

UNIVERSITY OF MUMBAI

No. UG/15 of 2018-19

CIRCULAR:-

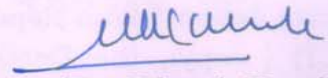
Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/205 of 2010, dated 21st July, 2010 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Geology at its meeting held on 26th April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.27 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Sc. in Geology (Sem -V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032

14th June, 2018

To



(Dr. Dinesh Kamble)

I/c REGISTRAR

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.27/05/05/2018

No. UG/15 -A of 2018

MUMBAI-400 032

14th June, 2018

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Geology,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-Ordinator, University Computerization Centre,



(Dr. Dinesh Kamble)

I/c REGISTRAR



University of Mumbai

Syllabus For B.Sc. Vth Semester Courses in Geology (June 2018 onwards)

- Contents:
- Theory Syllabus for Courses:
 - USGE 501 – Precambrian Geology of India
 - USGE 502 – Igneous Petrology
 - USGE 503 - Structural Geology
 - USGE 504 – Metamorphic Petrology
- Practical Course Syllabus for: USGE 5 PR

Learning Objectives:

1. To bring about an understanding of the principals of Stratigraphy.
2. Understand the Precambrian Stratigraphy of India.

Number of lectures: 60

Unit 1

Introduction

(15 lectures)

Earth's Crustal Structure and Tectonic framework of India- Cratons.

Tectonic Elements of Continents & Oceans.

Tectonic Divisions of India.

Indian Cratons:

Dharwar Craton,
Bastar Craton,
Singhbhum Craton
Aravalli Craton

Unit 2

Proterozoic History

(15 lectures)

Proterozoic Sedimentary Basins:

Vindhyan Basin,
Delhi Basin
Cuddapah & Kurnool Basins.
Kaladgi Basin.

Unit 3

Mobile Belts

(15 lectures)

Proterozoic Eastern Ghat Mobile Belt

Marginal & Transition Zone
Western Charnockite Zone
Western & Eastern Khondalite Zone.

Satpura Mobile Belt

Central Indian Tectonic Zone
Sausar, Mahakoshal & Betul Supracrustal Belts.

Unit 4

Precambrians of Extra – Peninsula

(15 lectures)

Precambrian of Himalaya (Lesser & Higher Himalayas)

Precambrian of the Tethyan Basement

Salkhala Group
Vaikrita Group
Jutogh Group
Daling Group

Precambrians of the Lesser Himalaya

Western Sector

List Of Recommended Reference Books

1. Dasgupta, A. (2010) Phanerozoic Stratigraphy of India; World Press, Kolkata.
 2. Ramakrishnan, M. and Vaidhyanadhan, R. (2010) Geology of India - Vol. 1, Geological Society of India, Bangalore.
 3. Vaidhyanadhan, R. and Ramakrishnan, M. (2008) Geology of India - Vol. 2, Geological Society of India, Bangalore.
 4. Prasad, C.V.R.K. (2005) Elementary Exercises in Geology; Universities Press (India) Pvt. Ltd, Hyderabad.
 5. Directorate of Geology and Mining, Nagpur. (2000) Geology and Mineral Resources of Maharashtra.
 6. Deshpande, G.G. (1998) Geology of Maharashtra; Geological Society of India, Bangalore.
 7. Kumar, R. (1996) Fundamentals of Historical Geology and Stratigraphy of India, 4th ed., New Age International (P) Limited, Publishers.
 8. Lemon, R.R. (1990) Principles of Stratigraphy; Merrill Publishing Company, Ohio.
 9. Wadia, D.N. (1984) Geology of India, 4th ed., Tata McGraw-Hill Publishing, New York.
 10. Krishnan, M.S. (1982) Geology of India and Burma; 6th Ed. CBS Publishers & Distributors (India).
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Practical:

Stratigraphy and Geology of India

- I) Study of common sedimentary, igneous and metamorphic rocks in Hand specimen from different stratigraphic horizons.
- II) Diagrammatic examples of Lithostratigraphic boundaries and classification.
- III) Study of Geological maps with geological history of the area in chronological order.
- IV) Problems:
 - a) Stratigraphic sequence from geological section.
 - b) Characteristics of a Fold & Fault from a geological map.
 - c) Stratigraphic Boundary Problem.
 - d) Understanding Precambrian Geological Time Scale.

