of water shed and river basins. Ground water provinces of india. Ground water potentiality in Kerala. Seawater intrusions

and remedies. Cloud seeding, artificial recharge and ground water harvesting techniques

Essential Reading:

1. Davis S.N and Dewiest (1966)-Hydrogeology, John wiley and sons.
2. Bouwer . H. Ground water hydrology,1978
3. Todd,D,K. ground water hydrology,Johnwiley and sons 1980
4. Tolman C. F, Ground water,McGraw Hill
5. Walton,W.C., Ground water resource evaluation, McGraw Hill,1970

COMPLEMENTARY COURSE: GEOLOGY
REMOTE SEINSING AND GIS

GEO1C01 - INTRODUCTION TO REMOTE SENSING AND GIS

Credits: 2 **Total Hours: 32**

Course Outcomes

CO1 – Understand the principles of aerial remote sensing

CO2 – Understand the different elements of image interpretation and the concepts of photogrammetric instruments and its applications such as the determination of heights of objects on the terrain.

CO3 – Understand the basic concepts of remote sensing, the various sources of energy and their interactions with the atmosphere and the earth's surface features

CO4 – Explain the concepts and fundamentals of GIS

CO5 – Understand the concept of projection system, datum, scale and types of maps

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Section A – Remote Sensing

Module 1:

- Introduction to Aerial Photography- Overlaps, Flight lines, Drift, Crab, Tilt, Dead ground
- Geometry of aerial photography- Scale, Principal point, Perspective centre, Fiducial marks, nadir, Focal length, Airbase, Photo base, Isocentre, Relief displacement.
- Types of cameras and films
- Types of aerial photographs- Based on scale, orientation of camera axis, lens system, special properties of films, filters or photographic equipment.

Module 2:

- Introduction to image interpretation
- Elements of image interpretation- Tone, Texture, Shape, Association, Pattern, Shadow, Size
- Stereoscopy
- Photogrammetric Instruments

Module 3:

- Concept of Remote Sensing. Basic principles of remote sensing- Stages in remote sensing process.
- Energy source- EMR. Characteristic of EMR –wave nature and particle nature. EMR spectrum
- Interactions ofEMR with atmosphere-Absorption, atmospheric windows, Scattering, Refraction, Reflection.
- Interactions of EMR with earth's surface features- Absorption, Reflection- Specular & Diffuse, Transmission

Section B –GIS

Module 4:

- Definition of GIS, Components of GIS-Hardware, Software, People, Methods, Data
- Important GIS software producers and their products
- Functions of GIS
- Limitations of GIS

Module 5:

- Map: Overview
- Elements of a map-Scale, Datum, Coordinate system, Projection.
- Types of Map Projections (Azhimuthal, Conical, Cylindrical).
- Types of Maps-Topographical map,Cadastral map, Thematic map.

GEO2C03 - DATA SOURCES OF REMOTE SENSING AND GIS

Credits: 2 **Total Hours: 32**

Course Outcomes

CO1 – Understand the various types of remote sensing and the behaviour of basic land cover types

CO2 – Understand the various types of platforms, their orbits, orbit control and satellite positioning system

CO3 – Understand the different types of sensor and sensor parameters

CO4 – Compute knowledge of GIS in different applications

CO5 – Understand the sources of data in GIS and the data models used in GIS. Differentiate the spatial and non-spatial data, data format and types.

Section A – Remote Sensing

Module 1:

- Blackbody radiation- Kirchoff's Law, Stefan Boltzmann Law, Wein's displacement Law.
- Types of remote sensing based on energy source – active & passive
- Types of remote sensing with respect to wavelength regions- Optical Remote sensing, Thermal infrared remote sensing, Microwave remote sensing
- Spectral reflectance of land covers- Soil, Clear water, Turbid water, Vegetation-Healthy and diseased.

Module 2:

- Platform: Types of platforms- Ground borne, Airborne (Balloons, Aircrafts, UAV) &Spaceborne (Sun-synchronous & Geo-synchronous)
- Attitude of platform- a. Rotation angles around the three axes;roll, pitch and yaw b. Jitter.
- Attitude control of a satellite (spin control and three axis control). Attitude sensors
- Orbital elements of satellite- six elements of Keplerian orbit.
- Orbit of satellite- Geosynchronous orbit, Sun synchronous orbit, Semi-recurrent orbit.
- GNSS – GPS, GAGAN

Module 3:

- Sensors- Classification of Sensors. Sensor Parameters-Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution.
- Components of sensors-Dispersing element, Spectroscopic filter, Spectrometer, Optical detectors
- Methods of scanning- Across-track scanning & Along-track scanning
- Hyperspectral imaging
- Atmospheric sensor, Sonar, LiDAR.

Section B –GIS

Module 4:

- GIS as a multidisciplinary science- Geography Statistics Cartography Operations Research Remote Sensing Computer Science Photogrammetry Mathematics Surveying Civil Engineering Geodesy Urban Planning etc.
- Areas of GIS applications- Facilities Management, Environment and Natural Resources Management, Street Network, Planning and Engineering, Land Information System.
- GIS for decision support.

Module 5:

- Sources of data in GIS- Introduction, Analog map-Topographical map Thematic map and Geologic maps, Aerial photos, satellite imageries, Ground survey with GPS, Reports and Publications-Socioeconomic data ,census data.
- Data model: Spatial data model-Raster data model and vector data model, Advantage and Disadvantages of Raster and vector data model; Non spatial data model- Hierarchical model ,Relational model, Network model, Relational model; Hybrid data model – Quad tree and vector topology.

