FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. (Honours School) Geology

(Semester System)

EXAMINATION 2015-2016

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Outlines of Tests, Syllabi and Courses of Reading for M.Sc. (Honours School) I Year in Geology (Semester System) Examination 2015-2016

I Semester Examination, December 2015

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Total Marks for M.Sc. (Hons. School) I Semester (Geology) 500

Note for Theory paper setter:

The theory question paper for the end-semester examination will have seven questions. Each question paper will be of 60 marks, with 20 marks reserved for first question, which is compulsory. Further, the latter would comprise of 10 short answer questions, without any choice, covering the whole syllabus. The remaining 4 questions carrying 10 marks each, are to be attempted from the 2 Units, selecting two questions from each unit. Each unit would comprise of three questions.
Syllabi and Courses of Reading

Paper I: IGNEOUS PETROLOGY & METAMORPHIC PETROLOGY – (Course Nos. 701 & 702)

Total Marks: [75 (Mid-Semester Test M.M. 15, End-Semester Exam. M.M. 60)]

Course No. 701: IGNEOUS PETROLOGY

Objectives: This course focuses on the basic concepts of chemical petrology to understand various igneous processes and the application of trace elements in igneous petrogenesis.

UNIT I
Cosmic elemental abundances; Major and minor elements; Analytical methods and results, sources of error, precision and accuracy; Presentation of analytical results; Major and minor elements in the crust; Normative minerals; Variation diagrams: bivariate plots and triangular plots; Magma series; Goldschmidt’s classification of elements; Goldschmidt’s rules of substitution and their modification, coupled substitutions and trace element substitutions. Types of elements: Transition elements, large-ion-lithophile elements, high field strength elements, incompatible and compatible elements, mobile and immobile elements; Rare earth elements (REE) and diagrams; Spider diagrams; Distribution coefficients; Models for solid-melt processes; Geochemical criteria for discriminating between tectonic environments; Application of trace elements in igneous rocks.

Essential Reading

Further Reading

Course No. 702: METAMORPHIC PETROLOGY

Objective: In continuation with the B.Sc. III year course, the aim of this course is to provide applications and details of advanced metamorphic concepts and processes.

UNIT II
Metamorphic assemblages and other definitions; The concept of equilibrium and its application to metamorphic rocks; Phase rule and its applications; Petrogenetic grid; Environmental controls of metamorphic reactions; Metamorphic reactions; Reaction mechanism and types. Evolution of facies concept; Metamorphic facies series and concept of paired metamorphic belts. Regional metamorphism in relation to plate tectonics; Ocean floor metamorphism. Geothermometer and Geobarometer; Pressure-Temperature-Time (P-T-t) models for metamorphism;
Essential Reading


Further Reading


Paper II: SEDIMENTOLOGY & TECTONICS – (Course Nos. 703 & 704)

Total Marks: [75 (Mid-Semester Test M.M. 15, End-Semester Exam. M.M. 60)]

Course No. 703: SEDIMENTOLOGY

Objectives: The prime aim of this course is to understand the clastic and non-clastic depositional systems and their applications in emerging areas of sedimentology.

UNIT I


Essential Reading


Further Reading

Course No. 704: TECTONICS

Objectives: This course intends to impart basic concepts of plate geometry and associated tectonic processes and also to understand the tectonics of mobile belts.

UNIT II
Plate Tectonics: accreting plate boundary, subduction, transform faults, hotspots and mantle plumes; palaeomagnetism and motion of plates, driving mechanism, geodynamics and heat transfer. Dynamic evolution of continental and oceanic crust. Tectonics of Precambrian orogenic belts of India. Formation of mountain roots. Anatomy of orogenic belts. Structure and origin of the Alpine-Himalayan belt, the Appalachian-Caledonian belt, the Andes and the North American Cordillera.

