

M.G.C.G.V.V. Chitrakoot Satna M.P.

Faculty of Science and Environment

Department of Physical Science

Syllabus of M. Sc App Geology

First Semester

1 – GEOMORPHOLOGY & GEODYNAMICS

UNIT -1

Concept of geomorphology-principles and significance. Cycle of erosion: Soil forming processes: soil types soil profile and classification of soils. Landslides, soil creep and solifluction. Types of rivers, Valley development-Base level and its varieties, graded streams, Cross profile of valleys. Drainage patterns and their significance. Erosion landforms and depositional landforms of streams.

UNIT -2

Glaciers: Types of glaciers, regimes of glaciers, nourishment of glaciers, wastage of glaciers. Major features resulting from glacial erosion and glacial deposition. Aeolian agency. Topographic effects of wind erosion. Landforms of Aeolian deposition. Arid cycle of erosion.

UNIT -3

Karst topography: Conditions essential for development of Karst and features characteristic of karst region. Karst geomorphic cycle. Marine erosion: Classification of coasts. Morphometric analysis of terrains and its significance. Morphometric analysis of drainage basin and its significance.

UNIT -4

Earth's surface features. Seismology: waves, intensity and isoseismic lines, earthquake belts, earthquake zones of India, seismograph, causes of earthquake. Volcanism :types and causes of volcanic eruptions .World distribution of volcanoes. Palaeo - magnetism Isostasy: Development of the concept, isostatic anomalies.

UNIT -5

Evidences of Geosynclines. Continental drift: Development of the concept, Taylor's and Wegner's theories of continental drift. Evidences of continental drift and polar wandering. Concept of plate tectonics: types of plate boundaries. Features of convergent and divergent boundaries. volcanic mountain chains. Origin of Himalayas

Reference:-

Holms, Doris and Arthur: Holme's Principles of Physical Geology. Wiley

Thornbury, W D : Geomorphology. Wiley.

VonEngelen, O D:Geomorphology- Systematic and regional.MacMillan.

Savinder Singh: Geomorphology.

Mathew Fountain Maury: The Physical Geography of Sea.Harvard Univ. Press.

Hallis J R: Applied Geomorphology

Peter J: The dynamic Earth. Wiley

Hodgson,, J H: Earthquake and Earath's structures. Prentice Hall.

Condie K C : Plate tectonics and crustal evolution.

Straheler: Earth sciences.

First Semester

2 - STRUCTURAL GEOLOGY & TECTONIC

UNIT -1

Rock failure: Mechanical principals of rock deformation, factors controlling behavior of material. Concept of stress and strain analysis in two and three dimensions. Progressive deformation. Moh's circles. Unconformities: types, significance and recognition.

UNIT -2

Geometry of fold surface: Single and multi-layered. Classification of folds. Types of folds. Effects of folds on outcrops. Super-imposed folding.

UNIT -3

Geometry of faults. Classification and types of faults. Slips, separation, recognition of faults, causes of faulting.

UNIT -4

Origin, types and their relation to other structure of fracture , joints, lineation, foliation, rock cleavages and schistosity.

UNIT -5

Mechanics of folding and faulting. Tectonic fabrics. Magma tectonics. Emplacement of plutons, origin of Ring Dykes and Cone Sheets.

Reference:-

Bayly B: Mechanics in structural Geology. Springer Verlag

Davis G H: Structural Geology of Rocks and regions. John Wiley Ghosh S K: Structural Geology fundamental of modern developments .

Hubert M K: Structural Geology Hafner Publ.

Moore E and Twiss R J: Tectonics Freeman Pergamon Press

Price N J and Cosgrove J W: Analysis of Geological Structure Cambridge university. Hobbs, Means and Williams: An Outline of Structural Geology.

Badgeley P C: Structural Geology for Exploration Geologist. Fairhurst: Rocks Mechanics Pergmon Press

Whitten E. H. T: Structural folded Rocks

First Semester

3-Crystallography & Mineralogy

UNIT- I

Concept of symmetry; space lattice and point groups; Classes of symmetry.

UNIT –II

Silicate structures of minerals; physical and chemical properties of minerals

UNIT –III

Study of following group of rock- forming minerals - olivine, garnet, kyanite, pyroxene, amphibole, talc, mica, chlorite, feldspar, cordierite, kaolinite, serpentinite feldspathoids.