GEO3C05 - SATELLITE REMOTE SENSING AND GIS DATA MANAGEMENT SYSTEM

Credits: 3 **Total Hours: 48**

Course Outcomes

CO1 – Explain the energy matter interaction mechanisms and data acquisition in the thermal and microwave region of the EM spectrum

CO2 – Explain the history of Indian remote sensing and the present scenario of satellite remote sensing in India

CO3 – Understand about the earth resources satellite and geostationary meteorological satellites

CO4 – Understand the various data input methods in GIS and the concept of DBMS

CO5 – Explain the GIS data editing methods

Section A – Remote Sensing

Module 1:

- Optical Remote Sensing- Panchromatic, Multispectral, Hyperspectral, superspectral.
- Microwave Remote Sensing- Introduction, attenuation of microwave, microwave radiation, surface scattering, volume scattering, Synthetic aperture radar, Real aperture radar, Types of antenna.
- Thermal remote sensing.

Module 2:

- History of Indian Remote Sensing
- Satellite remote sensing scenario in India- IRS & INSAT satellite system, Launch vehicles,Antrix, Bhuvan
- Major Indian Space Centres- ISRO, NRSC, IIRS

Module 3:

- Earth resource satellites: Landsat series& SPOT
- Geostationary meteorological satellites: GOES, Meteosat

Section B –GIS

Module 4:

- Data input –Introduction, Entering the data -Analogue, Digital data. Methods of entering data -Manual digitizing –Heads-up digitising, and Heads down digitizing; Automatic digitizing-Scanning and Electronic line following; Electronic data transfer, Keyboard entry.

- Data management in GIS-Database approach, Database management system, Designing a Database, GIS database applications.

Module 5:

- Data editing - Detecting and correcting errors- Dangles, Psuedonode, Duplicate lines, Silver polygon. -Reprojection, Transformation, Reduction and Generalization. - Edge-matching and Rubber sheeting.
- Querying Data-Queries, Types of Queries- Spatial and Non Spatial, Combining Queries-Boolean Operators AND, OR and NOT

GEO4C07 - APPLICATIONS OF REMOTE SENSING AND GIS

Credits: 3 **Total Hours: 48**

Course Outcomes

CO1 - Compute knowledge of remote sensing in different applications

CO2 – Understand the basic digital image processing techniques

CO3 – Learn the topological and layering concept in GIS

CO4 – Familiar with GIS spatial analysis, identifying the sources of errors in GIS data and the types of GIS output

CO5 – Familiar with GIS installation

Section A – Remote Sensing

Module 1:

- Application of Remote Sensing in:
  - Land use Land cover mapping
  - Agriculture: Crop monitoring, crop damage assessment, NDVI
  - Geology: Structural mapping, lineament extraction, mineral exploration
  - Hydrology: Water quality monitoring
  - Mapping: Planimetry, DEMs, Topographic & BTM
  - Oceans: Measurement of SST, Oil spill detection

Module 2:

- Introduction to digital images
- Digital Image Processing- Preprocessing (Radiometric Correction, Geometric Correction), Image Enhancement, Spatial Filtering, Classification Methods (Supervised & Unsupervised)
-

- **Section B –GIS**

Module 3:

- Topology: Definition of Topology. Topology and Spatial Relationships- Adjacency,Containment, Connectivity. Topological Data structure-Nodes, Arcs, Polygons. Advantages ofthe Topological Data Structure. Building a Topology in GIS.
- Layering Concept in GIS

Module 4:

- Sources of error in GIS- Obvious sources of errors, Error resulting from naturalvariation or from original measurement, Error arising through processing.
- Data Analysis: SpatialAnalysis Surface Analysis, Network Analysis.
- Output in GIS: Cartographic Output and Non-cartographic Output.

Module 5:

- Installation of GIS-
- Keys for successful GIS, Reasons for unsuccessful GIS
- Human resources for GIS
- Cost analysis for GIS project

Essential reading:

1. Elements of Cartography, 6th edition.- Robinson, Arthur H., Morrison
2. Geographical Information Systems and Computer Cartography- Jones, Christopher. 1997
3. *Remote sensing and image interpretation (5th ed.)-Lillesand, T.M.; R.W. Kiefer, and J.W. Chipman*
4. Remote Sensing of the Environment- Jensen, John R
5. Introductory Digital Image Processing- Jensen, John R., 2005
6. Remote Sensing and Geographical Information system (sec ed)-M.Anji Reddy
7. Principles of Geographical Information Systems for Land Resources Assessment- Burrough P.A and Frank A V
8. Geographical Information Systems for Natural Resources Assessment- Burrough P.A
9. *Remote sensing digital image analysis: an introduction (4th ed.).*
10. Principles and Applications of Photogeology -SHIV N.PANDEY
11. GIS Fundamentals, A First Text on Geographic Information Systems- Bolstad, Paul. 2005
12. Introduction to GIS –Dr M A Siddiqui
13. Basics of Remote sensing and GIS-Dr S Kumar
14. A guide to Image Interpretation-Dr Gary Prost
15. GIS: A Visual Approach- Davis, Bruce E. 2001
16. GIS and AutoCAD Map-NIIT

17. Physical Principles of Remote Sensing- W. G. Rees
18. An Introduction to Ocean Remote Sensing- Seelye Martin
19. Spatial Databases- Shekhar, Shashi, and Sanjay Chawla.
20. GIS Work Book Fundamental course ShunjiMurai
21. GIS Work Book TechnicalcourseShunjiMurai
22. Remote Sensing Notes- Japan Association of Remote Sensing
23. Remote Sensing of Landscapes with Spectral Images- John B. Adams, Alan R. Gillespie

COMPLEMENTARY COURSE:
REMOTE SENSING AND GIS (PRACTICAL)