Essential Reading

Further Reading

Paper III: PALAEONTOLOGY & STRATIGRAPHY– (Course Nos. 705 & 706)

Total Marks: [75 (Mid-Semester Test M.M. 15, End-Semester Exam. M.M. 60)]

Course No. 705: PALAEONTOLOGY

Objectives: This course addresses instrumental techniques and advanced applications of microfossils for petroleum and palaeoclimatic interpretations.

UNIT I

Techniques in micropalaeontology. Principles and applications of SEM, EDX and Cathodoluminescence. Morphotaxonomy of Foraminifera (larger and smaller); Morphotaxonomy of Ostracodes, Conodonts and Radiolaria. Precambrian microbiota and its significance. Importance of microfossils in stratigraphy, determination of palaeoclimatic environments and sea-level changes in the geological past and the role of micropalaeontology in oil exploration.

Essential Reading

Further Reading

Schrock, Twenhofel and Williams (1953). Principles of Invertebrate Palaeontology. CBS, Delhi

Course No. 706: STRATIGRAPHY

Objectives: Conceptual aspects of international chronological classification, and to comprehend Precambrian and Phanerozoic world stratigraphy are the main objectives of this course.

UNIT II


Essential Reading


Further Reading


Practical I: IGNEOUS PETROLOGY & METAMORPHIC PETROLOGY-(Course No. 707P)

Total Marks: [75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)]


Metamorphic Petrology: Petrographic study of pelitic, metabasic and carbonate rocks of different facies of metamorphism, viz. greenschist and amphibolite facies.

Practical II: SEDIMENTOLOGY & TECTONICS - (Course No. 708P)

Total Marks: [75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)]
**Sedimentology:** Detail megascopic and microscopic study of non-clastic sedimentary rocks.

**Tectonics:** Preparation and interpretation of geological maps and sections. Study of large scale tectonic features of the Earth. Orthographic projection method in structural geology. Vertical and inclined Fault plane solutions.

**Practical III: PALAEONTOLOGY & STRATIGRAPHY- (Course No. 709P)**

Total Marks: [75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)]


**Stratigraphy:** Interpretation of palaeogeographic maps of all geological periods. Study of specimens of rock types of Indian formations showing typical characters (lithotype/structure/fossils) and geological age inference.

**FIELD WORK – (Course No. 710FW) - Total Marks: 50**

Geological field Work: The duration of Field Work would be about two weeks. The field work would consist of independent geological mapping, study of regional geology including the study of rocks/minerals/fossils of geologically important areas. It is mandatory for the student to maintain a systematic field diary and collect good geological samples. The marks for field work will be awarded by teachers who conducted the field work.

A candidate, who does not attend the field work or fails to get pass marks in it, will have to do the field work by joining the field tour of the same class (M.Sc. Hons. School I Year) in a subsequent year as per University rules.
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**Total Marks for M.Sc. (Hons. School) II Semester (Geology) 500**

**Note for Theory paper setter:**

The theory question paper for the end-semester examination will have seven questions. Each question paper will be of 60 marks, with 20 marks reserved for first question, which is compulsory. Further, the latter would comprise of 10 short answer questions, without any choice, covering the whole syllabus. The remaining 4 questions carrying 10 marks each, are to be attempted from the 2 Units, selecting two questions from each unit. Each unit would comprise of three questions.
Syllabi and Courses of Reading

Paper I: IGNEOUS PETROLOGY & METAMORPHIC PETROLOGY– (Course Nos. 801& 802)

Total Marks: [75 (Mid-Semester Test M.M. 15, End-Semester Exam. M.M. 60)]

Course No. 801: IGNEOUS PETROLOGY

Objective: This course is a sequel to course # 701 as the concepts of chemical petrology taught previously are applied here extensively to understand the petrogenesis of important igneous rocks/associations.

UNIT I
Classification, petrography, chemistry and petrogenesis of: Layered mafic intrusions; Komattites; Ophiolites; Mid-ocean ridge basalt (MORB); Ocean island basalt (OIB); Continental flood basalt (CFB); Island arc magmatism; Continental arc magmatism; Granitoid rocks; Continental rift magmas: Alkaline magmatism, Carbonatites, Lamorophyres, Kimberlites; Anorthosites.

