FAROOK COLLEGE (AUTONOMOUS)

P.O FAROOK COLLEGE, KOZHIKODE

Regulations, Scheme of Evaluation, Course Structure and Syllabus for

M.Sc. Integrated Programme

in

Geology (Core)

with

Chemistry and Physics (Allied Cores)

(2020 Admission onwards)

For Postgraduate (Integrated 5 years programme) Curriculum 2020-21

(FCCBCSS INT-PG -2020-21)

Board of Studies in Geology

Farook College (Autonomous), Kozhikode

March 2021

CERTIFICATE

I hereby certify that the documents attached are the bona fide copies of the syllabus of M.Sc. (Integrated) Geology Programme to be effective from the academic year 2020-21 onwards.

FAROOK COLLEGE (AUTONOMOUS) CALICUT 673 632 P.O. FAROOK COLLEGE

Principal
FAROOK COLLEGE
(AUTONOMOUS)
Farook College.P.O.(Calicut)

PRINCIPAL

Date:

Place: Farook College (Autonomous), Kozhikode

Farook College (Autonomous), Kozhikode

Scheme of Postgraduate (M.Sc. Integrated, 5 years) Programme in Geology

Rules, Regulations, and Syllabus

1. TITLE

These regulations shall be called "Farook College (Autonomous), Kozhikode" Regulations for Postgraduate (Integrated 5 years programme) Curriculum 2020-21 (FCCBCSS INT-PG-2020-21).

2. SCOPE, APPLICATION & COMMENCEMENT

The regulations provided herein shall apply to M.Sc. Integrated course in Geology at Farook College Autonomous under Faculty of Science conducted by the Farook College autonomous for the admissions commencing from 2021, with effect from the academic year 2020-2021. Every programme conducted under the Choice Based Credit and Semester System in the College shall be monitored by the College Council.

3. ADMISSION

Registration and admission to the M.Sc. Integrated programme in Geology will be as per the rules and regulations of the University of Calicut. Minimum qualification for the admission is a pass in higher secondary degree (10+2 Science scheme/ equivalent) or qualifications announced by the University from time to time.

The applicants for M.Sc. Integrated 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 ten semesters distributed in a period of five years. Each semester consists of a minimum of 18 weeks, (16 instructional weeks and two weeks for examination). The odd (1, 3, 5,7,9) semesters shall be from June to October and even (2, 4, 6,8,10) semesters shall be from November to March.

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

- Common Courses (4 theory) with 22 credits (14 for common English courses + 8 for common languages other than English)
- Core courses (25 Theory, 11 Practical, 7 Elective theory, and 2 Projects and 2 Field Training and a field mapping camp) with a total credits of 153.

- Complimentary courses with Chemistry as compulsory course (4 theory courses) and 4 theory courses of Physics and 2 practicals with a total of 24 credits.
- Open Course (one from other department) with 2 credits; and
- Altogether, there shall be a total of 201 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 College and 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 lists 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	14
2.	Common	Additional Language	8
3.	Core	Geology	153
4.	Complimentary Course I	Chemistry	12
5.	Complimentary Course II	Physics	12
6.	Open Course	One theory course offered by any other department	3
7.	Audit Course (Extra Credits)	One theory course	16
		Total	**218**

(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 marks 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 minimum credits required in a programme, for achievements in co-curricular activities and social activities conducted 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 single condonations during the entire programme). If a student fails to get 65% attendance, he/she can move to the next semester only if he/she acquires 50% attendance. In that case, a provisional registration is needed. Such students can appear for supplementary examination for such semesters after the completion of the programme. Less than 50% attendance requires Readmission. 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 a student in that semester is calculated using the formula given below. For the successful completion of a semester, a student should pass all courses. However, a student is permitted to move to the next semester 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. COURSE STRUCTURE

Sem	Course Type	Course Code	Course Title	Hrs per week	Credits	Max Marks		
						Internal	External	Total
I	Theory	IGL1C01	Earth & Environment	4	3	15	60	75
			Chemistry I	4	4	20	80	100
			English I	5	4	20	80	100
			English II	4	3	15	60	75
			Additional language I	4	4	20	80	100
	Practical*	IGL1C02(P)	Field Geology	2	0	-	-	-
			Chemistry Practical I	2	0	-	-	-
II	Theory	IGL2C03	Crystallography and Mineralogy	4	4	20	80	100
			Physics I	4	4	20	80	100
			English III	5	4	20	80	100
			English IV	4	3	15	60	75
			Additional language II	4	4	20	80	100
	Practical*	IGL2C04(P)	Crystallography	2	0	-	-	-
			Physics Practical I	2	0	-	-	-
III	Theory	IGL3C05	Geomorphology	4	3	15	60	75
		IGL3C06	Optical and Descriptive Mineralogy	5	4	20	80	100
		IGL3C07	Remote Sensing and Geographical Information Systems	4	3	15	60	75
			Physics II	4	4	20	80	100
	Practical*	IGL3C08(P)	Geomorphology, Mineralogy, Remote Sensing and Geographic Information System	4	0	-	-	-
			Physics Practical II	4	4	20	80	100
IV	Theory	IGL4C09	Igneous Petrology	5	4	20	80	100
		IGL4C10	Metamorphic Petrology	4	4	20	80	100
		IGL4C11	Sedimentary Petrology	4	3	15	60	75
			Chemistry II	4	4	20	80	100
	Practical*	IGL4C12(P)	Crystallography Mineralogy, Geomorphology, Remote Sensing and Geographic Information System	4	4	20	80	100
			Chemistry Practical II	4	4	20	80	100
V	Theory	IGL5C13	Mineral and Fossil Fuel Resources	5	4	20	80	100
		IGL5C14	Paleontology	5	4	20	80	100
	Elective#	IGL5C15(E01a)	Marine Geology and Oceanography	4	3	15	60	75
		IGL5C15(E01b)	Environmental Geology					

		IGL5C15(E01c)	Soil Geology					
			Open Course	3	3	15	60	75
	Practical*	IGL5C16(P)	Petrology Practical's	4	4	20	80	100
		IGL5C17(P)	Economic Geology and Palaeontology	4	4	20	80	100
VI	Theory	IGL6C18	Stratigraphy and Indian Geology	5	4	20	80	100
		IGL6C19	Structural Geology and Geotectonics	5	4	20	80	100
	Elective#	IGL6C20(E02a)	Field Survey	4	3	15	60	75
		IGL6C20(E02b)	Engineering Geology and hydrogeology					
		IGL6C20(E02c)	Research Methodology					
	Practicals*	IGL6C21(P)	Structural Geology	5	4	20	80	100
	Field Trip	IGL6C22(FT)	Geological Field work	3	2	15	60	75
	Project	IGL6C23(PR)	Project Viva Voice	3	2	15	60	75

***** Study tour, Study project and practical evaluation will be held at the end of even semester.

An institution can offer any one among these courses.

