



UNIVERSITY OF JAMMU

NOTIFICATION

(12/Feb/ADP/04)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the competent bodies, has been pleased to authorize adoption of the Syllabi and Courses of Study in the subject of Geology for Part-II of Three Year B.Sc. (General) Course and II & III Semesters of Master's Degree Programme (given in annexure) for the examinations to be held in the years as indicated below against each alongwith %age of change in each paper/course no.:-

<u>Class</u>	<u>Part/Semester</u>	<u>For the Examinations to be held in the year</u>	<u>Paper/Course No.</u>	<u>%age of change</u>
B.Sc	II	2013, 2014 & 2015	A B	60% 80%
M.Sc	II	May 2012, May 2013 & May 2014	All Course Nos.	100%
M.Sc	III	Dec 2012, Dec 2013 & Dec 2014	All Course Nos.	100%

The alternative question papers are required to be set as per the University regulation given as under:-

- If the change in the Syllabi and Courses of Study is less than 25%, no alternative Question paper will be set.
- if the change is 25% and above but below 50% alternative Question Paper be set for one year.
- If the change is 50% and above or whole scheme is changed, alternative Question Paper are set for two years.

Sd/-
REGISTRAR

No. F.Acd./II/26/12/ 2028-57

Dated: 05/03/2012

Copy for information and necessary action to:

1. Special Secretary to Vice-Chancellor
2. P.S. to Dean Academic Affairs
3. P.A. to Registrar
4. Sr. P.A. to Controller of Examinations
5. Dean, Faculty of Science
6. Convener/All the members of the Board of Studies in Geology
7. Head, Post Graduate Department of Geology
8. Principals of all the Colleges concerned
9. C.A. to Controller of Examinations
10. I/c Deputy Registrar (Publication/Eval. NP)
11. Asst. Registrar (Conf./Exams. UG/PG /PRI)
12. S.O (Confidential)
13. Content Manager University Website

Asst. Registrar (Academics)

SYLLABI AND COURSES OF STUDY IN GEOLOGY FOR B.Sc PART –II FOR EXAMINATIONS TO BE HELD IN THE YEARS 2013, 2014 and 2015.

There shall be two theory papers and one practical paper of 50 marks each. Each theory paper shall be of three hours duration and the practical paper shall be of four hours duration. 20% of the marks shall be reserved for internal assessment in each theory paper 50% in practical paper. Each theory paper will be set for 40 marks and practical paper for 25 marks. In case of regular students, internal assessment received from the colleges will be added to the marks obtained by them in the University examination and in case of private candidates, marks obtained by them in the University examination shall be increased proportionately in accordance with the Statutes / Regulations.

Paper – A Earth's Resources

UNIT-I

- 1.1 Natural resources and their classification, inexhaustible resources (sunlight, wind, water, sea waves) – an alternative source of energy.
- 1.2 Mineral resources and their potential in India.
- 1.3 Non-renewable resources, conservation of fossil fuels.
- 1.4 Environmental implications of exploitation of mineral resources.

UNIT –II

- 2.1 Concept of ore – ore mineral, tenor and gangue. Factors controlling mineral availability.
- 2.2 Types of mineral deposits – syngenetic, epigenetic, exogenetic & endogenetic with reference to India
- 2.3 Distribution of mineral deposits in time and space, metallogenic provinces & epochs.
- 2.4 Supergene enrichment of ore deposits, role of water table in deciphering the scheme of supergene enrichment.

UNIT-III

- 3.1 Magmatism as a process of ore formation, magmatic ore deposits, early and late magmatic ore deposits.
- 3.2 Sedimentation as a process of ore formation, placer deposits, deposits through bacterial precipitation.
- 3.3 Metamorphism as ore forming process, metamorphic and metamorphosed mineral deposits.
- 3.4 Hydrothermal solutions, classification of hydrothermal ore deposits.

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UNIT-IV

- 4.1 Geological setting, mode occurrence and distribution of iron, copper, lead and zinc deposits in India.
- 4.2 Coal-composition, ranks of coal, origin and distribution in India. Petroleum-origin, distribution in India
- 4.3 Mode of occurrence and distribution of minerals related to fertilizer and cement industry in India.
- 4.4 Refractory minerals, their properties, mode of occurrence and their distribution in India.

UNIT-V

- 5.1 Abrasive minerals- classification and distribution of abrasive minerals in India.
- 5.2 Radioactive minerals-properties, occurrence and distribution in India.
- 5.3 Geophysical prospecting methods
- 5.4 Mineral wealth of J&K, metallic, non-metallic, precious stones, building stones and coals.

Note for Paper setting:

The Question Paper will contain two questions from each unit (Total Ten Questions) and the Candidates will be required to answer one question from each unit. Total Question to be attempted will be **five** i.e. there will be an internal choice within each unit.

Books recommended:

- | | |
|-----------------------|---------------------------------------|
| 1. Chatterjee | Mineral Economics. |
| 2. Sinha & Rai | Mineral Economics |
| 3. N.L.Sharma | Geology of coal & Indian coal fields. |
| 4. Krishnaswamy | Mineral deposits of India. |
| 5. Gokhle & Rao | Ore deposits of India. |
| 6. Prasad | Ore deposits of India. |

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Paper – B**Palaeontology and Stratigraphy****UNIT-I**

- 1.1 Fossil-definition, conditions and mode of preservation, types, their significance.
- 1.2 Origin of life and life through ages.
- 1.3 Morphology and geological distribution of Nautiloidea
- 1.4 Geological distribution and morphological characteristics of Ammonoidea

UNIT-II

- 2.1 Morphology and geological distribution of Pelecypoda and Gastropoda.
- 2.2 Geological distribution and important morphological features of Brachiopoda
- 2.3 Morphological characters and geological distribution of Echinodermata.
- 2.4 Geological distribution and important morphological characters of trilobite.

UNIT-III

- 3.1 An introduction to Vertebrate palaeontology. Evolutionary history of Horse and Elephant.
- 3.2 A brief study of reptiles with special reference to dinosaurs.
- 3.3 Gondwana Stratigraphy- litho and biostratigraphic classification, climatic variations and economic importance.
- 3.4 Important characteristics of Gondwana plants – Glossopteris, Gangmopteris, Vertebraria, Thinfeldia, Sigillaria, Nilsonia, Ptylophylum, Lepidodendron, Calamites, Schizoneura.

UNIT-IV

- 4.1 Principles of Stratigraphy and the criteria for correlation of strata.
- 4.2 Standard stratigraphic time scale. Concept of litho-bio-chronostratigraphy.
- 4.3 Physical and structural subdivisions of Indian subcontinent and their characteristics..
- 4.4 Brief description of Archean and Proterozoic sucssions of India – Dharwar, Aravallies, Cuddapha, Vindhyan, Salkhala, Dogra/Shimla Slates.

UNIT-V

- 5.1 Litho and biostratigraphic classification of Palaeozoic sequence of Kashmir and Spiti.
- 5.2 Stratigraphy of the Jurassic of Kutch and Cretaceous of Trichnopoly.
- 5.3 Deccan lava flows-distribution and stratigraphic position.
- 5.4 Litho and biostratigraphic classification of Siwalik sequence.
- 5.5 Karewas of Kashmir.

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Note for Paper setting:

The Question Paper will contain two questions from each unit (Total Ten Questions) and the candidates will be required to answer one question from each unit. Total Question to be attempted will be **five** i.e. there will be an internal choice within each unit.

