FYUGP

GEOLOGY MINOR PAPERS FROM DISCIPLINE-1 & VOCATIONAL STUDIES/ DISCIPLINE-2

FOR UNDER GRADUATE COURSES UNDER

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD

Implemented from
Academic Session 2023-2027

UNIVERSITY DEPARTMENT OF GEOLOGY

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD- 828130 (JHARKHAND)

Memo No: BBMKU/ / /2024, dated on

As per Guidelines of the Binod Bihari Mahto Koyalanchal University, Dhanbad, Syllabus for undergraduate courses of Geology honours/research under NEP-2020 was prepared by Members of Board of Studies of FYUGP. List of members are following below

Name of Members		Signature
1. **Dr. Leelawati Kumari** Dean, Faculty of Science, Head, Geology Dept. BBMK Univ. Dhanbad	**-Chairman**	
2. **Dr. Atul Kumar Sinha,** University Dept. of Geology, BBMK Univ. Dhanbad	**- Member**	
3. **Dr. Sagar Kumar Swain,** HoD, Dept. of Geology, PKRMC, BBMK Univ. Dhanbad	**-Member**	
4. **Dr. Krishna Gopal,** University Dept. of Geology, BBMK Univ. Dhanbad	**-Member**	
5. **Prof. Pradeep Kumar Adhikari** Head, Department of Geology, K.C.B. College, Bero, Ranchi University, Ranchi	**-External expert**	

COURSE STUCTURE FOR FYUGP **'HONOURS/ RESEARCH'**

Table 1: Credit Framework for Four Year Undergraduate Programme (FYUGP) under State Universities of Jharkhand [Total Credits =160]

Level of Courses	Semester	MJ: Discipline specific courses-Core or Major (80)	MN: Minor from discipline (16)	MN: Minor from vocational (16)	MDC: Multidisciplinary Courses [Life Sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc.] (9)	AEC: Ability Enhancement Courses (Modern Indian Language and English (8)	SEC: Ability Enhancement Courses (9)	VAC: Value added Courses (6)	IAP: Internship / Dissertation (4)	RC: Research Courses (12)	AMJ: Advanced Courses in lie of Research (12)	Credits	Double Major (DMJ)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
100-199: Foundation or Introductory courses	I	4	4		3	2	3					20	4+4
	II	4+4		4	3	2	3					20	4+4
	Exit Point: Undergraduate Certificate provided with Summer Internship/Project (4 credits)												
200-299: Intermediate-level courses	III	4+4	4		3	2	3					20	
	IV	4+4+4		4		2		2				20	4+4
	Exit Point: Undergraduate Diploma Certificate provided with Summer Internship in 1st or 2nd year /Project (4 credits)												
300-399: Higher-level courses	V	4+4+4	4						4			20	4+4
	VI	4+4+4+4		4								20	4+4
	Exit Point: Bachelor's Degree												
400-499: Advanced courses	VII	4+4+4+4	4									20	4+4
	VIII	4		4						12	4+4+4	20	4+4
	Exit Point: Bachelor's Degree with Hons. /Research											160	224

Note: Honours students not undertaking research will do 3 courses for 12 credits in lieu of a Research project / Dissertation

SEMESTER WISE COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME **2023 onwards**