UNIT – IV

Birefringence, pleochroism and interference phenomena in minerals; extinction angles; optical indicatrix; concept of uniaxial and biaxial indicatrix; dispersion in minerals; optical anomalies; and optical accessories like quartz, mica and gypsum plate.

UNIT-V

Identification of Minerals - Physical and microscope optical properties of minerals.

RECOMMENDED BOOKS

1. Dana:- Elements of Mineralogy
2. Deer, Howie and Zussman:- Rock forming minerals
3. Kerr:- Optical mineralogy
4. Winchell:- Elements of Optical Mineralogy (Part I, II and III)
5. Wahlstrom:- Optical crystallography
6. Phillipps:- An introduction to crystallography
7. Barry and Mason:- Mineralogy
8. Klein and Hubert:-Manual of mineralogy
9. Spear, F. S.-Mineralogical phase equilibrium and Pressure- Temperature- Time paths
10. Phillips, W. R. and Guffen, D. T.- Optical mineralogy

First Semester

4- STRATIGRAPHY OF INDIA

UNIT -1

Criteria for the stratigraphic classification and correlation. Litho-,Bio- and chronostratigraphic units. Sequence stratigraphy. Geological timescale. Orogenic cycles in Indian stratigraphy. Tectonic framework of India. Geological column of the Indian stratigraphy.

UNIT -2

Ice ages in Indian stratigraphy. Precambrian Permo-Carboniferous and Pleistocene ice ages, their evidences. Archaean (Azoic) History of India: Distribution and stratigraphy of the Archaeans of South India, Madhya Pradesh, Rajasthan, Jharkhand and Orissa.

UNIT -3

Precambrian (Proterozoic) History of India: Distribution and stratigraphy of the Cuddapah and Vindhyan Supergroups. Palaeozoic history: distribution and stratigraphy of Salt Range and Spiti. Origin and age of Saline formations . Precambrian-Cambrian boundary problem. Precambrian and Palaeozoic stratigraphy of Rajasthan.

UNIT -4

Mesozoic history: Distribution and stratigraphy of Triassic of Spiti, Jurassic of Cutch (Kutchh) and Cretaceous of South India. Bagh beds, Lameta Beds. Deccan Traps. Permo-Triassic Boundary.

UNIT -5

Palaeoclimate, classification, distribution and stratigraphy of the Gondwana Supergroup. Cenozoic history: Tertiary of Assam and Rajasthan. its economic importance. Siwaliks and its vertebrate fossil record. K-T boundary.

Reference:-

Boggs Sam, JR: Principles of sedimentary and stratigraphy. Prentice Hall.

Krishnan, MS: Geology of India and Burma. Higginbothams Madras. Ravindra Kumar :Historical geology and Stratigraphy of India. John Wiley.

Waddia, DN: Geology of India. McMillan.

Doyal and Brennet MR: Unlocking the Stratigraphy: Concepts and Application. Prentice Hall.

First Semester

5- PALAEOBIOLOGY

UNIT -1

Modes of fossilization, technique of collection and preparation of fossils. Elements of palaeoecology, uses of fossils. Classification, evolution and geological history of following: Trilobites, Graptolites, Echinoides and Corals.

UNIT -2

Classification, evolution and geological history of following: Brachiopoda, Gasteropoda,, Lamellibranchia and Cephalopoda.

UNIT -3

Succession of vertebrate life through the geological time. Evolutionary history of Man, Elephant and Horse.

UNIT -4

Micropalaeontology : Classification and separation of micro fossils. Application of microfossils in fossil fuel exploration. Morphology, classification palaeoecology and geological history of following : Foraminifers and Ostracodes.

UNIT -5

Concept of palaeobotany and palynology .Plant life through ages. Characteristic features of Lower Gondwana flora. Characteristic features of Upper Gondwana flora.

Reference:-

Moore,Lalicher and Fisher. Invertebrate fossils.

Woods,H: Invertebrate palaeontology.

Clarkson,ENK :Invertebrate palaeontology and evolution. Blackwell.

Stearn CW and Carrol RL : Palaeontology – The record of life.John Wiley

Smith, AB: Systematics and fossil record –Documenting evolutionary pattern. Blackwell.

Prothero, DR : Bringing fossils to life : An introduction to Palaeobiology. McGraw hill.

Ananthraman and Jain : Textbook of Palaeontology.

Banner,FT and Lord AR: Aspects of micropalaeontology.

Roger, AS: Vertebrate palaeontology.

Jones DJ : Microfossils.

