NEP PG

1-YEAR CURRICULUM

M.Sc. GEOLOGY PROGRAMME

SUBJECT CODE = GLG

FOR POSTGRADUATE COURSES UNDER RANCHI UNIVERSITY, RANCHI

Implemented w.e.f.
Academic Session 2026-27 Onwards

UNIVERSITY DEPARTMENT OF GEOLOGY

Basic Science Building, Morabadi Campus
Ranchi University, Ranchi - 834008, Jharkhand

Ref No. : PS/GL-760(A)/25 **Date :** 24.11.2025

MEETING OF BOARD OF STUDIES (UNIVERSITY DEPARTMENT OF GEOLOGY)

A meeting of board studies was held on 24.11.2025 at 11:00 AM in the University Department of Geology, Ranchi University, Ranchi under the chairmanship of Dr. C.P Mahto, H.O.D University Department of Geology to modify the syllabus of U.G & P.G NEP curriculum to be implemented from 2025-26. The syllabus was thoroughly discussed and modifications were suggested by the members present in the meeting.In the light of suggestions of the members, the draft of the syllabus is prepared and approved; The following faculty Members were present in the meeting.

1.	Dr. C.P Mahto Head University Dept. Geology, R.U	Chair person
2.	Dr. P.K Verma Former H.O.D, University Dept. of Geology, R.U	External Member
3.	Dr. Jayant Sinha Former H.O.D, St. Xavier College, Ranchi.	External Member
4.	Mr. A.C Mishra H.O.D, Gossner College, Ranchi	Member
5.	Dr. Binita Kumari H.O.D, P.P.K College, Bundu	Member
6	Mr. Arvind Rana Bilung H.O.D, K.C.B College, Bedo	Members
7.	Dr. Chanchal Lakra Faculty, Uni. Dept. of Geology, R.U	Member
8.	Mrs. Neelu Priya Tirkey Faculty, Uni. Dept. of Geology, R.U	Member
9.	Mr. Amit Kumar Faculty, Uni. Dept. of Geology, R.U	Member
10	Dr. Nitish Priyadarshi Faculty (Contractual), Uni. Dept. of Geology, R.U	Alumnus Member
11	Dr. Suresh Kumar Samad Faculty, Uni. Dept. of Geology, R.U	Member

24/11/25
HEAD
University Department of Geology
Ranchi University, Ranchi

Approval by the Members of the NEP Implementation and Monitoring Committee of Ranchi University, Ranchi

The prepared Curriculum of the Master's Degree has been approved by the NEP Implementation and Monitoring Committee of R.U., duly forwarded by the Head of the Department; it will be offered to the Students of the 1-year and 2-year Postgraduate Programme. It is implemented from the 1st Semester of the Academic Session 2025-26 and onwards.

10/9/25 10/9/25 10/9/2025

Anuradha Rani 10/09/25 10/9/25 10/9/25

10/9/25 10/9/25 10/09/2025

Chowdhary 10/09/2025

10/09/25

Member Secretory

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HIGHLIGHTS OF NEP PG CURRICULUM

CREDIT OF COURSES

The term 'credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. The workload relating to a course is measured in terms of credit hours. It determines the number of hours of instruction required per week over a semester (minimum 15 weeks).

a) One hour of teaching/ Lectures or two hours of laboratory /practical work will be assigned per class/interaction.
One credit for Theory = 15 Hours of Teaching
One credit for Practicum = 30 Hours of Practical work
One credit for Internship = 02 Weeks of Practical experience

b) For credit determination, instruction is divided into three major components:
Hours (L) – Classroom Hours of one hour duration.
Tutorials (T) – Special, elaborate instructions on specific topics of one hour duration
Practical (P) – Laboratory or field exercises in which the student has to do experiments or other practical work of a two-hour duration.

Internship – For the Exit option after 1st year of the 2-year P.G. Programme for the award of P.G. Diploma, Level 6.5, Students can either complete two 4-week internships worth 2 credits each or one 8-week internship for all 4 credits. This practical experience connects academic learning with real-world applications, offering valuable exposure to professional environments in their fields of study

PG CURRICULUM

1. The PG Curriculum will be either of 1-year duration for students who studied the four-year UG Programme (FYUGP) or a 2-year duration for students who studied a three-year UG programme from a CBCS/LOCF/FYUGP Curriculum.
2. There is a flexible mode in the PG programme offered to the students of Ranchi University, Ranchi. The total credit for any semester will be 20 credits.
3. **One-year PG curriculum:** The Courses in the 1-year PG programme and the second year of the 2-year PG programme are the same.
   a. **Course work only**: There will be 5 courses at level 500 of 4 credits each in every semester for the coursework offered in the programme.
   b. **Course work and Research**: There will be 5 courses at the level 500 bearing 4 credits each in the first semester of a 1-year PG or in the third semester of a 2-year PG. Research work will be offered in the next semester for this mode of the programme. The eligibility for this mode is available in the NEP PG curriculum of Ranchi University, Ranchi.
   c. **Research work only**: The eligible student will be offered this mode to conduct extensive research under the supervision of a guide. Each semester will be equivalent to 20 credits. The selection of a candidate for the research mode will depend upon the eligibility of the student, availability of the guide and seat in the department/institution of Ranchi University, Ranchi.

PROMOTION CRITERIA

One Year Post-graduation programme having coursework only:

i. Each course shall be of **100 marks,** having two components: **30 marks for Sessional Internal Assessment (SIA), conducted by the Department/College and 70 marks shall be assigned to the End Semester University Examination (ESUE), conducted by the University**.
ii. The marks of SIA shall further break into 20 for Internal Written Examinations, 05 for Written Assignment/ Seminar presentation and 05 for overall performance of a student, including regularity in the classroom lectures and other activities of the Department/College.
iii. The Requisite Marks obtained by a student in a particular subject will be the criterion for promotion to the next Semester.
iv. There shall be two written internal examinations, each of 1 hour duration and each of 20 marks, in a semester, out of which the '**better of the two**' shall be taken for computation of marks under SIA.

v. If a student failed to secure pass marks in the Mid Semester Examination, he/she has to reappear in Mid & End Semester Examinations, of the following year.

vi. In case a student fails to secure pass marks in End Semester Examination, then he/she has to appear only in the End Semester Examination of the following session within the period of Upper Limit of Two Years and the Marks of the Mid Semester will be carried for the preparation of the result.

vii. Students' final marks and the result will be based on the marks obtained in the Mid Semester and End Semester Examination taken together.

viii. The pass marks in the programme will be 45% of the total marks obtained in each Core/ Elective/ Other Courses offered.

ix. In absolute terms of marks obtained in a course, **a minimum of 28 marks is essential in the ESUE** and **a minimum of 17 marks is to be secured in the SIA** to clear the course. In other words, a student shall have to pass separately in the ESUE and in the SIA by securing the minimum marks prescribed here.

x. Every candidate seeking to appear in the ESUE shall be issued an Admit Card by the University. **No candidate will be permitted to appear in the examination without a valid admit card.**

xi. A candidate shall be permitted to proceed in the next Semester (2^{nd}), **provided he/she has passed at least 3 courses out of 5 courses** in the respective semester in theory and practical/ project courses taken together.

xii. A student will have to clear all his/her papers within a maximum of Two Years of duration to qualify for the degree.

However, it will be necessary to procure pass marks in each of the papers before completion of the programme.

VALUE-ADDED COURSES

1. The Value-added course will be of **2 credits** to be covered during the first semester.
2. The End Semester University Examination (ESUE) of this course will comprise 50 objective-type questions of 1 mark each.
3. ESUE shall be OMR-based and the correct option is to be marked by a black ballpoint pen.
4. For the **50 Marks Examination,** the student will be provided **two hours** to mark their responses.
5. Students are not allowed to choose or repeat courses already undergone at the undergraduate level in the proposed major and minor streams.
6. The performance in this course will not influence the SGPA or CGPA of the PG Programme wherein the student is registered to obtain the Master's Degree. However, it will be mandatory to secure minimum pass marks in the course before exiting the Programme.
7. If a student fails to secure the minimum pass marks in this course in the first semester, he/she must reappear in the examination of the said course with the following batch of the next session.
8. The student may appear in the examination of the said course further if they could not clear the course in the following attempt, subject to the date of validation of the Registration.

The existing Regulations of the PG Curriculum of Ranchi University, Ranchi, shall guide the Regulations related to any concern not mentioned here.

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COURSE STRUCTURE FOR **'PG COURSEWORK/ COURSEWORK WITH RESEARCH/ RESEARCH ONLY'**

Table 1: Credit Framework for One Year Postgraduate Programme [Total Credits = 40]

Academic Level	Level of Courses	Semester	Coursework Level 400	Coursework Level 500	Research Preparedness	Research thesis/ Project/ Patent	Total Credits
YEAR 1							
Level 6.5	**Coursework**	**III**	**---**	**4+4+4+4+4**	**---**	**---**	**20**
		IV	**---**	**4+4+4+4+4**	**---**	**---**	**20**
OR							
Level 6.5	**Coursework + Research**	**III**	**---**	**4+4+4+4+4**	**---**	**---**	**20**
		IV	**---**	**---**	**20**		**20**
OR							
Level 6.5	**Research**	**III**	**---**	**---**	**20**	**---**	**20**
		IV	**---**	**---**	**---**	**20**	**20**
Total credits = **40**							

Note: **Every student has to take any one Value-added course of 2-credits compulsorily in the 1st Semester of PG programme.**

There is no provision of 'Exit' in the 1-Year PG Programme.

AIMS OF MASTER'S DEGREE PROGRAMME IN GEOLOGY

The aim of Master's degree programme in Geology is intended to provide:

The aim of the Master's degree programme in Geology is to deliver advanced and comprehensive knowledge of Earth sciences, integrating fundamental principles with modern analytical tools and techniques. The programme emphasizes core domains such as mineralogy, petrology, structural geology, geochemistry, sedimentology, and geophysics, as well as the application of geospatial and spectroscopic methods for the identification and analysis of geological materials. It also explores the theoretical foundations of geological processes and their practical applications in understanding Earth systems and resource evaluation.

The programme is designed to develop a deep understanding of research methodology, geological data interpretation, and field-based investigation. It promotes awareness of environmental and sustainability issues, and fosters an understanding of the interrelationships among lithosphere, hydrosphere, atmosphere, and biosphere. The course also introduces aspects of Indian Knowledge Systems (IKS) relevant to traditional geological and natural resource practices. Emerging interdisciplinary areas such as environmental geology, hydrogeology, and biogeochemistry are incorporated to highlight the role of geological materials and processes in life-supporting systems and ecological balance.

Through rigorous laboratory work, extensive field training, and research projects, the programme fosters scientific inquiry, critical thinking, and analytical skills. A key objective is to prepare students for careers in geoscientific research, mineral and energy exploration, environmental consultancy, geotechnical industries, and academia. It also equips them for higher studies and encourages contributions toward solving contemporary challenges such as resource management, climate change, and sustainable development. Ultimately, the programme aims to nurture competent geoscientists with strong technical expertise, ethical responsibility, and a commitment to the sustainable utilization of Earth resources.

PROGRAMME LEARNING OUTCOMES

The broad aims of the Master's degree programme in Geology are:

(i) Core competency: Students will acquire comprehensive knowledge in Geology, with specialization in core areas such as Physical Geology, Mineralogy, Petrology, Structural Geology, Geochemistry, Sedimentology, and Geophysics.