Table 2: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses Code	Papers	Credits
I	AEC-1	Language and Communication Skills (Modern Indian language including TRL)	2
	VAC-1	Value Added Course-1	4
	SEC-1	Skill Enhancement Course-1	3
	MDC-1	Multi-disciplinary Course-1	3
	MN-1A	Minor from Discipline-1	4
	MJ-1	Major paper 1 (Disciplinary/Interdisciplinary Major)	4
II	AEC-2	Language and Communication Skills (English)	2
	SEC-2	Skill Enhancement Course-2	3
	MDC-2	Multi-disciplinary Course-2	3
	MN-2A	Minor from Vocational Studies/Discipline-2	4
	MJ-2	Major paper 2 (Disciplinary/Interdisciplinary Major)	4
	MJ-3	Major paper 3 (Disciplinary/Interdisciplinary Major)	4
III	AEC-3	Language and Communication Skills (Modern Indian language including TRL)	2
	SEC-3	Skill Enhancement Course-3	3
	MDC-3	Multi-disciplinary Course-3	3
	MN-1B	Minor from Discipline-1	4
	MJ-4	Major paper 4 (Disciplinary/Interdisciplinary Major)	4
	MJ-5	Major paper 5 (Disciplinary/Interdisciplinary Major)	4
IV	AEC-3	Language and Communication Skills (MIL-2/English-2)	2
	VAC-2	Value Added Course-2	2
	MN-2B	Minor from Vocational Studies/Discipline-2	4
	MJ-6	Major paper 6 (Disciplinary/Interdisciplinary Major)	4
	MJ-7	Major paper 7 (Disciplinary/Interdisciplinary Major)	4
	MJ-8	Major paper 8 (Disciplinary/Interdisciplinary Major)	4
V	MN-1C	Minor from Discipline-1	4
	MJ-9	Major paper 9 (Disciplinary/Interdisciplinary Major)	4
	MJ-10	Major paper 10 (Disciplinary/Interdisciplinary Major)	4
	MJ-11	Major Paper 11 (Disciplinary/Interdisciplinary Minor)	4
	IAP	Internship/Apprenticeship/ Field work / Dissertation/ Project	4
VI	MN-2C	Minor from Vocational Studies/Discipline-2	4
	MJ-12	Major paper 12 (Disciplinary/Interdisciplinary Major)	4
	MJ-13	Major paper 13 (Disciplinary/Interdisciplinary Major)	4
	MJ-14	Major Paper 14 (Disciplinary/Interdisciplinary Minor)	4
	MJ-15	Major Paper 15 (Disciplinary/Interdisciplinary Minor)	4
VII	MN-1D	Minor from Discipline-1	4
	MJ-16	Major paper 16 (Disciplinary/Interdisciplinary Major)	4
	MJ-17	Major paper 17 (Disciplinary/Interdisciplinary Major)	4
	MJ-18	Major Paper 18 (Disciplinary/Interdisciplinary Minor)	4
	MJ-19	Major Paper 19 (Disciplinary/Interdisciplinary Minor)	4
VIII	MN-2D	Minor from Vocational Studies/Discipline-2	4
	MJ-20	Major paper 20 (Disciplinary/Interdisciplinary Major)	4
	RC/	Research Internship/ Field work/ Dissertation	12/
	AMJ-1	Advanced Major Paper-1 (Disciplinary/Interdisciplinary Major)	4
	AMJ-2	Advanced Minor Paper-2 (Disciplinary/Interdisciplinary Major)	4
	AMJ-3	Advanced Minor Paper-3 (Disciplinary/Interdisciplinary Major)	4
		Total Credits	**160**

Abbreviations:

AEC Ability Enhancement Courses

SEC Skill Enhancement Courses

IAP Internship/Apprenticeship/ Project
MDC Multidisciplinary Courses
MJ Major Disciplinary/Interdisciplinary Courses
DMJ Double Major Disciplinary/Interdisciplinary Courses
AMJ Advance Major Disciplinary/Interdisciplinary Courses
MN Minor Disciplinary/Interdisciplinary Courses
RC Research Courses

AEC (Ability enhancements courses)- 2 Credits

- *Full marks – 50, Pass Marks – 20*
- *In AEC the students of all faculties will have to select either Hindi or English in Semester -1 and those students who have opted Hindi will have to select English as AEC in Semester -2 and vice versa. For 3rd and 4th semester student can opt Sanskrit, Urdu, Bengali, English, Hindi or TRL.*
- *In 4th semester there will be AEC-3 will include Language and Communication Skill in Hindi and English.*
- *No internal examination will be conducted.*

VAC (Value added Courses)- 2 Credits

- *Full marks – 50, Pass Marks – 20*
- *For 1st semester – "Understanding India"*
- *For 4th Semester – "Environmental Studies"*
- *No internal examination will be conducted.*

SEC (Skill Enhancement Courses) – 3 Credits

- *Full Marks – 75, Pass Marks – 30*
- *Digital Education or Mathematical & Computational Thinking Analysis is selected as SEC. Student will have to select or opt either of the two subjects for semester – I, II and III in no case both subject will be allowed to opt.*
- *No internal examination will be conducted.*

MDC (Multidisciplinary Courses) – 3 credits

- *Full Marks – 75, Pass Marks – 30*
- *A student will study three different subjects in the multidisciplinary courses during first three semesters.*
- *No internal examination will be conducted.*

Table3: Semester wise Course Code and Credit Points and Marks distribution of Minor Papers from Discipline-1:

S.N.	Semester	Paper	Credits	Full Marks		Pass Marks	
				Theory (Internal+ End Sem)	Practical End Sem.	Theory (Internal+ End Sem	Practical
1.	I	MN-1A	3+1	15+60	25	30	10
2.	III	MN-1B	3+1	15+60	25	30	10
3.	V	MN-1C	3+1	15+60	25	30	10
4.	VII	MN-1D	3+1	15+60	25	30	10

- *No internal or mid semester examination will be conducted for practical papers.*

Table 4: Semester wise Course Code and Credit Points and Marks distribution of Minor Papers from Vocational Studies/Discipline-2:

S.N.	Semester	Paper	Credits	Full Marks		Pass Marks	
				Theory (Written test)	Practical/ Demonstration/ Skill test & Viva voce	Theory	Practical/ Demonstration/ Skill test & Viva voce
1.	II	MN-2A	4	75	25	30	10
2.	IV	MN-2B	4	75	25	30	10
3.	VII	MN-2C	4	75	25	30	10
4.	VIII	MN-2D	4	75	25	30	10