Learning objective:

To provide students a systematic approach in understanding the origin of igneous rocks, nomenclature, classification and their association with particular tectonic settings.

Number of lectures: 60

Unit-1

(15 lectures)

The Interior of the Earth:

Evidence of the Earth's Composition and Mineralogy: Seismic data, The Geothermal Gradient, Meteorites, Xenoliths.

Mantle Petrology; Low Velocity Zone, Pressure and Temperature variations with Depth and high pressure experimentation.

Classification and Description of Igneous Rocks:

The IUGS Classification System, Other aspects of classification; Chemical Classification;

Textures of Igneous rocks,

Crystallinity, Granularity, Shape of Crystals and Mutual Relations.

Equigranular, Inequigranular, Directive and Intergrowth Textures.

Terms related to some specific Textures and Microstructures : Perlitic Cracks, Spherulites, Orbicular Structure, Rapakivi Structure, Zoned Crystals, Xenocrysts, Quench Texture, Crystal Pseudomorph, and Cumulus Crystals.

Characters of the Common Igneous Rocks: Plutonic and Volcanic types; Examples of Common Igneous Rock Types and their Indian Occurrences.

Unit 2

(15 lectures)

The Phase Rule and crystallization and melting relations in one, two and three component Systems:

Melting Behavior of Natural Magmas, Phase Equilibrium and The Phase Rule, One Component Systems, Two Component (Binary Systems) and Its Petrogenetic Significance.

Binary Systems with Complete Solid Solution, Binary Eutectic Systems, Binary Peritectic Systems, the Alkali Feldspar System,

Ternary Systems:- Ternary Eutectic Systems, Ternary Systems with Solid Solution

Reaction Series, The Effect of Pressure and Fluid on Melting Behavior. The effects of Pressure on the Melting and Crystallization of Magma; Time and Crystallization; Rock Types and Mode of Occurrence.

Unit 3

(15 lectures)

The Evolution of Magmas:

Differentiation: Fractional Crystallization; Other Differentiation Mechanisms.

Magmatic Mixing and Assimilation.

Melting of the Mantle, Partial Melting, Magma Generation and Differentiation.

Generation of Basaltic magma from a Chemically Uniform Mantle.

Unit 4

(15 lectures)

Brief study of Plate tectonic settings and associated igneous rocks.

Subduction –Related Activity: Island Arc Volcanism, Rocks and Magma Series, The Ophiolite Suite; Calcalkaline and Tholeiite Groups; Petrogenesis of Island Arc Magmas, Plutonic Rocks – Batholiths related to subduction zones.

Gabbroic Layered Intrusions; Anorthosites; Alkali Basalts and Nephelinites; Carbonatites, Kimberlites and related Rocks.

List Of Recommended Reference Books

1. Bose M.K. (1997), Igneous Petrology. The World Press Pvt. Ltd. 568 p.
2. Bowen N.L. (1928), The evolution of Igneous Rocks. Princeton Univ. Press. N.J 332 p.
3. Hall A. (1987), Igneous Petrology. Longman. 573p.
4. Hatch F.H., Wells A.K and Wells M.K. (1984), Petrology of the igneous rocks. CBS Publishers, 551 p.
5. Philpotts A.R. (1994), Principles of igneous and metamorphic Petrology, Prentice Hall of India. 498p.
6. Turner F.J & Verhoogen J. (1951), Igneous and Metamorphic Rocks, McGraw Hill.
7. Williams H, Turner F.J & Gilbert C.M. (1955), Petrography. San Francisco: W.H. Freeman and company. 406p
8. Winter J. D. (2001), an Introduction to Igneous and Metamorphic Petrology, Prentice Hall, 697p.
9. Ehlers, E.G. and H. Blatt (1982), Petrology, Igneous, Sedimentary and Metamorphic, W.H Freeman, San Francisco.
10. Philpotts A. R. (2009), Petrography of Igneous and Metamorphic Rocks, Cambridge University Press, 686p.

Practical Course:

Megascopic identification and Petrography of Igneous Rocks

Igneous Textures.