$ Report evaluation of the Internship may be done at the end of Xth Semester

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 works carried 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 paper	Out of 8 (Max. internal mark is 20)	Out of 6 (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 1:

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.

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 of different 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 and recommendations	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 and ninth 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**

PROGRAMME SPECIFIC OUTCOMES

Integrated M.Sc. Geology:

Integrated M.Sc. Geology is a 5-year long course focused on Earth Science. The program is aimed at providing training in Geosciences of the highest academic quality in a challenging and supportive learning environment. The program will demonstrate, help to solve and understand major concepts of various disciplines of Geology. Since field trips are a key aspect of our course, we have been offering fieldtrips every year including one-week long field works outside the state. The students will be trained to conduct geologic field mapping, statistical analyses of data collected through field studies/ experimentally generated, use of computer techniques and software, petrological microscopy, fossil identification, study groundwater resources and environmental issues of Earth. The students will get an intense learning experience enabling them to identify and differentiate different minerals, rocks and other geological structures in their natural environment.

After successful completion of Five-year Integrated M.Sc. program in Geology a student should be able to:

- Students will get an understanding about concept of geological time, different periods and important events in geology and dating of geological materials.
- Students will be able to identify geological structures like fold, fault, joints and unconformity.
- Students will be exposed to studies on natural hazards, assess its effects and various management and mitigation measures.
- Construct and interpret geologic cross sections from geological and topographic maps.
- Good understanding about plate tectonic process and explain its relationship to earth processes, features and landforms.
- Understand the basic concepts of basic tenants of Geology and apply this knowledge to analyze geological formations and structures for the benefit of mankind.
- Understand spatial and temporal relationships between Earth processes, landforms and products, and development and evolution of various spheres of Earth including Lithosphere, Hydrosphere, Atmosphere and Biosphere.
- Explain the causes and effects of global climate change, understand proxies to reconstruct past climate.
- Application of Earth Observation Science with the help of Remote sensing techniques, its visualization and interpretation using Geographic Information System tools and software.
- Think methodically, independently and draw a logical conclusion about Geological processes and its applications.

- Employ critical thinking and the scientific knowledge in solving geological issues by carrying out field studies, record field observations, design and use of laboratory analyses, interpret results and prepare scientific/ technical reports and its presentation.
- Lead the team to create awareness about the importance of Geoscience on the environment and society, importance of conservation and sustainability of its resources.

CORE COURSE: GEOLOGY
(THEORY)

IGL1C01 –EARTH AND ENVIRONMENT

Credit: 3 **Total Hours: 64**

Course Outcome

Students will be able to understand about

CO1: Basic knowledge about the subject and Planet Earth
CO2: Basic knowledge about minerals and Rocks
CO3: Basic knowledge about structural features
CO4: Basic knowledge about Natural Hazards
CO5: Knowledge about earthquakes and Volcanoes

Unit 1

- Geology and its perspective
- Origin of Planets- Nebular hypothesis, Planetesimal hypothesis, Gaseous-Tidal Hypothesis; Binary star
- Earth in relation to solar system, size, shape, mass, density and its development.
- Age of the Earth – Determination of Earth's age, - Radioactive methods and Non-radioactive methods.
- Plate Tectonics: The Discovery of Plate Tectonics, The Mosaic of Plates, Rates and History of Plate Motions, The Grand Reconstruction, The Engine of Plate Tectonics.
- Geological Time scale: Eons; Eras; Periods; and Epochs

Unit 2

- Minerals: A brief introduction to minerals, The Atomic Structure of Minerals. Rock-Forming Minerals, Physical properties of Minerals.
- Rocks: Types of rocks - brief introduction to Igneous, sedimentary and metamorphic rocks; Concept of rock cycle, Rock and Fossil Record

Unit 3

- Brief Introduction about Folds, Faults, and other Records of Rock Deformation, Evolution of the Continents
- Elementary ideas about outcrops, dip, strike, outlier, inlier and overlap

Unit 4

- Natural Hazards: Volcanism, Earthquakes, Tsunamis, Landslide Issues relating to prediction, protection and mitigation. Landscape - Tectonic and Climate Interaction

Unit 5

- Volcanoes – Classification based on Lava Types; Styles of Eruptions – Products - Global Distribution; Causes; Effects; Prediction
- Classification of mountains, Isostasy – Airy Theory, Pratt Theory, Heiskanen's Theory
- 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.

Reference:-

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4. Cox A. & Hart R.B.: Plate Tectonics How it works. Blackwell Scientific Publ. Co. Boston. 1986.

5. Philip A. Allen.: Earth Surface Processes Blackwell Sciences Ltd, Oxford. 1997

6. Murck B.W., Skinner B.J & Porter S.C.: Dangerous Earth – An Introduction to Geologic Hazards John Wiley & Sons New York. 1996

7. Condie, K.C.: Earth as an Evolving Planetary System, 3rd Edition, Academic Press, USA. 2015

8. Marshak, S.: Earth: Portrait of a Planet. W.W. Norton & Co., Inc., USA. 2001

9. Tarbuck, E.J. and Lutgens, F.K.: Earth: An Introduction to Physical Geology. 9th Edition, Pearson Education, Inc., New Jersey, USA. 2008

10. Wicander, R. and Monroe, J.: Essentials of Geology. 4th Edition, Thomson Learning Inc., USA. 2006

IGL2C02-CRYSTALLOGRAPHY AND MINERALOGY

Credit: 4 **Total Hours: 64**

Course outcome:

Students will be able to understand

CO1: Basics of mineralogy and crystallography helps in building the overall knowledge in Geology .

CO2: Identify face, form, Axis, symmetry and laws of crystallography.

CO3: To recognize and calculate Miller indices of crystallographic planes & directions.

CO4: Describe different symmetry class and morphological forms present in particular symmetry class.

CO5: Define mineral and describe physical properties and optical properties of given minerals.