Books recommended:

H. Woods	Invertebrate Palaeontology
R.N.Black	The elements of Palaeontology
Davis & Stubblefield	An introduction to Palaeontology
Ravinder Kumar	Fundamentals of Historical Geology
D.N.Wadia	Geology of India
M.S.Krishnen	Geology of India & Burma
Weller	Stratigraphic Principles and Practice
Colbert	Evolution of Vertebrates
Shukla	Essentials of Palaeobotany

Practicals:

1. Study of invertebrate fossils.
2. Study of plant fossils
3. Drawing of geological sections, writing of geological history and completion of out crops in the given geological maps.
4. Study of ore minerals.
5. Field work and its report.
6. Viva-Voce.

Legend

Syllabi
M.Sc. GEOLOGY

SECOND SEMESTER

Examinations to be conducted in May 2012, May 2013 and May 2014

Course No.	Title	Credits
Theory		
475	Elements of Hydrogeology	2
476	Non-Clastic Sedimentology	2
477	Igneous Petrology	2
478	Indian Phanerozoic Stratigraphy	2
479	Geotectonics	2
480	Ore Geology	2
481	Descriptive Mineralogy	2
482	Environmental Geology	2
Practical		
483	Practical related to course No's. 475, 476 and 477	4
484	Practical related to course No's. 479, 480 and 481	4

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Course No.- 475

ELEMENTS OF HYDROGEOLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objectives To study the origin and causative factors, occurrence, distribution, quality and general behaviour of groundwater under varying geological and geographical conditions.

UNIT-I **Origin occurrence and distribution of water**

- 1.1 Origin of water – magmatic, metamorphic, juvenile, connate, marine, volcanic plutonic water. Subsurface movement and vertical distribution of groundwater and governing physical laws, surface and ground water relationship, renewable and non-renewable groundwater resources.
- 1.2 Hydrological properties of formations, porosity and permeability, their determination in the laboratory. Physical properties of the reservoir rocks-intrinsic permeability. Hydraulic conductivity, transmissivity, storativity, specific yield, specific retention, formation constants. Genetic and hydrologic classification of reservoir rocks and boundary conditions.
- 1.3 Hydrostratigraphic units, water table contour maps and flow net analysis. Concept of drainage basin and groundwater basin. Hot water springs, their origin, distribution and economic importance.
- 1.4 Mode of occurrence of groundwater in unconsolidated and semi-consolidated formations. Hydrogeology of arid and wet land zones of Indian Sub-continent.

UNIT-II **Hydrometeorology**

- 2.1 Precipitation – process, causes, types and measurements. Computation of average rainfall.
- 2.2 Evapotranspiration – process, causes, factors influencing and measurements in the field and of empirical equations.
- 2.3 Infiltration – process, factors effecting, measurements, relation to runoff and computation of runoff. Hydrographs.
- 2.4 Elements of snow hydrology – factors influencing snow melt and determination of runoff (snow melt).

Legend

UNIT-III Groundwater quality

- 3.1 Physical and chemical properties of water. Quality criteria for domestic, irrigation and industrial use. Graphic presentation of water quality data.
- 3.2 Groundwater quality in different provinces of India. Water contaminants and pollutants, arsenic, fluorides and nitrates. Relationship of water quality to use. Change in water quality.
- 3.3 Sea water intrusion in coastal aquifers and remedial measures. Upconing Ghyben-Herzberg relation.
- 3.4 Influence of aquifer material on groundwater quality. Water quality estimation and methods of treatment for various uses.

UNIT-IV Groundwater resource behaviour

- 4.1 Fluctuations in groundwater – briefs and causative factors.
- 4.2 Groundwater recharging methods.
- 4.3 Consumptive and conjunctive use of surface and groundwater.
- 4.4 Radioisotopes in hydrological studies.

Books Recommended

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|----|-----------------|--|
| 1. | Todd, D.K. | Groundwater Hydrology |
| 2. | Harinarayan | Exploration techniques for groundwater |
| 3. | Davis & Wiest | Hydrology |
| 4. | Chow | Handbook of Applied Hydrology |
| 5. | Johnson | Groundwater and Wells |
| 6. | Walton | Groundwater Resource Evaluation |
| 7. | Fetter, C.W. | Applied Hydrogeology |
| 8. | Subramaniam, V. | Water |
| 9. | Alley, W.M. | Regional Groundwater Quality |

Note for Paper Setter

The paper setter is required to set the question paper as per the scheme given below.
The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. (1 mark for each question)

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 476

NON CLASTIC SEDIMENTOLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objectives To impart knowledge about the genesis of carbonate rocks. To study the sedimentary structures in carbonate rocks. To discuss the microfacies concept and techniques used for staining the carbonate minerals.

UNIT-I

- 1.1 Allochemical and orthochemical constituents of carbonate rocks and their origin.
- 1.2 Nomenclature and Classification of carbonate rocks (Folk and Dunham).
- 1.3 Petrogenesis of biogenic silica deposits.
- 1.4 Petrogenesis of phosphate deposits.

UNIT-II

- 2.1 Diagenesis – Types and its role in shaping carbonate rocks.
- 2.2 Diagenesis and porosity evolution of carbonate rocks.
- 2.3 Chemically formed sedimentary structures and their geological significance.
- 2.4 Biogenic sedimentary structures and their geological significance..

UNIT-III

- 3.1 Introduction to modern carbonate sedimentary environments.
- 3.2 Carbonate evaporate shorelines, shelves and basins.
- 3.3 Introduction to evaporates and Subkha Model.
- 3.4 Dolomitization models and dedolomitization.

UNIT-IV

- 4.1 Staining techniques for carbonate minerals.
- 4.2 Microfacies concept and techniques.
- 4.3 Cathodoluminescence principles and techniques.
- 4.4 Plate tectonics vis-a-vis oil prospecting.

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Books Recommended

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|-----|------------------------------|---|
| 1. | Balatt, Middleton and Murray | Carbonate sediments and their origin |
| 2. | Bathurst, R.G.C. | Carbonate sediments and their diagenesis |
| 3. | Knut Bjorlykke: | Sedimentology and Petroleum Geology |
| 4. | Carozzi, A.V. | Carbonate rock depositional models:
A Microfacies Approach |
| 5. | Wilson, J.L. | Carbonate rocks in Geologic History |
| 6. | Carver, R.F. | Procedures in Sedimentary Petrology |
| 7. | Leeder, M.R. | Sedimentology: Process and Product |
| 8. | Prothero and Schwab | Sedimentary Geology |
| 9. | Reading, H.G. | Sedimentary Environments |
| 10. | Collinson and Thomson | Sedimentary Structures |

Note for Paper Setter

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The candidate has to attempt all the three questions.

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Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. *(5 marks for each question)*

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. *(10 marks for each question)*

(Paper setter has to provide the key for objective type questions)

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Course No.- 477

IGNEOUS PETROLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objectives To acquaint the students of varied types of igneous rocks, their tectonic environment and petrogenesis.

UNIT-I

- 1.1 Classification schemes of igneous rocks, Hierarchy of classification, IUGS classification of plutonic and volcanic rocks.
- 1.2 Generation of magma in mantle and crust.
- 1.3 Magmatic gases and volatile components, Oxygen fugacity, Factors for magma crystallization (nucleation and crystal growth).
- 1.4 Phase equilibrium studies of binary system with eutectic (Di-An), peritectic (Fo-Silica) and solid solution relation (Ab-An) and ternary system (Di-Ab-An) and their significance.