Equigranular:

- a. Coarse –grained, Holocrystalline, Panidomorphic.
- b. Coarse –grained, Holocrystalline, Hypidiomorphic
- c. Medium –grained, Holocrystalline, Hypidiomorphic
- d. Fine –grained, Holocrystalline, Panidomorphic. (Orthophyric)
- e. Fine –grained, Holo/ Hemicrystalline, Hypidiomorphic
- f. Fine-grained, Holocrystalline, Allotriomorphic (Aplitic)
- g. Fine- grained, Hemicrystalline, Aphanitic, (Felsitic)
- h. Fine –grained, Holohyaline, Aphanitic

Inequigranular:

- a. Coarse/Medium/Fine, Holo/Hemicrystalline, Porphyritic
- b. Coarse/Medium/Fine, Holo/Hemicrystalline, Glomeroporphyritic
- c. Coarse/Medium, Holo/Hemicrystalline, Ophitic/ Subophitic
- d. Medium/ Fine, Holo/Hemicrystalline, Poikilitic
- e. Medium/Fine, Holocrystalline, Intergranular

- f. Medium/Fine, Hemicrystalline, Intersertal
- g. Medium/Fine, Intergranular-cum-ophitic (Ophimottling)

Directive:

- a. Fine, Hemicrystalline/Holohyaline, Banded (Fluidal)
- b. Fine, Hemicrystalline, Trachytic

Intergrowth:

- a. Graphic/Micrographic
- b. Perthitic
- c. Granophyric

Igneous Mega-Structures

- 1. Vesicular/ Amygdaloidal Lava
- 2. Blockery/ Clinkery Lava
- 3. Ropy Lava Surface
- 4. Columnar Joint Block
- 5. Flow Banding
- 6. Glomeroporphyritic Clusters
- 7. Intrusive Contacts and Xenoliths

Igneous Micro-Structures

- 1. Reaction: (a. Corona , b. Myrmekite)
- 2. Xenolithic
- 3. Spherulitic/ Variolitic
- 4. Perlitic Fracture

Study of the Texture, Mineral composition, Mode of occurrence, and Association of the following Rock Types.

- 1. Granite
- 2. Rhyolite
- 3. Pegmatite
- 4. Aplite
- 5. Quartz porphyry
- 6. Pitchstone
- 7. Obsidian
- 8. Syenite (Hornblende / Biotite)
- 9. Trachyte
- 10. Feldspar porphyry
- 11. Nepheline Syenite
- 12. Diorite
- 13. Gabbro
- 14. Norite
- 15. Dolerite
- 16. Basalt (Vesicular/ Non- Vesicular/ Porphyritic, Amygdaloidal)
- 17. Picrite
- 18. Peridotite
- 19. Dunite
- 20. Anorthosite
- 21. Carbonatite

T.Y.B.Sc Geology

Course: USGE 503

Title: Structural Geology

Learning Objectives:

To understand the concept of stress and strain and how rock behaves under different stress regimes. A detailed study of various geological structures i.e. Joints, Folds and Faults

Number of lectures: 60

Unit 1

(15 lectures)

Introduction, Types of Structures, Stress, Strain, Measurements of Stress and Strain, Mechanical Behaviour of Rocks

Introduction and Review

Structures and Structural Geology

Fundamental Concepts

Stress

Definitions

Stress on a Plane

Stress at a Point

Mohr Construction

Mohr's Hypothesis

Stress Ellipsoid

Strain

Definitions

Kinds of Strain

Strain Ellipsoid

Mohr Circles for Strain

Simple and Pure Shear

Measurement of Strain in Rocks

Kinds of Strain

Strain Markers

Flinn Diagram

Mechanical Behavior of Rock Materials

Elastic (Hooken) Behavior

Permanent Deformation – Ductility

Controlling Factors

Unit 2

(15 lectures)

Study of Structures I: Joints and Faults

Joints and Shear Fractures

Griffith and Coulomb theory of fractures

Joints and Fracture Mechanics

Classification of joints

Fault Classification and Terminology

Anatomy of Faults

Criteria for Faulting

Fault Mechanics

- Anderson's Fault Types
- Brittle versus Ductile Faults
- Shear Zones
- Shear – Sense Indicators

Thrust Faults

- Nature of Thrust Faults
- Detachment within a Sedimentary Sequence
- Small – Scale Features of Thrust Sheets

Strike – Slip Faults

- Properties and Geometry
- Environments of Strike – Slip Faulting
- Fault Geometry and Other Fault Types
- Termination of Strike – Slip Faults
- Transforms