Essential Reading

Further Reading

Course No. 802: METAMORPHIC PETROLOGY

Objective: This course aims to provide a detailed account of various metamorphic textures along with overviews of some advanced topics in metamorphic petrology.

UNIT II
Textures of contact metamorphism: granoblastic polygonal, deccusate, nodular, skeletal; High strain metamorphic textures, cataclasism and mylonitisation; Regional orogenic metamorphic textures; Deformation versus metamorphic mineral growth; Analysis of polydeformed and polymetamorphosed rocks; Replacement textures and reaction rims. Metamorphic fluids and metasomatic processes; Experimental Petrology: Methods and techniques; Application of experimental petrology to anatexis and formation of granitic magmas; Charnockites and debate associated with charnockitic rocks.
Essential Reading


Further Reading


Paper II: SEDIMENTOLOGY & STRUCTURAL GEOLOGY—(Course Nos. 803 & 804)

Total Marks: [75 (Mid-Semester Test M.M. 15, End-Semester Exam. M.M. 60)]

Course No. 803: SEDIMENTOLOGY

Objectives: This course aims to understand the techniques and methodology used in sedimentological analyses and the role of sedimentary processes and principles in other branches of geoscience.

UNIT I


Essential Reading


Further Reading

Course No. 804: STRUCTURAL GEOLOGY

Objectives: The main objective of the course is to comprehend various minor and major structures to evolve deformation history besides their application in mineral exploration.

UNIT II

Essential Reading

Further Reading

Paper III: PALAEONTOLOGY & STRATIGRAPHY – (Course Nos. 805 & 806)

Total Marks: [75 (Mid-Semester Test M.M. 15, End-Semester Exam. M.M. 60)]

Course No. 805: PALAEONTOLOGY

Objectives: This course focuses on principles and chronologic distribution of vertebrate- and palyno fossils for biostratigraphic and palaeoenvironmental usage.

UNIT I
Characteristics of vertebrates; preservation and taphonomy; fundamentals of osteology; structure of bones and teeth; Trends in vertebrate evolution. Indian pre-Tertiary vertebrates: geographic distribution, affinities and palaeogeographic implications. Indian Tertiary vertebrates and Siwalik mammals. Human evolution and Indian fossil hominids.
Introduction to Palynology. Morphotaxonomy of pollen and spores and charophyta. Significance of plant microfossils in biostratigraphy and oil exploration.

**Essential Reading**


**Further Reading**


**Course No. 806: STRATIGRAPHY**

**Objectives:** The major objective revolves around modern concepts of stratigraphy, and to comprehend world and Indian stratigraphic boundaries.

**UNIT II**

Detailed study of sequence and event stratigraphy, seismic stratigraphy, magnetostratigraphy and chemostratigraphy. Fossil-based high resolution biochronology. Stratigraphic facies analysis, environments of deposition and basin analyses. Boundary problems in Indian stratigraphy. Demarcation of Precambrian-Cambrian, Permian-Triassic, Cretaceous-Tertiary and Neogene-Quaternary boundaries in Indian and World stratigraphy in relation to mechanisms of extinction and evolution.

**Essential Reading**


**Further Reading**


**Practical I: IGNEOUS PETROLOGY & METAMORPHIC PETROLOGY**-(Course No. 807P)

**Total Marks:** [75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)]

**Igneous Petrology:** Mineral composition, texture and order of crystallisation of the following rock types involving handspecimens and thin section study: Granite and its varieties; Syenite and nepheline syenite; Diorite, Gabbro and Dolerite; Anorthosite; Dunite; Peridotite; Pyroxenite;
Rhyolite and its varieties, Andesite, Dacite, Trachyte; Basalt and its varieties; Lamprophyre and its varieties.