- *No internal or mid semester examination will be conducted.*

SEMESTER WISE COURSES IN GEOLOGY FOR FYUGP **2023 onwards**

Table 5: Semester wise Papers and Examination Structure for GEOLOGY Minor from Discipline-1:

Semester	Code	Minor Papers	Credits	Full Marks		Pass Marks	
				Theory (Internal+ End Sem)	Practical End Sem	Theory (Internal+ End Sem	Practical End Sem
I	MN-1A	Introductory Geology	3+1	15+60	25	30	10
III	MN-1B	Essentials of Geology, Rocks & Minerals	3+1	15+60	25	30	10
V	MN-1C	Earth Resources	3+1	15+60	25	30	10
VII	MN-1D	Fossils & their Applications	3+1	15+60	25	30	10

Table 6: Semester wise Papers and Examination Structure for GEOLOGY Minor from Vocational Studies/Discipline-2:

Semester	Code	Minor Papers	Credits	Full Marks		Pass Marks	
				Theory (Written test)	Practical/ Demonstration / Skill test & Viva voce	Theory	Practical/ Demonstration / Skill test & Viva voce
II	MN-2A	Gemmology and Gem Testing	4	75	25	30	10
IV	MN-2B	Applications of Remote Sensing in Geosciences	4	75	25	30	10
VII	MN-2C	X-Ray Diffraction and phase identification & XRF	4	75	25	30	10
VIII	MN-2D	Geographic Information System in Geology	4	75	25	30	10

MINOR PAPERS

SEMESTER I

Geology-MN 1A: Introductory Geology

(Credits: Theory-03, Practicals-01)

MN-1A: Theory

Credit: 03 Lectures: 45

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05) **Pass Marks (Internal + End Semester): = 30**

Instruction to Question Setter for

Semester Internal Examination (SIE 10 marks):

*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

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

Course Objective:

The primary objective of the course is:

- To provide student the fundamental ideas about igneous rocks.
- The students will get to know the different types of sedimentary, metamorphic rocks and fundamentals of sedimentary and metamorphic petrology.
- The students will able to understand the texture, structures and process of their formation.

Learning outcomes

After successfully completing this course, the students will be able to understand:

- This course helps the students to understand how to use structures and appreciate the dynamic nature of the Earth's lithosphere.
- The students will learn the skills of identifying different structures.

Skills to be Learned

- Know basic terminologies and concepts in structural geology
- Get familiar with clinometers and measure dip and strike;
- Significance of folds and faults
- Evaluate the geological significance of joints and unconformity;
- Can understand the difference between various types of sedimentary rocks
- Know the Process and control of physico-chemical and compositional control on metamorphism of rocks.

COURSE CONTENT:

Unit 1: **(10-Lectures)**

Holistic understanding of dynamic planet 'Earth" through Geology, Introduction of various branches of Earth Sciences, Application of Geology in various fields.

Unit 2: **(10-Lectures)**

Earth in Solar System: Origin, the internal constitution of the Earth: core, mantle, crust. Atmosphere and Hydrosphere, Physiographic division of India, Earthquake and volcano, Major engineering projects of India:

Type of Dam/Reservoir, Tunnel, Bridges.

Unit 3: **(05-Lectures)**

Energy: Renewable and Non-renewable energy, use of alternate energy sources, growing energy needs. **Unit 4:** **(10-Lectures)**

Mineral: Definition, Classification and physical properties, distribution of important economic minerals

of India.

Rocks: definition and types, and basics of formation

Igneous: Magma, their types, origin and composition,

Sedimentary: Weathering and Erosion, a process of formation

Metamorphic: agents and types of metamorphism

Unit 5: **(10-Lectures)**

Fossils and their application: Definition, processes, modes of preservation and uses, application of

Fossils, Gondwana fossils and their types.

Reference Books:

- *1. Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge*
- *University Press.*
- *2. Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.*
- *3. Lutgens, F., Tarbuck, E., and Tasa, D., (2009). The Atmosphere: An Introduction to Meteorology. Pearson*
- *Publisher*
- *4. Johnson, R.B. and De Graf, J.V. (1988). Principles of Engineering Geology, John Wiley.*
- *5. Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. John Wiley & Sons, N.Y.*
- *6. Waltham, T., (2009). Foundations of Engineering Geology (3rd Edn.) Taylor & Francis.*
- *7. Bateman, A.M. and Jensen, M.L. (1990). Economic Mineral Deposits. John Wiley.*
- *8. Gokhale, K.V.G.K. and Rao, T.C. (1978). Ore deposits of India their distribution and processing, Tata McGraw*
- *Hill, New Delhi*
- *9. Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts, Cambridge*
- *University Press, 2013.*
- *10. Understanding Earth (Sixth Edition), John Grotzinger and Thomas H. Jordan, 2010, W.H. Freeman and Company,*
- *New York.*
- *11. Schoch, R.M. (1989). Stratigraphy, Principles and Methods. Van Nostrand Reinhold*
- *12. Prothero, D.R. (1998). Bringing fossils to life - An introduction to Palaeobiology, McGraw Hill.*