UNIT-II

- 2.1 Classification of basalts: IUGS, Kuno, Yoder and Tilley, Macdonald and Katsura, Chayes, Pearce and Cann.
- 2.2 Generation of basalts: parent materials, primary origins, secondary origins.
- 2.3 Petrogenesis of basalts in relation to tectonic environment: ORB (OFB), WPB (IPB), IAB and OCMB (subduction zone).
- 2.4 Lunar basalts; Ophiolite suite; Andesites and their petrogenesis.

UNIT-III

- 3.1 Petrology, textures and classification of granites (I, S, M, A types).
- 3.2 Granite in various tectonic environments.
- 3.3 Petrogenesis of granites: source materials, sediments and metasediments, basalt or andesites.
- 3.4 Petrological and geochemical characters of pegmatites and their petrogenesis.

UNIT-IV

- 4.1 Petrological characters, classification and petrogenesis of Lamprophyres.
- 4.2 Mineral composition, classification and petrogenesis of Carbonatites and Nepheline Syenites.
- 4.3 Mineralogy of Kimberlites and their petrogenesis.
- 4.4 Petrography, composition and petrogenesis of Komatiite and Anorthosites.

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Books Recommended

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|------------------------|--|
| 1 Alexander McBirney | Igneous Petrology. |
| 2 Anthony Hall | Igneous Petrology. |
| 3 Anthony R. Philpotts | Principles of Igneous and Metamorphic Petrology. |
| 3 Daniel S. Barker | Igneous Rocks. |
| 4 Loren A. Raymond | Petrology. |
| 5 Marjorie Wilson | Igneous Petrogenesis. |
| 6 Mihir K. Bose | Igneous Petrology. |
| 7 Myron G. Best | Igneous and Metamorphic Petrology. |

Note for Paper Setter

The paper setter is required to set the question paper as per the scheme given below.
The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. (1 mark for each question)

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 478

INDIAN PHANEROZOIC STRATIGRAPHY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objectives To impart knowledge about Palaeozoic, Mesozoic and Cenozoic strata with faunal and floral elements and the Gondwana successions.

UNIT-I Palaeozoic Stratigraphy

- 1.1 Precambrian – Cambrian boundary problem and its fixation in India.
- 1.2 Distribution of Palaeozoic rocks in India.
- 1.3 Correlation of the Palaeozoic faunal and successions of India.
- 1.4 Tethyan and Lesser Himalayan basins and their tectonic history during Palaeozoic times.

UNIT-II Gondwana Stratigraphy

- 2.1 Concept of Gondwanaland and global distribution of Gondwana rocks.
- 2.2 Nature and distribution of Gondwana outcrops in Peninsular and Extra-Peninsular India.
- 2.3 Age limits of Gondwana rocks and climatic fluctuations.
- 2.4 Permo-Triassic boundary and its identification in India.

UNIT-III Mesozoic Stratigraphy

- 3.1 Distribution of Mesozoic rocks of India and the faunal & floral variations.
- 3.2 Correlation of the Mesozoic strata of Peninsular India and Himalaya.
- 3.3 Significance of marine transgressions in Mesozoic and the development of coastal facies in India.
- 3.4 Cretaceous –Tertiary boundary and its identification in India.

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UNIT-IV Cenozoic Stratigraphy

- 4.1 Deccan volcanic and their age relationship.
- 4.2 Himalayan ophiolites & mélanges and their significance.
- 4.3 Classification and correlation of Cenozoic successions in Himalaya.
- 4.4 Siwalik Group – classification and fauna.
- 4.5 Karewa Group – classification, fauna, flora and age.

Books Recommended

- | | |
|------------------------------|---------------------------------------|
| 1. Weller | Stratigraphic Principles and Practice |
| 2. Pasco (Vol. I – III) | Geology of India and Burma |
| 3. Ravinder Kumar | Fundamentals of Historical Geology |
| 4. M.S.Krishnen | Geology of India and Burma |
| 5. D.N.Wadia | Geology of India |
| 6. Rama Krishna & Vadhyathan | Stratigraphy |

Note for Paper Setter

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The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. (1 mark for each question)

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 479

GEOTECTONICS

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objectives To introduce the advanced ideas of internal structure of earth. To introduce the latest concept of geomagnetism and its application. To equip with the latest knowledge on tectonic evolution of Himalaya and Indian craton.

UNIT-I Internal structure and mechanics of earth

- 1.1 Seismic investigations of the earth's interior, waves velocity, velocity curves, density distribution, elastic properties, pressure and temperature within the earth.
- 1.2 Bulk composition of the earth and of its various zones.
- 1.3 Composition of the earth's crust and upper mantle and crust-mantle relationship.
- 1.4 Gravity anomalies.

UNIT-II Sea floor spreading and plate movement

- 2.1 Concept of continental drift, evidences of movement of continents, modern concept of plate tectonics, fitting of continents together, palaeoclimatic units.
- 2.2 Evidences of sea floor spreading, magmatic anomaly patterns, age of ocean sediments, oceanic ridges and trenches, benioff zone.
- 2.3 Geomagnetism-magnetization, types, magnetic field reversals, polar wandering curve, application in geology.
- 2.4 Nature of plate margins, constructive and destructive geometry of plate motion, mosaic of plates, direction of motion, causes of plate motion, convection plumes and other classical hypothesis.

UNIT-III Tectonic evolution of Himalaya

- 3.1 Convergence of continents, pre-Himalayan sedimentation, closing of continents, rotation of continental block, phases of deformation, shifting of depositional basins, vertical tectonics.
- 3.2 Drift and subduction of Indian plate, Andaman subduction zone, Andaman sea spreading centre and Makran subduction zone.
- 3.3 Indus-Tsangpo suture zone, Main Central Thrust, Main Boundary Fault, Siwalik structure, Himalayan Frontal Fault, evolution of Himalaya.
- 3.4 Neotectonic evidences in parts of Himalaya.

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UNIT-IV **Tectonic evolution of Indian craton**

- 4.1 Evolutionary history and structural layout South Indian craton.
- 4.2 Evolutionary history and structural layout Central Indian craton.
- 4.3 East Indian region, evolutionary history.
- 4.4 Gravity conditions in Indian craton.

Books Recommended

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|----|-----------|---|
| 1. | Condie | Plate Tectonics and Crustal Evolution |
| 2. | Cox | Plate Tectonics and Geomagnetic Reversals |
| 3. | Balanssov | Basic problems in Geotectonics |
| 4. | Wadia | Geology of India |
| 5. | Gansser | Geology of the Himalaya |
| 6. | Valdiya | Aspects of Geotectonics |
| 7. | Wyllia | Dynamics of Earth |

Note for Paper Setter

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The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. *(1 mark for each question)*

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. *(5 marks for each question)*

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. *(10 marks for each question)*

(Paper setter has to provide the key for objective type questions)

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Course No.- 480

ORE GEOLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objectives - To impart the knowledge and understanding about the various processes of the ore formations. To introduce the modern concepts of the ore genesis. To understand the formation, mode of occurrences and types of various petrological ore associations.