Glassener, MP: Principles of micro palaeontology.

Haq, BU and Boersma: Introduction to marine micropalaeontology.

Andrew: Palaeontology.

First Semester

PRACTICALS

PRACTICAL-I - Practical related to course 1 & 2 of semester I.

PRACTICAL-II - Practical related to course 3 ,4 & 5 of semester I.

SEMINAR – Study and preparation of given topics and its presentation.

Second Semester

1- IGNEOUS AND METAMORPHIC PETROLOGY

UNIT -1

Origin of magma. Factors affecting magma composition. Evolution of magma by differentiation and assimilation. Phase equilibria of monary (Silica), Binary (Mixed and eutectic Ab-An, Leu-Si) and Ternary (Ab-An-Di, Fo-Fa-Sil) Silicate systems. Magmatism in relation to plate tectonics.

UNIT -2

Forms, structures and textures of igneous rocks. Layered igneous structures. Classification of igneous rocks including IUGS system. Reaction principle and reaction series. Petrographic provinces.

UNIT -3

Origin of Granite: Magmatic and granitisation processes. Petrogenesis. Indian occurrences of Basic and Ultrabasic plutonic association; Granite –Granodiorite association; Tholeiite and alkali olivine basalt; Basalt-Dacite-Rhyolite association; Nepheline syenites, Ophiolites, Anorthosites and Pegmatites

UNIT -4

Agents of metamorphism, kinds of metamorphism, types of metamorphism. Structures and textures of metamorphic rocks. Metamorphic differentiation. Concept of metamorphic zones in contact aureole.

UNIT -5

Metamorphic grades, facies and facies series, facies classification. Metasomatism and their types. Types and origin of migmatites. Metamorphism of carbonates, pelites and mafic rocks. Charnockites, Khondalites, Eclogites. Paired metamorphic belts.

Reference:-

- Best M.; Igneous and metamorphic petrology. CBS.
- Bose, MK: Igneous petrology. World Press.
- Bucher, K and Frey, M. Petrogenesis of metamorphic rocks. Springer Verlag.
- Kretz, R: Metamorphic crystallization. John Wiley.
- McBerney, AR: Igneous petrology. Jones and Bartlet.
- Phillipots, A Igneous and metamorphic petrology. Prentice Hall.
- Turner, FJ: Metamorphic Petrology. McGraw Hills. Yaardley, BW; An introduction to metamorphic petrology. Longman.
- Winkler, HGF: Petrogenesis of metamorphic rocks. Springer Verlag.
- Miyashiro, A: Metamorphism and metamorphic rocks.. George Allen & Unwin.
- Wyllie PJ: Ultramafic rocks. PJ Heffer.
- Huand, VJ Petrology.

Second Semester

2- SEDIMENTARY PETROLOGY

UNIT -1

Origin of sediments. Processes of sedimentation. Mode of transport of sediments. Stoke's law. Classification of common sediments (rudites, arenites, argillites). Classification of sedimentary rocks.

UNIT -2

Origin, classification and significance of primary, secondary and organic sedimentary structures. Palaeocurrent significance in quality assessment. Classification of sandstones and limestones. Dolomites.

UNIT 3

Textures of sedimentary rocks and their genetic significance. Granulometric analysis of clastic particles, statistical measure and interpretation of nature of sediments. Diagenesis.

UNIT -4

Elements and types of depositional environments: Continental (Fluvial, Lacustrine, Aeolian and Glacial), Transitional and Marine environments. Evaporates and Volcanoclastic sediments. Sedimentary facies.

UNIT -5

Provenance and mineral stability. Concept and types of sedimentary provenance. Heavy minerals: Their separation and utility in the provenance analysis. Tectonic framework of sedimentation.

Reference:-

Allen, P: Earth surface processes. Blackwell.
Davis, RA: Depositional systems. Prentice Hall.
Einsel, G: Sedimentary basins. Springer Verlag.
Miall, AD: Principles of sedimentary basin analysis. Springer Verlag.
Nichols, G: Sedimentology and stratigraphy. Blackwell.
Reading, HG: Sedimentary environments. Blackwell.
Pettijohn, FJ: Sedimentary rocks.
Pettijohn, Potter & Seiver: Sand and sandstones.
Second Semester

Second Semester

3 - ECONOMIC GEOLOGY:

UNIT I

Introduction –The importance and history of mining - The nature and morphology of the principal types of ore deposit- Textures and structures of ore and gangue minerals-Fluid inclusion studies- Wall rock alteration-Geothermometry, Geobarometry, Paragenetic Sequence, Zoning and dating of ore deposits-Classification of mineral deposits.