MN-1A:Practical

Credit: 01 Lectures: 30 (15X2)

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

1. Distribution of Seismic zone in India
2. Locate the major engineering projects in India: Dam/Reservoir, Tunnel, Bridges.
3. Physiographic division of India
4. Distribution of renewable and non-renewable energy sources of India
5. Megascopic study of Igneous, Sedimentary and Metamorphic rocks.
6. Distribution of important economic minerals in India with special reference to Jharkhand.
7. Megascopic study of Invertebrate fossils.
8. Megascopic study of Plant fossils.

Reference Books

1. Sen, A.K.: Laboratory Manual of Geology (Modern Book Agency Pvt. Ltd. Calcutta).
2. Sinha, R.K. and Sharma, N.L. (1993): An introduction to Mineral Economics, Wiley Eastern.
3. Mahadevan, T.M. (2002): Geology of Bihar and Jharkhand, GSI, Bangalore.
4. Krishnan, M.S. (1982): Geology of India and Burma, CBS publication and distributors, Delhi.

SEMESTER III

GEOLOGY- MN-1B: Essentials of Geology, Rocks & Minerals

(Credits: Theory-03, Practicals-01)

MN-1B: THEORY

Credit: 03 Lectures: 45

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05) **Pass Marks (Internal + End Semester): = 30**

Instruction to Question Setter for

Semester Internal Examination (SIE 10 marks):

*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

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

Course Objective:

This course aims in helping the students:

- To know the basic of geology, its scope and its various branches
- This course will emphasize the knowledge on the solar system and planets, interior of Earth, Plate Tectonics
- Learn the basics of crystallography and its application to optical mineralogy;
- Understand the fundamental concepts of crystal structure, morphology and its application to mineral sciences. Optical mineralogy part will help the student to understand microscopic techniques applicable to mineralogical and petrographic studies.

Learning Outcomes:

After successfully completing this course, the students will be able to understand:

- The aim of this course is to study the major mineral groups, their occurrences, physical, chemical and crystallographic properties and their possible uses in industry.
- Focus is given on the physical and chemical properties of minerals, from macroscopic to microscopic.
- The course will investigate how geologic materials and processes influence mineral occurrence, stability, and composition.

Skills to be Learned

- Problem-solving skills and creativity thinking
- The ability to recognize and understand complex patterns systems

COURSE CONTENT:

Unit 1: (10-Lectures)

Introduction to Geology, scope, sub-disciplines and relationship with other branches of Sciences, Earth in the solar system: Origin. Solar System- Introduction to Various planets- Terrestrial and Jovian Planets, Internal constitution of the Earth: core, mantle and crust.

Unit 2: (10-Lectures)

Conventions in the Earth's core and production of the magnetic field; Earthquake: causes,

effects and distribution; Volcanoes: types, products and distribution, Introduction to hydrosphere, biosphere and atmosphere; Origin of mountains; Elementary idea about Plate Tectonics.

Unit 3: **(10-Lectures)**

Age of the Earth: Radioactivity and its application in determining the age of the Earth. Basic concept of:

a. Rocks: types with examples

b. Minerals: Definition and Classification.

c. Fossils: mode of preservation and uses

Unit 4: **(10-Lectures)**

Minerals: Definitions, Classification and Physical properties of minerals. Mineral structures. Silicate Structure. Nature of light and principles of optical mineralogy. Classification of minerals based

on optical properties; Petrological Microscope.; Optical properties of minerals. Nature of light and principles of optical mineralogy, Isotropic & Anisotropic, Birefringence, Interference color, Extinction, Twinning and its types

Introduction to the petrological microscope and identification of common rock-forming minerals

Unit 5: **(05-Lectures)**

Rocks: Definitions and types, Basics of rock formation.

Igneous rock: texture and Structure, magma: Origin and Composition, Bowen's reaction series and magmatic differentiation.

Sedimentary rocks: the process of formation, texture and Structure.

Metamorphic rocks: Agents and types of metamorphism, texture and Structure.

Reference Books:

1. Holme's Principles of Physical Geology (1992). Chapman & Hall

2. Emiliani, C. (1992). Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge

University Press.

3. Gross, M.G. (1977). Oceanography: A view of the Earth, Prentice Hall.

4. Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts, Cambridge

University Press, 2013.

5. Understanding Earth (Sixth Edition), John Grotzinger and Thomas H. Jordan, 2010, W.H. Freeman and Company,

New York.