CO6: Describe physical and optical properties of a given mineral group.

CO7: Polymorphism, pseudomorphism, isomorphism and solid solution.

Unit 1:

- Crystallography – A brief introduction to scope and its applications.
- 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
- 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.

Unit 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.

Unit 3:

- Study of the symmetry elements and forms of the Normal and Sphenoidal

classes of the 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.

Unit 4:

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

Unit 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.

Reference:-

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

IGL3C05- GEOMORPHOLOGY

Credit: 3 **Total Hours: 64**

Unit–1:

- Introduction: Fundamental concepts; Cycle of erosion; Base level.
- Weathering: Factors influencing weathering Types - Physical: Expansion, crystal growth, thermal expansion, organic activity, colloidal plucking. Chemical: Hydration, hydrolysis, oxidation, carbonation and solution.
- Products of Weathering, Soil and Soil Profile
- Mass wasting: Conditions favouring mass wasting: lithology, stratigraphy, structure, topography, climate, organism etc. Slow flowage: creep, solifluction Rapid flowage: Earthflow, Mudflow, Debris avalanche Landslides: slump, slide, fall.

Unit-2:

- Running water as a geological agent: Development of a typical stream-Drainage system consequent and subsequent streams - Drainage basin- Drainage Pattern-Geological work of stream, erosional and depositional fluvial landforms, Concept of base level, Peneplanation, Monadnocks, Stream terrace, Rejuvenation, Knick Point, Entrenched meanders.
- Geological work of wind. Erosional and depositional landforms. Loess, types of dunes, Pedi planation, playas and inselbergs. Formation of deserts.

Unit-3:

- Glaciers- Formation of glaciers- Types- Movements-Erosional and depositional landforms, Glacier landforms, glacial ages.
- Underground water: occurrence, zone of aeration & saturation, Water table, Perched water table, porosity, permeability, Aquifers- confined and unconfined, aquicludes, aquitard and aquifuge. Artesian wells, Geyser and springs. Erosional and depositional landscapes produced by action of ground water.
- Origin of limestone caverns-Stalactite and stalagmites. Karst topography: Terra rosa, lapies, sinkholes, blind valley, caverns, stalactites and stalagmites, natural bridge, tunnel.

Unit 4

- Oceans and Seas: Waves, tides and currents. Geological work of oceans. Classification of shore line and Coast, Shore line types, description of continental margins, Continental Shelf-Continental slope submarine canyons- sea mount-Guyots, midocean ridges, trenches.
- Coral reefs – types and origin.
- Lakes and its types

Unit 5

- Field methodologies in Geology– Topographic Maps and its uses – Instruments – Clinometer, Brunton compass, Map Symbols, Toposheets, GPS, Aerial Photographs, Satellite imageries

References: -

1. Thornbury W.D. 1984, Principles of Geomorphology, First Willey Eastern Reprint, New Delhi.

2. Frank Press and Raymond Siever 1998, Earth (4th Edition) W.H. Freeman & Co., San Francisco.

3. Avery T. E and Berlin G. L, 1992, Fundamentals of remote sensing and Air photo interpretation. McMillion Publishing Co., New York.

4. Pitty A.F., 1971, Introduction to geomorphology, Methuen, London.

5. PandeyS. N. 1987 Principles and Applications of Photogeology, Wiley Eastern

6. Lo, C.P. and Yeung, A.K.W., 2007. Concepts and Techniques in Geographic Information Systems.

7. Tarbuck, E.J. and Lutgens, F.K., 2008. Earth: An Introduction to Physical Geology. 9th Edition, Pearson Education, Inc., New Jersey, USA.

8. Wicander, R. and Monroe, J., 2006. Essentials of Geology. 4th Edition, Thomson Learning Inc., USA.

IGL3C06-OPTICAL AND DESCRIPTIVE MINERALOGY

Credit: 4 **Total Hours: 80**

Course outcome :

Students will be able to understand

CO1: The physics of how light interacts with minerals.

CO2: Petrological microscope, isotropic and anisotropic minerals;

CO3: Uniaxial and biaxial indicatrices;

CO4: Optical properties in relation to indicatrices absorption and pleochroism, extinction, birefringence; Interference figures

Unit 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
- Isotropic and anisotropic minerals - Optical properties.

Unit 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).

Unit 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.

Unit 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.

Unit 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.

Reference :-

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

IGL3C07-REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

Credit: 3 **Total Hours: 64**

Unit 1

- History and development of Remote Sensing. Basic concepts and principles of Remote Sensing.
- Introduction to electromagnetic radiation and electromagnetic spectrum. Interaction of EMR with objects and Atmosphere.
- Passive and Active remote sensing. Platforms and Sensors. Different resolutions concepts, pixel size and scale.

Unit 2

- Introduction to the basics of aerial photography and photogrammetry
- Introduction to GPS, Orbit elements, Types of orbits, Motions of planets and satellites
- Satellites and their characteristics, Sun synchronous and geo-synchronous satellites, basics of visual interpretation of satellite images and their keys.

Unit 3

- Brief history of GIS; Introduction to GIS – definition, concepts and components of GIS,Geospatial data type
- GIS system, GIS science and GIS applications; Definition of map, different types of thematic maps, scale
- Geographic coordinate system, Datum; Types of map projections; Commonly used map projections; Projected Coordinate System.

Unit 4

- Visualization of geographical data, Basic ideas about data visualization, Geo-referencing, Maps and cartographic communication.
- Digital representation of geographic data: Data structure, spatial data model, raster and vector models. Comparison of raster and Vector data.

Unit 5

- GIS Data Management: GIS File Data Formats-Vector Data File Formats and Raster Data File Formats
- Database design - editing and topology creation in GIS, linkage between spatial and non-spatial data
- Database Management System, Types of data management system;

Reference Books:

1. Drury S.A. 1987. Image interpretation in Geology. Chapman and Hall.

2. Gupta R.P. 1991 Remote Sensing Geology. Springer-Verlag.

3. Lillisand, T. M. and Keifer, R. W., 2007 : Remote sensing and image interpretation John Willey and Sons, USA

4.Chang.T.K. 2002: Geographic Information Systems. Tata McGrawHill

5. Heywood.I, Cornelius S and CrverSteve. 2003: An Introduction to Geographical Information Systems. Pearson Education

6. Wise S.2002: GIS Basics. Taylor Publications

7.ESRI Map book: GIS the Language of Geography by ESRI-USA ESRI-2004

IGL4C09-IGNEOUS PETROLOGY

Credit: 4 **Total Hours: 80**

Course outcome:

Students will be able to understand about

CO1: Important structures and textures of igneous rocks.
CO2: Different classifications of igneous rocks.
CO3: Reasons for diversity in igneous rocks.
CO4: Crystallization behaviour and petrogenetic significance of magmas.
CO5: Different rock types their Mineralogy, classification and occurrence

Unit 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.