UNIT II

Ore deposits and ore minerals. Orogenesis. Magmatic processes of mineralisation. Porphyry, skarn and hydrothermal mineralisation. Mineralisation associated with (i) Ultramafic, mafic and acidic rocks, (ii) greenstone belts, (iii) komatiites, anorthosites and kimberlites and (iv) submarine volcanism. Magma-related mineralisation through geological time. Stratiform and stratabound ores. Ores and metamorphism — cause and effect relations.

UNIT III

Principles of chemical weathering – lateritic deposits- clay deposits – calcrete- hosted deposits – supergene enrichment of Cu and other metals in near surface deposits – clastic sedimentation and heavy mineral concentration – placer deposits – chemical sedimentation – banded iron formations – phosphorites and evaporates.

UNIT IV

Mineral deposits- Patterns in the distribution– continental growth rates - crustal evaluation and metallogenesis – metallogeny through time – plate tectonics and ore deposits. Application of fluid inclusion study and stable isotope geochemistry in understanding ore forming processes. Ore textures and paragenesis

UNIT V

Occurrence and distribution in India of metalliferous deposits — base metals, iron, manganese, aluminum, chromium, nickel, gold, silver, molybdenum. Indian deposits of non-metals — mica, asbestos, barytes, gypsum, graphite, apatite and beryl. Gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint, ceramic and cement industries. Building stones. Phosphorite deposits. Placer deposits, rare earth minerals. Strategic, critical and essential minerals. India's status in mineral production. Changing patterns of mineral consumption. National Mineral Policy. Mineral Concession Rules. Marine mineral resources and Law of Sea.

REFERENCES:

1. Bateman, A. M. and Jensen, M. L. Economic mineral deposits, John Wiley and sons, New York. 1981.
2. Gailbert, J.M., Park, C. P. Jr. and Freeman, W. H. The geology of ore deposits, John Wiley and sons, New York. 1986.
3. Krishnaswamy, S. India's mineral resources, Oxford and IBH publishing, New Delhi. 1979.
4. Edwards, R. and Atkinson, K. Ore deposit geology, 1st Edition, Chapman and Hall. New Delhi, 1986.
5. Robb, L. Introduction to ore-forming processes, Blackwell publishing, U.K., 2005.
6. Anthony Evans, Ore Geology and Industrial Mineral, John Wiley & sons, USA, 1993
7. R.M. Umthay, Mineral Deposits of India, Dattsons, New Delhi, India, 2006

Second Semester

4 - GEOCHEMISTRY

UNIT I

INTRODUCTION TO GEOCHEMISTRY Introduction – Periodic table, Geochemistry of the Earth; Formation of the solar system. The geochemical cycles - Distribution of elements in rocks and soils.

UNIT II

GEOCHEMISTRY OF MINERALS, ROCKS AND WATERS Mineral stability, compositional changes in minerals. River water, Seawater, Seafloor hydrothermal systems; Groundwater and Lakes. Characteristics of Magma, Melting of rocks, Water in Magmas. Distribution of trace components between rocks and melts

UNIT III

ISOTOPE GEOCHEMISTRY Radioactive Decay, Determining Isotope Decay time, Potassium-Argon Systematics, Uranium-Thorium-Lead Systematics. Types of Isotope-Fractionation, isotope Exchange between minerals and water, Carbon, Oxygen and Sulphur isotopes.

UNIT IV

EXPLORATION GEOCHEMISTRY Introduction – Primary dispersion pattern, Secondary dispersion pattern – background values. Geochemical anomaly – geochemical sampling. Principles and techniques used in the design and implementation of an exploration geochemical survey.

UNIT V

ENVIRONMENTAL GEOCHEMISTRY Anthroposphere aquatic environment – Marine, fluvial, lacustral, aerosols. Impact caused by human activity.

REFERENCES:

1. John V. Walther, Essentials of Geochemistry, Jones and Bartlett Publishers, 2005, Boston.
2. Girard, Principles of Environmental Chemistry, Jones and Bartlett Publishers, 2005, Boston.
3. Faure, G, Principles and applications of Geochemistry, Pearson Education, 1998, INC, Australia.
4. Arthur Brownlow, Geochemistry (Second edition), Pearson Education, INC., Australia, 1996.
5. Faure, G., Principles and applications of Geochemistry, Pearson Education, INC, Australia, 1998.
6. Nelson EBY, G., Principles of Environmental Geochemistry, Thomson Brooks/Cole, UK, 2004.
7. Criss, R.E. Principles of stable Isotope distributions. Oxford University Press, U.K., 1999.
8. Lajtha, J. and Michener, R. Stable isotopes in ecology and environmental Science, Blackwell, U.K., 1994.