UNIT-I

- 1.1 Spatial and temporal distribution of ore deposits – a global perspective.
- 1.2 Mode of occurrences of ore bodies – morphology of ore body, attitudinal relation with host rock and secondary structures in the host rocks.
- 1.3 Concept of ore bearing fluids – their origin and migration.
- 1.4 Structural, physico-chemical and stratigraphic controls of ore localization.

UNIT-II

- 2.1 Orthomagmatic ores of mafic and ultramafic associations- (Chromite, $\text{Fe} \pm \text{Ti} \pm \text{V}$ oxides, $\text{Cu-Ni} + \text{Co}$ sulfides and PGE ores), their types and genetic models.
- 2.2 Mineralization associated with Kimberlites and Carbonatites their characteristics and genetic models.
- 2.3 Ores of silicic igneous rock association – disseminated and stockwork deposits, porphyry type of deposits, types, alterations and process of formation.
- 2.4 Mineralization associated with Carbonatites- their characteristics and genetic models.

UNIT-III

- 3.1 Placers and paleoplacers – process and mechanism of development, tectonic and temporal aspects of placer deposition and origin of ores.
- 3.2 Sedimentary and syngenetic iron ore deposits – types, general characteristics and origin.
- 3.3 Stratabound carbonate hosted base metal deposits – types, general characteristics and genetic models.
- 3.4 Ores related to weathering processes – bauxite, laterite and Ni/Au-laterite deposits, general characteristics and process of formation.

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UNIT-IV

- 4.1 Volcanic hosted massive sulfide deposits – types, characteristics and mode of occurrences.
- 4.2 Hydrothermal deposits – classification, general characteristics, zoning and associated wall rock alterations.
- 4.3 Supergene enrichment of ores and protores – process, development of alteration zones and their characteristics.
- 4.4 Ores of metamorphic affiliations – metamorphic and metamorphosed ores. Skarn deposits, their types and process of formation.

Books Recommended

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|-----|--------------------|---|
| 1. | Barnes | Geochemistry of Hydrothermal Ore Deposits |
| 2. | Edwards & Atkinson | Ore Deposit Geology |
| 3. | Evans | Ore Geology and Industrial Minerals |
| 4. | Evans | An Introduction to Ore Geology |
| 5. | Klemm & Schneider | Time and Strata Bound Deposits |
| 6. | Mukerjee | Ore Genesis: A Holistic Approach |
| 7. | Park & Macdarmid | Ore Deposits |
| 8. | Smirnov | Geology of Ore Deposits |
| 9. | Mishra | Understanding Mineral Deposits |
| 10. | Pirajna | Hydrothermal Mineral Deposits |

Note for Paper Setter

The paper setter is required to set the question paper as per the scheme given below.
The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. (1 mark for each question)

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 481

DESCRIPTIVE MINERALOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objective To impart the knowledge about the rock forming minerals.

UNIT-I

- 1.1 Oxides and Hydroxides minerals : Structure, Chemistry, classification, Distinguishing features and paragenesis of Spinel Group of minerals, Hematite, ilmenite, rutile, gibbsite and diaspore.
- 1.2 Sulphide and sulphate minerals : Structure, Chemistry, Distinguishing features and paragenesis of common minerals (pyrite, chalcopyrite, sphalerite, baryte, gypsum, and anhydrite).
- 1.3 Carbonate Minerals : Structure, Chemistry, Distinguishing features and paragenesis of calcite, dolomite, and aragonite
- 1.4 Phosphate and halide minerals : Apatite, monazite, fluorite and halite.

UNIT-II

- 2.1 Olivine Group : Structure, Classification, Chemistry, Distinguishing features and paragenesis.
- 2.2 Garnet Group : Structure, Classification, Chemistry, Distinguishing features and paragenesis.
- 2.3 Pyroxene and Pyroxenoid Group: Compositional changes and nomenclature; Structure and paragenesis of ortho- and clino-pyroxenes; Pyroxene thermometry.
- 2.4 Amphibole Group : Nomenclature, structure, chemistry and paragenesis of amphibole minerals. Exsolution textures in amphiboles.

UNIT-III (Phyllosilicates/Sheet Silicates)

- 3.1 Mica Group : Classification and Structure, Compositional variation and paragenesis.
- 3.2 Chlorite and chlorotoids : Classification and Structure, Compositional variation and paragenesis.
- 3.3 Clay Mineralogy : Classification, Structure, Identification and paragenesis.
- 3.4 Hydrous magnesian silicate minerals : Talc, Serpentine, vermiculite

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UNIT-IV (Tecto-and cyclo-silicates)

- 4.1 Feldspar Group : Classification, structure, morphology and twinning, chemical characteristics and paragenesis of alkali feldspar, plagioclase and barium feldspar.
- 4.2 Feldspathoid Group : Structure, phase relations and paragenesis.
- 4.3 Mineralogy of silica minerals : quartz, tridimite, cristobalite, coesite and stishovite.
- 4.3 Cyclo- silicates : cordierite, beryl, tourmaline, axinite their structures, chemistry, distinguishing features and paragenesis.

Books Recomendaded

- | | |
|--------------------|--|
| 1. Dana | A text book of mineralogy |
| 2. Deer & Zussman | An introduction to the rock forming minerals |
| 3. Cerreves | Introduction to mineralogy |
| 4. Berr and Messon | Mineralogy |
| 5. Kestov | Mineralogy |
| 6. Batckhtin | Mineralogy |

Note for Paper Setter

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The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. (1 mark for each question)

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 482

ENVIRONMENTAL GEOLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in May 2012, May 2013 & May 2014)

Objectives To introduce the concept and role of geology in the study of environment. To study the various aspects of Geo-hazards and their mitigation. To impart knowledge about pollution and their remedial measures. To introduce the awareness and legislative measures in the mitigation of environmental problems.

UNIT-I

Earth system and biosphere

- 1.1 Inter-relationship of Earth, Man and Environment - population and environment, population and limited resources, disruption of natural system, causes and consequences of growth rates, population control strategies.
- 1.2 Ecological spectrum - biotic communities; food chains, stratification in biotic communities, community stability, species diversity. Anthropogenic changes in ecosystem. Preserving gene pools and conserving endangered species.
- 1.3 Components of the geosphere and environment - lithosphere, biosphere, hydrosphere and atmosphere.
- 1.4 Biogeochemical cycles – nitrogen cycle, carbon cycle and phosphorous cycle.

UNIT-II

Earth processes and geological hazards

- 2.1 Conditions promoting the hill slope instability, rockslides and avalanches, monitoring mass movements, slope control and stabilization.
- 2.2 Factors governing floods, flood characteristics, flood hazards and urbanization, flood management, flood forecasting.
- 2.3 Seismic hazards - causes and consequences, awareness and public response, coping with seismic hazards. Seismic conditions in India - Himalayan and Peninsular India. Tsunami generation mechanism and its impact on the coasts.
- 2.4 Volcanic hazards - volatiles, pyroclasts, flows, lahars, toxic gases, Nature, prediction and mitigation of volcanic hazards.