Normal Faults

- Properties and Geometry

Unit 3

(15 lectures)

Study of Structures II: Folds-I

Fold Geometry and Classifications

- Descriptive Anatomy of Simple Folds
- Map – Scale Parallel Folds and Similar Folds
- Recognition of Folds

Fold Classifications

- Based on interlimb angle
- Ramsay standard classification
- Noncylindrical and Sheath Folds
- Fundamentals of Parallel Folds and Similar Folds

Complex Folds

Identification of overturned folds

- Occurrence and Recognition
- Fold Interference Patterns
- Recognition of Multiple Fold Phases

Unit 4.

(15 lectures)

Study of Structures II: Folds-II

Fold Mechanics

- Fold Mechanisms and Accompanying Phenomena
- Deformation Mechanisms and Strain
- Theory of progressive evolution of fold shapes in single competent layers.
- Layer parallel shortening
 - Dependence of fold shape on viscosity contrast in a single layer buckles
 - High competence contrast, Low Competence contrast
 - Zone of contact strain and its interrelationship with buckle folds
 - Change of fold shape with packing distance of competent layers

Fold styles in multilayers

List Of Recommended Reference Books

1. Fossen, H. (2010), Structural Geology, Cambridge University Press
2. Hobbs D.W., Means W.D. And Williams P.F. (1976), An Outline of Structural Geology, John Wiley.
3. Benninson, G and Moseley, K. (2003), An introduction to geological structures and maps, 7th edition, Arnold Publications
4. Lisle, R (2003) Geological structures and maps: a practical guide, Butterworth-Heinemann Ltd.
5. Billings M.P. (1972), Structural Geology, 3rd ed., Prentice- Hall, Inc., Englewood cliffs, New Jersey.
6. Ragan D.M. (1968), Structural Geology- An Introduction to Geometrical Techniques, 2nd ed., John Wiley and Sons.
7. Ramsay J.G. and Huber M.I. (2002), The Techniques of modern structural geology, 2nd ed., Vol. 2, Elsevier Science Ltd.

Practical Course:

- Profiles and cross sections of geological maps with showing various structural features: folds, faults, dykes, two series of dipping beds. (8 maps atleast)
- Patterns of dipping strata; Three-Point problems.
- Trigonometric solution of fault problems
- Equal-area net part I
 - a. Plotting a line that lies in a plane
 - b. Determining the angle between two lines
 - c. True strike and Dip from apparent dips
 - d. Attitude of intersection of two planes
- Equal-area net part II
 - a. Determining the angle between two planes
 - b. Determining the orthographic projection of a line on a plane
 - c. Determining the angle between a line and a plane
 - d. Bisecting the angle between two lines
 - e. Bisecting the angle between two planes

Learning Objectives:

As a branch of petrology, metamorphic petrology deals with the change in rock structure, composition and texture based on the varying pressure and temperature conditions. This course aims at preparing the learner for appreciating the processes that lead to such changes. The learner will be able to identify in hand specimen as well as through petrographic examination, the various rocks.

Number of lectures: 60

Unit 1: (15 lectures)

Introduction to Metamorphic Petrology

Definition of metamorphism.
Agents of metamorphism
Types of Metamorphism
Introduction to metamorphic fluids
Metasomatism and examples of metasomatism
Classification of Metamorphic rocks
Textures and structures of metamorphic rocks

Unit 2: (15 lectures)

Thermodynamics and metamorphism

Phase rule and phase diagrams
Introduction to chemographic projections
Types of metamorphic reactions
Concept of metamorphic facies

Unit 3: (15 lectures)

Metamorphism- types and products-I

Metamorphism of basic rocks and their facies
UHP and UHT metamorphism of basic rocks
Introduction to P-T-t paths
Metamorphism of pelitic rocks- Barrovian zones
Partial melting and migmatites

Unit 4: (15 lectures)

Metamorphism- types and products-II

Metamorphism of carbonate rocks- Contact and regional
Zones of metamorphism of calc-silicate rocks
Charnockites and Khondalites-Granulites with reference to Indian examples
Porphyroblasts and Tectonism: pre-, syn- and post- tectonic porphyroblasts
Introduction to paired metamorphic belts