**Metamorphic Petrology:** Detailed megascopic and microscopic fabric study of rocks of different facies of metamorphism, viz. greenschist, amphibolite and granulite facies. Graphic construction of ACF, AKF and AFM diagrams. Use of computer. Estimation of pressure and temperature from important models of geothermobarometry.

**Practical II: SEDIMENTOLOGY & STRUCTURAL GEOLOGY -** (Course No. 808P)  

**Total Marks:** [75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)]

**Sedimentology:** Laboratory studies for heavy minerals. Detailed petrographic studies of phosphatic rocks. Isodynamic separator and grain size analyses. Staining techniques.

**Structural Geology:** Preparation and interpretation of geological maps and sections. Structural problems concerning economic mineral deposits. Recording and plotting of field data using beta and pi diagrams. Plotting and interpretation of petrofabric data and resultant diagrams.

**Practical III: PALAEONTOLOGY & STRATIGRAPHY-** (Course No. 809P)  

**Total Marks:** [75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)]

**Palaeontology:** Study of selected hominid taxa as *Pondaungia, Aegyptopithecus, Ramapithecus, Australopithecus* and Homo. Morphotaxonomical study of common planktonic, larger and smaller foraminiferal taxa. Morphological study of common ostracodes, conodonts, microvertebrates, charophyta and spores-pollen taxa. Computer techniques in palaeontology.

**Stratigraphy:** Interpretation of paleogeographic maps of all geological periods. Study of specimens of rock types of Indian formations showing typical characters (litholotype/structure/fossils) and geological age inference.

**FIELD WORK –** (Course No. 810FW)  

**Total Marks:** 50 (Field Report M.M. 25 and Viva-Voce M.M. 25)

Field Report & Viva-Voce: The student will prepare a well illustrated field report based on the field work conducted in the previous semester. A board of examiners will evaluate the field report and conduct the viva-voce and would consist of the Chairman or his nominee, the faculty members who conducted the field work and three other faculty members appointed by the Board of Control.

A candidate, who does not submit the field report and/or does not attend the viva-voce examination or fails to get pass marks in it, will have to resubmit the report or attend the viva-voce examination as the case may be of the same class (M.Sc. Hons. School I Year) in a subsequent year as per University rules.
Outlines of Tests, Syllabi and Courses of Reading for M.Sc. (Honours School) II Year in Geology (Semester System) Examination 2015-2016

III Semester Examination, December 2015

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Practical Continuous Assessment*

| I 907P | Remote Sensing-GIS, Geomorphology-Climatology & Ore geology | 15 | 60 | 75 |
| II 908P | Petroleum Geology, Isotope Geology & Engineering Geology | 15 | 60 | 75 |

Field Work No Continuous Assessment

| 909FW | Project Oriented Geological Field Work: | 50 |

Total Marks for M.Sc. (Hons. School) III Semester (Geology) 500

* Continuous Assessment: Seminar (10 marks) and Sessional (5 marks).

Note for Theory paper setter:
The theory question paper for the end-semester examination will have seven questions. Each question paper will be of 80 marks, with 20 marks reserved for first question, which is compulsory. Further, the latter would comprise of 10 short answer questions, without any choice, covering the whole syllabus. The remaining 4 questions carrying 15 marks each, are to be attempted from the 2 Units, selecting two questions from each unit. Each Unit would comprise of three questions.
Syllabi and Courses of Reading

Paper I: REMOTE SENSING-GIS & GEOMORPHOLOGY – CLIMATOLOGY (Course Nos. 901 & 902)

Total Marks: 100 (Mid-Semester Test M.M. 20, End-Semester Exam. M.M. 80)

Course No. 901: REMOTE SENSING-GIS

Objectives: This course aims to understand the basic principles and applications of remote sensing in various branches of geosciences, besides evolving decision support system using GIS.