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UNIT-III

Energy resources and pollution

- 3.1 Energy resources- consumption and production trends of energy resources, environmental effects of various energy resources i.e. petroleum, natural gas, nuclear, hydropower, wind and solar.
- 3.2 Mineral resources and reserves. Environmental impact of exploitation, processing and smelting of minerals. Conservation of mineral resources.
- 3.3. Waste and its disposal - surface and subsurface disposal of toxic, metallic and radioactive wastes. Planning and management of hazardous waste. Domestic refuse and landfill.
- 3.4. Global warming - increase of CO₂ and N₂O due to industrialization, urbanization, burning of fossil fuels, volcanic activity and deforestation. Magnitude of ozone depletion and its impact. Suggestive measures.

UNIT-IV

Environmental management

- 4.1 Environmental impact of mining - hazards of opencast and underground mining, effects on air, water and land. Disposal of mining waste, environmental management of mining.
- 4.2 Desertification - causes and extant. Drylands of the Indian subcontinent - Thar desert, aggravation of desertic conditions. Signs of desertification in Himalaya. Measures to combat desertification.
- 4.3 Environmental Laws – Water Reserves Law, Mineral and Fuel Resources Law, Pollution Control Law, Natural Hazard Mitigation Law, International Resources Dispute i.e. Law of the Sea and Antarctica.
- 4.4 Medical Geology – trace elements and health; controls on elemental intake, iodine, fluorine, zinc, selenium. Radioactivity and cigrates, regional variations in heart disease.

Books Recommended

- | | | |
|----|---|------------------------------|
| 1. | Environmental Geology | Montgomery, C.W. |
| 2. | Natural Disaster and Sustainable Developments | Casale, R. & Margottini, C. |
| 3. | Introduction to Environmental Studies | Turk, J. |
| 4. | Exploitation-Conservation-Preservation:
(A geographic perspective on natural resource use) | Cutter, S.L. & Renwick |
| 5. | Environmental Geotechnology | Hsai – Yang Fang |
| 6. | Environmental Geology | Keller, E.A. |
| 7. | Environmental Geology | Valdiya, K.S. |
| 8. | Environmental Geology
Menking, K. | Merritts, D., Wet, A.D. & |
| 9. | The Atmosphere: An introduction to meteorology | Lutgen, F.K. & Tarbuck, E.J. |

10. Encyclopedia of Global Change:
(Environment Change and Human Society
Vol 1 and Vol 2)
11. Natural Resources
12. Environmental Science

Gaudie & Cuff (Editors)
Holechek, Cole, Fischer
& Valdez
Santra, S.C.

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(Paper setter has to provide the key for objective type questions)

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Course No. 483

Credits 4

Maximum Marks : 100

PRACTICAL RELATING TO COURSE NO'S. 475, 476 & 477

- UNIT-I Course No. 475 (Elements of Hydrology)
Basic exercises in hydrometeorologic processes-evapotranspiration, average rainfall and runoff. Computation and climate water balance study. Determination of water equivalent in snow hydrology. Presentation of hydrogeochemical data, flow net analysis.
- UNIT-II Course No. 476 (Non Clastic Sedimentology)
Preparation of rose diagrams from primary and secondary structures. Megascopic identification of non clastic sedimentary rocks. Microscopic examination of limestones and dolomites. Staining and its application in identification of non clastic minerals. Identification of carbonate minerals using X-ray and DTA data. Analysis of insoluble residue.
- UNIT-III Course No. 477 (Igneous Petrology)
Megascopic study of important representative igneous rocks. Microscopic description of standard sections of igneous rocks.
- UNIT -IV Field work and submission of field report (**An essential component of fifteen marks**)
- UNIT-V Viva – Voce.

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Course No. 484

Credits 4

Maximum Marks : 100

PRACTICAL RELATING TO COURSE NO'S. 479, 480 & 481

- UNIT-I Course No. 479 (Geotectonics)
To draw cross section showing position and displacement of various beds of a given geological map and to write geological history represented by the map.
- UNIT-II Course No. 480 (Ore Geology)
Megascopic examination of economic ore minerals. Microscopic identification of polished ore sections.
- UNIT-III Course No. 481 (Descriptive Mineralogy)
Megascopic description and spotting of minerals. Microscopic identification and description of minerals.
- UNIT -IV Field work and submission of field report (**An essential component of fifteen marks**)
- UNIT-V Viva – Voce.

C. S. J. / J. S. J.

Syllabi
M.Sc. GEOLOGY
THIRD SEMESTER

Examinations to be conducted in December 2012, December 2013 and December 2014

Course No.	Title	Credits
Theory		
520	Metamorphic Petrology	2
521	Vertebrate Palaeontology and Palaeobotany	2
522	Groundwater	2
523	Petroleum Geology	2
524	Coal Geology	2
525	Geochemistry	2
526	Mining Geology	2
527	Oceanography	2
Practical		
528	Practical related to course No's. 520, 521 and 522	4
529	Practical related to course No's. 523, 524 and 526	4

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Course No.- 520

METAMORPHIC PETROLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives - To discuss the process of metamorphic reactions and paragenesis. To study the various aspects of metamorphic facies. To acquaint the students with latest metamorphic processes. To introduce the students to concept of metamorphic convergence.

UNIT-I

- 1.1 Metamorphic reactions, polymorphic transition, solid-solid, solid-gas application to geothermo-barometry.
- 1.2 Composition-paragenesis diagrams, ACF and AKF diagrams, AFM projections.
- 1.3 Metamorphic differentiation and anatexis in metamorphic rocks and granite magmas.
- 1.4 The process of metasomatism and its types.

UNIT-II

- 2.1 The concept and system of metamorphic facies.
- 2.2 Systematic description and characteristics of Sanidinite Facies.
- 2.3 Systematic description and characteristics of Hornfels Facies.
- 2.4 Systematic description and characteristics of Green Schist Facies.

UNIT-III

- 3.1 Ocean floor metamorphism and its types.
- 3.2 Shock metamorphism.
- 3.3 Paired metamorphic belts and their significance.
- 3.4 Plate tectonics and regional metamorphism.

UNIT-IV

- 4.1 Mineralogy, texture, chemical composition, types and petrogenesis of Amphibolites.
- 4.2 Characters, composition, classification and genesis of Eclogites.
- 4.3 Characters, composition, types and origin of Charnokites.
- 4.4 Characters, types and origin of Migmatites.

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Books Recommended

- | | |
|-------------------------|--|
| 1. Turner, F.J. | Metamorphic Petrology |
| 2. Bhaskar Rao, B. | Metamorphic Petrology |
| 3. Best, M.G. | Igneous and Metamorphic Petrology |
| 4. Bowes, D.R. | Ecyclopedia of Igneous and Metamorphic Petrology |
| 5. Philipots, A. | Igneous and Metamorphic Petrology |
| 6. Yardley, B.W. | An Introduction to Metamorphic Petrology |
| 7. Bucher, K & Frey, M. | Petrogenesis of Metamorphic Rocks |
| 8. Miyashiro, A. | Metamorphic Petrology |

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Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 521

VERTEBRATE PALAEONTOLOGY & PALAEOBOTANY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives - To provide conceptual knowledge of the evolutionary processes of vertebrates as evidenced from the fossil record. To have detailed knowledge of the evolution of saurischian and ornithischian reptiles, proboscideans, perissodactyls, and primates with an emphasis on fossil distribution of these groups in India. To have a working knowledge of plant fossils with special reference to those of Gondwana Group and their geological significance.