List Of Recommended Books:

1. Winter J.D (2013) Principles of Igneous and Metamorphic Petrology (Second Edition), PHI Learning Private Limited, Delhi.
2. Williams H, Turner F.J & Gilbert C.M. (1955), Petrography, W.H. Freeman and company. San Francisco, 406p.
3. Greensmith J. (1989), Petrology of the Sedimentary rocks (7th Edition), C.B.C. Publishers, New Delhi.
4. Blatt H., Tracy R.J. and Owens B.E. (2006), Petrology – Igneous, sedimentary and Metamorphic (3rd Edition), W.H. Freeman and Company, New York.
5. Yardley Bruce W.D. (1989), An Introduction to Metamorphic Petrology, Longman Singapore Publishers (Pvt.) Ltd.
6. Harker Alfred (1974), Metamorphism, Chapman and Hall, London.
7. Turner F.J and Verhoogen J. (1960), Igneous and Metamorphic Petrology, Mc Graw-Hill.
8. Bayley B. (1996), Introduction to Petrology, Prentice Hall, New York.
9. Miyashiro A. (1998), Metamorphism and Metamorphic Belts, George Allen & Unwin, New York.
10. Mason Roger (1984), Petrology of the Metamorphic Rocks, CBS Publishers and Distributors, New Delhi.
11. Winkler Helmut G.F. (1987), Petrogenesis of Metamorphic Rocks (Fifth Edition), Narosa Publishing House, New Delhi.
12. Philpotts A and Ague J. (2009) Principles of Igneous and Metamorphic Petrology (Second Edition), Cambridge University Press, UK.

Practical Course:

Calculations of stable mineral composition at equilibrium

Megascopic and Microscopic Identification of Metamorphic Rocks.

Metamorphic Textures

1. Idioblastic
2. Porphyroblastic
3. Granuloblastic
4. Xenoblastic

Metamorphic Structures

1. Cataclastic
2. Slaty cleavage
3. Maculose
4. Granulose
5. Schistose
6. Gneissose

Metamorphic Rocks

1. Quartzite
2. Marble
3. Slate

4. Phyllite
5. Mica Schist (with Staurolite/ Garnet)
6. Actinolite/ Chlorite Schist
7. Mica- Gneiss
8. Hornblende Gneiss.
9. Granulite
10. Eclogite
11. Serpentine
12. Khondolite
13. Charnockite



University of Mumbai

Syllabus for B.Sc. VIth Semester Courses in Geology (June 2018 onwards)

Contents:

- Theory Syllabus for Courses:
 - USGE 601 – Phanerozoic Geology of India
 - USGE 602 – Sedimentary Petrology
 - USGE 603 - Engineering Geology
 - USGE 604 - Photogrammetry, Photo Interpretation & Fundamentals of GIS
- Practical Course Syllabus for USGE 6 PR

Learning Objectives: To bring about an understanding of the principals of stratigraphy and Understand the Phanerozoic stratigraphy of India.

Unit 1: (15 lectures)

Palaeozoic History

Tectonic History
Precambrian Cambrian Boundary
Marine Palaeozoic Formations of India
 Kashmir Basin
 Spiti Basin
 Krol Basin

Unit 2: (15 lectures)

Mesozoic History

Tectonic History
Permian Triassic Boundary
Marine Mesozoic Formations of India - Kashmir Basin
Marine Transgressive Sequences of Kachchh and Tiruchirapalli.

Unit 3: (15 lectures)

Gondwana Sequence of India

Sedimentation and Palaeoclimates
Lower Gondwana Sequence of different basins.
Upper Gondwana Sequence of different basins.

Unit 4: (15 lectures)

Cenozoic History

Tectonic History
Boundary Problems
Indian Palaeogene - Neogene Formations:
 Siwalik Supergroup
 Assam –Arakan Region
 Andaman-Nicobar Islands
 Sirmur Group
Geology and Stratigraphy of Maharashtra
 Deccan Flood Basalts.