Unit 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 hypidiomorphic, Panidiomorphic. inequigranular Textures: porphyritic and Intergrowth texture – Trachytic texture – Intergrowth texture structures orbicular structure Spherulitic structure – Perlitic fracture. , Directive textures, Overgrowth textures, Reaction textures - Micro Structures

Unit 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.

Unit 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 Ab- Or system.
- Reaction principle and Bowen's reaction series - Causes for the diversity of Igneous rocks – Magmatic Differentiation: Fractional Crystallization, Liquid immiscibility, Assimilation

Unit 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

Reference :-

- Frost, B.R., Frost, C.D., 2014. Essentials of Igneous and Metamorphic Petrology. Cambridge University Pres. 318 p.
- Raymond, L.A., 2002. Petrology: The Study of Igneous, Sedimentary and Metamorphic Rocks, 720p.
- Winter, J.D., 2009. Principles of Igneous and Metamorphic Petrology. Pearson, 720 p.

IGL4C10-METAMORPHIC PETROLOGY

Credit: 4 **Total Hours: 64**

Course outcome:

Students will be able to understand about

CO1: Identify and define basic concept, factors and types of metamorphism
CO2: Identify different structures and textures of metamorphic rocks
CO3: Different metamorphic grades and facies
CO4: Apprehend petrography and origin of various metamorphic rocks

Unit 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

Unit 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 assemblages; Introduction to chemographic diagrams: ACF, AKF Diagrams

Unit 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.

Unit 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, hornblende gneiss, amphibolite, marble, charnockite, eclogite, and mylonite

Unit 5:

- Prograde and retrograde metamorphism

- Nature of metamorphic fluids and metasomatism
- Anatexis and migmatites; metamorphic differentiation

References:

- Barker, A.J., 1990. Introduction to Metamorphic Textures and Microstructures. Blackie, 162p.
- Bucher, K. and Grapes, R., 2011. Petrogenesis of Metamorphic Rocks. Springer-Verlag, Berlin-Heidelberg, 428p.
- Frost, C.D., Frost, B.R, 2013. Essentials of Igneous and Metamorphic Petrology, Cambridge University Press, 336p.
- Kretz, R., 1994. Metamorphic Crystallization. John Wiley & Sons, 507p.
- Miyashiro, A., 1978. Metamorphism and Metamorphic Belts. 3rd Edition. George Allen & Unwin, London, 492p.
- Vernon, R.H. and Clarke, G.L., 2008. Principles of Metamorphic Petrology. Cambridge University Press, 446p.

1. Winter, J.D., 2011. Principles of Igneous and Metamorphic Petrology, Prentice-Hall, 728p.

IGL4C11-SEDIMENTARY PETROLOGY

Credit: 3 **Total Hours: 64**

Course outcome:

Students will be able to understand about

CO1: Broad classification of sedimentary rocks.
CO2: Sedimentary structures and textures.
CO3: Different rock types their Mineralogy, classification and origin

Unit 1

- Origin of sediments
- Weathering and sedimentary flux: Physical and chemical weathering,
- Soils and paleosols.

Unit 2:

- Sediment granulometry, Grain size scale, particle size distribution, Environmental connotation; particle shape and fabric

Unit 3:

- Sedimentary textures, structures and environment Fluid flow, sediment transport and sedimentary structures:
- Types of fluids, Laminar vs. turbulent flow, Particle entrainment, transport and deposition.
- Paleocurrent analysis- Paleocurrents for different sedimentary environments Sedimentary structure- Primary and syn-sedimentary structures

Unit 4:

- Varieties of sedimentary rocks
- Siliciclastic rocks: Conglomerates, sandstones and its classification, mudrocks.
- Carbonate rocks, controls of carbonate deposition, components and classification of limestone, dolomite and dolomitisation

Unit 5:

- Diagenesis Concepts of diagenesis Stages of diagenesis Compaction and cementation.

References

1. Prothero, D. R., & Schwab, F. 2004. Sedimentary geology. Macmillan.
2. Tucker, M. E. 2006 Sedimenary Petrology, Blackwell Publishing.
3. Collinson, J. D. & Thompson, D. B. 1988 Sedimentary structures, Unwin- Hyman, London.
4. Nichols, G. 2009. Sedimentology and Stratigraphy Second Edition. Wiley Blackwell

IGL5C13- MINERAL AND FOSSIL FUEL RESOURCES

Credit: 4 **Total Hours:80**

Course outcome:

Students will be able to understand about

CO1 - Classification of different mineral deposits in earth.
CO2 - How prevailing geological features controls ore deposition and also serve as tools to find hidden treasure
CO3 – Formation of mineral deposits.
CO4 - Mineral deposits of India
CO5 - The formation and different aspects related to Coal, crude oil and natural gas

Unit 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.
- 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.
- Brief study of metallogenic epochs and provinces – geologic thermometers.

Unit 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.
- 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.

Unit 3

- 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 enrichments – Gossans and capping.
- Metamorphic processes – Formation of Graphite, Asbestos, Talc, Soapstone and

Sillimanite group of minerals.

Unit 4

- Diagnostic physical properties, chemical composition, uses, modes of occurrence and distribution in India of the following:

1) Economic Minerals- Gold, Silver, Copper, Lead, Zinc, Iron, Manganese, Chromium, Tin, Aluminium

2) Radioactive metals - Thorium, Uranium, Titanium.

3) Industrial Minerals- Asbestos, Barite, Graphite, Gypsum and Mica.

4) Abrasives- Diamond, Corundum, Emery garnet, Abrasive sand, Tripoli, Pumice, Sand feldspar, Limestone, Clay, Talc etc.

5) Refractories- fireclay, graphite, Dolomite and sillimanite group of minerals, diaspore, pyrophillite, zircon etc

6) Ceramic minerals- Clay, Feldspar, Wollastonite,

7) Gemstones.