UNIT-I

- 1.1. Evolutionary process and the fossil record: Micro- and Macro-evolution, heterochrony, punctuated equilibrium, Hennigian systematics, molecular clocks and estimation of divergence time.
- 1.2. Origin of vertebrates; general characters of vertebrates; function and evolution of bone and teeth.
- 1.3. Nature of vertebrate fossil record, methods of collection and preparation of vertebrate fossils; vertebrate life through ages and important landmarks in their evolution.
- 1.4. Classificatory characters and divisions of vertebrates at the level of class; the vertebrate transition from water to land.

UNIT-II

- 2.1. Classification of reptiles; origin of dinosaurs; origin of birds, anatomy of *Archaeopteryx*, birds as dinosaurs.
- 2.2. Endothermy versus ectothermy in dinosaurs; extinction of dinosaurs.
- 2.3. Palaeobiogeographic significance of Gondwana and Deccan intertrappean vertebrates of India.
- 2.4. Brief classification of mammals; habitat shift in whales - the fossil record from the Indian subcontinent.

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UNIT-III

- 3.1. Interrelationships of major groups of primates; evolution of man and lithic cultures associated with various stages of human evolution.
- 3.2. Cenozoic distribution of horses; classic trends in the evolution of horses; evolutionary implications of climatic changes.
- 3.3. Evolution of proboscideans; Pleistocene extinction of mammoths.
- 3.4. Siwalik vertebrate faunal changes and their relation to tectonic and eustatic events.

UNIT-IV

- 4.1. Modes of preservation of plant fossils; modern techniques used in palaeobotanical studies; classification of plants.
- 4.2. Origin and highlights in the evolution of plants; dispersal and migration of plants.
- 4.3. Study of flora of past geological periods with special reference to Gondwana flora of India.
- 4.4. Application of palaeobotany in biostratigraphic correlation and palaeoclimatic studies; dendrochronology

Books Recommended

- | | |
|------------------------|--|
| 1. Romer, A.S.1966 | Vertebrate Paleontology (3 rd edition). |
| 2. Carroll, R.L.1988 | Vertebrate Paleontology and Evolution. |
| 3. Colbert, E.H.1955 | Evolution of Vertebrates. |
| 4. Lull, R.S.1976 | Organic Evolution. |
| 5. Benton, M.J.1990 | Vertebrate Palaeontology. |
| 6. Doyle, P.1996 | Understanding of Fossils. |
| 7. Fastovsky, D.E.1996 | The evolution and extinction of dinosaurs. |
| 8. Shukla, A.C.1975 | Essentials of Palaeobotany. |
| 9. Tschudy, R.H.1969 | Aspects of Palynology. |
| 10. Briggs, D.E.G.2001 | Palaeobiology II. |

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The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. *(1 mark for each question)*

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. *(5 marks for each question)*

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. *(10 marks for each question)*

(Paper setter has to provide the key for objective type questions)

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Course No.- 522

GROUNDWATER

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives To acquaint the students with water well conduction, development and completion, well hydraulics and varying problems being faced in the field under different climatological conditions.

UNIT-I

- 1.1. Darcy's law - assumptions, derivation, applications and limitations.
- 1.2. Differential equation governing groundwater flow. Surface indicators of groundwater, fracture trace analysis.
- 1.3. Unconfined, confined, steady, unsteady and radial flow to the well. Theim's, Thies equation.
- 1.4. Evaluation of aquifer parameters using Theim's, Thies, Cooper-Jacob and Walton methods. Pump tests methods data analysis and interpretation of hydrogeologic boundaries.

UNIT-II

- 2.1 Determination of aquifer parameters - Pump test; Step-draw down test (SDT), formation and well characteristics; Slug test.
- 2.2 Partially penetrating well, well interference and criteria for spacing of wells. Aquifer-well relationships.
- 2.3 Volume elasticity of confined aquifer, $BE+TE=1$.
- 2.4 Groundwater basin management and perennial (safe) yield determination.

UNIT-III

- 3.1 Different drilling methods used in the construction of shallow and deep wells. Various groundwater structures.
- 3.2 Different well development and completion methods.
- 3.3 Maintenances of water wells, their abandonment and sanitary protection.
- 3.4 Over pumping and land subsidence.

UNIT-IV

- 4.1 Groundwater problems in arid regions and urban areas. Rainwater harvesting.
- 4.2 Groundwater balance and utilization.
- 4.3 Groundwater legislation.
- 4.4 Watershed management.

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Books Recommended

- | | | | |
|-----|---------------------------|------|--|
| 1. | D. K. Todd | 1980 | Groundwater Hydrology. <i>John Wiley and Sons</i> |
| 2. | R.J. Lynch | 1976 | Formation Evaluation. <i>English Book Depot</i> |
| 3. | S.N. Davis & R.J.M. Wiest | 1966 | Hydrogeology. <i>John Wiley and Sons</i> |
| 4. | V. Chow | | Handbook of Applied Hydrology |
| 5. | E.E. Johnson | 1982 | Ground Water and Wells. <i>Johnson Division, UOP Inc</i> |
| 6. | W.C. Walton | 1970 | Groundwater Resource Evaluation. <i>Mc-Graw Hill Inc</i> |
| 7. | H. Bouwer | 1978 | Groundwater Hydrology. <i>Mc-Graw Hill Inc</i> |
| 8. | C.W. Fetter | 1990 | Applied Hydrogeology. <i>CBS Publishers and Distributors</i> |
| 9. | S.P. Garg | 1987 | Groundwater and Tube Wells. <i>Oxford and IBH Publishing Co. Pvt. Ltd.</i> |
| 10. | H.M. Raghunath | 1983 | Ground Water. <i>Wiley Eastern Limited</i> |
| 11. | H.M. Raghunath | 1986 | Hydrology. <i>Wiley Eastern Limited</i> |
| 11. | Harinarayan | | Exploration Techniques for Groundwater. <i>COSTED</i> |
| 12. | O.P. Handa | 1988 | Water Well Technology. <i>Oxford and IBH Publishing Co. Pvt. Ltd.</i> |
| 13. | Karanth | 1989 | Hydrogeology. <i>Tata Mc-Graw Hill Publ. Comp. Ltd.</i> |
| 14. | US Department | 1985 | Ground water Manual of the Interior |

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Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 523

PETROLEUM GEOLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives- To impart knowledge about the genesis, exploration, geological and spatial distribution of oil and gas.

UNIT-I

- 1.1 Origin of petroleum-organic and inorganic theories, limiting conditions; source material.
- 1.2 Transformation of organic matter into petroleum (bacterial activity, heat and pressure, catalytic reaction, radioactivity).
- 1.3 Kerogen, transformation of kerogen, factors influencing maturation of kerogen.
- 1.4 Surface and subsurface occurrence of petroleum.

UNIT-II

- 2.1 Physical and chemical properties of crude oil, composition of natural gas.
- 2.2 Extraction of petroleum products from crude oil; crude oil refining.
- 2.3 Reservoir rocks: classification, characteristics, relationship between porosity and permeability.
- 2.4 Reservoir fluids (water, oil and gas): distribution and classification in the reservoir, Characters of oilfield waters.

UNIT-III

- 3.1 Structural Traps for oil and gas accumulation: traps caused by folding, faulting and fracturing.
- 3.2 Primary and secondary stratigraphic traps.
- 3.3 Combination traps, salt domes, cap rock.
- 3.4 Primary and secondary migration of oil and gas.