Reference Books:

1. Dasgupta, A. (2010) Phanerozoic Stratigraphy of India; World Press, Kolkata.
 2. Deshpande, G.G. (1998) Geology of Maharashtra; Geological Society of India, Bangalore.
 3. Directorate of Geology and Mining, Nagpur. (2000) Geology and Mineral Resources of Maharashtra.
 4. Krishnan, M.S. (1982) Geology of India and Burma; 6th Ed. CBS Publishers & Distributors (India).
 5. Kumar, R. (1996) Fundamentals of Historical Geology and Stratigraphy of India, 4th ed., New Age International (P) Limited, Publishers.
 6. Lemon, R.R. (1990) Principles of Stratigraphy; Merrill Publishing Company, Ohio.
 7. Prasad, C.V.R.K. (2005) Elementary Exercises in Geology; Universities Press (India) Pvt. Ltd, Hyderabad.
 8. Ramakrishnan, M. and Vaidhyanadhan, R. (2010) Geology of India - Vol. 1, Geological Society of India, Bangalore.
 9. Vaidhyanadhan, R. and Ramakrishnan, M. (2008) Geology of India - Vol. 2, Geological Society of India, Bangalore.
 10. Wadia, D.N. (1984) Geology of India, 4th ed., Tata McGraw-Hill Publishing, New York.
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Practical Course:**Stratigraphy and Geology of India, Maharashtra and Mumbai**

- I) Study of characteristic index fossils of a particular stratigraphic horizon.
- II) Diagrammatic examples of Lithostratigraphic boundaries and classification.
- III) Study of Geological maps with geological history of the area in chronological order.
- IV) Problems:
 - a) Stratigraphic sequence from geological section.
 - b) Interpretation of depositional environments for stratigraphic sequences.
 - c) Stratigraphic Boundary Problem.
 - d) Understanding Phanerozoic Time Scale.

Title: Sedimentary Petrology

Learning Objectives:

To understand the various provenances, processes of formation and environments of deposition of sedimentary rocks.

Number of Lectures - 60

Unit 1:

(15 lectures)

Introduction

Origin, transportation and deposition of sediments.

Classification of Sedimentary rocks

Basin, environment and facies concept.

Field techniques:

Sedimentary structures- Basic measurements and data records

Sketches and lithologs

Sediment interpretation in cores

Sedimentary Texture analysis:

Grain Size scales and laboratory methods of analysis

Shape analysis

Concept of maturity

Unit 2:

(15 lectures)

Siliciclastic sedimentary rocks

Sandstones

Field observations

Petrography and classification

Heavy minerals and other provenance indicators

Concept of diagenesis and authigenesis

Conglomerates and breccia

Classification and field observations

Depositional environments for sandstones and conglomerates

Mudrocks:

Field Observations: Textures, Structures, Colour, Nomenclature

Laboratory Studies: Mineral composition and provenance.

Unit 3:

(15 lectures)

Limestones and dolomites

Field Observations

Components and mineralogy of limestones

Classification of limestones and petrography

Carbonate diagenesis

Dolomitization and dedolomitization

Silicification of limestone

Carbonate depositional environments

Unit 4:

(15 lectures)

Other Types of Sedimentary Rocks:

Evaporites-

Origin of Giant Evaporite Deposits

Palaeoclimatic interpretation from evaporites

Bedded Cherts and Phosphate Rocks- Origin, mineralogy and types

Coal and petroleum

Organic deposits- Modern and ancient

Coal petrology

Oil shales

Formation of Kerogen and Petroleum

Volcaniclastic sediments- Types and field characters.

List Of Recommended Books:

1. Collinson J.D and Thompson D.B (2006), Sedimentary Structures (2nd Edition),
2. Lindholm R.C. (1987), A practical approach to Sedimentology, Allen and Unwin, London.
3. Nichols, G. (2009), Sedimentology and stratigraphy (2nd Edition), Wiley India.
4. Pettijohn F.J. (1984), Sedimentary Rocks (3rd Edition), CBS Publishers and Distributors, New Delhi.
5. Staw, A.V.D (2005), Sedimentary rocks in the field: A colour guide, Manson Publishing, London.
6. Tucker, M. E (2001), Sedimentary Petrology (3rd Edition), Blackwell Science Ltd. Unwin Hyman Ltd, Sydney.

Practical Course

Megascopic and Microscopic Identification of Sedimentary Rocks.