(ii) Conceptual understanding: Students will develop a systematic and coherent understanding of fundamental geological concepts, including Earth processes, tectonics, mineral formation, rock genesis, and surface–subsurface interactions.

(iii) Analytical approach: Students will be able to interpret geological data using evidence-based approaches, including field observations, petrographic analysis, geochemical signatures, and geophysical datasets.

(iv) Material characterization: Students will understand the identification and characterization of minerals, rocks, and geological materials using modern analytical techniques.

(v) Instrumentation knowledge: Students will gain knowledge of the principles and applications of laboratory instruments and field equipment used in geological investigations.

(vi) Experimental and field skills: Students will be able to demonstrate field mapping, sampling techniques, laboratory experimentation, and data interpretation relevant to their area of specialization.

(vii) Disciplinary knowledge and skill: Graduates will demonstrate integrated knowledge of theoretical and applied geology across domains such as economic geology, environmental geology, hydrogeology, and engineering geology. They will also be able to use advanced analytical tools and software (e.g., GIS, remote sensing, geochemical modeling).

(viii) Skilled communicator: Students will develop the ability to communicate geological concepts and research findings effectively through technical writing, reports, presentations, and scientific discussions.

(ix) Critical thinker and problem solver: Students will be able to apply critical thinking to solve geological problems, including resource evaluation, hazard assessment, and environmental challenges.

(x) Sense of inquiry: Students will develop scientific curiosity and the ability to design, plan, and execute independent geological investigations and research projects.

(xi) Team player: Students will gain experience working collaboratively in fieldwork, laboratory environments, and interdisciplinary projects.

(xii) Project management skills: Students will acquire skills in planning, executing, and managing geological projects, including data collection, interpretation, reporting, and adherence to scientific and ethical standards.

(xiii) Digitally literate: Students will develop proficiency in digital tools such as GIS, remote sensing, geological modeling software, and data analysis platforms relevant to geosciences.

(xiv) Ethical awareness and responsibility: Students will understand ethical practices in geological research, resource utilization, environmental protection, and professional conduct.

(xv) Lifelong learning: The programme is designed to instill the ability for continuous learning through the use of modern scientific tools, ICT resources, journals, and field-based knowledge, enabling sustained academic growth and enhanced employability in geoscience-related sectors.

The Courses in One Year P.G. Programme and in the Second year of Two years P.G. Programme are Common.

Table 2: Semester-wise Course Code and Credit Points

Sem	Core, AE/ GE/ DC/ EC & Compulsory FC Courses			Examination Structure			
	Paper	Paper Code	Name of Paper	Credit	Mid Semester Evaluation (F.M.)	End Semester Evaluation (F.M.)	End Semester Practical/ Viva (F.M.)
I	Core Course	CCGLG311	IKS in Geological Sciences	4	30	70	----
	Skill Enhancement Course	ECGLG312	Analytical Instrumentation and Laboratory Techniques in Geosciences	4	30	70	----
	Elective Core	ECGLG313	A. Fossil Fuel Geology-I B. Sedimentology-I C. Hydrogeology-I D. Ore Geology-I E. Environmental Geology-I	4	30	70	----
	Core Course	CCGLG314	Advanced Stratigraphy and Palaeobiology	4	30	70	----
	Practicals on Core	CPGLG315	Practical	4	----	----	100
II	Elective	ECGLG411	A. Fossil Fuel Geology-II B. Sedimentology-II C. Hydrogeology-II D. Ore Geology-II E. Environmental Geology-II	4	30	70	----
	Elective	ECGLG412	A. Fossil Fuel Geology-III B. Sedimentology-III C. Hydrogeology-III D. Ore Geology-III E. Environmental Geology-III	4	30	70	----
	Core Course	CCGLG413	Mineral Exploration	4	30	70	----
	Practicals on Elective	EPGLG414	A. Fossil Fuel Geology-Pr B. Sedimentology-Pr C. Hydrogeology-Pr D. Ore Geology-Pr E. Environmental Geology-Pr	4	----	----	100
	PROJECT	PRGLG415	Dissertation/ Project Work/ Teaching Aptitude	4	----	----	100

Note:

1. **Every student has to take any one Value-added course of 2-credits compulsorily in the 1st Semester of PG programme.**
2. **There is no provision of 'Exit' in the 1-Year PG Programme.**

INSTRUCTION TO QUESTION SETTER

SEMESTER INTERNAL EXAMINATION (SIE):

There **Marks Weightage of a Course:** Each non-practical/non-project course shall be of **100 marks** having two components: **70 marks shall be assigned to the End Semester University Examination (ESUE), conducted by the University, and, 30 marks for Sessional Internal Assessment (SIA), conducted by the Department/College**.

The marks of SIA shall further break into, 20 for Internal Written Examinations, 05 for Written Assignment/ Seminar presentation and 05 for overall performance of a student including regularity in the class room Lectures and other activities of the Department/College. There shall be two written internal examinations, each of 1-hour duration and each of 20 marks, in a semester out of which the **'Better One out of Two'** shall be taken for computation of marks under SIA.

In absolute terms of marks obtained in a course, **a minimum of 28 marks is essential in the ESUE and a minimum of 17 marks is to be secured in the SIA to clear the course**. In other words, a student shall have to pass separately in the ESUE and in the SIA by securing the minimum marks prescribed here.

A. (SIE 20+5=25 marks):

There will be a uniform pattern of questions for mid-semester examinations in all the courses and of all the programmes. There will be **two** groups of questions in 20 marks written examinations. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered. Department may conduct Sessional Internal Examinations in other format as per needs of the course.

The Semester Internal Examination shall have two components. (a) One Semester Internal Assessment Test (SIA) of 20 Marks, (b) Class Attendance Score (CAS) of 5 marks.

Conversion of Attendance into score may be as follows:

Attendance Upto 45%, 1mark; 45<Attd.<55, 2 marks; 55<Attd.<65, 3 marks; 65<Attd.<75, 4 marks; 75<Attd, 5 marks.

END SEMESTER UNIVERSITY EXAMINATION (ESUE):

A. (ESUE 70 marks):

There will be a uniform pattern of questions for all the courses and all the programmes. There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short-answer type** consisting of five questions of 1 mark each. **Question No.2 will be a short-answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered. The questions will be so framed that examinee could answer them within the stipulated time.

[**Note:** There may be subdivisions in each question asked in Theory Examinations]

B. (ESUE 100 marks):

Practical/ Project courses would also be of 100 marks but there **shall be no internal written examinations** of the type specified above. The total 100 marks will have two components: **70 marks for the practical ESUE and 20 marks for the Viva-voce examination** conducted during the ESUE to assess the applied and practical understanding of the student.

The written component of the project (**Project Report**) shall be of **70 marks and 20 marks will be for the Viva-voce examination** jointly conducted by an external examiner, appointed by the University, and the internal supervisor/ guide.

10 marks will be assigned on the cumulative assessment of the examinee during the semester and will be awarded by the department/faculty concerned.

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FORMAT OF QUESTION PAPER FOR MID/ END SEMESTER EXAMINATIONS

Question format for **20 Marks**:

Subject/ Code

F.M. =20 **Time**=1Hr. Exam Year

General Instructions:

i. **Group A** carries very short answer type compulsory questions.
ii. **Answer 1 out of 2** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]

Group B

3. ..... [10]
4. ..... [10]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **70 Marks**:

Subject/ Code

F.M. =70 **Time**=3HrS. Exam Year

General Instructions:

i. **Group A** carries very short answer type compulsory questions.
ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]

Group B

3. ..... [15]
4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

SEMESTER III

I. CORE COURSE [CCGLG311]

IKS IN GEOLOGICAL SCIENCES

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to:

1. Understand principles of Indian Knowledge Systems (IKS) in relation to geology. Learn traditional concepts of Earth processes, time cycles, and landscapes. Study indigenous water management and environmental practices.
2. Explore traditional mineral use, mining, and metallurgical knowledge.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain IKS concepts and their relevance to Earth sciences. Interpret traditional views of Earth processes and environmental changes. Evaluate indigenous practices in water management and sustainability.
2. Relate traditional mineral and metallurgical knowledge to modern geology.

Course Content:

Unit 1: IKS: definition, scope, and relevance to Earth Science/Geology; Panchabhuta and its geological significance; Indian stone sculpture and architectural heritage; descriptions of rocks and minerals in the Rigveda and Atharvaveda; accounts of mountains, rivers, and landforms in the Ramayana and Mahabharata; comparison of IKS with modern geological studies.

Unit 2: Cosmogenesis in the Rigveda (Nasadiya and Hiranyagarbha Sukta); Vedic–Puranic concepts of Bhumi, its origin, structure, and stability; cyclic processes of Srishti–Sthiti–Pralaya; SaptaDvipa and Sapta Samudra; traditional descriptions of Meru, Himalaya, Vindhya, and major rivers; indigenous explanations of earthquakes, floods, droughts, and other natural events; references to calamities in epics and Smritis; ecological wisdom emphasizing harmony and conservation of land and water.

Unit 3: Four Yugas (Satya, Treta, Dvapara, Kali) as traditional time divisions and cyclic Earth history; indigenous ideas on Earth's origin and evolution; concepts of succession and antiquity of landforms in ancient literature; accounts of mountains, rivers, forests, and landscape changes; traditional narratives on the formation of the Indian subcontinent; historical records of Earth events; regional descriptions of land, soils, and rocks; cultural and resource significance of the land's layered history.

Unit 4: Jala Tattva and Varuna worship emphasizing water sanctity and conservation; indigenous water management through kund, baoli/vapi, pushkarini, talaab, sarovar, kalyani, and nadi; community storage and distribution; traditional methods for locating groundwater using natural indicators; purification practices in Vedas, Brahma Samhita, Arthashastra, and Brihat Samhita (filtration, boiling, herbal cleansing, storage); sacred status of rivers and ponds; ecological ethics for sustainable water use.

Unit 5: Minerals and metals (gold, silver, copper, zinc, iron) in ancient and medieval India; symbolic and practical uses of minerals; traditional mining, ore prospecting, smelting, and alloying; metallurgical practices and preparation of bhasma; relevance of indigenous mining knowledge.

Books Suggested:

1. Bhandarkar Oriental Research Institute, n.d. Geology in the Ancient Vedic Literature.
2. Gaur, V.K., 1989. Geodynamics of the Indian Peninsula and the Indian Plate Margin.
3. Jha, A., 2010. Traditional Knowledge System in India. Atlantic Publishers.
4. Kak, S., n.d. The Astronomical Code of the Rigveda.
5. Kumar, R., n.d. Fundamentals of Historical Geology and Stratigraphy of India. New Age International.
6. Ramakrishnan, M. and Vaidyanadhan, R., n.d. Geology of India. Geological Society of India.
7. Ratha Shastra, n.d. Gemology in Ancient India.
8. Sen, S., 2022. The Synergy of Ancient Indian Thought and Modern Science.
9. Sharma, D.P., 2021. Indian Knowledge Systems: A Holistic Approach.
10. Valdiya, K.S., 2001. Geodynamics of the Indian Plate: Evolutionary Perspective.
11. Valdiya, K.S., 2010. The Making of India: Geology of India. Macmillan.
12. Varahamihira, n.d. Brihat Samhita.
13. Vatsyayan, K., n.d. Ecology and Indian Myth. IGNCA.