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UNIT-IV

- 4.1 Geological and geographical distribution of oil and natural gas in India.
- 4.2 Geology of Assam oil fields.
- 4.3 Geology of Gujarat & Bombay High oil fields.
- 4.4 Environmental impact of oil extraction, land subsidence caused by petroleum withdrawal, environmental concerns regarding use of petroleum.

Books Recommended

- | | |
|--|-----------------------------------|
| 1. Mc.Cray, A.W & Frank, W.C. | Oil Well Drilling Technology |
| 2. Chapman, R.E. | Petroleum Geology |
| 3. Landes, K.K. | Petroleum Geology |
| 4. Russel, W.L. | Principles of Petroleum Geology |
| 5. Chandra, D. & Singh, R. M. | Petroleum (Indian Context) |
| 6. Hager, D. | Practical Oil Geology |
| 7. Levorson, A.I. | Geology of Petroleum |
| 8. Amyx, J.W., Ban, D.M. & Whiting, R.L. | Petroleum Reservoir Engineering |
| 9. Deshpande, B.G. | The World of Petroleum |
| 10. Holson, G.D. & Tiratsoo, E.N. | Introduction to Petroleum Geology |
| 11. Selley, R.C. | Elements of Petroleum Geology |

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Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)



Course No.- 524

COAL GEOLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives : To impart knowledge about the genesis and distribution of coal in space and time.

UNIT-I

- 1.1 Origin of coal: accumulation of vegetable matter (insitu and drift theories), formation of coal (humification and coalification processes).
- 1.2 Types of coal, coal-rank, grade; physical properties of coal.
- 1.3 Seyler's Classification of coal, grading of coking and non-coking coals of India.
- 1.4 Chemical characteristics; proximate and ultimate analysis.

UNIT-II

- 2.1 Lithotypes of hard and soft coal; structures in coal seams.
- 2.2 Petrography of coal: lithotypes, macerals and microlithotypes.
- 2.3 Stages and methods of coal exploration; estimation of coal reserves.
- 2.4 Coal preparation for different industrial uses.

UNIT-III

- 3.1 Combustion and carbonization of coal.
- 3.2 Gasification and hydrogenation of coal.
- 3.3 Coal forming epochs, coal and lignite resources of India.
- 3.4 Geological and geographical distribution of coal in India.

UNIT-IV

- 4.1 Detailed geology of Jharia coalfield.
- 4.2 Detailed geology of Raniganj coalfield.
- 4.3 Coal bed methane: new energy resource, maturation of coal and generation of methane in coal beds.
- 4.4 Environmental hazards related to coal.

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Books Recommended

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|----|---------------------------------------|--|
| 1. | Chandra, D., Singh, R.M & Singh, M.P. | A Text Book of coal. |
| 2. | Singh, M.P. (Ed.) | Coal and Organic Petrology. |
| 3. | Sharma, N.L. | Introduction to the Geology.
of Coal and Indian Coalfields. |
| 4. | S.K. Acharyya | Coal and Lignite Resources of India. |

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Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 525

GEOCHEMISTRY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives To impart the knowledge about the concept of geochemistry and classification of elements.

UNIT-I

- 1.1 Concept of geochemistry, geochemical classification of elements.
- 1.2 Geochemical constitution of earth; Washington's, Goldschmidt's, Kuhn and Ritmann Hypothesis.
- 1.3 Meteorites: mineralogy and classification.
- 1.4 Geochemical cycles; endogenic and exogenic cycles.

UNIT-II

- 2.1 Geochemistry of the lithosphere.
- 2.2 Geochemistry of the hydrosphere.
- 2.3 Geochemistry of the atmosphere; structure and composition of atmosphere.
- 2.4 Geochemistry of the biosphere; geochemical role of bacteria, organogenic sediments.

UNIT-III

- 3.1 Radiogenic isotopes, isotopic decay and growth of daughter isotopes, cosmogenic radionuclides.
- 3.2 Radiometric dating of single mineral and whole rock by various methods and their limitations.
- 3.3 Stable isotopes, nature, abundance and fractionation.
- 3.4 Oxygen, hydrogen, sulfur and carbon isotopes and their application in geology.

UNIT-IV

- 4.1 Significance of crystal chemistry in geochemistry, isomorphism and diadochy, camouflage, capturing and admission of trace elements.
- 4.2 Laws of thermodynamics, entropy and enthalpy, Gibb free energy.
- 4.3 Elemental partitioning in minerals/rocks, partition coefficient, simple and exchange reactions, application in petrogenetic studies.
- 4.4 Rare earth geochemistry, general geochemical properties of REE's and their abundance and mobility in crust.

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Books Recommended

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|----|---------------|--|
| 1. | Barnes | Geochemistry of Hydrothermal Ore Deposits. |
| 2. | Faure | Principle of Isotope Geology. |
| 3. | Henderson | Inorganic Geochemistry. |
| 4. | Henderson | Rare Earth Element Geochemistry. |
| 5. | Wedepohl | Handbook of Geochemistry. |
| 6. | Mason & Moore | Introduction to Geochemistry. |
| 7. | Alborede | Geochemistry: An introduction. |
| 8. | Ottonello | Principles of Geochemistry |

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Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

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Course No.- 526

MINING GEOLOGY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives : To impart the basic knowledge about the methods and techniques involved in mining, evaluation and exploration of the economic deposits.

UNIT-I Mineral exploration

- 1.1 Geological guides for the prospecting of mineral deposits; mineralogical, lithological and structural guides, gossans and capping.
- 1.2 Geochemical exploration; mobility and geochemical association of elements, primary and secondary geochemical dispersion patterns.
- 1.3 Geobotanical survey and biogeochemical method of mineral exploration.
- 1.4 Radioactive method of prospecting.

UNIT-II Ore deposit evaluation

- 2.1 Methods of sampling - channel, bulk, grab, chip, car, core and sludge. Trenching and pitting method.
- 2.2 Grade and methods of average grade calculation, assaying the sample.
- 2.3 Classification of resources and reserves.
- 2.4 Methods of estimation of the reserves for ore deposits.

UNIT-III Mining method

- 3.1 Classification of mining methods, introductory geological and economic aspects of mine planning, developmental works for underground mining, mode of entry in mines, drift, crosscuts, winz, raise, ore bin and ore chutes.
- 3.2 Surface mining methods; placer mining methods and open pit methods, ground sluicing, hydraulic mining, dredging, drift mining, shovel mining and multi bench, lateral advance mining method, their advantages and disadvantages.
- 3.3 Underground mining methods; open stopes mining methods, supported stopes mining methods, shrinkage, cut and fill and square set mining methods, caving methods- top slicing sublevel caving and block caving, their advantages and disadvantages.
- 3.4 Coal mining methods; coal stripping, room and pillar method, long wall mining methods, other miscellaneous methods, their advantages and disadvantages.

Essential

UNIT-IV Mining operations

- 4.1 Mining supports; support types with their merits and demerits.
- 4.2 Stowing methods; subsidence – causes and prevention.
- 4.3 Methods of breaking and blasting the rocks, types of explosives used, arrangements of drill holes for blasting in surface and underground mines.
- 4.4 Mining atmosphere; ventilation in underground mines, types and arrangements of directing ventilations in underground mining.