UNIT I

Concept and principles of remote sensing; general idea about electromagnetic spectrum; aerial photography and satellites remote sensing; remote sensing sensors; remote sensing platforms and types of remote sensing; advantage of remote sensing; aerial photography, types of aerial photographs; aerial photo interpretation-tone; texture, pattern, shape, size, drainage etc. and identification of geological rock types; stereoscopes: pocket and mirror stereoscope; different satellite exploration programmes and their characteristics: LANDSAT, SPOT, IRS, etc; image interpretation techniques; applications of remote sensing data for geological and environmental studies; introduction of Geographic Information System; components of GIS; vector and raster modes; idea about various GIS softwares being used in Geology; applications and advantages of Geographic Information System.

Essential Reading


Further Readings


Course No. 902: GEOMORPHOLOGY-CLIMATOLOGY

Objectives: The main aim of this course is to understand the techniques and methodology used in geomorphic analyses, and to comprehend the applications of geomorphology in geology. The fundamental principles of climatology are highlighted based on Earth’s radiation balance and global insolation.
UNIT II

Concepts in geomorphology; geomorphic processes and landforms: fluvial, glacial, eolian, coastal and karst. Structural landforms; geomorphic models of landscape evolution: ideas of Penck and Davis; morphometric analysis; pedology: classification and origin of soils; Application of geomorphology in hydrology, economic geology, engineering and environmental studies.

Fundamental principles of Climatology; earth’s radiation balance; distribution and variation in global insolation; heat and air temperature; air pressure and wind belts; atmospheric circulation; humidity; cloud formation and precipitation; water balance; air masses: distribution, classification and sources; monsoon, jet streams; tropical cyclones; ENSO; classification of climates: Koppen’s and Thornthwaite’s classification; climatic change.

Essential Reading


Further Reading


Paper II: PETROLEUM GEOLOGY & ORE GEOLOGY – (Course Nos. 903 & 904)

Total Marks: 100 (Mid-Semester Test M.M. 20, End-Semester Exam. M.M. 80)

Course No. 903: PETROLEUM GEOLOGY

Objectives: This course intends to impart basic conceptual aspects of petroleum and gas, and its reservoirs through sedimentological dynamics and geophysical exploration.

UNIT I

Introduction, occurrence, indications and composition of petroleum and gas; origin, generation, migration and accumulation of petroleum and gas; characteristics of sandstones and carbonate reservoirs and provenance; Petroleum Traps and mechanisms; Geology of onshore and offshore petrolierous basins of India; global distribution of petroleum and gas; principles of stratigraphic classification and correlation. Hydrodynamic processes of sediment transport and depositional systems; facies maps; concepts and applications of sequence stratigraphy: boundaries, flooding
surfaces, system tracts, sea level changes and basin analysis; applications of seismic stratigraphy in petroleum and gas; well logging and geophysical techniques; economics and management of reservoirs; non-conventional energy resources: coal bed methane and gas hydrates.

**Essential Reading**


**Further Reading**


**Course No. 904: ORE GEOLOGY**

**Objectives:** In this course emphasis is laid on modern concepts of ore genesis and metallogeny along with mineral economics.

**UNIT II**

Modern concepts of ore genesis; global metallogeny as related to crustal evolution in space and time; ore deposits and plate tectonics; fluid inclusions and their significance in ore geology; mineral deposits associated with igneous (ultramafic, mafic, alkaline, felsic, mafic-felsic), sedimentary (clastic, chemical, biochemical), metamorphic (contact and regional ) rocks vis-à-vis India and world classic examples; some typical mineral deposits of the world such as: residual, supergene enriched, black smokers, Mn nodules, porphyry deposits.

Resources and reserves, and their classification; strategic, critical and essential minerals; India's status in mineral production; changing patterns of mineral consumption; importance of minerals in national economy; National Mineral Policy; Mineral Concession Rules; marine mineral resources and Law of Sea.

**Essential Reading**


Further Reading


Further Reading


Paper III: ISOTOPE GEOLOGY & ENGINEERING GEOLOGY - (Course Nos. 905 & 906)
Total Marks: 100 (Mid-Semester Test M.M. 20, End-Semester Exam. M.M. 80)

Course No. 905: ISOTOPE GEOLOGY

Objectives: The prime aim of this course is to provide detailed insights into the principles, methodology and applications of important radiogenic-stable- and cosmogenic-isotope dating technique.