Sedimentary Textures. (Clastic)

Rudaceous (Conglomeratic/ Brecciated), Arenaceous (Gritty/ Sandy), Argillaceous

Sedimentary Structures

1. Parallel bedding
2. Current Bedding
3. Graded Bedding
4. Ripple Marks
5. Rain Imprints
6. Concretions/Secretions

Grain size and shape analysis

Preparation of lithologs and sections

Paleocurrent analysis

Identification and description of heavy minerals

Learning Objectives: To understand the engineering properties of rocks and their use as construction material. Detailed study of various geological and geotechnical investigations for various civil engineering projects. To understand the impact of Geological activities on the environment.

Number of lectures: 60

Unit 1:

(15 lectures)

Engineering Properties of Rocks:

- Specific Gravity
- Porosity
- Sorption
- Compressive Strength
- Tensile Strength
- Elasticity of Rocks
- Residual Stress and Shear Stress in Rocks.

Engineering properties of soil

- Soil classification
- Soil gradation
- Compressive and shear strength
- Atterberg limits
- Consolidation and swelling of clays

Unit 2:

(15 lectures)

Rocks as Construction Materials:

Types of Rocks used in construction: How are they obtained in nature? Use of Rocks as facing stone. Factors influencing Engineering usefulness of Rocks.

Use of Rocks as aggregates: Use of rock as an aggregate in different types of constructions, sources of different grades of aggregates. Properties of aggregates (Shape, Size, Surface Texture, Roundness, Coating), Cement aggregate reaction, Thermal effects on aggregate. Highway aggregate, Rail – road ballast, Runway aggregate.

Source of Rock aggregate:

Types of quarries, Exploration for quarries, processing of aggregates.

Source of sand and gravel

Unit 3:

(15 lectures)

Geological and Geotechnical investigations for Civil Engineering Projects:

Tunnels: Terminology, Geological conditions for tunnel sites, Tunnels in folded rocks and bedded rocks. Influence of divisional planes, Effects of faults, Crushed zones, Tunnels near slopes, Role of Groundwater in tunneling.

Landslides: Causes, types and prevention of landslides. Influence of divisional planes, effects of faults, Crushed zones.

Bridges: Classification, abutments, foundations, investigations for site selection.

Unit 4

Geological and Geotechnical investigations for Civil Engineering Projects:

Dams and Reservoirs: Geological conditions for the selection of dam and reservoir sites. Terminology associated with dams. Types of dams: Masonary Dams (Gravity Buttress and Arch types), Earthen dams. Types of spillways. Locations of all the important dams and Hydro – electric projects in India.

Dam failures-causes and case studies.

List Of Recommended Reference Books

Engineering Geology

1. Narayanswami S.B.S. (2000), Engineering Geology, Dhanpat Rai & Co, India.
2. Legget F. R and Hatheway A.W. (1988), Geology and Engineering., 3rd ed. McGraw-Hill.
3. Gupte R.B. (1992), A Textbook of Engineering Geology.2nd ed. Pune Vidyarthi Griha Prakashan.
4. Krynine D.P. And Judd W.R (2003), Principles of Engineering Geology and Geotechniques, CBS Publishers.
5. Wahlstrom E.E. (1974), Dams, Dam Foundations and Reservoir Sites. Elsevier Scientific.
6. Dunn I.S., Anderson L.R and Kiefer F.W. (1980), Fundamentals of Geotechnical Analysis, John Wiley.
7. Maslov N.N. (1987), Basic Engineering Geology and Soil Mechanics. Mir Publishers.
8. Gokhale K.V.G.K and Rao D.M. (1981), Experiments in Engineering Geology. Tata McGraw-Hill.

Practical Course:

Engineering Geology

- Geological maps to demarcate and evaluate the suitability of sites for engineering projects such as Tunnels, Dams and Reservoir construction.
 - Correlation of borehole data.
 - Determining uniaxial compressive strength of rocks.
 - Equal-area net
 - a) Locus of rotating line
 - b) Determining core-pole angle and orientation of plane in recovered core
 - c) Determining slope stability
 - d) Determining orientation of bed in rotational fault
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T.Y. B.Sc. Geology

Course: USGE 604

Title: Photogrammetry, Aerial Photo Interpretation and Fundamentals of Geographical Information Systems

Learning Objectives:

- 1.To bring about an understanding of the principles of Photogrammetry and about the various analytical techniques used. To understand the construction and working of various instruments used in the process of aerial photo interpretation
- 2.Understand the principles of GIS and study its application in Earth Sciences.