UNIT 5

- Fossil fuels – coal and lignite – uses, classification, constitution, origin and distribution in India.
- Petroleum- composition, uses, theories of origin, oil traps, and important oil fields of India.
- A brief account of mineral deposits in Kerala.
- Significance of minerals in the National Economy. Strategic, critical and essential minerals.

References:

1. Gokhale and Rao. 1973. Ore deposits of India. Thomson Press (India), Publication Division, Delhi

2. Mead. L.Jensen and Alan M.Bateman. 1981. Economic Mineral Deposits. John Wiley and Sons, New York

3. Krishnaswamy, S. 1972. Indian Mineral Resources. Oxford & IBH Pub. Co. New Delhi

4. Park C. F and Macdiarmid. 1964. Ore deposits. W.H. Freeman and CO

6. Umeshwar Prasad. 2006. Economic geology. CBS Publishers, New Delhi

IGL5C14– PALAEONTOLOGY

Credit: 4 **Total Hours: 80**

Course outcome:

Students will be able to understand about

CO1: Different methods of fossil preservation and uses of fossils
CO2: Morphology, classification and importance of foraminifera
CO3: Morphology, classification of different Phylum – Coelenterate, Hemichordata, Mollusca, Gastropoda, Cephalopoda, Brachiopoda, Echinodermta and Arthropoda
CO4: Different plant fossils in India.

Unit 1

- An outline of life through ages, its evolution and distribution
- Definition of Palaeontology – organic world – classification of animals– Habitats and habits of animals - Flora and Fauna – 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

Unit 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

Unit 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.

Unit 4

- Phylum Brachiopoda:- General morphology, umbo, hinge line , pedicle opening, delthyrium, deltidium pseudo deltidium – Brachial skeleton – morphometric details, ornamentation , classification , geological history.
- Phylum Echinodermata: - 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

Unit 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

References:

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

IGL6C18-STRATIGRAPHY AND INDIAN GEOLOGY

Credit: 4 **Total Hours: 80**

Course outcome:

Students will be able to understand about

CO1: Various stratigraphic laws & physical and biological criteria of correlation
CO2- Students can able to understand different stratigraphic distribution of Indian.
CO3- Students will get a detailed understanding of stratigraphy and geology of Kerala

Unit 1

- Scope of the subject, its relationship with other disciplines.
- Principles of stratigraphy.
- Indian Time Scale
- Correlation, facies and unconformities.

Unit 2

- Facies and facial changes-litho and bio facies- break in stratigraphic records - diastems.
- Stratigraphic classification. Walters law
- 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.

Unit 3

- Early Precambrian Stratigraphy: concept of craton, mobile belt, shield area, Sargur supracrustals; Tectonic frame work of south India; Dharwar Supergroup; Aravalli Supergroup
- Late Precambrian Stratigraphy: Delhi Supergroup, Cudappah Supergroup, Vindhyan Super group. Brief study of Singhbhum craton, Sausar and Sakoli group

Unit 4

- Cambrain of Salt Range and Paleozoic rocks of Kashmir Valley, Spiti Valley and Pensinsular India
- Gondwana Supergroup – their classification, lithology, fossils and distribution in India.
- Brief knowledge on distribution, lithology, fossil content and classification of Triassic of Spiti, Jurassic of Kutch and Cretaceous of Tiruchirappali.

Unit 5

- Deccan Traps – Intra and Inter trapeans – Origin, composition, distribution.
- Stratigraphy of Siwalik system, fauna and flora of Siwaliks
- Tertiary rocks of Assam, Karewa formation
- Tertiary rocks of Tamil Nadu

- Stratigraphy and Geology of Kerala

Reference:-

1. Lemon,R.R .1990. Principles of stratigraphy.. Merrill Publ. New York
2. Boggs,S.1987. Principles of Sedimentology and Stratigraphy, Merrill, New York.
3. Krishnan, M.S. 1982. Geology of India and Burma. CBS publishers, New Delhi
4. Vaidyanathan R and Ramakrishnan M. 2008. Geology of India, GSI Publications.
5. Soman,K.(1997): Geology of Kerala, Geological society of India publications

IGL6C19-STRUCTURAL GEOLOGY AND GEOTECTONICS

Credit: 4 **Total Hours: 80**

Course outcome:

Students will be able to understand about

CO1: Different types of rock deformation, associated pressure temperature conditions, stages of deformation.
CO2: Geometric and genetic classification of types of different structures and associated deformation mechanism.
CO3: Different tectonic deformation structures in Earth surface

Unit 1

- Concept of force and stress. Normal stress and shear Stress. Stress components. Hydrostatic and deviatoric stresses.
- Concept of strain. Nature of strain. Pure shear and simple shear. Concept of strain ellipsoid. Behaviour of materials under stress.
- Concept of deformation. Elastic and plastic behaviour of rocks. Brittle and ductile deformation.

Unit 2

- Folds: Basic fold geometry, nomenclature and definitions.
- Classification of folds. Describing folds. Interference and superposition of folds. Folds and ductile deformation.
- Unconformity: Concept of unconformity, types of unconformity, criteria of recognition, significance of unconformity

Unit 3

- Faults: Fault geometry, nomenclature and definitions,
- Classification of faults, Features associated with fault plane, criteria for recognizing fault in field. Faulting and earthquakes.
- Concept of Shear zone.

Unit 4

- Joints: Nomenclature and definitions related to joints and the structures related to joints. Classification of joints.
- Linear structures: Lineations, cleavages and foliations. Morphology and description of lineations and cleavages, cleavages on different scales.
- Significance of linear structures.

Unit 5

- Introduction to plate-tectonics, Historical development of the concept of plate-tectonics
- Continental drift, Sea-floor spreading; Concept of lithosphere and lithospheric plates.

Nature of plate boundaries. Hot-spots and mantle plumes.

- Geological structures associated with different plate boundaries, Continents and Oceans, Mountain ranges, Oceanic ridges and trenches, Stable and unstable tectonic zones.
- Tectonics of Indian plate. Brief study of origin of Himalayas.