II. SKILL ENHANCEMENT COURSE [ECGLG312]
ANALYTICAL INSTRUMENTATION TECHNIQUES

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand principles of analytical methods and sample preparation.
2. Learn mineralogical and geochemical instrumentation techniques.
3. Develop knowledge of physical, thermal, and separation methods.
4. Gain familiarity with field and geophysical instruments.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Apply analytical methods with accuracy and proper calibration.
2. Use mineralogical and geochemical instruments for analysis.
3. Interpret data from physical and chemical techniques.
4. Operate field and geophysical tools for geological investigations.

Course Content:

Unit 1: Fundamentals of Analytical Methods: Role of instrumentation in geosciences; destructive vs non-destructive methods; Qualitative vs quantitative analysis; Units, standards, calibration curves, accuracy, precision, detection limits, Errors, Laboratory safety and good lab practices, Sample preparation methods: Crushing, grinding, sieving; Thin section preparation, Powdering and pelletizing, Fusion beads, Acid digestion

Unit 2: Mineralogical & Imaging Instruments: Petrographic Microscope, Image Analysis System, Scanning Electron Microscope (SEM–EDS): Electron Probe Micro Analyzer (EPMA), X-ray Diffraction (XRD), Raman, and Fourier Transform Infrared (FTIR) Spectroscopy.

Unit 3: Geochemical & Chemical Analytical Instruments: Atomic Absorption Spectrometer (AAS), X-Ray Fluorescence (XRF), Induced Coupled Plasma Mass Spectrometer (ICP-MS), Basics of Thermal Ionization Mass Spectrometry (TIMS), Multi-collector ICP-MS, and Isotope Ratio Mass Spectrometry (IRMS)

Unit 4: Thermal, Physical & Separation Techniques: Thermogravimetric Analysis (TGA), UV lamps, Heavy Mineral Separation, Particle Size Analysis, Magnetic susceptibility & density measurements, Ion chromatography, CHNS Elemental Analyzer.

Unit 5: Introduction to field &Geophysical Instruments: Portable XRF and Raman, Geiger Muller /Scintillation detectors, Laser-Induced Breakdown Spectroscopy (LIBS), Geophone & seismic sensors; Gravimeter; Resistivity meter; Gamma-ray spectrometer; Ultrasonic P- and S-wave tester.

Books Suggested:

1. Deer, W.A., Howie, R.A. and Zussman, J., n.d. Rock-Forming Minerals (series).
2. Dhanaraj, R., 2009. Handbook of Geochemistry Techniques and Applications in Mineral Exploration. Geological Survey of India (GSI).
3. Hutchison, C.S., n.d. Laboratory Handbook of Petrographic Techniques.
4. Kerr, P.F., 1977. Optical Mineralogy. McGraw-Hill.
5. Perkins, D., 2013. Mineralogy. Prentice Hall.
6. Potts, P.J., 2012. A Handbook of Silicate Rock Analysis. Springer.
7. Reed, S.J.B., 1996. Electron Microprobe Analysis and SEM in Geology. Cambridge University Press.
8. Rollinson, H., 2014. Using Geochemical Data: Evaluation, Presentation, and Interpretation. John Wiley & Sons.

III. ELECTIVE CORE-A [ECGLG313A]
FOSSIL FUEL GEOLOGY-I

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand the origin, occurrence, and classification of coal.
2. Learn physical, chemical, and petrographic properties of coal.
3. Develop knowledge of coal-based energy resources.
4. Study applications of coal in industrial and environmental contexts.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain coal formation, occurrence, and classification systems.
2. Analyze coal properties using petrographic and chemical methods.
3. Evaluate coal as an energy resource, including CBM and shale gas.
4. Apply coal studies in industrial processes and paleoenvironmental analysis.

Course Content:

Unit 1: Definition and origin of coal, sedimentology of coal-bearing strata; Mode of occurrence and structures of coal; Coal-forming Epochs in the geological past.

Unit 2: Physical and chemical characterization of coal; Proximate and Ultimate analysis of coal; Rank, grade, and types of coal; Types of coking and non-coking coals; Classification of Coal.

Unit 3: Macroscopic and microscopic examination of coal, Concepts of Macerals and Micro lithotypes, Origin and classification of macerals, Concept of coal rank; Application of Coal Petrology.

Unit 4: Basics of Coal Bed Methane, coal as its reservoir, its exploration and production; Application of microscopic methods for CBM Prospecting; Gas Hydrates, Shale gas.

Unit 5: Microscopic techniques for evaluation of rank, Paleoenvironmental study, and characterization of coal for carbonization, gasification, and hydrogenation processes.

Books Suggested:

1. Chandra, D., Singh, R.M. and Singh, M.P., 2000. Textbook of Coal (Indian Context). Tara Book Agency, Varanasi.
2. Scott, A.C., 1987. Coal and Coal-Bearing Strata: Recent Advances. Blackwell Scientific Publications.
3. Singh, M.P., 1998. Coal and Organic Petrology. Hindustan Publishing Corporation, New Delhi.
4. Taylor, D.W., 1993. Coal: Typology–Physics–Chemistry–Constitution. Elsevier Science, Netherlands.
5. Teichmüller, M., Davis, A., Diessel, C.F.K., Littke, R. and Robert, P., 1998. Organic Petrology. Gebrüder Borntraeger, Stuttgart.
6. Thomas, L., 2002. Coal Geology. John Wiley & Sons Ltd., England.
7. Van Krevelen, D.W., Stach, E., Mackowsky, M., Taylor, G.H., Chandra, D. and Teichmüller, M., 1982. Stach's Textbook of Coal Petrology. Gebrüder Borntraeger, Stuttgart.

OR ELECTIVE CORE-B [ECGLG313B]

SEDIMENTOLOGY-I

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	**Pass Marks: (MSE: 17 + ESE: 28) = 45**

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand petrogenesis and classification of sedimentary rocks.
2. Learn carbonate, evaporite systems, and diagenetic processes.
3. Develop knowledge of sequence stratigraphy concepts.
4. Study stratigraphic surfaces and systems tracts.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain the origin and classification of clastic and carbonate rocks.
2. Analyze diagenetic processes affecting sedimentary rocks.
3. Interpret depositional sequences and stratigraphic frameworks.
4. Apply sequence stratigraphy in basin analysis and correlation.

Course Content:

Unit-1: Types of sandstones and their petrogenesis; Graywacke and graywacke problem; plate - tectonics and sandstones composition; Argillaceous rocks, their classification and genesis.

Unit-2: Limestone and dolomites: classification and petrography, Models of dolomitization. Study of evaporites such as gypsum and anhydrite.

Unit-3: Diagenesis of sandstones and carbonate rocks.

Unit-4: Historical developments of sequence stratigraphy, key concepts, transgressions, and regressions. Order and duration of sequences; application and significance of sequence stratigraphy; Para sequence.

Unit-5: Sequence boundary, Transgressive surface, maximum flooding surface, marine flooding surface.
Systems tract: Low stand systems tract, High stand systems tract, Falling stage systems tract, Regressive systems tract.

Books Suggested:

1. Blatt, H., Middleton, G.V. and Murray, R.C., 1980. Origin of Sedimentary Rocks. Prentice-Hall Inc.
2. Collins, J.D. and Thompson, D.B., 1982. Sedimentary Structures. George Allen & Unwin, London.
3. Lindholm, R.C., 1987. A Practical Approach to Sedimentology. Allen & Unwin, London.
4. Pettijohn, F.J., 1975. Sedimentary Rocks. 3rd ed. Harper & Row, New Delhi.
5. Reading, H.G., 1997. Sedimentary Environments and Facies. Blackwell Scientific Publications.
6. Reineck, H.E. and Singh, I.B., 1973. Depositional Sedimentary Environments. Springer-Verlag.
7. Selley, R.C., 2000. Applied Sedimentology. Academic Press.
8. Tucker, M.E., 1981. Sedimentary Petrology: An Introduction. John Wiley & Sons, New York.
9. Tucker, M.E., 1990. Carbonate Sedimentology. Blackwell Scientific Publications

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OR ELECTIVE CORE-C [ECGLG313C]

HYDROGEOLOGY-I

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand groundwater occurrence, properties, and aquifer systems.
2. Learn groundwater flow principles and evaluation methods.
3. Develop knowledge of groundwater resources and well design.
4. Study groundwater quality, contamination, and management issues.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain groundwater systems and aquifer characteristics.
2. Apply flow laws and analyze aquifer parameters.
3. Assess groundwater resources and design wells.
4. Evaluate water quality and address contamination issues.

Course Content:

Unit 1: Hydrologic Cycle, Distribution of water in Earth's crust, Groundwater in hydrologic cycle; Groundwater, origin, types, importance; Aquifer, their types and characteristics; Hydrologic properties of aquifer materials: porosity; permeability; specific yield; specific retention, hydraulic conductivity, transmissivity, storage coefficient.

Unit 2: Forces and laws of groundwater movement; Darcy law and its application in hydrogeology; Confined, unconfined, steady, unsteady, and radial flows of groundwater; Methods of pumping test and evaluation of aquifer parameters. Springs: types, origin, and movement of water; Water Table map and its significance.

Unit 3: Hydrographic analyses, Water budget studies; Water resource inventory of the basin; Consumptive and conjunctive use of surface and groundwater; Causative factors for Water Table fluctuation. Wells: types, drilling methods, construction, design, and development of wells;

Unit 4: Physical and Chemical characteristics of groundwater. Interpretation of chemical analysis. Relationship of quality to use. Groundwater pollution; Sources of surface and subsurface pollution; Control of groundwater pollution.

Unit 5: Chemical characteristics of groundwater in relation to various uses–domestic, industrial, and irrigation; Water contaminants and pollutants, natural (geogenic) and anthropogenic contaminants; Saline water intrusion in coastal and other aquifers and its prevention; Groundwater contamination and problems of arsenic and fluoride in the Indian subcontinent with special reference to Jharkhand.

Books Suggested:

1. Davies, S.N. and De Wiest, R.J.M., 1966. Hydrogeology. John Wiley & Sons, New York.
2. Driscoll, F.G., 1988. Groundwater and Wells. UOP, Johnson Division, St. Paul, Minnesota, USA.
3. Fetter, C.W., 2016. Applied Hydrogeology. 4th ed. Pearson Education Ltd.
4. Hiscock, K.M., 2009. Hydrogeology: Principles and Practice. Wiley-Blackwell.
5. Jakeman, A.J., Barreteau, O., Hunt, R.J., Rinaudo, J.D. and Ross, A., 2016. Integrated Groundwater Management: Concepts, Approaches and Challenges. Springer.
6. Karanth, R., 1989. Hydrogeology. Tata McGraw-Hill Publishing.
7. Nagabhu Shaniah, H.S., 2001. Groundwater in Hydrosphere (Groundwater Hydrology). CBS Publishers.
8. Patra, H.P., Adhikari, S.K. and Kumar, S., 2016. Groundwater Prospecting and Management. Springer.
9. Raghunath, H.M., 1990. Groundwater. Wiley Eastern Ltd.
10. Ramanathan, A., Johnston, S., Mukherjee, A. and Nath, B. (eds.), 2015. Safe and Sustainable Use of Arsenic-Contaminated Aquifers in the Gangetic Plain: A Multidisciplinary Approach. Springer.
11. Singhal, B.B.S. and Gupta, R.P., 2010. Applied Hydrogeology of Fractured Rocks. Springer.
12. Todd, D.K., 1995. Groundwater Hydrology. John Wiley & Sons.
13. Tolman, C.F., 1937. Groundwater. McGraw-Hill, New York and London.