Number of lectures: 60

Unit 1

(15 lectures)

Principles of Aerial Photography

Early history of aerial photography;

Aerial cameras, Film resolution.

Electronic Imaging, Aerial Videography.

Basic Geometric Characteristics of Aerial Photographs: Geometric types of Aerial Photographs,

Taking Vertical Aerial Photographs, Geometric Elements of Vertical Photograph.

Photographic Scale.

Ground Coverage of Aerial Photographs.

Area Measurement on aerial photographs.

Unit 2

(15 lectures)

Principles of Photogrammetry:

Relief Displacement of Vertical Features in aerial photographs.

Characteristics of Relief Displacement,

Object height determination from Relief Displacement Measurement.

Correction for Relief Displacement.

Image Parallax: Characteristics of Image Parallax, Parallax Measurement.

Ground Control for Aerial Photography.

Mapping with Aerial Photographs: Stereoscopic Plotting Instruments, Orthophotos,

Photogrammetric Work Stations.

Flight Planning.

Unit 3

(15 lectures)

Aerial Photo Interpretation:

Fundamentals of Visual Image Interpretation.

Basic Visual Image Interpretation Equipment- Construction and Working.

Land-use/Land cover mapping.

Geologic and Soil mapping.

Water Resource Applications.

Archaeological Applications.

Environmental Assessment

Principles of Landform Identification.

Unit 4

(15 lectures)

Basics of Geographical Information Systems

Definitions of GIS

The components of a geographical information system.

Basic requirements for a GIS.

Data Models: Conceptual models of real world geographical phenomena.

Conceptual models of space.

Geographical Data models: Vector models of Entities – Simple points, lines and polygons.

Raster Data Structures-The grid Cell Data Types: Boolean, Nominal, Ordinal, Integer, Real, Topological. Data Input: Sources of Geographical Data, Geographical data Collectors and providers.

Geo-referencing.

Reference Books:

1. Lillisand Thomas M., Ralph W. Kiefer and Jonathan W. Chapman, (2004), Remote Sensing and Image Interpretation, 5th ed., Wiley.
2. Jensen John R., (2007), Remote Sensing of the Environment – An Earth Resource perspective, 2nd ed. Pearson Education Series.
3. Linder Wilfried (2003), Digital Photogrammetry- Theory and Applications, Springer.
4. Ramasamy S.M. (2005), Remote Sensing in Geomorphology, New India Publishing Agency.
5. Misra R.P. and Ramesh A. (1999), Fundamentals of Cartography, 2nd ed., Concept Publishing Company. New Delhi.
6. Longley Paul A, Michael F. Goodchild, David J. Maguire and David W. Rhind (2005), Geographic Information Systems and Science, 2nd ed., Wiley
7. Nag P. and Sengupta Smita (2008), Introduction to Geographical Information System., Concept Publishing Company, New Delhi.
8. Burrough Peter A. and Rachael A. McDonnell (1998), Principles of Geographical Information Systems, Oxford University Press.
9. Chang K. (2002), Introduction to Geographical Information Systems, Tata McGraw-Hill Edition.
10. Morain Stan and Shirley Lopez Baros (ed.) (1996), Raster Imagery in Geographical Information Systems., Onward Press.
11. Davis Bruce E (1996), GIS – A Visual Approach., Onward Press.

Practical Course:

- Test and Exercise for Stereoscopic vision
- Determination of Photo Scale and numerical problems on photo scale.
- Orientation of Stereographic pair of aerial photographs under a mirror stereoscope and point transfer. Plotting of principal point, flight line and match line.
- Construction of stereogram
- Handling of a parallax bar and height calculation
- Numerical problems on height calculation using measured relief displacement on a single aerial photograph.
- Flight Planning: Calculations necessary to develop a flight plan and draw a flight map.

- Interpretation of aerial photographs: various landforms, erosion types , horizontally bedded sandstones, shale and limestone. Intrusive igneous rocks, extrusive (lava flows). Aeolian Landforms: transverse sand dunes, longitudinal sand dunes, loess. Glacial landforms: end moraine, basal moraine, drumlins, eskers. Fluvial Landforms: alluvial fans, deltas. Coastal landforms: beach ridges, beach cusps, dunes, surface expressions of anthropogenic activities.