Second Semester

5- HYDROGEOLOGY

UNIT I

Hydrologic cycle – Scope, hydrograph - origin and source - distribution of groundwater – aquifers – aquifer compressibility - porosity - rock properties – specific yield, storage coefficient – groundwater occurrence in various geological formations – geological structures – Hydrology of India.

UNIT II

Darcy's law – validity of Darcy's law – hydraulic gradient - hydraulic conductivity – field mapping - flow nets - transmissivity – homogeneity and heterogeneity – isotropic and anisotropic formations – groundwater resources evaluation – unsaturated flow.

UNIT III

General groundwater flow equation – steady and unsteady radial flow towards wells – confined, unconfined and semi confined aquifers – impact of boundaries – multiple wells - estimation of aquifer parameters by pump tests – slug tests – well loss - groundwater recharge – groundwater modelling.

UNIT IV

Advantage of groundwater use – Construction of wells – shallow and deep wells – methods of well completion and development – testing for yield - safe yield – horizontal wells – galleries - interference between wells and aquifer boundaries - aquifer response to pumping - land subsidence – Groundwater recharge.

UNIT V

Constituents in groundwater – dissolved ions – chemical analysis – reporting of results – groundwater quality for various uses - geochemical evolution of groundwater - sources of contaminants – solute and particle transport – remediation - seawater intrusion - Case studies.

REFERENCES:

- 1 Domenico P.A. and F.W. Schwartz, Physical and chemical hydrogeology. John Wiley 1990.
- 2 Fetter, C. W., Applied Hydrogeology, (3rd edition), New York, Macmillan, 1994
- 3 Freeze, R.A and Cherry, J.A, Groundwater, Prentice Hall, 1979
- 4 Elango, L and Jayakumar, R (Eds.) Modelling in Hydrogeology, Unesco-IHP Publications, Allied Publ, 2001
- 5 Elango, L (Ed.) Hydraulic conductivity – Issues, Determinations and applications, Intech Open Acces Publishers, ISBN 978-953-307-288-3, 434 P. 2011.
- 6 Todd, D.K Groundwater Hydrology, John Wiley, 1979
- 7 Hiscock, K, Hydrogeology: Principles and Practice, Wiley-Blackwell, 2005.

PRACTICALS

PRACTICAL-I - Practical related to course 1 & 2 of semester II.

PRACTICAL-II -Practical related to course 3,4 & 5 of semester II.

FIELD WORK

PRESENTATION

Third Semester

1- MINERAL EXPLORATION, MINING GEOLOGY AND MINERAL DRESSING

UNIT 1

Mineral exploration, Geomorphological and remote sensing techniques, • Geobotanical and geochemical methods • Guides to ore: Regional and Topographical Guides, Mineralogical Guides, Structural Guides and Stratigraphic Guides, Methods of surface and subsurface exploration, prospecting for economic minerals – drilling, sampling and assaying

UNIT 2

Geophysical techniques. Principle, field procedure and application of - Gravity method, Electrical method, Magnetic method, Radioactivity method and Seismic, method.

UNIT 3: Mining terms and their descriptions. Sampling - Principles – Types of sampling – Collection & preparation of samples. Drilling: Types of drills and methods of drilling. Geological logging. Explosives and Blasting Methods. Opencast mining: Mine machinery-power shovel, bucket wheel excavator, conveyor and spreader.

UNIT 4

Types of mining. Surface mining / Underground mining;- Stopping: Open stopes – supported stopes, shrinkage stopes. Caving;- Top slicing-sub level caving –block caving. Ground water control – Mine ventilation Coal Mining: Prospecting and planning – underground mining –Room and pillar method – long wall (advancing & retreating) method – Future trends in India. Mining and environment, Mitigation of mining hazards. Factors controlling the choice of various mining methods.