OR ELECTIVE CORE-D [ECGLG313D]

ORE GEOLOGY-I

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand properties, textures, and classification of ore minerals and deposits.
2. Learn ore-forming processes and types of mineral deposits.
3. Develop knowledge of major ore deposit models.
4. Study geochemical tools used in ore genesis interpretation

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Identify ore minerals and interpret textures and paragenesis.
2. Explain the formation and classification of ore deposits.
3. Analyze different ore deposit types in geological settings.
4. Apply fluid inclusion and isotope studies in ore genesis.

Course Content:

Unit 1: Ore minerals and industrial minerals; physical and optical properties of ore minerals; ore textures and paragenesis; characteristics of mineral deposits- spatial and temporal distribution, rock-ore association;

Unit 2: syngenetic and epigenetic deposits, forms of ore bodies, stratiform and strata-bound deposits; ore forming processes-source and migration of ore constituents and ore fluid, mechanism of ore deposition;

Unit 3: magmatic and pegmatitic deposits (chromite, Ti-magnetite, diamond, Cu-Ni sulphide, PGE, REE, muscovite, rare metals); hydrothermal deposits (porphyry Cu-Mo, greisen Sn W, skarn, VMS and SEDEX type sulphide deposits, orogenic gold);

Unit 4: sedimentary deposits (Fe, Mn, phosphorite, placer); supergene deposits (Cu, Al, Ni and Fe); metamorphic and metamorphosed deposits (Mn, graphite);

Unit 5: fluid inclusions in ore mineral assemblage- physical and chemical properties, microthermometry; stable isotope (S, C, O, H) in ore genesis- geothermometry, source of ore constituents; global tectonics and mineralization

Books Suggested:

1. Chatterjee, K.K. (1993). An Introduction to Mineral Economics, Wiley Eastern.
2. Arogyaswamy, R.N.P., 1995. Courses in Mining Geology. Oxford & IBH Publishing Co., New Delhi.
3. Barnes, H.L., 1979. Geochemistry of Hydrothermal Ore Deposits. John Wiley & Sons.
4. Chatterjee, K.K., 1993. An Introduction to Mineral Economics. Wiley Eastern.
5. Clark, G.B., 1967. Elements of Mining. Asia Publishing House.
6. Craig, J.R. and Vaughan, D.J., 1981. Ore Microscopy and Ore Petrography. John Wiley & Sons.
7. Edwards, R. and Atkinson, K., 1986. Ore Deposit Geology. Chapman & Hall, London.
8. Evans, A.M., 2012. Ore Geology and Industrial Minerals. 3rd ed. Blackwell.
9. Guilbert, J.M. and Park, C.F., 1986. The Geology of Ore Deposits. W.H. Freeman.
10. Jensen, M.L. and Bateman, A.M., 1981. Economic Mineral Deposits. John Wiley & Sons, New York.
11. Klemm, D.D. and Schneider, H.J., 1977. Time- and Strata-Bound Ore Deposits. Springer-Verlag.
12. McKinstry, H.E., 1972. Mining Geology. Prentice-Hall Inc.
13. Mookherjee, A., 2000. Ore Genesis: A Holistic Approach. Allied Publishers.
14. Sawkins, F.J., 1984. Metal Deposits in Relation to Plate Tectonics. Springer-Verlag.
15. Sinha, R.K. and Sharma, N.L., 1993. An Introduction to Mineral Economics. Wiley Eastern.
16. Stanton, R.L., 1972. Ore Petrology. McGraw-Hill.
17. Thomas, L.J., 1978. An Introduction to Mining. Methuen, Brisbane.
18. Wolf, K.H., 1981. Handbook of Strata-Bound and Stratiform Ore Deposits. Elsevier.

OR ELECTIVE CORE-E [ECGLG313E]

ENVIRONMENTAL GEOLOGY-I

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand environmental systems and human–environment interactions.
2. Learn atmospheric processes and climate change mechanisms.
3. Develop knowledge of air and water pollution.
4. Study hydrological processes and environmental impacts.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain environmental geology concepts and global changes.
2. Analyze atmospheric processes and climate change effects.
3. Assess sources and impacts of air and water pollution.
4. Evaluate groundwater and hydrosphere-related environmental issues.

Course Content:

Unit 1: Basics of Environment; Types of Environments; Man and Environment; Components of environmental geology, Concepts and principles of Environmental Geology; Time scales of global changes in the ecosystem and climate.

Unit 2: Atmosphere, structure, and composition of atmosphere; Global warming. Greenhouse effect.CO2 increase and global warming in the present and past atmospheres;

Unit 3: Environmental Pollution: Sources of Air Pollution, emission of major industrial air pollutants, effects of air pollution on atmospheric processes, oxides of carbon as pollutants, greenhouse effect, global warming, chlorofluorocarbons (CFC's), depletion of ozone layer, effects of ozone depletion, smog, acid rain;

Unit 4: Components of the Hydrosphere; Water cycle; solubility of gases in water, Acidification of the Ocean; Impact of oceanic and atmospheric circulation on climate and rainfall. Fluctuation of the water table due to anthropogenic and geogenic causes.

Unit 5: Water Pollution: Types of water pollution, groundwater pollution and its effects, sources of water pollution; organic and inorganic contamination of groundwater and its remedial measures.

Books Suggested:

1. Bell, F.G., 1999. Geological Hazards. Routledge, London.
2. Bryant, E., 1985. Natural Hazards. Cambridge University Press.
3. Dutta, A., n.d. Environmental Issues and Challenges.
4. Ghosh, R. and Chatterjee, D.S., n.d. Environmental Geology.
5. Keller, E.A., 1978. Environmental Geology.
6. Patwardhan, A.M., 1999. The Dynamic Earth System.
7. Sharma, B.K., n.d. Environmental Pollution.
8. Smith, K., 1992. Environmental Hazards.
9. Strahler, A.N. and Strahler, A.H., n.d. Environmental Geology.
10. Subramaniam, V., 2001. Textbook of Environmental Hazards.
11. Valdiya, K.S., 1987. Environmental Geology: Indian Context.

IV. CORE COURSE [CCGLG314]
ADVANCED STRATIGRAPHY AND PALAEOBIOLOGY

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand principles of stratigraphy and the geological time framework.
2. Learn the stratigraphy of India and major fossil groups.
3. Develop knowledge of paleontological classification and evolution.
4. Study applications of micropaleontology and palynology in exploration.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Apply stratigraphic principles for correlation and geological interpretation.
2. Interpret the geological history of India using stratigraphy and fossils.
3. Identify and classify fossil groups and analyze evolutionary trends.
4. Use microfossils and palynology in biostratigraphy and hydrocarbon exploration.

Course Content:

Unit 1: Principles of Stratigraphy; Concept of Lithofacies and Biofacies; Stratigraphic Correlation; Concepts of Magnetostratigraphy and Sequence Stratigraphy. Precambrian Stratigraphy of Dharwar and Singhbhum-Chota Nagpur craton; Proterozoic stratigraphy -tectonic framework, geological history and evolution of Vindhyan Super Group, Cuddapahs and their equivalents;

Unit 2: Palaeozoic stratigraphy: Palaeozoic formations of India with special reference to type localities, history of sedimentation, fossil content; Concept, classification, lithology, life and age of Gondwana super group; Mesozoic formations of India with special reference to type localities, history of sedimentation, fossil content; Tertiary formations of Northeastern India, Siwalik Group; Stratigraphic boundary problems –Pre Cambrian-Cambrian (P/C), Permian-Triassic(P/Tr) and Cretaceous –Tertiary(K/T)boundaries.

Unit 3: Study of Ichnofossils; Taphonomy and Preservation. Morphology, classification, biostratigraphy, and evolutionary trends of Trilobites, Brachiopods, Bivalves, Cephalopoda, Gastropods, and Echinoids.

Unit 4: Vertebrates and their classification. Evolutionary trends in Equidae, Proboscidae, and Man; Siwalik mammals and their causes of extinction;

Unit 5: Micropalaeontology; Foraminifera, diamorphism, morphology and biostratigraphy; Gondwana flora and their significance, Palynology, types of Gondwana palynomorphs and its importance; Microfossils and their significance in oil exploration.

Books Suggested:

1. Arnold, A.J., 2002. Quaternary Environmental Micropaleontology. In: Haslett, S.K. (ed.). Oxford University Press, New York.
2. Bignot, G., Graham, J. and Trottman, S., 1985. Elements of Micropaleontology. London.
3. Boardman, R.S., Cheetham, A.H. and Rowell, A.J., 1988. Fossil Invertebrates. Blackwell.
4. Boggs, S., 2001. Principles of Sedimentology and Stratigraphy. Prentice Hall.
5. Clarkson, E.N.K., 1998. Invertebrate Paleontology and Evolution. Allen & Unwin, London.
6. Dunbar, C.O. and Rodgers, J., 1957. Principles of Stratigraphy. John Wiley & Sons.
7. Doyle, P. and Bennett, M.R., 1996. Unlocking the Stratigraphic Record. John Wiley & Sons.
8. Horowitz, A.S. and Potter, P.E., 1971. Introductory Petrography of Fossils. Springer-Verlag.
9. Krishnan, M.S., 1982. Geology of India and Burma. CBS Publishers & Distributors, Delhi.
10. Mahadevan, T.M., 2002. Geology of Bihar and Jharkhand. Geological Survey of India, Bangalore.
11. Mayr, E., 1971. Population, Species, and Evolution. Harvard University Press.
12. Naqvi, S.M. and Rogers, J.J.W., 1987. Precambrian Geology of India. Oxford University Press.
13. Naqvi, S.M., 2005. Geology and Evolution of the Indian Plate (From Hadean to Holocene: 4Ga to 4Ka). Geological Survey of India, Bangalore.
14. Pascoe, E.H., 1968. A Manual of the Geology of India and Burma. Vols. I–IV. Government of India Press, Delhi.
15. Pomerol, C., 1982. The Cenozoic Era: Tertiary and Quaternary. Ellis Harwood Ltd., Halsted Press.
16. Prothero, D.R., 2004. Bringing Fossils to Life: An Introduction to Paleontology. 2nd ed. McGraw-Hill.
17. Raup, D.M. and Stanley, S.M., 1985. Principles of Paleontology. CBS Publishers.
18. Romer, A.S., 1959. The Vertebrate Story. University of Chicago Press.
19. Sahni, A., 1996. Cretaceous Stratigraphy and Paleoenvironments. Geological Survey of India, Bangalore.
20. Schoch, R.M., 1989. Stratigraphy: Principles and Methods. Van Nostrand Reinhold, New York.