GEO1C02(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-I

Credits: 0 **Total Hours: 32**

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1. Draw Spectral reflectance signature curve for different land covers
2. Cartography(Manual)- Choropleth map, Dot map, Isarithmic map, Proportional symbol map
3. Digitization

GEO2C04(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-II

Credits: 0 **Total Hours: 32**

Course Outcomes

Students learn on the identification of features on toposheets and aerial photographs

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1. From the aerial photographs supplied to you, identify the cultural/ geomorphological features and mark them on the corresponding toposheet.
2. Photogrammetry exercises (without the aid of instruments)
   a. Calculation of Photoscale
   b. Calculation of Relief displacement
   c. Calculate the number of aerial photographs for the given area
3. Viewing Photographs Stereoscopically
4. Stereoscopic depth perception
5. On screen digitization -Georeferencing

GEO3C06(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-III

Credits: 0 **Total Hours: 36**

Course Outcomes

Students will be able to interpret aerial photographs

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1. Preparation of aerial mosaic.
2. Prepare a base map-Drainage, Road network, contour from the given grid of toposheet/satellite imagery by using Light table
3. Interpretation aerial photographs.
4. Aerial photographs stereoscopic vision-Measurement of height,Parallax measurement
5. On screen digitization- Georeferencing- attribute data entry

GEO4C08(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-IV

Credits: 4 **Total Hours: 36**

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1. Satellite image interpretation.-Panchromatic image,Multispectral,Truecolour,Falsecolr composite
2. Digital image processing.
3. On screen digitization- Georeferencing -attribute data entry- Linking of Spatial data and Non spatial data -Spatial analysis-Query-model-GIS Output in the form of Map/Graph/Chart
4. Preparation of different thematic layers from satellite imageries / Toposheet by using GIS

COMPLEMENTARY COURSE: GEOLOGY
(FOR OTHER STREAM)

GEO1CO1 – EARTH AS A SYSTEM

Credits: 2 **Total Hours: 32**

Course Outcomes

- Students will learn about the different spheres within the Earth
- Also understand different geological agents like streams, glaciers, earthquakes

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Module 1:

- Introduction to Earth Science: Earth in the solar system; size, shape and dimension of the earth.
- Lithosphere; Hydrosphere; Atmosphere; Biosphere; Geological significance of major interfaces.
- Geological processes: Types of rocks; Rock cycle; Weathering– Physical and chemical and biological

Module 2:

- Mass movement: definition, causes, types-Landslides- Soil – types. Ground water-source- types, Hydrologic cycle.
- Water bearing rock formation- Types of wells- Geological work of ground water. Ground water flow.

Module 3:

- Streams- Types- Drainage pattern and drainage basin. Geological work of streams. Land forms developed by streams.
- Wind- Geological work of wind. Types of Aeolian land forms. Deserts of the world.

Module 4:

- Glaciers- Types, distribution, geological work of glaciers, glacial land forms- Ice ages. Oceans- composition of sea water- eustatic change of sea level and their causes. Marine sediments and environment, submarine topography. Coral reefs, coral landforms. Mineral deposits of ocean floor.

Module 5:

- Earthquake- causes, types, seismic waves, epicenter, focus, isoseismal lines, intensity and magnitude. Seismograph- seismic belt- Interior of the earth.
- Volcanoes- classification and distribution Volcanic landforms. Volcanic products

Essential Reading:

1. Arthur Holmes-Principles of Physical Geology
2. Arthur N. Strahler- The Earth Sciences
3. LennisBarlin (!980) , Earthquakes and urban Environment , Vol.1, 2 & 3.
4. Davisetal (1976) Environmental Geoscience NileyEastern .
5. Weller, Stratigraphic principles and practice,Harper and Raw ,1959
6. Donald R coates, 1981, Environmental geology, John wiley and sons

7. Plummer, Mc Geary Carlson- Physical Geology
8. Parbinsingh- Engineering and general Geology

GEO2C03– ROCKS AND MINERALS

Credits: 2 **Total Hours: 32**

Course Outcomes

Students are able to know about the crystals and their properties

Understand the important properties of common minerals

Formation and types of igneous, sedimentary and metamorphic rocks

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Module 1:

- Crystalline and non-crystalline substances: Amorphous material; Minerals; Physical properties of minerals (Colour, Streak, Luster, Fracture, Cleavage, Hardness, Transparency, Specific gravity)
- Crystals – Crystal systems and their symmetry; Significance of the study of crystals as an aid to mineral identification

Module 2:

- Chemical composition and diagnostic properties of the following minerals:
  Quartz, Feldspar, Mica, Amphiboles, Pyroxenes, Magnetite, Haematite, Gypsum, Garnet, Kyanite, Sillimanite, Calcite, Barite, Apatite, Corundum, Chromite, Ilmenite, Pyrite, Sphalerite, Graphite, Diamoand, Gold, Silver, Chalcopyrite, Talc, Galena, Fluorite, Magnesite, Beryl, Psilomelane, Pyrolusite, Dolomite.

Module 3:

- Magma – Lava: Types, Origin, Physical properties and chemical composition.
- Textures and Structures of igneous rocks.
- Modes of occurrences: Dyke, Sill, Laccolith, Lopolith, Stock, Batholiths, Traps.
- Classification of igneous rocks; Megascopic study of the following rocks: Granite, Pegmatite, Rhyolite, Basalt, Gabbro, Dolerite, Dunite, Syenite, Pumice, Diorite.

Module 4:

- A Brief study on the origin of sediments and sedimentary rocks.
- Texture and structures of sedimentary rocks.
- Field classification of Sedimentary rocks.
- Megascopic study of Conglomerate, Breccia, Sandstone, Shale, Limestone, Laterite and Lignite.

Module 5:

- Metamorphism and Metamorphic rocks.