References:

1. Billings M P, Structural Geology, Pearson Education, 624pp
2. Davis, G.H., Reynolds, S.J., 1996, Structural geology of rocks and regions, 2nd Edition, John Wiley & sons.
3. Hamblin, W.K., Christiansen, E.H. 2003, Earth Dynamic Systems, 10th Edition, Prentice Hall.
4. Turcotte, D.L., & Schubert, G., 2001, Geodynamics 2nd Edition, Cambridge University Press
5. Pollard, D.D. & Fletcher, R.C. 2005, Fundamentals of Structural Geology, CambridgeUniversity Press
6. Park, R. G., 1983, Foundations of structural Geology, Blackie Academic and Professional
7. Ramsay, J.G. & Huber, M.I. 1984, The Techniques of Modern Structural Geology, Vol 1: Strain Analysis, Academic Press
8. Ramsay, J.G. & Huber, M.I. 1987, The Techniques of Modern Structural Geology, Vol 2: Folds and Fractures, Academic Press.
9. Moores, E.M., Twiss, R.J. 1995, Tectonics,W.H. Freeman
10. Ragan, D. M. (2009) Structural Geology: an introduction to geometrical techniques (4th Ed). Cambridge University Press (For Practical)

CORE COURSE: GEOLOGY (PRACTICALS)

IGL1C02(P) - FIELD GEOLOGY

Credit: 0 **Total Hours: 32**

Course outcome:

Students will be able to

CO1: Read a Survey of India Toposheet
CO2: Decipher Different information's in the Toposheet
CO3: Identify Structural features in the Toposheets
CO4: Understand different Geological Instruments and their use in Field

- Description of features in Survey of India toposheet.
- Study of marginal information.
- Interpretation of intramarginal and extramarginal information.
- Study of geological conventional signs, symbols, physical and socio-cultural features.
- Instructional training on uses of Clinometer, Brunton compass and GPS.

IGL2C04(P) - CRYSTALLOGRAPHY

Credit: 0 **Total Hours: 32**

Course outcome:

Students will be able to

CO1: Identify the axial disposition, axial relationship and axial analysis of crystal systems
CO2: Identification and description of crystal models in normal class.
CO3: Identification and description of simple twin models

- 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.

IGL3C08(P) - GEOMORPHOLOGY, MINERALOGY, REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

Credit: 0 **Total Hours: 48**

Course outcome:

Students will be able to

CO1: Witness natural examples which are studied in the theory classes
CO2: Geomorphology of the adjacent areas
CO4: Identification of mineral specimens based on physical properties.
CO5: Identification of mineral thin sections.
CO6: The new software tools to the geology
CO7: More operation using GIS

Geomorphlogy

- Field trip to understand the geomorphology and topography of an adjacent locality.
- Report preparation on field trip

Crystallography

- 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.

Mineralogy

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:

Microscopic 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.

Remote Sensing and GIS

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

IGL4C12(P) - CRYSTALLOGRAPHY, MINERALOGY REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

Credit: 4 **Total Hours: 64**

*This course will include the practical component of the courses IGL1C02(P) – IGL3C08(P) Field Geology, Crystallography, Geomorphology, Minerology, Remote sensing and GIS

IGL5C16(P) - PETROLOGY

Credit: 4 **Total Hours: 64**

Course outcome:

Students will be able to

CO1: Identify and describe important igneous rock specimens in hand and thin section.
CO2: Identify and describe important Metamorphic rock specimens in hand and thin section.
CO3: Identify and describe important Sedimentary rock specimens in hand and thin section.
CO4: Identify different structures and textures of igneous rocks
CO5: Identify different structures and textures of metamorphic rocks
CO6: Identify different structures and textures of sedimentary rocks

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, Nepheline Syenite, 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.

IGL5C17(P) - ECONOMIC GEOLOGY AND PALEONTOLOGY

Credit: 4 **Total Hours: 64**

Course outcome:

Students will be able to

CO1: Identify the Common Economically important minerals in Hand Specimen
CO2: Identify megascopic fossils based on their morphological characters.

Economic Geology

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.

Paleontology

Megascopic identification and description of the following fossils 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.

IGL6C21(P) – STRUCTURAL GEOLOGY

Credit: 4 **Total Hours: 64**

Course outcome:

Students will be able to

CO1: Identify and explain different types of geological structures in the field, their geometries and types, and relate them to distinct deformation regime.
CO2: Draw, interpret geological maps, construct geological cross sections, read topographic maps.
CO3: Determine the thickness, width of an outcrop, attitude of a formation both by construction and calculation methods.
CO4: Identify different types of geological structures in the map (horizontal bed, inclined bed, fold, fault, unconformity.

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.

CORE COURSE: ELECTIVE

(THEORY)

IGL5C15(E01a)- MARINE GEOLOGY AND OCEANOGRAPHY

Credit: 3 **Total Hours:48**

Course Outcome:
Students will be able to understand

CO1: Ocean bottom topography
CO2: Physical and Chemical properties of seawater
CO3: Distribution and classification of marine sediments
CO4: Major Surface currents in world ocean
CO5: Atmospheric disturbances – El Nino and LaNina
CO6: Coastal geomorphology and processes

Unit 1

- History of Marine geological studies contribution of Challenger Expedition JOIDES resolution.
- Hypsometry-Sea bottom topography, Submarine canyons, trenches, volcanoes, midoceanic ridges and abyssal plains.
- Marine Mineral resources: Controlling factors and distribution
- Eustatic changes of sea level: evidences

Unit 2

- Physical properties of seawater: distribution of temperature, pressure and density-Thermocline, Pycnocline, halocline.
- Chemical properties of seawater elements and dissolved gases present in sea water.
- Salinity and distribution of salinity.
- Marine sediments: Distribution and classification, CCD, Oxygen Minimum layer in Ocean

Unit 3

- Coriolis effect, Circulation: general circulation of the atmosphere boundaries - major surface currents of the world oceans, Ekman spiral, geostrophic currents, upwelling and sinking, diverging and converging surface water
- Thermohaline circulation

Unit 4

- Coupled ocean atmosphere system.
- EL Nino southern oscillation (ENSO), LaNina,
- General weather systems of India, Monsoon system
- Cyclone and anticyclone, Jet stream.

Unit 5

- Coastal processes: waves, currents and tides.
- Coastal geomorphology, classification of coasts; Coastal erosion. Coastal protection

structures seawalls, jetties, groins.

- Coastal Regulatory zone (CRZ) Continental margin: features of continental shelf, continental slope and continental rise.