UNIT I
Introduction and physics of the nucleus; radioactive decay; the law of radioactive decay; review of mineral structure; principles of mass spectrometry; K-Ar method: principles, methods and applications; Ar-Ar method: principles, method and advantages: Rb-Sr method: principles, Rb-Sr isochron and limitations. Sm-Nd Method: decay scheme, evolution of Nd with time, Nd model ages and application of Nd to petrogenesis; U-Th-Pb Method: decay schemes, U-Pb isochron, U-Pb mineral dating and application; principles and application of Fission Track and Radiocarbon methods of dating; stable isotopes and their fractionation; ratio Mass Spectrometry; principles of oxygen, carbon and sulphur isotope geochemistry.

Essential Reading


Further Reading
**Course No. 906: ENGINEERING GEOLOGY**

**Objectives:** The main aim of this course is to understand the engineering properties of rocks and application of geology to various engineering projects.

**UNIT II**

Mechanical properties of rocks and soils; types of foundations; Geological consideration relative to building stones and road materials; Geological investigations for river valley projects; dams and reservoirs; tunnels: types, methods and problems; bridges: types and foundation problems; landslides: classification, causes, prevention and rehabilitation; geotechnical case studies of major projects in India, viz. Bhakra Nangal project, Nagarjunsagar project, Andhra Pradesh & others.

**Essential Reading**


**Further Reading**


**Practical I: REMOTE SENSING-GIS, GEOMORPHOLOGY- CLIMATOLOGY & ORE GEOLOGY (Course No. 907P)**

**Total Marks:** 75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)

**Remote Sensing-GIS:** Study and use of stereoscopes. Identification of various parameters such as tone, texture, size, shape, association for different rock types-sedimentary, igneous and metamorphic. Interpretation of Satellite imageries for lithology, soils, and groundwater. Spectral signatures of various terrains and study of environmental problems. Introduction to GIS softwares.

**Geomorphology-Climatology:** Morphometric analyses of drainage; morphometric analyses using GIS software; distribution of climatic parameters; wind and rainfall variation.

**Ore Geology:** Maps of major and important mineral and metallic deposits of world and India; megascopic study of metallic ores – sulphides, oxides and silicates of copper, iron, aluminium, zinc, lead, tin, tungsten, chromium, nickel, manganese and molybdenum.

**Practical-II PETROLEUM GEOLOGY, ISOTOPE GEOLOGY & ENGINEERING GEOLOGY (Course No. 908P)**

**Total Marks:** 75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)

**Petroleum Geology:** Magascopic and microscopic study of cores and well cuttings. Study of geological maps and sections of important oilfields of India and world. Study of larger benthic foraminifers useful in petroliferous basins in India. Study of sedimentary rocks, their facies and depositional characteristics. Study of sedimentary structures in context of their palaeoenvironments. Exercises on sequence stratigraphic frameworks. Calculation of oil reserves.
**Isotope Geology:** Calculation of atomic weight of elements; Calculation and plotting of binding energy and neutron/proton ratios of various isotopes; problems related to radioactive decay of nuclides; determination of K-Ar ages; Rb-Sr and Sm-Nd, ages, initial ratios and plotting of isochrons using Rb-Sr and Sm-Nd isotope data.

**Engineering Geology:** Study of properties of common rocks with reference to their utility in engineering projects. Study of maps and models of important engineering structures as dam sites and tunnels. Interpretation of geological maps for landslide problems.

**PROJECT ORIENTED GEOLOGICAL FIELD WORK - (Course No. 909FW)**

**Total Marks: 50**

Each candidate will carry out an independent field study, which should include sampling and recording of field observations/data. The marks for Field Work will be awarded by teacher(s) who conduct the field work.