UNIT 5: Principles and scope of mineral dressing; Physical and chemical properties of minerals as applied to mineral dressing. Size reduction Fundamentals – Preliminary breaking – Jaw crushers – Gyratory crushers and Stamping; - Fine grinding – Wet and dry – Ball Mills;- Size separation – Screening –Sieve scale, Grizzlies , Vibrating screens;- Settling- Principles of settling, free settling hindered settling, gravity concentration;- Jigs;- Rakes Classifiers; - shaking tables – Wilfley tables – principles of magnetic separation and Electrostatic separation.

References

1. Krynine, D. P. and Judd, W. R. 1957 Principles of Engineering Geology and Geotechniques, McGraw Hill.
2. Arogyaswamy, R. N. P. 1973 Courses in Mining Geology, Oxford & IBH, New Delhi.
3. Mc Kinstry, H.E 1960 Mining Geology, New York..
4. Gauding, A.M. 1939 Principles of Mineral Dressing , McGraw Hill.
5. Taggart, A.E. Elements of ore dressing.
6. Awakes, H &Wobb J.S. Harper & Row Geochemistry In Mineral Exploration New York.
7. Principles Of Geochemical Prospecting, Ginsburg. I.I. Pentagon Press, N.Y. london.
8. Biochemical Methods Of Prospecting, Malyuga, D.P.
9. Sharma. P.V-. Geophysical Methods in Geology

Third Semester

2- GEOTECHNICAL ENGINEERING

UNIT I

Field investigations, electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering, Description of discontinuities, Nature bed rock. Geological information for slope stabilization.

UNIT II

Engineering classification of rocks – weathering and its significance in engineering site- Engineering properties of rocks and soils, RMR, RQD methods, determination of engineering properties in field and laboratory.

UNIT III

Geological investigations for Dams - suitability of site, geological profile from catchment area to dam site, lithology, structures, topography, slope, drainage system, Reservoir site investigations, siltation analysis.

UNIT IV

Geological investigations for soft rock and hard rock tunnels construction. Coastal erosion and accretion process and its impact. Geological investigations for harbor construction, Coastal protection structures-Sea walls, bulk heads, groins, jetties.

UNIT V

Landslide - Classification, causative factors, control measures. Land subsidence, factors, causes and remedial measures. Geological considerations for monitoring of landslides. geotechnical problems related to foundation for bridge and building site investigations

REFERENCES:

1. Krynine and Judd. Principles of Engineering Geology and Geotechnology. McGraw Hill, New York, 1962.
2. Chandler. R.J. Slope Stability and Engineering Developments 1992. 3. Waltham, T. Foundations of Engineering Geology, SPON Press, London 2002, ISBN 0-415- 25449-3,,.
4. Bell F G Engineering Geology, Second Edition by, 2007. Butterworth-Heinemann, Oxford
5. Sathya Narayanaswami. Engineering Geology. Dhanpat Rai and Co. 1710, Nai Sarak, Delhi-110006.. 2000
6. Waltham, A.C. Foundations of Engineering Geology, Blackie Academic Professional Pub., I Ed.,UK,1994.

Third Semester

3- REMOTE SENSING , GIS GPS APPLICATION IN GEOLOGY

UNIT I

Introduction to remote sensing its types. Photogrammetry – principles and concepts. Image interpretation elements. Spectral Signature of various lithologic and structural feature.

UNIT II

Introduction to GIS. Type of data – spatial and non spatial data , vector and raster formats – hardware for GIS. GPS its types, principle, function and use.

UNIT III

Image characters of landforms, Significance of landforms -. Role of aerial photographs and satellite images in Geomorphic mapping.

UNIT IV

Application of Remote sensing and GIS for mineral, ground water and petroleum exploration. Case studies with methodology.

UNIT V

Integrated surveys using Remote sensing and GIS for mineral exploration, Groundwater studies, Coastal erosion and accretion, Landslides and Earthquake studies, Coastal Zone Management.

REFERENCES:

1. George Joseph, Fundamentals of Remote Sensing, Second Edition, Universities Press (India) Private Limited, 2005 ISBN 8173715351, 9788173715358
2. Lillesand. TM., Kiefer, R.W and Chipman, K.W. Remote sensing and image interpretation Fifth Edition. Wiley. 2007.
3. Ravi P. Gupta, Remote Sensing Geology, Springer-Verlag New York, 2002.
4. Burrough, PA; and RA McDonnell. Principles of Geographic Information Systems. Oxford Press, U.K., 1998.
5. Wolf. P. R. Elements of Photogrammetry. Mc Graw Hill, Japan, 1993.
6. G. Rees. Physical Principles of Remote Sensing. Cambridge University Press, U.K., 2000.
7. SN Pandey, Principles and Applications of Photogeology: New Age International (P) Ltd., New Delhi. 1988.