References

1. Tom Garrison – Essentials of Oceanography
2. Trujillo and Thurman – Essentials of Oceanography
3. John Marshall, R Alan Plumb – Atmosphere, Ocean and Climate Dynamics- An introductory Text
4. Robert H Stewart – Introduction to physical Oceanography
5. Yasso, W. E., Oceanography
6. Trask, P. D., Recent Marine sediments, Dover publications, 1939
7. Weisberg, J., and Parish, R, Introductory Oceanography. .McGraw Hill, 1974Text Books
8. J.P.Kennet (1982) Marine geology. Printice Hall Inc., New Jersy, 813p.
9. E. Seibold & W.H.Berger (1982) The sea floor. Springer-Verlag, Berlin.
10. J.Weisberg & H. Parish (1974). Introductory Oceanograpghy. McGraw Hill.
11. B.W.Pipkin, D.S.Gorslin, R.E.Casey & D.E. Hammord (1972). Laboratory exercises in oceanography. W.H.Freeman & Co., San Francisco, 255p.

IGL5C15(E01b) - ENVIRONMENTAL GEOLOGY

Credit: 3 **Total Hours: 48**

Course Outcome:
Students will be able to understand

CO1: Various biosphere- geosphere interactions
CO2: How earth processes create hazards to life and property
CO3: The occurrence and formation of earth resources and significant environmental effects caused by their extraction, processing, and use.
CO4: The major sources of water pollution and methods for their management
CO5: Methods of solid and radioactive waste management
CO6: Various aspects of environmental regulations in India

Unit 1

- Introduction: Earth, man and environment: Basic environmental problems. Geoscience factors in environmental planning. Environmental Geosciences-fundamental concepts.
- The Earth Systems and Biosphere: Conservation of matter in various geospheres - lithosphere, hydrosphere, atmosphere and biosphere. Concepts of ecology / Ecosystems. Biogeographical zonations of earth. The earth's major ecosystems-terrestrial and aquatic.

Unit 2

- Earth's Processes and Geological Hazards Earth's Processes and Geological Hazard: Earth's processes; Concept of residence time and rates of natural cycles.
- Catastophic geological hazards. Study of floods, landslides, earthquakes, volcanism and avalanche, with a view to assess the magnitude of the problem, prediction and perception of the hazards.

Unit 3

- MINERAL RESOURCES AND ENVIRONMENT: Resource and Reserves. Environmental impact of exploitation, processing and smelting of minerals.
- ENERGY RESOURCES AND ENVIRONMENT: Environmental effects associated with each types of energy resource, viz. Petroleum, natural gas, hydropower, nuclear, coal, solar and wind energy.

Unit 4

- WATER RESOURCE AND ENVIRONMENT: Global Water Balance. Ice Sheets and fluctuations of sea levels. Origin and composition of sea water. Resources of oceans. Ocean pollution by toxic wastes. Human Use of Surface and Ground Waters. Ground Water Pollution.

Unit 5

- WASTE DISPOSAL: Solid waste disposal - geology in planning and siting of land fills. Radioactive waste management.
- ENVIRONMENTAL LAW: Environmental legistation in India.

Reference

1. Keller, E.A.: Environmental Geology: CBS Publisher, New Delhi.
2. Valdiya, K.S. : Environmental Geology-Indian Context. Tata McGraw Hill Publ. Co., Bombay.
3. Coates, D.R: Geology and Society. Chapman & Hall,New York.
4. Bryant, E.: Natural Hazard. Camb. Univ. Press.

IGL5C15(E01c) - SOIL GEOLOGY

Credit: 3 **Total Hours: 48**

Course Outcome:
Students will be able to understand

CO1: Soil formation process and classification of soils
CO2: Concepts of Fabric and structure analysis of soil
CO3: Primary, secondary and Tertiary structures

Unit 1

- Concept of soil, components of soil, soil profile
- Process of soil formation, pedogenic processes
- Classification of soil, mineral and chemical composition of soils, mineral stability during weathering; Soil organic matter form and function
- A brief introduction to methods of soil conservation.

Unit 2

- Fabric analysis - size and shape, concepts of size and shape, grade scale, methods of analysis, presentation of data, analysis and field grading
- Concepts of structure fabric: Soil fabric, soil structure, soil texture and field grading units;

Unit 3

- Peds and pedalilty, size and shape of peds, pedality, primary, secondary and tertiary structures and their interpretation; Voids - concepts, size, shape, arrangement and morphological classification.

Unit 4

- Paleosols - Field recognition, description, origin and causes
- Paleosol in stratigraphic records; Significance of paleosol study; Paleosols and human evolution.

Unit 5

- Calcrete - definition, classification, calcrete formation, pedogenic calcrete soil profile, macro features in calcretes, micromorphology (petrography), calcretes from Quaternary and ancient sedimentary sequences; significance of calcretes
- Laterite - characteristics, genesis, Indian occurrences.

References

1. Braddy, N.C: Nature and properties of soils.
2. Gerrard, A.J.J. : Soil and Land forms
3. Govinda Rajan, S.V. & Gopala Rao, kH.G.: Studies of Soils of India.
4. Gurrison, S. (1989): The Chemistry of Soils, Oxford University Press.
5. Hunt,C.B.: Geology of Soils
6. Jeffe, J.S.: The A.B.C. of soils

7. Terzaghi, K. & Pock,R.G.: Soil Mechanics in Engineering
8. Tayler, D.W.: Fundamentals of Soil Mechanics
9. Wright; V. Paul (Ejditer) j: Paleosols: their recognition and interpretation, Blackwell Scientific Publication.
10. Wright; V. Paul and Tucker, M.E. (1991) Calcretes. Blackwell Scientific Publicaton.

IGL6C20(E02a) - FIELD SURVEY

Credit: 3 **Total Hours: 48**

Course Outcome:
Students will be able to understand

CO1: Fundamentals and classification of surveys
CO2: Working principle and use of different survey Instruments
CO3: In details about contouring methods

Unit 1

- Surveying: Fundamental Concepts and principles
- Primary division and classification of surveys.
- Common methods of surveying: Reconnaissance survey, Offsetting, Radiation, and triangulation
- Open and closed traversing
- Leveling. Accuracy and errors in surveying
- Basic elements of map preparation and map reading.

Unit 2

- Working principles and use of different Surveying Instruments- Chain: Definition – Principles – Classification
- Plane Table Surveying: Plane table instruments and accessories – merits and demerits methods, Prismatic Compass, Dumpy level.