A candidate who does not attend field work or fails to get pass marks in it will have to do the field work by joining the field tour of the same class M.Sc.(H.S.) 2nd Year in a subsequent year as per university rule.
IV Semester Examination, May 2016

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Total Marks for M.Sc. (Hons. School) IV Semester (Geology) 500

* Continuous Assessment: Seminar (10 marks) and Sessional (5 marks).

**Note for Theory paper setter:**
The theory question paper for the end-semester examination will have seven questions. Each question paper will be of 80 marks, with 20 marks reserved for first question, which is compulsory. Further, the latter would comprise of 10 short answer questions, without any choice, covering the whole syllabus. The remaining 4 questions carrying 15 marks each, are to be attempted from the 2 Units, selecting two questions from each unit. Each Unit would comprise of three questions.
Paper I: PETROLEUM GEOCHEMISTRY & EXPLORATION GEOPHYSICS -  
(Course Nos. 1001 & 1002)

Total Marks: 100 (Mid-Semester Test M.M. 20, End-Semester Exam. M.M. 80)

Course No. 1001: PETROLEUM GEOCHEMISTRY

Objectives: This course aims to understand various techniques in petroleum geochemistry with special emphasis on geochemical exploration.

UNIT I

Application of petroleum geochemistry to exploration and reservoir management; source rocks relation with kerogen and related hydrocarbon types; geochemical techniques of source rock evaluation; pyrolyzer and pyrolysis results; hydrogen and oxygen indices in hydrocarbons; vitrinite reflectance, thermal alteration & conodont alteration index and associated hydrocarbons and fixed carbon values analyses; gas chromatography of drill cuttings and evaluation of gases composition; biomarker analysis for reservoir and source rock evaluation; reservoir geochemical processes and application; petroleum geochemical proxies for reservoir management during exploration to production phase; extraction of core samples; recovery of hydrocarbons and polar non-hydrocarbons by solid phase extraction; mass spectrometry and its use in exploration and development of reservoir; linkages between geochemical proxies and petrophysics of reservoir rocks.

Essential Reading


Further Reading


Course No. 1002: EXPLORATION GEOPHYSICS

Objectives: The major objective of this course is to comprehend Geophysical Exploration methods used for mineral, water and oil exploration.

UNIT II

Introduction to geophysics; shape and size of earth; gravitational field of the earth; variation of gravity on the earth surface; principles of gravity methods and instrument used; gravity field surveys; corrections applied to gravity data; The Bouguer anomaly; regional and residual anomalies; gravity anomaly maps and their interpretation; geomagnetic field of the earth; magnetic properties of rocks; principles of magnetic methods; instruments of magnetic surveying; fluxgate magnetometer, proton-precision magnetometer, alkali vapour magnetometer; field surveys and data reductions; aeromagnetic surveys; electrical methods: basic principles and various types of electrode configuration; electrical surveying, self potential and resistively surveying; field procedures; profiling and sounding; seismic methods: principles and instruments used; seismic velocity and
interpretation of seismic data; seismic reflection and refraction methods; application in mineral and petroleum exploration; description of borehole environment; brief outline of various well logging techniques: self potential and resistivity logs, radioactive logs, induction logs, caliper logs, sonic logs, borehole video; well logging applications in petroleum, groundwater and mineral exploration.

**Essential Reading**


**Further Reading**


**Paper II: HYDROGEOLOGY & ENVIRONMENTAL GEOLOGY- (Course Nos.1003 & 1004)**

**Total Marks: 100 (Mid-Semester Test M.M. 20, End-Semester Exam. M.M. 80)**

**Course No.1003: HYDROGEOLOGY**

**Objectives:** The main emphasis of this course is on the principles of occurrence, movement development and management of groundwater resources.