- Metamorphic Processes. Textures and Structures of metamorphic rocks.
- Megascopic study of the following metamorphic rocks: Slate, Phyllite, Schist, Amphibolite, Gneiss, Granulite, Marble, Charnockite, Khondalite

Essential Reading:

1. Dana, F.S. 1955 – A text book of mineralogy – Asia publishing House, Wiley.
2. Read, H.H- 1974, - Rutley's elements of mineralogy – Thomas murby& co.
3. Mason B and Berry, L.G- Elements of Mineralogy – W.H. Freeman & Co.
4. Deer. W.A.,Howie. R.A and Zussman, J. -1966 .An introduction of the Rock forming minerals. Longmans.
5. Berry, Mason, Dietrich,2000 - Mineralogy, CBS Publication
6. CornelisKlen and Cornelius S. Hurlbut , 1985 – Manual of Minerology, John wiley& Sons
7. Chakrapani-
8. Naidu, P.R.J, Optical Mineralogy.
9. Philips,W.R Mineral Optics-Principles and techniques.
10. Kerr.P.F- Optical Mineralogy.
11. Winchell. A.N-Elements of Optical Mineralogy.
12. Battey, M.H., Mineralogy for students.
13. Tyrrell, G.W. 1978 -Principles of petrology – Chapman and Hall Ltd., London.
14. Bowen, N.L.-The Evolution of the Igneous Rocks – Dover publication, Inc, New York.
15. Barth, FW. 1962-Theoretical petrology - Wiley.
16. Walstrom, E.E. 1961- Theoretical Igneous petrology, Wiley.
17. Turner.F.J and Verhoogen.J –1960.- Igneous and Metamorphic petrology – McGraw Hill.
18. Hatch, F.H. Wells, A.K.-Petrology of Igneous Rocks, Thomas Murby& Wells, M.K. – 1949
19. Johannesen, A – 1962-Descriptive petrography of Igneous Rocks, Vols. I to IV - Allied Pacific.

GEO3C05 – GEOLOGICAL STRUCTURES, FOSSILS, AND TIME

Credits: 2 **Total Hours: 48**

Course Outcomes

- Students will understand the structural features of rock formations
- Classification of folds, faults and joints
- Students will learn about the formation of mountains and basics of plate tectonics
- Also learn about the types of fossils and fossilization
- Basic principles of stratigraphy

Module 1:

- Rock out crops: Attitude of beds- Primary and secondary structures. Measurement of attitude of planar and linear structures- unconformities and their geological significance.
- Folds- geometrical elements- Geometric classification. Antiform, synform, anticline, syncline, anticlinorium, synclinorium, geanticline, gesyncline , isoclinal folds, recumbent fold, overturned fold, Nappe

Module 2:

- Faults- Basic terminology, Types of faults. Mechanics of faulting- Normal fault, Reverse fault, strike slip fault, dip slip fault,oblique slip fault, horst, graben, rift valley. Joints- Types of joints and their geological significance. Planar and linear structures- Foliation, lineation

Module 3:

- Geotectonics- Plate tectonics- Continental movement, Plate margins- Palaeomagnetism, Ocean floor spreading.
- Mountains- Orogenic and epirogenic movements, Types of mountains.
- Structural maps, topographic maps, geological maps- Map study and interpretation- Preparation of maps, Conventional symbols.

Module 4:

- Palaeontology- Fossilization and fossils- Uses of fossils, Types of fossilization , Index fossils. General morphology of typical Trilobites, Brachiopods, Lamellibranchs, Gastropods, and Cephalopods

Module 5:

- Stratigraphy- Laws of Stratigraphy; concept of Uniformitarianism, law of order of super position, law of faunal succession, law of original horizontality, law of cross cutting relationship, physical and biological criteria of correlation
- Geologic Time scale and its units - Eon, Era, Period, Epoch

Essential Reading:

1. Billings M.P. structural geology, 11 edition,prentice hall,1974

2. Hills,E.S. elements of structural geology
3. Hobbs .B.E., means,W.D and William P.F an out line of structural geology, John wiley,1976
4. John L. Robbers, introduction to geological maps and the structures, Pergamon press
5. Ken MeClay the mapping of geological structures, geological society of London, John wiley and Sons.
6. Henry woods : Invertebrate palaeontolgy – Cambridge.
7. Romer , A.S.: Vertebrate palaeontology, Chicago press.
8. Arnold, C.A., An introduction to Palaeobotany., MC-Graw Hill.
9. B.U. Haq and A. Boersma (1978) Introduction to marine Micropalaeontology. Elsevier, Netherlands
10. Raup, D.M. and Stanely, M.S.: Principles of Palaeontology, CBS Publishers.
11. Moore , R.C., Laliker , C.G.&Fishcher, A.G.: Invertebrate Fossils , Harper brothers
12. Shrock. R.R. and Twenhofel , W.H – 1953 : Principles of invertebrate Palaeontology, Amold publication
13. Ravindrakumar K.R. - Stratigraphy of India.
14. Lemon R.Y (1990) - Principles of Stratigraphy, Merrill Publishing Co.
15. Gregory , J.W. and Barret B.H- General Stratigraphy.
16. Dunbar.C.O&Rogers.J 1961 Principles of Stratigraphy. Willey.
17. Krumbein.W.C. &Sloss.L.D 1963 Stratigraphy &Sedimentation.Freeman

GEO4C07– GEOLOGY AND MINERAL WEALTH OF INDIA

Credits: 2 **Total Hours: 48**

Course Outcomes

- Students will learn about the major stratigraphic formations of India and Kerala
- Learn about the economic mineral formations
- Processes of ore formations
- Get an idea on the impact of disasters
- Importance of geoscience study in disaster management

Module 1:

- Major Geological divisions of India – Precambrian, Cuddapah Super Group, Vindhyan Super Group, Deccan Traps, Jurassic of Kutch, Cretaceous of Trichinopoly, Tertiary formation, Quarternary, Indo Gangetic Alluvium, Brief study of the Stratigraphy of Kerala - Precambrian, Tertiary and Quaternary

Module 2:

- Economic Geology- Ore and gangue minerals. Industrial minerals.
- Bauxite, Copper deposits, Lead and Zinc deposits, Iron deposits, Radioactive minerals, Manganese deposits, Chromite deposits, Gold deposits, Beach sands

Module 3:

- Types of ore formation- Brief study.
- Magmatic process, hydrothermal process, Residual formation, Mechanical concentration.
- Selected mineral deposits in India: Kundremukh Iron ore, lead and zinc deposit of Zawar, Kolar and Wayanad gold fields, Nellur mica deposits, Manganese deposits

of Karnataka, Khetri copper deposits, Bauxites of Kerala, Neyvelli Lignite, Petroleum deposits of Bombay High, Cauvery and North East. Coal deposits of Bihar

Module 4:

- Environmental Geology: Human impact on environment. Waste management. Ecology and environment. Air pollution, Water pollution, Impact of chemical residues on human health. Change of life style- Water conservation. Salt water intrusion. Sustainable development

Module 5:

- Geoscience and Disaster Management. Disasters - Natural and human made. Role of geologists in disaster management. Effect of earthquake, landslides, flooding and Tsunami on human being- Mitigation measures. Warning system for natural disasters

Essential Reading:

1. Krishnan M.S. (2003) - Geology of India and Burma, 6th Edition, CBS.
2. Wadia D.N. (1953) – Geology of India, TATA McGraw – Hill.
3. Ravindrakumar K.R - Stratigraphy of India.
4. Pascoe, E.H.(1968) - A manual of the Geology India and Burma, Govt of India Publications.
5. GSI publications, Bangalore. Geology of IndiaVol 1 &2, 2008
6. Gokhale and Rao – Ore deposits of India.
7. Jensen and Bateman A.M. – Economic Mineral Deposits.
8. Krishnaswamy, S. – Indian Mineral Resources.
9. Krauskopf – Introduction to Geochemistry.
10. Park and Macdiarmid -Ore deposits.
11. Umeshwer Prasad- Economic geology
12. Abbott .P.C (2002); Natural Disasters, Mcraw- Hill Publications-New Delhi
13. Coates D.R (1985) ; Geology and society chapman and hall publishers- New Delhi
14. Davisetal (1976) Environmental Geoscience Niley Eastern
15. Howard .A.D and Irwin Remson (1978); Geology in Environmental Planning, M.C Graw-hill publications
16. Keller. E.A (1976); Environmental Geology. Charles E.Merril Publishers, New Jerseys
17. Lundgren. L. (1986) Environmental Geology. Prentice-Hall publishers, New Jerseys
18. Strahler. N. and Strahler. A.H (1973); Environmental Geoscience; Willey eastern
19. Donald R coates, Ed 1973 Environmental geomorohologyand Environmental geo science. Willey international
20. Donald R coates, 1981, Environmental geology, John wiley and sons
21. Peter T Elawan ,1970. Environmental geology,Harper& Raw

COMPLEMENTARY COURSE: GEOLOGY (PRACTICAL FOR OTHER STREAM)

GEO1C02(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-I

Credits: 0 **Total Hours: 36**

I. Preparation of neat diagrams/charts/maps/models of the following:

1. Solar system.
2. Seismic Belt of the World.
3. Rock types- Igneous, sedimentary, metamorphic.
4. Soil profile.
5. Hydrologic cycle.
6. Drainage pattern.
7. Confined aquifer- artesian wells.
8. Seismic waves.
9. Seismograph.
10. Seismogram.
11. Seismic zones of India.

II. Preparation of neat Block diagrams/Models of the following:

1. Dyke.
2. Sill.
3. Laccolith.
4. Lopolith.
5. Batholiths.
6. Volcanoes.
7. Earth quake with focus and epicenter. Movement of waves.
8. River terraces.
9. Slumping.
10. Landslide.

III. Exercise

Identification of salient topographic and drainage features using toposheets. (1:50000 or 1: 25000) of Survey of India – 3 exercises.Covering 100 Sq. Km.

IV. Collections

Different types of soil/mineral/rock- put it in polythene cover pack it on a display board with neat labeling. Brief description of its physical properties.

V. Preparation of record

GEO2C04(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-II

Credits: 0 **Total Hours: 36**

I. Preparation of neat diagrams/charts/maps/models of the following:

1. Solar system.
2. Seismic Belt of the World.
3. Rock types- Igneous, sedimentary, metamorphic.
4. Soil profile.
5. Hydrologic cycle.
6. Drainage pattern.
7. Confined aquifer- artesian wells.
8. Seismic waves.
9. Seismograph.
10. Seismogram.
11. Seismic zones of India.

II. Preparation of neat diagrams/charts/maps/models of the following:

1. Solar system.
2. Seismic Belt of the World.
3. Rock types- Igneous, sedimentary, metamorphic.
4. Soil profile.
5. Hydrologic cycle.
6. Drainage pattern.
7. Confined aquifer- artesian wells.
8. Seismic waves.
9. Seismograph.
10. Seismogram.
11. Seismic zones of India.

III. Neat drawing of 6 crystal systems.

1. Crystallographic axes.
2. Plane of symmetry.
3. Axis of symmetry.
4. Typical models-
5. Cube- Isometric.
6. Prism + Base- Tetragonal.
7. Prism+ Base- Hexagonal.
8. Pinacoids- Orthorhombic.
9. Pinacoids- Monoclinic.
10. Pinacoids- Triclinic.