V. CORE COURSE [CCGLG315]
PRACTICAL

Marks: 100 (ESE Pr: 6 Hrs) = 100	Pass Marks = 45

(Credits: Theory-04, 60 Hours)

Instructions to Question Setter for

End Semester Examination (ESE Pr):

There will be one Practical Examination of 3 hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment/Lab work = 70 marks
Practical record notebook = 05 marks
Attendance = 05 marks
Viva-voce = 20 marks

Course Content:

1. Study of rocks in hand specimens from known Indian stratigraphic horizons and type localities
2. Megascopic study of invertebrate fossils and plant fossils
3. Study of the molar tooth of important vertebrate fossils
4. Study of morphological characters of selected microfossils and palynomorphs
5. Proximate and ultimate analysis of coal
6. Reserve estimation for metals, industrial rocks, and coal
7. Mineral formulation calculation of silicates and oxides
8. Major oxides, trace, and REE plotting
9. Marking the important geo-heritage of Jharkhand and India

Books Suggested:

1. oggs, S. (2011). Principles of Sedimentology and Stratigraphy (5th ed.). Pearson.
2. Clark, I. (2015). Groundwater Geochemistry and Isotopes. CRC Press.
3. Deer, W. A., Howie, R. A., & Zussman, J. (2013). An Introduction to the Rock-Forming Minerals (3rd ed.). Mineralogical Society.
4. Faure, G. (1998). Principles and Applications of Geochemistry (2nd ed.). Prentice Hall.
5. Goldstein, J. et al. (2017). Scanning Electron Microscopy and X-ray Microanalysis (4th ed.). Springer.
6. Gradstein, F. M., Ogg, J. G., & Schmitz, M. (2012). The Geologic Time Scale 2012. Elsevier.
7. Klein, C., & Dutrow, B. (2007). Manual of Mineral Science (23rd ed.). Wiley.
8. Krumbein, W. C., & Pettijohn, F. J. (1938). Manual of Sedimentary Petrography. Appleton-Century-Crofts.
9. McKinley, J. M., & Lloyd, J. W. (1991). Geochemical Techniques for Groundwater Studies. Elsevier.
10. Moore, R. C., Lalicker, C. G., & Fischer, A. G. (1952). Invertebrate Fossils. McGraw-Hill.
11. Nichols, G. (2009). Sedimentology and Stratigraphy (2nd ed.). Wiley-Blackwell.
12. Perkins, D. (2002). Mineralogy. Prentice Hall.
13. Rollinson, H. (1993). Using Geochemical Data: Evaluation, Presentation, Interpretation. Longman.
14. Scholle, P. A., & Ulmer-Scholle, D. S. (2003). A Color Guide to the Petrography of Carbonate Rocks. AAPG.
15. Selley, R. C. (1998). Elements of Petroleum Geology (2nd ed.). Academic Press.
16. Singh, M. P. (Ed.). (2000). Coal and Organic Petrology. Hindustan Publishing Corporation.
17. Tucker, M. E. (2001). Sedimentary Petrology (3rd ed.). Blackwell Science.
18. United States Geological Survey (USGS). (n.d.). Mineral Resources Data System (MRDS). Retrieved from https://www.usgs.gov
19. Winter, J. D. (2010). Principles of Igneous and Metamorphic Petrology (2nd ed.). Pearson

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SEMESTER IV

I. ELECTIVE COURSE-A [ECGLG411A]

FOSSIL FUEL GEOLOGY-II

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand coal processing, utilization, and technologies.
2. Learn methods of coal exploration and reserve estimation.
3. Develop knowledge of mining practices and environmental impacts.
4. Study the distribution of coal resources in Jharkhand and India.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain coal utilization processes and technologies.
2. Apply exploration techniques for coal resource assessment.
3. Analyse mining methods, hazards, and environmental issues.
4. Interpret the distribution and significance of coal deposits in India.

Course Content:

Unit 1: Elementary idea about coal preparation, Washing and beneficiation of coal, Blending of coal, coal carbonization, coal gasification, coal liquefaction, and coal combustion; Briquetting of coal.

Unit 2: Assessment of coal reserves; Geological, Geobotanical and Geophysical survey for coal; Gondwana palynology and its application for coal exploration;

Unit 3: Mining of coal- underground mining and open cast mining; Coal Mining hazards and its mitigation; Trace elements in coal; Coal as environmental pollutant; Conservation of coal.

Unit 4: Geological and geographical distribution of coal deposits of Jharkhand.

Unit 5: Geological and geographical distribution of coal and Lignite deposits in India except Jharkhand.

Books Suggested:

1. Chandra, D., Singh, R.M. and Singh, M.P., 2000. Textbook of Coal (Indian Context). Tara Book Agency, Varanasi.
2. Scott, A.C., 1987. Coal and Coal-Bearing Strata: Recent Advances. Blackwell Scientific Publications.
3. Singh, M.P., 1998. Coal and Organic Petrology. Hindustan Publishing Corporation, New Delhi.
4. Taylor, D.W., 1993. Coal: Typology–Physics–Chemistry–Constitution. Elsevier Science, Netherlands.
5. Teichmüller, M., Davis, A., Diessel, C.F.K., Littke, R. and Robert, P., 1998. Organic Petrology. Gebrüder Borntraeger, Stuttgart.
6. Thomas, L., 2002. Coal Geology. John Wiley & Sons Ltd., England.
7. Van Krevelen, D.W., Stach, E., Mackowsky, M.-Th., Taylor, G.H., Chandra, D., Teichmüller, M. and Teichmüller, R., 1982. Stach's Textbook of Coal Petrology. Gebrüder Borntraeger, Stuttgart.

OR ELECTIVE COURSE-B [ECGLG411B]
SEDIMENTOLOGY-II

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:
On completion of this course, the students will be able to understand:
1. Understand basin analysis and controls on sedimentation.
2. Learn sedimentary basins and dispersal systems of India.
3. Develop knowledge of facies and depositional models.
4. Study depositional environments and their processes.

Course Learning Outcomes:
On successful completion of this course, the student should know:
1. Explain basin evolution and sedimentation controls.
2. Interpret sediment dispersal and basin characteristics.
3. Analyze facies and depositional models.
4. Identify and evaluate depositional environments in geological records.

Course Content:
Unit 1: Concept of basin analysis; Tectonic classification and geothermal evolution of sedimentary basins; Allogenic and autogenic controls on sedimentation.

Unit 2: Sedimentary basin of India. Paleocurrent analysis and sediment dispersal patterns;

Unit 3: Sedimentary facies and Facies association. Facies models with Indian analogues;

Unit 4: Processes and characteristics of depositional environments such as fluvial, estuarine, and deltaic,

Unit 5: Processes and characteristics of depositional environments such as lagoonal, barrier beach, tidal flats, and deep-sea environments.

Books Suggested:
1. Allen, P.A. and Allen, J.R.L., 2005. Basin Analysis: Principles and Applications. Blackwell Publishing.
2. Miall, A.D., 2000. Principles of Basin Analysis. Springer-Verlag.
3. Perry, C.T. and Taylor, K.G., 2006. Environmental Sedimentology. Blackwell Publishing, U.K.
4. Reading, H.G., 1996. Sedimentary Environments and Facies. Blackwell Scientific Publications.
5. Reineck, H.E. and Singh, I.B., 1978. Depositional Sedimentary Environments. Springer-Verlag.

OR ELECTIVE COURSE-C [ECGLG411C]

HYDROGEOLOGY-II

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	**Pass Marks: (MSE: 17 + ESE: 28) = 45**

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand groundwater occurrence and hydrogeological settings.
2. Learn basin characterization and controlling factors.
3. Develop knowledge of exploration techniques using RS–GIS and geophysics.
4. Study groundwater problems and management strategies.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain groundwater distribution in different geological settings.
2. Analyze basin characteristics and groundwater potential.
3. Apply RS–GIS and geophysical methods for exploration.
4. Evaluate groundwater issues and propose management solutions.

Course Content:

Unit 1: Occurrence of groundwater in different rock types; Geologic structures favoring groundwater occurrence; Occurrence of groundwater in various hydrostratigraphic units of India; Groundwater provinces of India.

Unit 2: Components of Groundwater basin characterization: slope characteristics, lithology and associated geological structures, soil type and thickness, etc.; Geomorphic controls for groundwater accumulation; Drainage pattern, their relationship with lithology and geologic structure; tools.

Unit 3: Groundwater basin characterization and prioritization by Remote Sensing and GIS.

Unit 4: Surface and subsurface geological and geophysical methods of groundwater exploration; Identification of groundwater potential zones by various Remote sensing techniques, Application of GPR in groundwater exploration, Use of radio isotopes in hydrogeological studies.

Unit 5: Groundwater problems and management related to foundation work, mining, reservoirs, tunnels, and effects of water in landslides; Environmental effects of over-exploitation of groundwater; Waterlogging problems;

Books Suggested:

1. Davies, S.N. and De Wiest, R.J.M., 1966. Hydrogeology. John Wiley & Sons, New York.
2. Driscoll, F.G., 1988. Groundwater and Wells. UOP, Johnson Division, St. Paul, Minnesota, USA.
3. Fetter, C.W., 2016. Applied Hydrogeology. 4th ed. Pearson Education Ltd.
4. Hiscock, K.M., 2009. Hydrogeology: Principles and Practice. Wiley-Blackwell.
5. Jakeman, A.J., Barreteau, O., Hunt, R.J., Rinaudo, J.D. and Ross, A., 2016. Integrated Groundwater Management: Concepts, Approaches and Challenges. Springer.
6. Karanth, R., 1989. Hydrogeology. Tata McGraw-Hill Publishing.
7. Nagabhu Shaniah, H.S., 2001. Groundwater in Hydrosphere (Groundwater Hydrology). CBS Publishers.
8. Patra, H.P., Adhikari, S.K. and Kumar, S., 2016. Groundwater Prospecting and Management. Springer.
9. Raghunath, H.M., 1990. Groundwater. Wiley Eastern Ltd.
10. Ramanathan, A., Johnston, S., Mukherjee, A. and Nath, B. (eds.), 2015. Safe and Sustainable Use of Arsenic-Contaminated Aquifers in the Gangetic Plain: A Multidisciplinary Approach. Springer.
11. Singhal, B.B.S. and Gupta, R.P., 2010. Applied Hydrogeology of Fractured Rocks. Springer.
12. Todd, D.K., 1995. Groundwater Hydrology. John Wiley & Sons.
13. Tolman, C.F., 1937. Groundwater. McGraw-Hill, New York and London.

OR ELECTIVE COURSE-D [ECGLG411D]

ORE GEOLOGY-II

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand the distribution and characteristics of mineral deposits in India.
2. Learn classification and uses of metallic, non-metallic, and industrial minerals.
3. Develop knowledge of regional mineral resources (Jharkhand).
4. Study strategic minerals, policies, and conservation practices.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain the occurrence and distribution of mineral deposits in India.
2. Identify and classify various economic and industrial minerals.
3. Analyze regional mineral resources and their economic significance.
4. Evaluate mineral policies, conservation, and resource management strategies.

Course Content:

Unit 1: Distribution of mineral deposits in the Indian shield; mineralogical and geological characteristics of important ore deposits in India- chromite, diamond, muscovite, Cu, Pb-Zn, Sn-W, Au, Fe, Mn, bauxite;

Unit 2: Mineralogical, geological characteristics, occurrences, and distribution of mineral deposits in India- Rare earth elements, phosphorites, Uranium and thorium, graphite, gemstones, apatite, gypsum, barytes, asbestos

Unit 3: Mineralogical and geological characteristics of important industrial minerals in India- minerals used in refractory, fertilizer, ceramic, cement, glass, and paint industries; minerals used as abrasives, fillers, and building stones.