Books Recommended

- | | | |
|----|---------------------|--|
| 1. | Arogyaswami, R.N.P. | Course in Mining Geology. |
| 2. | Beky, B. | Mining. |
| 3. | Brooks | Geobotanical and Biogeochemical Exploration. |
| 4. | Clarke & Lewis | Elements of Mining. |
| 5. | Deshmukh, D.J. | Elements of Mining Technology. |
| 6. | Forester | Field and Mining Geology. |
| 7. | Mckinstry | Mining Geology. |
| 8. | Nelson & Nelson | Applied Geology. |

Note for Paper Setter

The paper setter is required to set the question paper as per the scheme given below.
The candidate has to attempt all the three questions.

Section-A:- Ten multiple choice questions with four options, selecting from all the four units of the syllabi uniformly as far as possible. (1 mark for each question)

Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

Assn. Jan

Course No.- 527

OCEANOGRAPHY

Credits – 2

Maximum Marks : 50

Duration of Examination : 2 ½ Hours

(Syllabus for the examinations to be held in December 2012, December 2013 & December 2014)

Objectives : To study the modern concepts regarding the topographic features of ocean basins their evolution in space and time. To study the dynamics of ocean water and sedimentation. To study the stratigraphy and geochronometry of marine sediments. To study the physical and biological resources of the marine realm.

UNIT-I

- 1.1 Origin and evolution of ocean basins; Palaeoceanography - Mesozoic, Palaeogene, and Neogene palaeoceans, sea-level fluctuations and their environmental response.
- 1.2 Topographic features of the ocean floor; continental margin provinces, ocean basin provinces; coral reefs.
- 1.3 Classification of marine sediments, sediment budget, sediment transport, accumulation of sediments in the ocean; sedimentation processes on continental shelves - physical processes, sediment response; sediment - organism interaction, deep-sea sediments.
- 1.4 Stratigraphic correlation and geochronology of deep-sea sediments.

UNIT-II

- 2.1. Origin and evolution of the Indian Ocean, structure and physiography of the Indian Ocean, bathymetry and bottom characteristics, sediment distribution on the Indian Ocean floor.
- 2.2. Marine exploration methods, direct methods and indirect methods; sea - bed deposits, oil and gas, petroleum potential of sea-bed provinces beyond the continental slope; petroleum occurrences and exploration activity around the margins of the Indian Ocean.
- 2.3. India's Exclusive Economic Zone (EEZ); marine minerals in the EEZ of India.
- 2.4. Wave dynamics, deep water waves, shallow water waves, wind waves; wave reflection, refraction and diffraction.

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UNIT-III

- 3.1 Ocean circulation: forces driving currents; surface currents – flow within a gyre, geostrophic gyres, current within gyres, counter currents and under currents, effects of surface currents on climate; thermohaline circulation - thermohaline circulation patterns, global heat connection.
- 3.2. Wind induced vertical circulation - equatorial upwelling, coastal upwelling, downwelling; Coastal upwelling - its physical, chemical, biological characteristics, physical structure and dynamics, the chemical characteristics of upwelling systems, the biological characteristics of upwelling areas.
- 3.3. Heat budget and Atmospheric Circulation- Composition and properties of the atmosphere, changes in the atmosphere, wind patterns, storms, jet streams, El Nino, land effects on winds.
- 3.4. Tides - equilibrium theory of tides, dynamical theory of tides, tidal currents in coastal areas, observation and prediction of tides.

UNIT-IV

- 4.1 Seawater chemistry - salinity, components of salinity, sources of ocean's salts, processes controlling the composition of sea water, determining salinity, dissolved gases - Nitrogen, Oxygen, Carbondioxide; Density structure of ocean, density stratification and water masses.
- 4.2 Phytoplankton dynamics in the marine food web: inputs of organic carbon, concept of food chain; primary production, measuring productivity, factors limiting productivity-grazing pressure, losses to deep water, factors affecting growth rates - light, temperature, nutrients, physiological adaptations; application of remote sensing.
- 4.3 Marine resources: Physical Resources - Petroleum and Natural Gas, sand and gravel, magnesium and magnesium compounds, salts, manganese and phosphate nodules, metallic sulfides and muds; Biological Resources - fish, crustaceans, molluscs, whaling, fur-bearing mammals, botanical resources, aquaculture.
- 4.4. Marine pollution - pollutants: oil, heavy metals, synthetic organic chemicals, eutrophication, solid waste, sediment, sewage, waste heat, introduced species, the cost of pollution; habitat destruction: bays and estuaries, coral reefs, other habitats; global changes - ozone layer depletion, global warming, acid rain; coastal pollution in India.

Issued Jan

Books Recommended

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|-----|------------------------------|--|
| 1. | Garrison, T. | Oceanography-An invitation to Marine Science. |
| 2. | Qasim, S.Z. & | India's Exclusive Economic Zone. |
| 3. | Thurman, B.Y. | Introductory Oceanography. |
| 4. | Gross, M.G. | Oceanography - A view of the Earth. |
| 5. | S. Davis, R.A. Jr. | Principles of Oceanography. |
| 6. | Roonwal, G.S. | The Indian Ocean: Exploitable mineral and petroleum resources. |
| 7. | Haq, B.U. & Milliman, J.D | Marine Geology and oceanography of Arabian Sea and coastal Pakistan. |
| 8. | Francis P. Shepard | Geological Oceanography |
| 9. | Bhatt, J.J. | Oceanography - Exploring the Planet Ocean. |
| 10. | Duxbury, A.B. & Duxbury, AC. | Fundamentals of Oceanography. |
| 11. | Turekian, K.K. | Oceans |

Note for Paper Setter

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Section-B:- Four short answer questions selecting uniformly from all the four units of the syllabi. (5 marks for each question)

Section-C:- Two essay type question with internal choice selecting from all the four units of the syllabi. (10 marks for each question)

(Paper setter has to provide the key for objective type questions)

Issued Jan

Course No. 528

Credits 4

Maximum Marks : 100

PRACTICAL RELATING TO COURSE NO'S. 520, 521 & 522

UNIT-I Course No. – 520 (Metamorphic Petrology)

Megascopic description and spotting of different metamorphic rocks.
Microscopic description of thin sections of metamorphic rocks.

UNIT-II Course No. 521 (Vertebrate Palaeontology & Palaeobotany)

Megascopic and microscopic study and identification of important
vertebrate fossils. Identification and description of important plant fossils.

UNIT-III Course No. 522 (Groundwater)

Computation of aquifer parameters from SDT and APT data. Identification
of aquifer boundaries. Computation of intergranular pressure changes with
declining water table.

UNIT –IV Two to three weeks field work / industrial training and submission of field
report (**An essential component of fifteen marks**).

UNIT-V Viva – Voce.

Essential

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Course No. 529

Credits 4

Maximum Marks : 100

PRACTICAL RELATING TO COURSE NO'S. 523, 524 & 526

UNIT-I Course No. 523 (Petroleum Geology)

Exercises on calculation of oil and gas reserves. Evaluation of bore hole data and their interpretation. Logging exercises and their application in petroleum exploration.

UNIT-II Course No. 524 (Coal Geology)

Megascopic and microscopic examination of coal types. Calculations of coal reserves.

UNIT-III Course No. 526 (Mining Geology)

Exercises on determination of tenor, cut-off grades and ore reserves. Surveying by chain and tape and plane table methods.

UNIT -IV Two to three weeks field work / industrial training and submission of field report **(An essential component of fifteen marks).**

UNIT-V Viva – Voce.

C. Srinivas