IV. Megascopic identification of the following minerals:

Quartz, orthoclase, plagioclase, microcline, biotite, muscovite, hornblende, chlorite, tremolite, actinolite, hypersthene, augite, diopside, magnetite, hematite, gypsum, garnet, kyanite, sillimanite, apatite, chromite, ilmenite, pyrite, sphalerite,

graphite, chalcopyrite, beryl, talc, fluorite, magnesite, psilomelane, pyrolusite, dolomite, calcite.

V. Megascopic identification of the following igneous rocks:

Granite, pegmatite, rhyolite, basalt, gabbro, dolerite, syenite, pumice, diorite, tuff.

VI. Megascopic identification of the following sedimentary rocks:

Conglomerate, breccia, sandstone, shale, limestone, laterite, coal, lignite.

VII. Megascopic identification of the following metamorphic rocks:

Slate, phyllite, mica schist, amphibolites, hornblende gneiss,,biotite gneiss, khondalite, marble, charnockite, chlorite schist, tremolite- actinolite schist.

VIII. Preparation of record.

GEO3C06(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-III

Credits: 0 **Total Hours: 36**

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1. Measurement of slope and distance using toposheets (3 Exercises)
2. Completion of outcrops in contour maps (3 Exercises)
3. Determination of attitude of beds from maps (3 Exercises)
4. Interpretation of geological maps with simple structures (Fold, fault, unconformity, intrusion [5 maps])
5. Diagrams/chart/block diagrams showing different kinds of folds, faults, unconformities, joints, foliation, lineation (3 Exercises)
6. Neat sketches of typical representation of the following fossil groups.
7. Brachiopoda, trilobites, lamellibranch, gastropoda, cephalopoda.
8. Geological time scale.

GEO4C08(P) – COMPLEMENTARY COURSE GEOLOGY PRACTICAL-IV

Credits: 4 **Total Hours: 36**

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1. Chart showing symbols of rocks and igneous, sedimentary, and metamorphic structures.
2. Megascopic identification or important ore and industrial minerals.
3. Geological map of Kerala showing major stratigraphic units.
4. In an India map mark the important places where ore minerals/ industrial minerals are found.
5. Preparation of mineral map of Kerala.
6. Revision of Practical-I
7. Revision of Practical-II
8. Revision of Practical-III

MODEL QUESTION PAPERS

MODEL QUESTION PAPER
FIRST SEMESTER B.Sc. DEGREE EXAMINATION
GEO1B01 – ESSENTIALS OF GEOLOGY

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

1. Sial and Sima
2. Era
3. Oldest stratigraphic period
4. Focus
5. Relative dating
6. Covalent bonding
7. Amorphous substance
8. Asteroids
9. Creep
10. Pahoehoe lava
11. Abyssal plain
12. Guyots

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Age of the Earth
14. Products of volcanic eruption
15. Seismograph
16. Classification of volcanoes
17. Causes of landslides
18. Origin and effects of Tsunami
19. Mid Oceanic Ridges

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Describe Geologic Time Scale
21. Write an essay on Layered structure of the earth and its major discontinuities.

(Maximum 10 marks

MODEL QUESTION PAPER
SECOND SEMESTER B.Sc. DEGREE EXAMINATION
GEO2B03 – DYNAMIC GEOLOGY AND GEOINFORMATICS

Time : Two Hours Maximum Marks : 60

Answer *all* questions *(Draw neat sketches, wherever necessary)*

Section A

I.Answer in one or two sentences (Each question carries 2 marks)

Exfoliation

2. Loess
3. Peneplanation
4. Perched water table
5. Deflation
6. Porosity
7. Inselbergs
8. Snowline
9. Raster data
10. Panchromatic data
11. Confined aquifer
12. Temporal resolution

(Maximum 20 marks)

Section B

II Write short notes (Each question carries 5 marks)

13. Types of chemical weathering
14. Depositional work of stream
15. Braided and Meandering streams
16. Karst topography
17. Describe different drainage patterns
18. Components of GIS
19. Multispectral scanner

(Maximum 30 marks)

Section C

III Write long essay on any of the following (Each question carries 10 marks)

20. Describe various geological work of glaciers
21. Erosional and depositional landforms of wind

(Maximum 10 marks)

MODEL QUESTION PAPER
SECOND SEMESTER B.Sc. DEGREE EXAMINATION
GEO2C03 - DATA SOURCES OF REMOTE SENSING AND GIS

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

1. Wein's displacement Law.
2. Active Remote Sensing
3. Microwave remote sensing
4. Sun-synchronous orbit
5. Roll and Pitch
6. Gagan
7. Spectroscopic filter
8. Spatial resolution
9. Lidar
10. Cartography
11. Raster model
12. Geodesy

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Thermal infrared remote sensing
14. Spectral reflectance of water and soil
15. Types of platforms
16. Resolution concepts
17. Multispectral scanners
18. Urban Planning using GIS
19. Quad tree and vector topology

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Describe Orbital elements of satellite and different orbits of satellites

21. Write an essay on applications of GIS in Environment and Natural Resources Management

(Maximum 10 marks)

MODEL QUESTION PAPER
THIRD SEMESTER B.Sc. DEGREE EXAMINATION
GEO3C05 - SATELLITE REMOTE SENSING AND GIS DATA MANAGEMENT SYSTEM

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

Hyperspectral Remote sensing

2. Mie scattering
3. Black body
4. Bhuvan
5. IIRS
6. Synthetic Aperture Radar
7. SPOT
8. Launch Vehicles
9. Rubber sheeting.
10. Silver polygon
11. Database management system
12. Reprojection