Unit 4: Geology and Mineral Resources of Jharkhand, status of mineral resources, occurrences and distribution of energy, ferrous, non-ferrous, industrial, refractory, noble metal group of minerals; Decorative, Precious, and semi-precious stone

Unit 5: Strategic, critical, and essential minerals; India's status in mineral production; co-products and by-products; consumption, substitution, and conservation of minerals; National Mineral Policy; Mineral Concession Rules; marine mineral resources and laws of the sea

Books Suggested:

1. Arogyaswamy, R.N.P., 1995. Courses in Mining Geology. Oxford & IBH Publishing Co., New Delhi.
2. Barnes, H.L., 1979. Geochemistry of Hydrothermal Ore Deposits. John Wiley & Sons.
3. Chatterjee, K.K., 1993. An Introduction to Mineral Economics. Wiley Eastern.
4. Clark, G.B., 1967. Elements of Mining. Asia Publishing House.
5. Craig, J.R. and Vaughan, D.J., 1981. Ore Microscopy and Ore Petrography. John Wiley & Sons.
6. Edwards, R. and Atkinson, K., 1986. Ore Deposit Geology. Chapman & Hall, London.
7. Evans, A.M., 2012. Ore Geology and Industrial Minerals. 3rd ed. Blackwell Publishing & Wiley India Pvt. Ltd.
8. Guilbert, J.M. and Park, C.F., 1986. The Geology of Ore Deposits. W.H. Freeman.
9. Jensen, M.L. and Bateman, A.M., 1981. Economic Mineral Deposits. John Wiley & Sons, New York.
10. Klemm, D.D. and Schneider, H.J., 1977. Time- and Strata-Bound Ore Deposits. Springer-Verlag.
11. McKinstry, H.E., 1972. Mining Geology. Prentice-Hall Inc.
12. Mookherjee, A., 2000. Ore Genesis: A Holistic Approach. Allied Publishers.
13. Sawkins, F.J., 1984. Metal Deposits in Relation to Plate Tectonics. Springer-Verlag.
14. Sinha, R.K. and Sharma, N.L., 1993. An Introduction to Mineral Economics. Wiley Eastern.
15. Stanton, R.L., 1972. Ore Petrology. McGraw-Hill.
16. Thomas, L.J., 1978. An Introduction to Mining. Methuen, Brisbane.
17. Wolf, K.H., 1981. Handbook of Strata-Bound and Stratiform Ore Deposits. Elsevier.

OR ELECTIVE COURSE-E [ECGLG411E]

ENVIRONMENTAL GEOLOGY-II

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	**Pass Marks: (MSE: 17 + ESE: 28) = 45**

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand natural resources, ecosystems, and conservation methods.
2. Learn environmental processes, hazards, and climate impacts.
3. Develop knowledge of pollution, contamination, and remediation.
4. Study environmental policies, laws, and management tools.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain resource management and ecosystem dynamics.
2. Analyse environmental hazards and climate change impacts.
3. Evaluate pollution sources and apply remediation measures.
4. Interpret environmental laws and apply them in management practices.

Course Content:

Unit 1: Natural resources and their conservation. Concept of ecosystem and its biotic and abiotic factors. Types of resources – conservation of soil, forest, and minerals. Mineral resources in India and environmental issues. Alternative energy resources.

Unit 2: Desert and Desertification; Impacts of global warming on surface water, groundwater resources, and Glaciers; Mass movement-types, Factors influencing slope stability. Solid Waste Management.

Unit 3: Human impact on soil, water, climate, and atmosphere. Impact assessment of degradation and contamination of surface water and groundwater quality due to industrialization and urbanization; organic and inorganic contamination of groundwater and its remedial measures; waterlogging problems due to the indiscriminate construction of canals, reservoirs, and dams

Unit 4: Geogenic and anthropogenic causes of water contamination; Issues of Arsenic and Fluoride contamination in groundwater, Methods for amelioration of Arsenic and Fluoride contamination in groundwater, Problems of Arsenic and Fluoride contamination in Jharkhand; Application of Remote Sensing for Water resources, Snow and Glacier, and Wetland management

Unit 5: Global initiatives for mitigation of environmental issues; Indian Constitution and Environment; Environmental protection and conservation laws in India, viz. The Prevention and Control of pollutionAct,1974, Water (Prevention & Control) Act 1974, The Forest (Conservation) Act,1980, Air (Prevention and Control of Pollution) Act 1981, Environmental (Protection) Act, 1986, Hazardous Waste Handling and management act 1989, Ozone Depleting Substances (Regulation and Control) Rules, 2000, National Green Tribunal Act 2010 etc.

Books Suggested:

1. Bell, F.G., 1999. Geological Hazards. Routledge, London.
2. Bryant, E., 1985. Natural Hazards. Cambridge University Press.
3. Dutta, A., n.d. Environmental Issues and Challenges.
4. Ghosh, R. and Chatterjee, D.S., n.d. Environmental Geology.
5. Keller, E.A., 1978. Environmental Geology.
6. Patwardhan, A.M., 1999. The Dynamic Earth System.
7. Sharma, B.K., n.d. Environmental Pollution.
8. Smith, K., 1992. Environmental Hazards.
9. Strahler, A.N. and Strahler, A.H., n.d. Environmental Geology.
10. Subramaniam, V., 2001. Textbook of Environmental Hazards.
11. Valdiya, K.S., 1987. Environmental Geology: Indian Context.

II. ELECTIVE COURSE-A [ECGLG412A]
FOSSIL FUEL GEOLGY-III

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand the origin, migration, and accumulation of petroleum.
2. Learn reservoir characteristics and trapping mechanisms.
3. Develop knowledge of source rock analysis and depositional environments.
4. Study exploration methods and the distribution of petroleum resources.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain petroleum generation, migration, and accumulation processes.
2. Analyse reservoir properties and identify trap types.
3. Interpret source rocks and depositional environments using fossil data.
4. Apply exploration techniques and evaluate petroleum resources.

Course Content:

Unit 1: Origin and nature of oil and gas; Amount, type, and maturation of organic matter; Migration of Petroleum;

Unit 2: Reservoir rocks-petrology of reservoir rocks, porosity and permeability; Reservoir traps–structural, stratigraphic, and combination traps.

Unit 3: Identification and characterization of petroleum source rocks, Oil and source rock or relation; Palaeo depositional and palaeo-environmental models with the help of micro fossils and Palynology;

Unit 4: Quantitative evaluation of oil and gas, Geological, Geochemical, and Geophysical exploration of Petroleum.

Unit 5: Petroleum basins of India, important oil fields of India; Brief idea about global occurrence of Petroleum; Position of oil and natural gas in India, Future prospects and economic scenario.

Books Suggested:

1. Barker, C., 1996. Thermal Modeling of Petroleum Generation. Elsevier Science, Netherlands.
2. Chapman, R.C., 1973. Petroleum Geology. Elsevier Scientific Publishing Co.
3. Hobson, G.D. and Tiratsoo, E.N., 1985. Introduction to Petroleum Geology. Gulf Publishing, Houston, Texas.
4. Hunt, J.M., 1996. Petroleum Geochemistry and Geology. 2nd ed. W.H. Freeman, San Francisco.
5. Jahn, F., Cook, M. and Graham, M., 1998. Hydrocarbon Exploration and Production. Elsevier Science.
6. Makhous, M., 2000. The Formation of Hydrocarbon Deposits in North African Basins: Geological and Geochemical Conditions. Springer-Verlag.
7. North, F.K., 1985. Petroleum Geology. Allen & Unwin.
8. Selley, R.C., 1998. Elements of Petroleum Geology. Academic Press.
9. Tissot, B.P. and Welte, D.H., 1984. Petroleum Formation and Occurrence. Springer-Verlag.

OR ELECTIVE COURSE-B [ECGLG412B]

SEDIMENTOLOGY-III

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	**Pass Marks: (MSE: 17 + ESE: 28) = 45**

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand soil formation, processes, and conservation.
2. Learn soil classification, composition, and organic matter roles.
3. Develop knowledge of soil fabric and analytical techniques.
4. Study paleosols, calcretes, and laterites in a geological context.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain soil formation processes and conservation methods.
2. Classify soils and analyze their composition.
3. Interpret soil fabric and grading data.
4. Evaluate paleosols, calcretes, and laterites in stratigraphy and environment.

Course Content:

Unit 1: Concept of soil, components of soil, soil profile; Process of soil formation, pedogenic processes, Factors of soil formation; Causes of Soil erosion and degradation, A brief introduction to methods of soil conservation.

Unit 2: Classification of soil, mineral and chemical composition of soils, mineral stability during weathering; Soil organic matter form and function.

Unit 3: 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; Peds and voids.

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.

Books Suggested:

1. Bouyoucos, S.W., Hole, F.D., McCracken, R.J. and Southard, R.J., 1997. Soil Genesis and Classification. 4th ed. Iowa State University Press.
2. Brady, N.C., 2002. The Nature and Properties of Soils.
3. Govindarajan, S.V. and Gopala Rao, K.H.G., 1979. Studies of Soils of India.
4. Sposito, G., 1989. The Chemistry of Soils. Oxford University Press.
5. Terzaghi, K. and Peck, R.B., 1996. Soil Mechanics in Engineering Practice. 3rd ed. John Wiley & Sons.
6. Wright, V.P., 1992. Paleosols: Their Recognition and Interpretation. Blackwell Scientific Publications.
7. Wright, V.P. and Tucker, M.E., 1991. Calcretes. Blackwell Scientific Publications.

OR ELECTIVE COURSE-C [ECGLG412C]

HYDROGEOLOGY-III

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	**Pass Marks: (MSE: 17 + ESE: 28) = 45**

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand watershed concepts and influencing factors.
2. Learn groundwater recharge and water conservation techniques.
3. Develop knowledge of water management structures and practices.
4. Study watershed governance, policies, and legislation.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain watershed systems and their components.
2. Apply recharge and conservation techniques in water management.
3. Evaluate the effectiveness of water management structures.
4. Interpret policies and legal frameworks for water resources.

Course Content:

Unit 1: Watershed concept, classification; Components of watershed: rainfall, temperature, topography, nature of soil and depth, lithology and geological structures, drainage pattern, land use pattern. Valley to basin concept in water management

Unit 2: Natural and artificial recharge of groundwater, Rainwater harvesting techniques for rural and urban areas; Physical structures for water resource management in Rural areas; Use of Remote sensing and GIS in Watershed Management.

Unit 3: Water management, physical structures and their characteristics, such as Ridge area treatment, gully plug, contour bunding, check dams, gabion structure, percolation tanks, etc. Traditional methods for water resource management in India;

Unit 4: Basic components of Watershed Guidelines of India, Participatory approach for programme implementation of watershed. Water management and Panchayati Raj Acts.

Unit 5: Legislation related to water resources: Basic Constitutional provisions, Water Pollution Acts, National Water Policy.

Books Suggested:

1. Constitution of India, n.d.
2. Heathcote, I.W., 2009. Integrated Watershed Management: Principles and Practice. John Wiley & Sons.
3. Jharkhand Panchayati Raj Act, n.d.
4. Karanth, R., 1989. Hydrogeology. Tata McGraw-Hill Publishing.
5. Murty, J.V.S., 2008. Watershed Management. New Age International.
6. Rao, K.L., n.d. India's Water Wealth. Central Ground Water Board (CGWB) Publications.
7. Watershed Guidelines, Government of India, n.d.