Elective Papers of A & B Group (Any one each)

Elective Paper 1 – One of A Group

Elective Papers 2 – One of B Group

PRACTICAL- I - Practical related to course 1 & 2 of semester III.

PRACTICAL- II - Practical related to course 3 semester III.

ELECTIVE PAPER - GROUP A

Elective papers - A1

GEOSTATISTICS

UNIT I

Simultaneous linear equations – Direct method - Gauss elimination, Gauss - Jordan methods – Iterative method – Jacobi and Gauss-eidal methods. Difference table – Newton’s forward and backward interpolation – Newton’s divided differences – Lagrangian interpolation.

UNIT II

Numerical integration – Trapezoidal and Simpson’s 1/3 rules. Taylor serie and Euler methods- Runge – Kutta method of fourth order – Adam– Bashforth Predictor - Corrector method.

UNIT III

Types of Sampling - Description of discrete and continuous data – Measures of Central tendency and dispersion for grouped and ungrouped data – Measures of position – Box and Whisker plot.

UNIT IV

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT V

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, χ^2 and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

REFERENCES:

1. Grewal ,B.S. and Grewal ,J.S. ,| Numerical methods in Engineering and Science —, 6th Edition, Khanna Publishers , New Delhi ,2002
2. P.S. Mann, —Introductory Statistics|, John Wiley and Sons. Inc 5th edition, 2004.
3. D.C. Montgomery and G.C. Runger, —Applied Statistics and Probability for Engineers|, Wiley Student Edition, 2007.
4. Balagurusamy ,E,| Numerical Methods —, Tata Mc Graw Hill Pub.Co. Ltd, New Delhi, 1999.
5. Walpole,R.E. and Myers R.H, Myers ,S.L. and Ye, K,|Probability and Statistics for Engineers and Scientists —, Pearson Education, Asia, 8th edition, 2007

COMPUTER APPLICATION IN GEOLOGY

Unit-1

Introduction to computer history and hardware . Historical development and generation of computers. Computer organization – control unit, arithmetic-logic unit, input / output device. Memory devices: RAM, ROM, PROM, EPROM, Serial access, Direct access memory. Data processing concepts-data storage, file organization, file utilities, data base management, advantages and limitations.

UNIT-II

Number Systems Positional and non-positional numbers, binary, octal and hexadecimal number system. Converting from one number system to another system. Binary arithmetic – addition, subtraction, multiplication division. Computer codes – BCD, EBCDIC ASCII 7 codes.

UNIT-III

Computer Languages .Machine language, assembly language, high level language. High level languages – preliminaries of Fortran, Cobol, Basic, Pascal. Introduction to Amphibol software, operating and commands. Petrocal software, operating and commands.

UNIT-IV

Fortran Programming Elements of Fortran programming-classes of data, constants and variables. Problem analysis, algorithm development, quality of algorithms, flow charts and symbols, debugging and testing. GOTO, IF, DO, LOOP Statements. Subscript variables, arrays, dimension and Format statements.

UNIT- V

WINDOWS operating system, Basic features of computer languages- C and C++; Use of spreadsheet; Basic features of MS word.

REFERENCES:

- 1 V. Rajaraman Fundamentals of Computers
2. B.B. Bayer Programming software, designing and problem solving
3. Krishnamurthy & Sen Computer based numerical algorithm
4. D.D. MoGracken A simplified guide to FORTRAN programming
5. Ram Kumar Programming with FORTRAN 77 6. P.K. Sinha Computer Fundamenta

Elective papers - A3

ENVIRONMENTAL GEOLOGY

UNIT I

Concept and scope of environmental geology – understanding earth processes and landforms; Geological characteristics of various environmental regimes – fluvial, coastal, marine, Aeolian, desert, and glacial. - Landforms as ecosystem units – Geomorphic controls on biodiversity and its conservation.

UNIT II

Environmental degradation due to mining and ore beneficiation – impact and management – Indian case studies - soil and mineral resources and their conservation.

UNIT III

Geological factors influencing the formation of surface, groundwater and marine Waters – geological basis of groundwater, surface and marine water pollution and management with Indian case studies.

UNIT IV

Environmental impact assessment – geological appraisal of waste disposal sites - geology in planning and siting of land fills - problems of deep well disposal, radioactive waste management - land use planning in EIA.