Section B

II. Write short notes (Each question carries 5 marks)

13. Microwave radiation and attenuation
14. Meteorological satellites
15. Multispectral scanner
16. Data editing
17. Indian space centres
18. INSAT satellite system
19. Queries in GIS

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Describe principles and application of thermal remote sensing
21. Describe different methods of data entering

(Maximum 10 marks)

MODEL QUESTION PAPER
THIRD SEMESTER B.Sc. DEGREE EXAMINATION
SUBJECT: GEOLOGY
GEO3B05 – CRYSTALLOGRAPHY AND MINERALOGY

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I Answer in one or two sentences (Each question carries 2 marks)

1. Contact goniometer
2. Weiss notation
3. Open form
4. Octahedron
5. Pyramid
6. Twin axis
7. Penetration twin
8. Forms of Triclinic Normal class
9. Streak
10. Hardness
11. Coordination Number
12. Piezoelecricity

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Morphology of crystals
14. Reflection Goniometer
15. Miller indices
16. Elements of symmetry
17. Isomorphism and pseudomorphism
18. Classification of silicates
19. Minerals and Mineraloids

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Physical properties of minerals

21. Describe the symmetry, forms and miller indices of normal class of hexagonal system

(Maximum 10 marks)

MODEL QUESTION PAPER
FOURTH SEMESTER B.Sc. DEGREE EXAMINATION
SUBJECT: GEOLOGY
GEO4B07 – OPTICAL AND DESCRIPTIVE MINERALOGY

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

Refractive index

2. Optic axis
3. 2V
4. Pleochroism
5. Symmetrical extinction
6. Uniaxial minerals
7. Structure of pyroxene
8. Composition of olivine
9. Extinction of tourmaline
10. Polymorphous varieties of quartz
11. Industrial uses of talc
12. Composition of Staurolite

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Isotropic and anisotropic minerals
14. Biaxial indicatrix
15. Determination of order of Interference Colour
16. Optical accessories and uses
17. Aluminium silicates
18. Optical and physical properties of garnet
19. Structure and chemistry of feldspar group

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Describe various parts of petrological microscope
21. Describe briefly the Amphibole group of minerals.

(Maximum 10 marks)

MODEL QUESTION PAPER
FOURTH SEMESTER B.Sc. DEGREE EXAMINATION
GEO4C07 - APPLICATIONS OF REMOTE SENSING AND GIS

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I Answer in one or two sentences (Each question carries 2 marks)

1 DEM
2 Landuse
3 Connectivity
4 Radiometric correction
5 Image enhancement
6 Spatial filtering
7 Network analysis
8 Cartographic output
9 Adjacency
10 Arcs and nodes
11 Layering concept in GIS
12 Polygons

Section B

II Write short notes (Each question carries 5 marks)

13 Application of Remote sensing in Oil spill detection
14 Supervised and unsupervised classification
15 Pre-processing techniques
16 Topology and Spatial Relationships
17 Data analysis
18 Keys for successful GIS
19 Cartographic Output in GIS

(Maximum 30 marks)

Section C

III Write long essay on any of the following (Each question carries 10 marks)

20 Write an essay on application of remote sensing in mineral exploration
21 Describe different sources of error in GIS

(Maximum 10 marks)

MODEL QUESTION PAPER
FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

SUBJECT: GEOLOGY

GEO5B09 – STRUCTURAL GEOLOGY AND GEOTECTONICS

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

1. Angular unconformity
2. Benioff zone
3. Conrad discontinuity
4. Dip slip
5. Hade
6. Monocline
7. Palaeomagnetism
8. Strike joints
9. Triple junction
10. Drag fold
11. Throw of a fault
12. Release joints

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Elastic deformation
14. Brunton Compass
15. Isostasy
16. Mid Oceanic Ridge
17. Overlap
18. Converging boundaries
19. Structural map

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Write an essay on the geometric classification of faults
21. Give an account on the sea floor spreading in the light of modern tectonic hypothesis

(Maximum 10 marks)

MODEL QUESTION PAPER
FIFTH SEMESTER B.Sc. DEGREE EXAMINATION
SUBJECT: GEOLOGY
GEO5B10 – STRATIGRAPHY AND SEDIMENTOLOGY

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

Chronostratigraphy

2. Law of original horizontality
3. Correlation
4. Phanerozoic eon
5. Hiatus
6. Index Fossils
7. Lithification
8. Sphericity
9. Graded bedding
10. Guano
11. Arkose
12. Alluvial Fan

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Concept of Uniformititarianism
14. Lithostratigraphic classification
15. Types of Unconformities
16. Primary Structures of sedimentary rocks
17. Brief outline of classification of Sedimentary rocks
18. Diagenesis
19. Briefly explain about various Marine Depostional environments

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Present is the key to the past – Elucidate your answer utilising the various stratigraphic laws
21. Briefly describe the various textures of sedimentary rocks.