OR ELECTIVE COURSE-D [ECGLG412D]

ORE GEOLOGY-III

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	**Pass Marks: (MSE: 17 + ESE: 28) = 45**

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand stages and methods of mineral exploration.
2. Learn geochemical surveys and resource estimation techniques.
3. Develop knowledge of mining methods and safety practices.
4. Study mineral processing and beneficiation techniques.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Apply exploration techniques for mineral resource identification.
2. Interpret geochemical data and estimate ore reserves.
3. Evaluate mining methods and operational safety.
4. Analyze mineral processing methods for efficient resource utilization.

Course Content:

Unit 1: Stages of exploration: scope, objectives, and methods of prospecting, regional exploration, and detailed exploration; geological, geochemical, and geobotanical methods;

Unit 2: litho-, bio, soil geochemical surveys, mobility and dispersion of elements, geochemical anomalies; ore controls and guides; pitting, trenching, drilling; sampling, assaying, ore reserve estimation; categorization of ore reserves;

Unit 3: Mining: types of mining – open cast and underground mining, its terminology, advantages and disadvantages; Criteria used for the mining methods; units and auxiliary operations; Drilling – its types, uses; Underground mining methods/stopping – room and pillar & long wall methods; Heavy machinery; Explosives; Mining hazards and mitigations

Unit 4: Introduction to Mineral Processing, liberation of ores, and Comminution of minerals (crushing and grinding). And Classification, Gravity and Magnetic separation, Tabling, Heavy mineral separation

Unit 5: Forth Flotation, Screening and classification, Particle size distribution and precipitation, Biomineral Processing, Processing of Industrial minerals, Selected Recycling of ore minerals / industrial minerals/scrap etc.

Books Suggested:

1. Arogyaswamy, R.N.P., 1995. Courses in Mining Geology. Oxford & IBH Publishing Co., New Delhi.
2. Barnes, H.L., 1979. Geochemistry of Hydrothermal Ore Deposits. John Wiley & Sons.
3. Chatterjee, K.K., 1993. An Introduction to Mineral Economics. Wiley Eastern.
4. Clark, G.B., 1967. Elements of Mining. Asia Publishing House.
5. Craig, J.R. and Vaughan, D.J., 1981. Ore Microscopy and Ore Petrography. John Wiley & Sons.
6. Edwards, R. and Atkinson, K., 1986. Ore Deposit Geology. Chapman & Hall, London.
7. Evans, A.M., 2012. Ore Geology and Industrial Minerals. 3rd ed. Blackwell Publishing & Wiley India Pvt. Ltd.
8. Fuerstenau, M.C. and Han, K.N. (eds.), 2003. Principles of Mineral Processing. Society for Mining, Metallurgy & Exploration.
9. Gaudin, A.M., 1974. Principles of Mineral Dressing. Tata McGraw-Hill.
10. Guilbert, J.M. and Park, C.F., 1986. The Geology of Ore Deposits. W.H. Freeman.
11. Jensen, M.L. and Bateman, A.M., 1981. Economic Mineral Deposits. John Wiley & Sons, New York.
12. Klemm, D.D. and Schneider, H.J., 1977. Time- and Strata-Bound Ore Deposits. Springer-Verlag.
13. McKinstry, H.E., 1972. Mining Geology. Prentice-Hall Inc.
14. Mookherjee, A., 2000. Ore Genesis: A Holistic Approach. Allied Publishers.
15. Sawkins, F.J., 1984. Metal Deposits in Relation to Plate Tectonics. Springer-Verlag.
16. Sinha, R.K. and Sharma, N.L., 1993. An Introduction to Mineral Economics. Wiley Eastern.
17. Stanton, R.L., 1972. Ore Petrology. McGraw-Hill.
18. Thomas, L.J., 1978. An Introduction to Mining. Methuen, Brisbane.
19. Wills, B.A., 1992. Mineral Processing Technology. 5th ed. Pergamon Press.
20. Wills, B.A. and Napier-Munn, T., 2006. Mineral Processing Technology: An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery. 7th ed. Butterworth-Heinemann.
21. Wolf, K.H., 1981. Handbook of Strata-Bound and Stratiform Ore Deposits. Elsevier.

OR ELECTIVE COURSE-E [ECGLG412E]

ENVIRONMENTAL GEOLOGY-III

Marks: 30 (MSE: 20 Th. 1 Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE: 28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

On completion of this course, the students will be able to understand:

1. Understand types, causes, and management of natural hazards.
2. Learn seismic, volcanic, and coastal hazard processes.
3. Develop knowledge of flood management and environmental issues.
4. Study EIA and impacts of mining activities.

Course Learning Outcomes:

On successful completion of this course, the student should know:

1. Explain causes and management of natural hazards.
2. Analyze seismic, volcanic, and coastal hazard risks.
3. Evaluate flood hazards and water-related problems.
4. Assess environmental impacts of mining and apply mitigation strategies.

Course Content:

Unit 1: Natural Hazards: Its causes, prediction and forecasting, control measures, and its proper management. Problems of urbanization, human population, and their impact on the environment

Unit 2: Distribution, magnitude, and intensity of earthquakes; Seismic hazard zones; Neotectonics in seismic hazard assessment; volcanic hazards, their causes, and control.

Unit 3: Landslide, soil creeping, mass movements; Coastal erosion, coastal inundations, cyclones, tsunamis, their causes and mitigation measures. Application of Remote Sensing techniques for Natural Hazards management.

Unit 4: Floods, causes of floods, flood hazard, management of floods; Water logging, problems of water logging in India; Consequences of developments in flood plain areas.

Unit 5: Concept of Environmental Impact Assessment (EIA). Environmental Impact Assessment of mining on air, water, noise, land, and soil; Hazards related to mining activities in India; Pollution in the mining areas and mitigation measures; Land degradation in mining areas; Stabilization of overburden in opencast mining areas; Management of underground mining areas. Impacts of mining on water availability.

Books Suggested:

1. Bell, F.G., 1999. Geological Hazards. Routledge, London.
2. Bryant, E., 1985. Natural Hazards. Cambridge University Press.
3. Keller, E.A., 1978. Environmental Geology.
4. Patwardhan, A.M., 1999. The Dynamic Earth System.
5. Smith, K., 1992. Environmental Hazards.
6. Strahler, A.N. and Strahler, A.H., n.d. Environmental Geology.
7. Subramaniam, V., 2001. Textbook in Environmental Hazards.
8. Tank, R.W., n.d. Focus on Environmental Hazards.
9. Turk, J. and Turk, A., n.d. Environmental Geology.
10. Valdiya, K.S., 1987. Environmental Geology: Indian Context.

III. CORE COURSE [CCGLG413]
MINERAL EXPLORATION

Marks: 30 (MSE: 20 Th. 1Hr + 5 Attd. + 5 Assign.) + 70 (ESE: 3 Hrs) = 100	Pass Marks: (MSE: 17 + ESE :28) = 45

(Credits: Theory-04, 60 Hours)

Course Objectives:

Upon completion of this course, the students will be able to understand

1. Understand principles and methods of mineral exploration.
2. Learn geochemical and geophysical exploration techniques.
3. Develop knowledge of mining methods and safety practices.
4. Study ore dressing and beneficiation processes.

Course Learning Outcomes:

Upon successful completion of this course, the students should know:

1. Apply exploration techniques using geological, geochemical, and GIS tools.
2. Interpret geophysical and geochemical data for mineral targeting.
3. Evaluate mining methods and ensure safety considerations.
4. Analyze ore beneficiation processes for resource utilization.

Course Content:

Unit 1: Criteria and guides for mineral search. Stages of mineral exploration in India. Field observations and field equipment. Use of GIS and remote sensing in mineral exploration.

Unit 2: Geochemical exploration: mobility of elements and their primary & secondary dispersion. Geochemical approaches, mapping, and sampling. Introduction to the geobotanical exploration method. Use of geostatistics in exploration.

Unit 3: Geophysical exploration methods: Gravity method, Magnetic method, Electrical method, Seismic method, Radiometric method, Basic principles of electromagnetic and GPR methods. Various well logging techniques.

Unit 4: Mining Methods: Placer mining methods, open pit methods, Underground mining methods, Coal Mining methods, and Ocean bottom mining methods. Mining hazards and safety measures.

Unit 5: Ore Dressing and Its Importance, Low-Grade Ores and Their Beneficiation. Basic ore dressing operations, viz., crushing (Primary crushing and Secondary/Tertiary Crushing), grinding, sizing, screening, and classification. Concentration processes: Magnetic and electrostatic separation, gravity concentration, Froth Flotation, Amalgamation, and Agglomeration.

Books Suggested:

1. Arogyaswami, R.P.N., 1996. Courses in Mining Geology. 4th ed. Oxford & IBH Publishing.
2. Bagchi, T.C., Sengupta, D.K. and Rao, S.V.L.N., 1979. Elements of Prospecting and Exploration.
3. Banerjee, P.K. and Ghosh, S., 1997. Elements of Prospecting for Non-Fuel Mineral Deposits.
4. Clark, G.B., 1967. Elements of Mining. 3rd ed. John Wiley & Sons.
5. Gaudin, A.M., n.d. Principles of Mineral Dressing. McGraw-Hill Publishing Co. Ltd., Bombay.
6. McKinstry, H.E., n.d. Mining Geology. Prentice Hall, Englewood Cliffs, NJ.
7. Moon, C.J., Whateley, M.K.G. and Evans, A.M., 2006. Introduction to Mineral Exploration. Blackwell Publishing.
8. Sinha, R.K. and Sharma, N.L., 1976. Mineral Economics.
9. Vijayendra, M.G., 1995. Handbook of Mineral Dressing. Vikas Publishing House Pvt. Ltd.
10. Wills, B.A., 1988. Mineral Processing Technology. Pergamon Press, Oxford.