MN-1B: Practical

Credit: 01 Lectures: 30(15X2)

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

1. Contour maps: profile drawing, identification and description of important topographical features.

2. Physical properties of minerals: Study and Documentation.

3. Study of physical properties of important rock-forming minerals in hand specimen:

4. Plotting of major Dams on the outline map of India, mention the name of the river and utility of the dam.

5. Study of Seismic Zones of India.

6. Observation and documentation of important structures of sedimentary and metamorphic Rocks.

7. Observation and documentation of forms of igneous rocks.

8. Study of optical properties of minerals.

9. Study of rocks in hand specimens.

Reference Books:

1. Laboratory Manual of Geology - A.K. Sen (Modern Book Agency Pvt. Ltd. Calcutta)

2. Singh, R.P. (1995) Structural Geology: A Practical Approach, Ganga Kaveri Publication House, Varanasi. 133p.

3. Bennison, G.M. (1990): An Introduction to Geological Structures and Maps, Fifth Edition, Edward Arnold. London. 5th edition, 67p.

SEMESTER V

GEOLOGY- MN-1C: Earth Resources

(Credits: Theory-03, Practicals-01)

MN-1C: THEORY

Credit: 03 Lectures: 45

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05) **Pass Marks (Internal + End Semester): = 30**

Instruction to Question Setter for

Semester Internal Examination (SIE 10 marks):

*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

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

Course Objectives: Course Learning Outcomes: After successful completion of the course, the students are expected to have the knowledge of mineral, energy and groundwater resources, their various components, and their uses providing benefits to the society.

Course Objective:

This course aims in helping the students:

- To understand the concept of earth resources;
- Ore minerals; its types, genesis, and occurrences, components and classification;
- Knowledge of energy resources and its different types;
- Groundwater resources and its management.

Learning Outcomes:

After successfully completing this course, the students will be able to understand the knowledge of mineral, energy and groundwater resources, their various components, and their uses providing benefits to the society.

Skills to be Learned

- Problem-solving skills and creativity thinking
- The ability to recognize and understand complex patterns systems

COURSE CONTENT:

Unit 1: **(10-Lectures)**

Earth Resources: Definition: Mineral, Ore and Gangue, Tenor, Grade. Introduction to Essential, Critical and Strategic Minerals. A brief overview of the Classification of Mineral deposits concerning processes of formation and mode of occurrences.

Unit 2: **(10-Lectures)**

Definition of Energy: Primary and Secondary Energy. Renewable and Non-Renewable Sources of Energy. Environmental Dimension of Energy.

Unit 3: **(10-Lectures)**

Major Types and Sources of Energy: Resources of Natural Oil and Gas. Coal and Nuclear Minerals: Types and distribution. Introduction to Hydroelectric Power, Solar Energy, Wind, Wave and Biomass-based Power and Energy.

Unit 4: **(10-Lectures)**

Groundwater resources and their management, Groundwater resources and their role in the economic development of a country. Rainwater harvesting and artificial recharge to groundwater. Watershed management.

Unit 5: **(05-Lectures)**

Surface and subsurface water interaction, Groundwater level fluctuations, Basic concepts of water balance studies.

Reference Books:

1. Energy and the Environment by Fowler, J.M. (1984). McGraw-Hill Global Energy Perspectives by Nebojsa Nakicenovic 1998, Cambridge University Press.

2. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M.A. Prelas. 2009, Springer

3. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.

4. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007, Springer.

MN-1C: Practical

Credit: 01 Lectures: 30(15X2)

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

1. Plotting of major Indian oil fields on the map of India.
2. Plotting of major Indian coalfields on the map of India/Jharkhand.
3. Plotting of natural hazards on the map of India.
4. Megascopic study of important ore forming minerals.

Reference Books:

1. Laboratory Manual of Geology - A.K. Sen (Modern Book Agency Pvt. Ltd. Calcutta)

2. Singh, R.P. (1995) Structural Geology: A Practical Approach, Ganga Kaveri Publication House, Varanasi. 133p.

3. Bennison, G.M. (1990): An Introduction to Geological Structures and Maps, Fifth Edition, Edward Arnold. London. 5th edition, 67p.

SEMESTER VII

GEOLOGY- MN-1D: Fossils & their Applications

(Credits: Theory-03, Practicals-01)

MN-1D: THEORY

Credit: 03 Lectures: 45

Marks: 75 (End Semester Examination=60, Semester Internal Examination=10, Class Performance & Attendance =05) **Pass Marks (Internal + End Semester): = 30**

Instruction to Question Setter for

Semester Internal Examination (SIE 10 marks):

*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

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

Course Objectives: Course Learning Outcomes: After successful completion of the course, the students are expected to have the knowledge of mineral, energy and groundwater resources, their various components, and their uses providing benefits to the society.

Course Objective:

This course aims in helping the students:

- To study the remains of animals and plants (fossils) of the geological past preserved in the rocks and how life forms had responded to climate, ecology and biogeography; also their application in geological field.