(Maximum 10 marks)

MODEL QUESTION PAPER
FIFTH SEMESTER B.Sc. DEGREE EXAMINATION
GEO5B11 – IGNEOUS PETROLOGY

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

1. Eutectic crystallization
2. Porphyritic texture
3. Vesicular structure
4. Batholith
5. Sills and dykes
6. Lever rule
7. Columnar joints
8. Colour index
9. Mineralogy of granite
10. Mafic magma
11. Reaction textures
12. Liquidus curve

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Composition of magma
14. Discordant igneous intrusions
15. Unary Magma
16. Solid solution series
17. Classification of basalts
18. Bowen's reaction series
19. Liquid immiscibility

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Describe the Forsterite-Silica system giving its petrogenetic significance
21. Write an essay on textures of igneous rocks

(Maximum 10 marks)

MODEL QUESTION PAPER
FIFTH SEMESTER B.Sc. DEGREE EXAMINATION
GEO5B12 – METAMORPHIC PETROLOGY

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

1. Contact metamorphic aureole
2. Poikiloblast
3. Mineral paragenesis
4. Prograde metamorphism
5. Slaty cleavage
6. Hornfels
7. AKF projection diagram
8. Migmatites
9. Eclogite facies
10. Foliation
11. Skarn rocks
12. Isograds

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Metamorphic grade
14. UHT metamorphism
15. Pertrography of amphibolites
16. Metamorphic differentiation
17. Facies of metamorphism
18. Metamorphic structures
19. Barrowian sequence

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Describe in detail metamorphic reactions in carbonate rocks
21. Describe the charnockite with emphasis on their petrography and petrogenesis

(Maximum 10 marks)

MODEL QUESTION PAPER
SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

SUBJECT: GEOLOGY

GEO6B17 – PALAEONTOLOGY

Time : 2½ Hours Maximum Marks : 80

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I Answer in one or two sentences (Each question carries 2 marks)

What is a trace fossil

2 Petrification
3 Dimorphism
4 Columella
5 Stipes
6 Cephalon
7 Palaeomagnetism
8 Guard in belemnites
9 Calceoloa
10 Suture lines
11 Lepidodron
12 Taxodont dentition
13 Prolocus
14 Blastoids
15 Monomyarians

(Maximum 25 marks)

Section B

II. Write short notes (Each question carries 5 marks)

16 Explain various uses of Fossils
17 Important morphology of Brachipod shell
18 Geological History of Trilobites
19 Gondwana Plant fossils
20 Siwalik Mammals
21 Dentition in Lamellibranch
22 Morphology of Gastropod Shell
23 Brief outline of classification of vertebrates

(Maximum 35 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

24 Describe the morphology distribution and palaeontological significance of Foraminifera

25 Define Fossils, Explain various modes of fossilisation.

26 Describe the morphology distribution and palaeontological significance of Graptolite

27 Describe the general morphology and important suture patterns of Cephalopods

(Maximum 20 marks)

MODEL QUESTION PAPER
SIXTH SEMESTER B.Sc. DEGREE EXAMINATION
GEO6B18 – INDIAN GEOLOGY

Time : 2½ Hours Maximum Marks : 80

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

1 Closepet granite

2 Lameta beds

3 Karewa formation

4 Talchir series

5 Alwar group

6 Craton and mobile belts

7 Infra-trappean beds

8 Main boundary fault

9 Barakar formation

10 Muth quartzite

11 Rajmahal traps

12 Fossils in upper Vindhyan groups

13 Lilang System

14 Niniyur formation

15 Raniganj coal fields

(Maximum 25 marks)

Section B

II. Write short notes (Each question carries 5 marks)

16 Age of deccan traps

17 Kurnool group

18 Quilon formation
19 Climate of Gondwana
20 Sargur super group
21 Fauna of Siwaliks
22 Cenozoic oil bearing formation of India
23 Granulites of South India

(Maximum 35 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

24 Describe the Dharwar Supergroup
25 Write an essay on Palaeozoic rocks of Spiti
26 Describe in detail on Cretaceous of Trichinapally
27 Write an essay on Tertiary rocks of Kerala

(Maximum 20 marks)

MODEL QUESTION PAPER
SIXTH SEMESTER B.Sc. DEGREE EXAMINATION
GEO6B19 – ECONOMIC GEOLOGY

Time : 2½ Hours Maximum Marks : 80

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

Tenor
2 Gangue
3 Sublimation
4 Epigenetic deposits
5 Wall rock alteration
6 Ladder veins
7 Hypothermal zone
8 Immiscible liquid segregation
9 Gossan
10 Bonanza
11 Minerals used in ceramic industry
12 Anthracite
13 Reservoir rocks
14 Gypsum

15 Eolian placers

(Maximum 25 marks)

Section B

II. Write short notes (Each question carries 5 marks)

16 Metallogenic epochs and provinces

17 Contact metasomatic process

18 Secondary sulphide enrichment

19 Pb-Zn deposits in India

20 Industrial minerals

21 Placer deposits of Kerala

22 Origin of coal

23 Proliferous basins of India

(Maximum 35 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

24 Describe various types of hydrothermal deposits

25 Give an account on bauxite deposits of India

26 Describe varieties and properties of coal. And also add a note on Geology and coal petrography of different coalfields of India.

27 Describe Lindgren's and Bateman's classification of ore deposits

(Maximum 20 marks)

MODEL QUESTION PAPER
SIXTH SEMESTER B.Sc. DEGREE EXAMINATION
GEO6B22(E01) – ENVIRONMENTAL GEOLOGY

Time : Two Hours Maximum Marks : 60

Answer *all* questions

(Draw neat sketches, wherever necessary)

Section A

I. Answer in one or two sentences (Each question carries 2 marks)

Disposal of industrial waste

2. Eutrophication

3. Aftershock and foreshock

4. Ozone depletion

5. Composting and recycling

6. Thermal pollution
7. Deep well disposal
8. Oil spills
9. Geothermal energy
10. Nuclear waste
11. Air pollutants
12. Persistent contaminants

(Maximum 20 marks)

Section B

II. Write short notes (Each question carries 5 marks)

13. Factors affecting slope stability
14. Geology of waste management
15. Radioactive waste disposal
16. Groundwater contamination
17. Heavy metal pollution
18. Types of hazards
19. Sustainable development

(Maximum 30 marks)

Section C

III. Write long essay on any of the following (Each question carries 10 marks)

20. Write an essay on surface water pollution
21. Describe the fundamental concepts of environmental geology

(Maximum 10 marks)