IV. ELECTIVE COURSE-A [EPGLG414A]
FOSSIL FUEL GEOLGY-PR

Marks: 100 (ESE Pr: 6 Hrs) = 100	Pass Marks = 45

(Credits: Theory-04, 60 Hours)

Instructions to Question Setter for

End Semester Examination (ESE Pr):

There will be one Practical Examination of 3 hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment/Lab work = 70 marks
Practical record notebook = 05 marks
Attendance = 05 marks
Viva-voce = 20 marks

Course Content:

1. Megascopic study of Coal and Coal-bearing strata
2. Proximate analysis of coal
3. Drawing and labeling of parts of Gondwana Plant Fossils from different coal fields.
4. Identification of different palynomorphs
5. Microscopic examination of coal macerals
6. Microscopic study of Heavy minerals
7. Borehole problems and calculation of reserves from the borehole
8. Study of Geological Maps and Sections of the important oilfields of India

Books Suggested:

1. Allen, P. A., & Allen, J. R. (2013). Basin Analysis: Principles and Application to Petroleum Play Assessment (3rd ed.). Wiley-Blackwell.
2. Boggs, S. (2011). Principles of Sedimentology and Stratigraphy (5th ed.). Pearson.
3. Collinson, J. D., Mountney, N. P., & Thompson, D. B. (2006). Sedimentary Structures (3rd ed.). Terra Publishing.
4. Jansonius, J., & McGregor, D. C. (Eds.). (1996). Palynology: Principles and Applications. American Association of Stratigraphic Palynologists Foundation.
5. Krumbein, W. C., & Pettijohn, F. J. (1938). Manual of Sedimentary Petrography. Appleton-Century-Crofts.
6. Nichols, G. (2009). Sedimentology and Stratigraphy (2nd ed.). Wiley-Blackwell.
7. Rider, M. H., & Kennedy, M. (2011). The Geological Interpretation of Well Logs (3rd ed.). Rider-French Consulting.
8. Singh, M. P. (Ed.). (2000). Coal and Organic Petrology. Hindustan Publishing Corporation.
9. Taylor, G. H., Teichmüller, M., Davis, A., Diessel, C. F. K., Littke, R., & Robert, P. (1998). Organic Petrology. Gebrüder Borntraeger.
10. Tucker, M. E. (2001). Sedimentary Petrology (3rd ed.). Blackwell Science.
11. United States Geological Survey (USGS). (n.d.). Energy Resources Program. Retrieved from https://www.usgs.gov

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OR ELECTIVE COURSE-B [EPGLG414B]

SEDIMENTOLOGY-PR

Marks: 100 (ESE Pr: 6 Hrs) = 100	**Pass Marks = 45**

(Credits: Theory-04, 60 Hours)

Instructions to Question Setter for

End Semester Examination (ESE Pr):

There will be one Practical Examination of 3 hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment/Lab work = 70 marks
Practical record notebook = 05 marks
Attendance = 05 marks
Viva-voce = 20 marks

Course Content:

1. Megascopic and microscopic study of clastic and non-clastic rocks.
2. Graphic plot of size data and calculation of statistical parameters.
3. Study of facies assemblages of different sedimentary environments
4. Preparation of rose diagrams and statistical analysis of the paleocurrent data.
5. Study of Heavy Minerals.

Books Suggested:

1. Boggs, S. (2011). Principles of Sedimentology and Stratigraphy (5th ed.). Pearson.
2. Folk, R. L. (1980). Petrology of Sedimentary Rocks. Hemphill Publishing Company.
3. Friedman, G. M., & Sanders, J. E. (1978). Principles of Sedimentology. Wiley.
4. Krumbein, W. C., & Pettijohn, F. J. (1938). Manual of Sedimentary Petrography. Appleton-Century-Crofts.
5. Nichols, G. (2009). Sedimentology and Stratigraphy (2nd ed.). Wiley-Blackwell.
6. Pettijohn, F. J., Potter, P. E., & Siever, R. (1987). Sand and Sandstone (2nd ed.). Springer.
7. Tucker, M. E. (2001). Sedimentary Petrology (3rd ed.). Blackwell Science.

OR ELECTIVE COURSE-C [EPGLG414C]

HYDROGEOLOGY-PR

Marks: 100 (ESE Pr: 6 Hrs) = 100	**Pass Marks = 45**

(Credits: Theory-04, 60 Hours)

Instructions to Question Setter for

End Semester Examination (ESE Pr):

There will be one Practical Examination of 3 hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment/Lab work = 70 marks
Practical record notebook = 05 marks
Attendance = 05 marks
Viva-voce = 20 marks

Course Content:

1. Determination of porosity of aquifer materials.
2. Determination of temperature, pH, T.D.S., conductivity, TSS, alkalinity, dissolved oxygen, hardness, etc.
3. Construction of Water Table and piezometric surface maps and their interpretations.
4. Interpretations of geological cross sections for locating water-bearing horizons.
5. Pumping test for evaluation of aquifer parameters.
6. Construction of lithology and its interpretations.
7. Graphical representation of hydrochemical data on the Piper Trilinear diagram.
8. Plotting and interpretation of resistivity data.
9. Delineation of watershed on topographical and satellite imagery.

Books Suggested:

1. APHA (2017). Standard Methods for the Examination of Water and Wastewater (23rd ed.). American Public Health Association.
2. Davis, S. N., & De Wiest, R. J. M. (1966). Hydrogeology. Wiley.
3. Freeze, R. A., & Cherry, J. A. (1979). Groundwater. Prentice Hall.
4. Fetter, C. W. (2001). Applied Hydrogeology (4th ed.). Prentice Hall.
5. Karanth, K. R. (1987). Groundwater Assessment, Development and Management. Tata McGraw-Hill.
6. Piper, A. M. (1944). A graphic procedure in the geochemical interpretation of water-analyses. Transactions, American Geophysical Union, 25, 914–928.
7. Reynolds, J. M. (2011). An Introduction to Applied and Environmental Geophysics (2nd ed.). Wiley-Blackwell.
8. Todd, D. K., & Mays, L. W. (2005). Groundwater Hydrology (3rd ed.). Wiley.
9. United States Geological Survey (USGS). (n.d.). Groundwater Resources Program. Retrieved from https://www.usgs.gov

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OR ELECTIVE COURSE-D [EPGLG414D]

ORE GEOLOGY-PR

Marks: 100 (ESE Pr: 6 Hrs) = 100	**Pass Marks = 45**

(Credits: Theory-04, 60 Hours)

Instructions to Question Setter for

End Semester Examination (ESE Pr):

There will be one Practical Examination of 3 hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment/Lab work = 70 marks
Practical record notebook = 05 marks
Attendance = 05 marks
Viva-voce = 20 marks

Course Content:

1. Megascopic study of important ores and their textures.
2. Megascopic study of important industrial, metallic, and non-metallic, precious and semi-precious stones.
3. Ore petrographic study of ore minerals and establishment of paragenetic sequence
4. Location of different mineral deposits associated with convergent, divergent, and transform plate margins;
5. Study of Metallogenic provinces of India.
6. Location of different ore deposits, non-metallic deposits, atomic fuel, gemstones, and REE on the outline map of Jharkhand, and India
7. Preparation of bar graphs showing the production status of different minerals year-wise and their interpretation;
8. Exercises on ore reserve calculations.
9. Estimation of the grade of ores.
10. Flowchart analysis of ore beneficiation techniques
11. To delineate the potential mineralization zone from geological and geochemical data
12. Plotting of geochemical data on various discrimination plots related to mineralization/ deposits

Books Suggested:

1. Bateman, A. M., & Jensen, M. L. (1981). Economic Mineral Deposits (3rd ed.). Wiley.
2. Craig, J. R., & Vaughan, D. J. (1994). Ore Microscopy and Ore Petrography (2nd ed.). Wiley.
3. Evans, A. M. (1993). Ore Geology and Industrial Minerals: An Introduction (3rd ed.). Blackwell Science.
4. Govett, G. J. S. (1983). Rock Geochemistry in Mineral Exploration. Elsevier.
5. Guilbert, J. M., & Park, C. F. (1986). The Geology of Ore Deposits. Waveland Press.
6. Jensen, M. L., & Bateman, A. M. (1981). Economic Mineral Deposits (3rd ed.). Wiley.
7. Moon, C. J., Whateley, M. K. G., & Evans, A. M. (2006). Introduction to Mineral Exploration (2nd ed.). Blackwell Publishing.
8. Rollinson, H. (1993). Using Geochemical Data: Evaluation, Presentation, Interpretation. Longman.
9. United States Geological Survey (USGS). (n.d.). Mineral Resources Data System (MRDS). Retrieved from https://www.usgs.gov

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OR ELECTIVE COURSE-E [EPGLG414E]

ENVIRONMENTAL GEOLOGY-PR

Marks: 100 (ESE Pr: 6 Hrs) = 100	**Pass Marks = 45**

(Credits: Theory-04, 60 Hours)

Instructions to Question Setter for

End Semester Examination (ESE Pr):

There will be one Practical Examination of 3 hours duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment/Lab work = 70 marks
Practical record notebook = 05 marks
Attendance = 05 marks
Viva-voce = 20 marks

Course Content:

1. Analyses of alkalinity, acidity, etc. in water samples.
2. Analyses of pH and Electrical Conductivity in water.
3. Preparation of ocean and atmospheric circulation maps.
4. Preparation of seismic and volcanic zonation maps of India and the world.
5. Demarcation of flood-prone areas in the outline map of India
6. Presentation of chemical analysis data
7. Plotting of chemical classification diagram
8. Demarcation of landslide-prone areas.

Books Suggested:

1. PHA (2017). Standard Methods for the Examination of Water and Wastewater (23rd ed.). American Public Health Association.
2. Garrels, R. M., & Christ, C. L. (1965). Solutions, Minerals, and Equilibria. Harper & Row.
3. Holmes, A. (1965). Principles of Physical Geology (2nd ed.). Ronald Press.
4. Keller, E. A., & DeVecchio, D. E. (2015). Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes (4th ed.). Routledge.
5. Piper, A. M. (1944). A graphic procedure in the geochemical interpretation of water-analyses. Transactions, American Geophysical Union, 25, 914–928.
6. Press, F., & Siever, R. (2001). Understanding Earth (3rd ed.). W.H. Freeman.
7. Rollinson, H. (1993). Using Geochemical Data: Evaluation, Presentation, Interpretation. Longman.
8. United States Geological Survey (USGS). (n.d.). Natural Hazards Program. Retrieved from https://www.usgs.gov

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V. PROJECT [PRGLG415]

DISSERTATION/ PROJECT/ TEACHING APTITUDE

Marks: 100 (ESE Pr: 6 Hrs) = 100	Pass Marks = 45

(Credits: Theory-04, 120 Hours)

Guidelines to Examiners for
End Semester Examination (ESE):

The evaluation of the dissertation will be done in 100 marks (70 marks + 30 marks of the session). The sessional component will be evaluated by the concerned supervisor.

The end-term evaluation (70 marks) will be done by a board of examiners. The end term evaluation in 70 marks will include the literary and scientific presentation of the dissertation and the performance in the viva-voce.

The overall project dissertation may be evaluated under the following heads:

- *Motivation for the choice of topic*
- *Project dissertation design*
- *Methodology and Content depth*
- *Results and Discussion*
- *Future Scope & References*
- *Participation in an Internship programme with a reputed organisation*
- *Application of the Research technique in Data collection*
- *Report Presentation*
- *Presentation style*
- *Viva-voce*

Course Objectives:

1. To develop research skills and scientific inquiry through independent investigations on a topic of problem in Geology.

Course Outcomes:

On successful completion of this course, the student should know:

1. About conducting research with approved stages of research methodology in Geology. A dissertation will enable students to further investigate and navigate different aspects and events of life through research.

PROJECT WORK

Each student has to submit three copies of hard-bound dissertation work (along with the raw data), duly forwarded by the HOD of the Department concerned. The forwarded copies will be submitted to the University Department of Geology, Ranchi University, for evaluation (one month before the viva voce examination).

The paper may involve:

(a) Laboratory research/ Field work/ Lab work related to the project.

(b) Survey research, Case Study, or any other type of geological research

(c) One Large study/ Experiment or several studies/ Experiments, depending on the objectives of the research.

(d) Content must be typed in Font: Times New Roman with Line Spacing: 1.5 and Font Size 12 points.

Presentation of project work in the seminar on the assigned topic in the P.G. Department of Geology, Ranchi University, Ranchi & open viva there on.

Topics: As decided by the Supervisor/Guide

Teaching Aptitude: Only selected candidates, in alternative to the Dissertation, may be provided duty to teach the assigned topics in selected colleges. The performance may be evaluated based on the organized feedback for the candidate.