Unit 3

- Level line – Horizontal line Levels and Staves – Spirit level – sensitiveness – Bench marks. Temporary and Permanent adjustments.
- Fly and check levelling – Booking – Reduction. Curvature and Refraction.
- Reciprocal levelling – Longitudinal and Cross sections – Plotting;

Unit 4

- Theodolite Surveying – Vernier and Microptic – Description and uses. Temporary and Permanent adjustments of vernier transit , Horizontal angles – Heights and Distances – Traversing ,Closing error and distribution Trigonometric levelling . Total Station
- Concept of Global Positioning System (GPS) .

Unit 5

- Contouring – Methods – Characteristics and uses of contours ,
- Plotting – Calculation of areas and volumes ,
- Measurement of slope heights, aspects and gradients; Use of abney level, pedometer.

References

1. Kanetkar .T.P,"Surveying and Levelling," Vols. I and II, United Book Corporation, Pune,2007
2. Punmia .B.C,"Surveying," Vols. I ,Laxmi Publications,Seventeenth edition,2016.
3. Chandra .A.M, "Plane Surveying and Higher Surveying", New Age International (P) Limited, Publishers, Chennai, 3rd Edition 2015.
4. James M. Anderson and Edward M. Mikhail, "Introduction to Surveying", McGraw Hill Book Company, Third Edition, 2001.
5. Clark.D, "Plane and Geodetic Surveying", Vols. I and II, C.B.S. Publishers and Distributors, Delhi, Seventh Edition, 2002.
6. Arora .K.P, "Surveying", Volume 3, Standard Book House, 11th edition, 2013.

IGL6C20(E02b) - ENGINEERING GEOLOGY AND HYDROGEOLOGY

Credit: 3 **Total Hours: 48**

Course Outcome:
Students will be able to understand

CO1: Basic information regarding groundwater geology
CO2: Different Surface and subsurface methods of groundwater explorations
CO3: Preliminary information's about engineering geology

Unit 1.

- Hydrologic cycle and its components.
- Origin, occurrence, accumulation and migration of water
- Introduction to Hydrological properties of rocks

Unit 2

- Groundwater geology: Aquifer systems, Type and properties.
- Natural and Artificial Recharge of Ground Water
- Ground Water flow: Head distribution, Darcy's Law

Unit 3

- Surface and Subsurface method of Ground water Exploration
- Physical and Chemical Quality of Ground Water.
- Ground water provinces of India

Engineering Geology

Unit 4.

- Introduction to Role of Geology in civil construction.
- Stages of Geological site Investigations for selection of site for engineering structures: **Desk study:** Analysis of Remote sensing data, Geological maps, cross sections and written reports.
- **Subsurface site characterization:** Coring, logging, introduction to application of geophysical methods. Emphasis on preconstruction geological analysis to recognize potential hazards and problems.

Unit 5

- Physical and Mechanical properties of rocks: Concepts of stress, strain, Mohr circle and failure theories.
- Strength, deformation, hydraulic aspects, geostresses, Weathering and Discontinuities in rock masses. Engineering classification of Rocks. Construction materials

References:

1. K.R Karanth, 1989. Hydrogeology, Tata McGraw Hill
2. Bell, F.G. 1983. Fundamentals of engineering geology, Butterworths
3. D.K. Todd, 1980.Groundwater Hydrology, John Wiley and Sons.
4. C.F. Tolman, 1937.Groundwater, McGraw Hill, New York.
5. H.M. Raghunath, 1987Groundwater, Wiley Eastern. Calcutta.
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9. Krynine, D.P. & Judd, W.R. 1957. Principles of engineering geology and geotechnique. McGraw Hill, New Yprk.
9. Goodman, R.E. 1980. Introduction to rock mechanics.
10. Schuster, R.L. & Krizek, R.J. 1978. Landslide analysis and control. National Academy of Science, Washington DC.

IGL6C20(E02c) - RESEARCH METHODOLOGY

Credit: 3 **Total Hours: 48**

Course Outcome:
Students will be able to understand

CO1: Concept of Research
CO2: Concept of Plagiarism
CO3: How to write a scientific report, project proposal and thesis
CO4: Ethics in research

Unit 1

- Concept and definition of Research: academic research, basic and fundamental research, applied research, theoretical, conventional and experimental research. Concepts and needs of research hypothesis.
- Research proposal and concepts; developing research proposal in the field of geosciences; research approach and identifying gap areas from literature review; problem formulation and statement of research objective

Unit 2

- Literature survey and review, use of digital library, online resource; necessity of review of literatures. Problem formulation and statement of research objective
- Developing of bibliography.
- Concepts on plagiarism
- ISSN and ISBN numbers
- Impact factors and citation index of research articles and assessing the quality of research articles.

Unit 3

- Structure and components of Scientific Reports – types of Report – Technical Reports and Thesis – Significance
- Different steps in the preparation – Layout, structure and Language of typical reports - Illustrations and tables – Bibliography, Referencing and foot notes –Importance of Effective Communication.
- Preparing Research papers for journals, Seminars and Conferences – Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index.
- Preparation of Project Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and work plan – Budget and Justification – References
- Documentation and scientific writing Results and Conclusions,
- Preparation of manuscript for Publication of Research paper,
- Presenting a paper in scientific seminar,
- Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography

Unit 4

- Types of data: primary and secondary data, Source and authenticity of secondary data,
- Introduction on the techniques of data representation, documentation and representation tools, basic presentation structures, writing a scientific paper, abstract and summary writing and organizing thesis, project reports;
- Integrative approach in geology.

Unit 5

- Ethical Issues – Ethical Committees – Commercialization – copy right – royalty – Intellectual Property rights and patent law – Track Related aspects of intellectual property Rights – Reproduction of published material – Plagiarism – Citation and Acknowledgement – Reproducibility and accountability

References

1. Qualitative Research Methods for Social Sciences by Bruce, L. B. 2001, Allyn and Bacon, Boston.
2. Research Design: Qualitative, Quantitative and Mixed Methods Approaches by John, W. C., 2011, Sage Publications, Thousand Oaks.
3. Principles of Writing Research Papers by Lester, James, D. and Lester Jr. J. D., 2007, Longman, New York.
4. Silicate rock analysis by P. J. Potts, 1997.
5. Handbook of Instrumental Techniques for Analytical Chemistry by Frank A. Settle, 1997, Prentice Hall, Upper Saddle River, NJ.
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11. Law relating to patents, trade marks, copyright designs and geographical indications. Wadehra, B.L.2000, Universal Law Publishing.
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