**UNIT I**

Groundwater: origin and various hydrological processes; geomorphic & geological controls of ground water occurrence in various rock types; interstices: porosity, specify yield & specify retention, hydraulic conductivity, transmissivity, storage coefficient; methodology (field & laboratory) for geohydrological investigations; groundwater quality, estimation and methods for various uses; hydrochemical facies; groundwater quality map of India; water contaminants and pollutants: problem of arsenic and fluoride; adverse effects of water quality on human health (medical geology); well hydraulics: methods of pumping test and analysis of test data, evaluation of aquifer parameters; water level fluctuations: causative factors and their measurements, hydrographs; conjunctive use of surface and groundwater, problem of overexploitation, groundwater legislation; artificial recharge of groundwater; rain water harvesting; water well technology: well types, drilling methods, construction, design, development and maintenance of wells; water management in rural and urban areas; sea water intrusion in coastal aquifers, and remedial measures; surface and subsurface geophysical and geological methods of groundwater exploration, hydrogeomorphic mapping using various remote sensing techniques; groundwater problems with special reference to northern region.

**Essential Reading**

Further Reading


Course No. 1004: ENVIRONMENTAL GEOLOGY

Objectives: The main objective of this course is to understand the role of geological processes on environment, and comprehend the impact of geology on natural resources.

UNIT II
Fundamental concepts of Environmental Geology; natural ecosystems on the Earth and their natural inter relations and inter actions (Atmosphere, Hydrosphere, Lithosphere and Biosphere); natural hazards: landslides, floods, earthquakes, volcanoes, water logging, pollution, their source, types and movement in air, soil, water and rocks, pollution of rivers, takes and groundwater and remedial measures; environmental aspects of natural resource development; water resources, mineral resources, soil resources, fossil fuels; environmental issues related to silting of dams, reservoirs, lakes and remedial measures; watershed management, concept of small dams waste disposal practices and management; environment management: impact assessment of degradation and contamination of surface water and groundwater quality due to industrialization and urbanization; disaster management preparation of EIA.

Essential Reading


Further Reading


Practical I: PETROLEUM GEOCHEMISTRY & EXPLORATION GEOPHYSICS - (Course No. 1005P)

Total Marks: 75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)

Petroleum Geochemistry: Sample preparation and techniques. Methods of determination of elemental composition of mineral and rocks by flame photometer, spectrophotometer, AAS and ICP.
**Exploration Geophysics:** Interpretation of bore hole logs. Interpretation of seismic and resistivity data. Study of gravity data maps and their interpretation.

**Practical-II: Hydrogeology & Environmental Geology (1006P)**

**Total Marks: 75 (Continuous Assessment M.M. 15, End-Semester Exam. M.M. 60)**

**Hydrogeology:** Preparation and interpretation of water table contour maps, hydraulic gradient, subsurface geological sections, hydrographs, pumping test data, hydrochemical maps and facies diagrams.

**Environmental Geology:** Use of portable kit for determination of chemical parameters of water and soil. Determination of major and trace elements in water and plotting chemical classification diagram. Risk zone maps. Case studies of environment related problems. Study of seismic and flood prone areas in India.

**PROJECT ORIENTED REPORT - (Course No. 1007FW)**


Each candidate will submit a project-oriented geological field report based on his/her own field and laboratory work:

It will have three components:
(a) Field observations/data recorded by the candidate,
(b) Laboratory investigation carried out by the candidate, and
(c) Synthesis of (a) and (b).

The marks of laboratory work will be awarded by the teacher(s) who supervised the laboratory investigations. A board of examiners will evaluate the field report, and would consist of the three faculty members appointed by the B.O.C. The latter would evaluate the field report and submit the marks independently to the Chairman. An average value of these marks will be considered as the final marks.

The students will also make a presentation of their project report/work (minimum time: 15 minutes) as a part of defense of their work conducted. The viva-voce examination will be conducted after the presentation. The board of examiners would award the marks of presentation and viva-voce independently. In both the cases, i.e. marks of presentation and viva-voce, an average value will be considered as the final marks.

A candidate who does not submit the field report or fails to get pass marks in it will appear again in viva-voce examination of the same class M.Sc.(H.S.) II Year in a subsequent year as per university rule.

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