Learning Outcomes:

After successfully completing this course, the students will be able to understand the evolution of life through time; knowledge of different fossil groups; appreciate how fossils provide the information on the paleoclimate, paleobiogeography, and paleoecology; application in hydrocarbon exploration, reservoirs correlations, pollution indicator etc.

Skills to be Learned

- Problem-solving skills and creativity thinking
- The ability to recognize and understand complex patterns systems

COURSE CONTENT:

Unit 1: **(10-Lectures)**

Introduction to fossils: Definition of fossil, fossilization processes, modes of fossil preservation and uses.

Unit 2: **(5-Lectures)**

Species concept: Definition of species, methods of description and naming of fossils.

Unit 3: **(10-Lectures)**

Introduction to various fossil groups, Brief Introduction of important fossil groups: morphology and geological history of Brachiopoda, Gastropod and lamellibranchia, Important age diagnostic fossiliferous horizons of India.

Unit 4: **(10-Lectures)**

Application of fossils: In the study of palaeoecology, paleobiogeography and palaeoclimate.

Unit 5: **(10-Lectures)**

The societal importance of fossils: implication of larger benthic and micropaleontology in hydrocarbon exploration: identification of reservoirs and their correlation. Application of spore and pollens in the correlation of coal seams. Fossils as an indicator of pollution.

Reference Books:

1. Schoch, R.M. (1989). Stratigraphy, Principles and Methods. Van Nostrand Reinhold.

2. Clarkson, E.N.K. (1998). Invertebrate Palaeontology and Evolution George Allen & Unwin

3. Prothero, D.R. (1998). Bringing fossils to life - An introduction to Palaeobiology, McGraw Hill.

4. Benton, M.J. (2005). Vertebrate palaeontology (3rd Edition). Blackwell Scientific, Oxford.

5. Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time, Edwin 6. H. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

MN-1D: Practical

Credit: 01 Lectures: 30(15X2)

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination will be as per the following guidelines:

Experiment	*= 15 marks*
Practical record notebook	*= 05 marks*
Viva-voce	*= 05 marks*

1. Study of fossils showing various modes of fossilization.
2. Distribution of diagnostic fossils in India.
3. Study of morphological characters of important Invertebrate fossils.
4. Drawing and labelling of various fossils.

Reference Books:

1. Laboratory Manual of Geology - A.K. Sen (Modern Book Agency Pvt. Ltd. Calcutta)
2. Singh, R.P. (1995) Structural Geology: A Practical Approach, Ganga Kaveri Publication House, Varanasi. 133p.
3. Bennison, G.M. (1990): An Introduction to Geological Structures and Maps, Fifth Edition, Edward Arnold. London. 5th edition, 67p.

MINOR PAPERS FROM VOCATIONAL STUDIES/ DISCIPLINE-2

SEMESTER II

GEOLOGY-MN-2A: Gemmology and Gem Testing

Credits: 04 (Theory + Practical/Demonstration/ Skill test & Viva voce)

Theory + Practical/ Demonstration/ Skill test & Viva voce *Marks*: 100	**Pass Marks= 40**

Instruction to External examiner for Written Test (Theory): 75 marks
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be 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 answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*
Practical/ Demonstration/ Skill test & Viva voce: 25 marks

Course learning outcome: The basic idea is to make students well versed with the different terminologies used in the gem industry and to provide skills to become a successful gemmologist.

Skills to be learned: The students will acquire skills which will be useful to them in the gem industry.

MN-2A: Theory **Lectures: 45**

COURSE CONTENT

Gemmology: Introduction to Gems, basic properties of gems, Formation of gem stones (4), Use of refractometers, Polariscope, Dichroscope (4), Methods of Specific Gravity determination (2), Causes of colours in gemstones (1), Introduction to special optical properties like chatoyancy, asterism, luminescence, play of colours, labradorescence, inclusions etc. (5), Distinction between synthetic and natural gem stones (3). Tectonic implications of Gemstone. Chemical & mineralogical composition of Gemstone

Reference Books:

1. Karanth R.V. (2000) Gems and Gem Industry in India, Geological society of India

2. Read, P. G. (1991) Gemmology, Butterworth-Heinemann Ltd.

3. Webster, R. and edited by Anderson, B.W. (1983) Gems: Their Sources, Descriptions and Identification, Butterworth-Heinemann Ltd

4. Sinkankas, J. (1969) Mineralogy: A First Course, Van Nostrand Reinhold Company.

5. Karanth R.V (2008) Gemstones Enchanting Gifts of Nature, Geological society of India

MN-2A: Practical/ Demonstration/ Skill test & Viva voce

Lectures: 30 (15X2)

Practical/ Demonstration/ Skill test & Viva Voce: 25 marks

Instruction to External examiner for End Semester Examination (ESE):

There will be one Practical/Demonstration Examination of 3Hrs duration. Evaluation of Practical/Demonstration Examination will be as per the following guidelines:

Demonstration/Experiment	= 15 marks
Practical/Demonstration record notebook	= 05 marks
Viva-voce	= 05 marks

- Megascopic properties of different Gems
- hand lens (10x), Detection of double refraction, by observing pleochroic colours with the Dichroscope (4),
- Identification of gemstones on the basis of pleochroic colours;
- Detection of double refraction, interference figures and internal strain with the Polariscope (2),
- study of the fluorescent colours exhibited by various gemstones under Ultraviolet (long wave and short wave) light (3),
- Measurement of refractive indices and birefringence tests using a gem-testing Refractometer (2),

Kumari

SEMESTER IV

GEOLOGY- MN-2B: Applications of Remote Sensing in Geosciences

Credits: 04 (Theory + Practical/ Demonstration/ Skill test & Viva voce)

Theory + Practical/ Demonstration/ Skill test & Viva voce *Marks:* 100 **Pass Marks= 40**

Instruction to External examiner for Written Test (Theory): 75 marks
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be 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 answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*
Practical/ Demonstration/ Skill test & Viva voce: 25 marks

Course learning outcome: The course is meant to address the fundamental techniques used for remote sensing. At the end of this course, the student will be appraised with all the theoretical knowledge, information and skills to use Remotely Sensed data for geological applications.

Skills to be learned: After completion of this course, the student will be well versed with the world of Remote Sensing and the applications and Interpretation of data related to geosciences.

MN-2B: Theory **Lectures: 45**

COURSE CONTENT

Applications of Remote Sensing in Geosciences: Basic concepts in remote sensing, electro-magnetic spectrum (3), Energy sources, energy interaction in the atmosphere, atmospheric windows, atmospheric effects on remotely sensed data (4), signatures in remote sensing, sensors and sensor platforms (3). Application of Remote sensing in geomorphology, structures & Mineral exploration. Introduction to aerial photographs, history of aerial photography, aerial camera, types of aerial photographs, classification, principles of stereoscopic viewing, conditions and cause for stereovision (2). Aerial photography missions. Use of pocket and mirror stereoscope, scale of aerial photographs, stereoscopic parallax, relief displacement, measurement of height of objects (3). Aerial photo interpretation, photo-recognition elements, methods of photointerpretation, advantages and limitations of aerial photographs (5). Remote Sensing from space: space crafts and sensors. Visual image interpretation of satellite imagery, image enhancement, digital analysis, preparation of thematic maps (5). Thermal Infrared remote sensing and microwave remote sensing for geological applications. Remote sensing satellites, Indian Remote Sensing Satellite programme (5).

Reference Books:

1. Miller Victor C. Miller Calvin F. (1961) Photogeology (International Series in the Earth Sciences. McGraw-Hill Book Company, Inc.

2. Drury S.A, A Guide to Remote Sensing - Interpreting Images of Earth, Oxford Science Publications, Oxford. (1990)

3. Sabins, F.F.Jr., (1978) Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco.

4. Paine, D.P (1981) Aerial photography and image interpretation for resource management, Wiley and Sons, New York. 1986.

MN-2B: Practical/ Demonstration/ Skill test & Viva voce
Lectures: 30 (15X2)

Practical/ Demonstration/ Skill test & Viva Voce: 25 marks

Instruction to External examiner for End Semester Examination (ESE):
There will be one Practical/Demonstration Examination of 3Hrs duration. Evaluation of Practical/Demonstration Examination will be as per the following guidelines:

Demonstration/Experiment	= 15 marks
Practical/Demonstration record notebook	= 05 marks
Viva-voce	= 05 marks

- Aerial photo interpretation, photo-recognition elements, methods of photointerpretation, advantages and limitations of aerial photographs (5).
- Visual image interpretation of satellite imagery, image enhancement, digital analysis, preparation of thematic maps (5).

SEMESTER VI

GEOLOGY- MN-2C: X-Ray Diffraction and phase identification & XRF

Credits: 04 (Theory + Practical/ Demonstration/ Skill test & Viva voce)

Theory + Practical/ Demonstration/ Skill test & Viva voce Marks: 100	**Pass Marks= 40**

Instruction to External examiner for Written Test (Theory): 75 marks
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be 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 answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*
Practical/ Demonstration/ Skill test & Viva voce: 25 marks

Course learning outcome: Lean and understand the functioning of various analytical techniques using X-ray Diffraction

Skills to be learned: On completion of this course the student will be well versed with single crystal and powder diffraction techniques which will help him in characterising minerals and crystalline material.

MN-2C: Theory **Lectures: 45**

COURSE CONTENT

X-Ray Diffraction and phase identification & XRF: Introduction to X-rays (2), Instrumentation (2), Braggs equation and derivation (4), X-ray diffraction methods (4), Single crystal diffraction (2), Powder diffraction (2), JCPDS cards (2), Mineralogical investigations using X-rays– Identification of X-ray pattern (12)., XRF- Principle, Functions, Geological implications. Different International standard for XRF.

Reference Books:

1. *Cracknell, A.P. (1969) Crystals and their structure. Pergamon Press*
2. *Cullity, B.D. and Stock,S.R. (2001) Elements of X-Ray Diffraction. Third Edition, AddisonWesley, 664 p.*
3. *Suryanarayana C. and Grant,M.N. (1998) X-Ray Diffraction: A Practical Approach. Plenum Press, New York.*
4. *Bish, D.L., and Post, J.E., eds., (1989) Modern Powder Diffraction, Min. Soc. America Reviews in Mineralogy Vol. 20, 369 p.*

MN-2C: Practical/ Demonstration/ Skill test & Viva voce

Lectures: 30 (15X2)

Practical/ Demonstration/ Skill test & Viva Voce: 25 marks

Instruction to External examiner for End Semester Examination (ESE):

There will be one Practical/Demonstration Examination of 3Hrs duration. Evaluation of Practical/Demonstration Examination will be as per the following guidelines:

Demonstration/Experiment	= 15 marks
Practical/Demonstration record notebook	= 05 marks
Viva-voce	= 05 marks

- Mineralogical investigations using XRD
- Element composition of different minerals using XRF (Olivine, Pyroxene, Amphibole, Mica, Felspar)

SEMESTER VIII

GEOLOGY- MN-2D: Geographic Information System in Geology

Credits: 04 (Theory + Practical/ Demonstration/ Skill test & Viva voce)

Theory + Practical/ Demonstration/ Skill test & Viva voce Marks: 100 **Pass Marks= 40**

Instruction to External examiner for Written Test (Theory): 75 marks
*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be 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 answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*
Practical/ Demonstration/ Skill test & Viva voce: 25 marks

Course learning outcome: This course provides a theoretical and practical, hands-on approach to spatial database design and spatial data analysis with Geographical Information Systems as applied to the various fields of geosciences.

Skills to be learned: The course provides knowledge of the fundamentals of GIS theory, and the stages of developing and using a GIS platform of various geological applications. It also promotes proficiency in the use of the GIS software's for visualization, query, mapping, and analytical purposes.

MN-2D: Theory **Lectures: 45**

COURSE CONTENT

Geographic Information System in Geology: Introduction to GIS, Components of GIS (2), Hardware & Software Requirements (2), Spatial databases and GIS, GIS and the art of digitizing, Geographic phenomena, Geographic object (4), Regular vs. Irregular tessellations, Triangulated Irregular Network (2), Topology and spatial relationships (2), Data input, Data output and visualization (2), Data storage, Query maintenance and spatial analyses, etc. (2). Different types of vector data: point, line, polygon, Concept of topology. Raster data model and comparison with vector (2), Sourcing satellite data, non-spatial data and their types (2), Georeferencing, Map projections (4) Applications of GIS, Limitations of GIS (4), Components of GPS (2).

Reference Books:

1. *Rolf, A. de (2001) Principles of Geographic Information Systems-An introductory textbook. ITC Educational Textbook Series. Enschede, The Netherlands.*
2. *Lo C.P. and Albert K. W. Yeung, (2002) Concepts and Techniques of Geographic Information System, Prentice –Hall, India.*

3. *Heywood I, el. (2011) An Introduction to Geographical Information Systems, Pearson Education Pvt. Ltd., New Delhi.*
4. *Kang – tsung – Chang, (2002) Introduction to Geographical Information System, McGraw Hill.*

MN-2D: Practical/ Viva voce/ Demonstration/ Skill test
Lectures: 30 (15X2)

Practical/ Demonstration/ Skill test & Viva Voce: 25 marks

Instruction to External examiner for End Semester Examination (ESE):

There will be one Practical/Demonstration Examination of 3Hrs duration. Evaluation of Practical/Demonstration Examination will be as per the following guidelines:

Demonstration/Experiment	= 15 marks
Practical/Demonstration record notebook	= 05 marks
Viva-voce	= 05 marks

- GIS applications Georeferencing, Map projections
- Identification of landform, drainage pattern, different lithology and ore deposits using satellite/remote sensing data
- GIS applications in Mapping of any Terrane, mineral exploration & etc.

FORMAT OF QUESTION PAPER FOR SEMESTER INTERNAL EXAMINATIONS

Question format for **10 Marks:**

Subject/ Code

F.M. =10 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. .....

Group B

2. ..... [5]
3. ..... [5]

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

FORMAT OF QUESTION PAPER FOR END SEMESTER UNIVERSITY EXAMINATIONS

Question format for 60 Marks:

Subject/ Code

F.M. =60 **Time**=3Hrs. Exam Year

General Instructions:

i. Group A carries very short answer type compulsory questions.
ii. Answer 3 out of 5 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]
3. ..... [5]

Group B

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

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

Question format for 75 Marks:

Subject/ Code

F.M. = 75 **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]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]
9. ..... [15]

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