UNIT V

Causes, types, Mitigation and Management of earthquakes, landslides, tsunami and volcanoes. ; Causes and Indicators of global environmental change

REFERENCES:

1. Montgomery, C.W. Environmental Geology, Won. C. Brown, Publishers, Iowa, 1989.
2. Dorothy Merritts, Andrew de Wet, Kirsten Menking, Environmental Geology W. H. Freeman & Co. and Sumanas, Inc. USA, 1997
3. Valdiya, K. S, Geology, Environment and Society, Universities Press, India, 2004

Elective papers -A4

MEDICAL GEOLOGY

Unit-1

Atmosphere-Lithosphere - Hydrosphere-Definitions-Composition of atmosphere- Atmospheric gases Green house effect Global warming. Soil composition humification- types of soils - Inorganic and Organic pollutants. Hydrological cycle- Water characteristics Groundwater provinces -water pollution. Noise levels Standards-impact of noise on human-Behavioural disorders

Unit-II

Geological hazards - hazards & Risks - Types of hazards - Earthquake - Volcanoes- Landslides - Floods - Tsunamis. Solid waste - Types - Sources-Factors-Disposal - Bio-medical waste-Incineration-Solid Waste Management.

Unit-III

Environmental health concept of Medical Geology - Eco-Toxicity - Toxicology Inorganic Pollutants - Organic pollutants - Organic compounds, Leachates; Potentially toxic organic compounds-Etiological agents. Exposure to toxic level of trace elements -Trace element deficiencies - Exposure to Natural & artificial dusts - Radioactivity- Dose response - Dispersion in Ambient and workplace environment - Occupational health.

Unit - IV

Heavy metals-Lead; Mercury; Cadmium; Arsenic; chromium; Zine; Copper etc.
Health effects-Chronic exposure-Inhalation - Indestion-Dermal contact-Parenteral Fluorine waterborne - Geological - Dental caries - Skeletal Fluorosis-Neurologica disorders Protal fibrosis haemotologic disorders.

Unit -V

Occurrence and distribution Use in medical purpose of- Gypsum, Gold, Diamond, Iron, Cupper sulfate, Magnesium carbonate, Arsenic Trisulfide Occurrence and distribution Use Gemstone, Mica,Pesticide Pharmaceutical - Glass - Micro-electronics Mineral dusts Silicosis; Asbestosis: Carcinoma; Mesothelioma; Pleural plaques; Byssinosis, Sideros Berylliosis; Methemoglobinemia - Radon emissions - Granies - Phosphatic rock Nephrotoxic and Carcinogenic Bio-transformations.

Reference:-

Practical Application of Medical Geology

Editors- Malcolm Siegel . Olle selinus

Robert Finkelman

Principal of Geochemistry

Editors- Brian manson, Carleton B. moor

Elective Paper – Group B

Elective papers - B1

WATERSHED MANAGEMENT

Unit – I

Introduction: Definition, concepts of watershed; Effects of watershed on community, topography, geology and soils & vegetation and landuse. Soils: Types of rocks, weathering of rocks, factors of soil formation, soil forming processes, soil profile, physical properties, types of the soils in India; Soil erosion: Basic processes, factors affecting soil erosion, types of soil erosion; Watershed development: Land capability classification, concept, objectives and need for watershed development.

Unit – II

Hydrologic processes: Hydrologic cycle, precipitation (liquid/solid), interception, evaporation and transpiration, infiltration and run-off; Participatory rural appraisal (PRA) in watershed programme: Basic principles, assumptions, basis, important types, benefits, tools, maps and models of PRA programmes.

Unit - III

Erosion control measures on agricultural land: Contour cultivation, contour bunding, graded bunds, bench terracing, grassed water ways; Mechanical erosion control measures for non agricultural land: Contour trenching, gully control measures, vegetative control measures, checkdams, brush dams, semi permanent gully, control structures, permanent control structures.

Unit - IV.

Water conservation and Harvesting: Rainwater harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks; Groundwater management in watershed: Types of aquifers, vertical distribution of groundwater, conjunctive use of surface and use of groundwater; Remote sensing, thematic maps, geological and hydrogeological maps.

Unit – V

Ecosystem Management: Role of ecosystem, crop husbandry, soil enrichment, inter-, mixed- and strip-cropping, cropping pattern, sustainable agriculture, bio-mass management, dryland agriculture, Silvi pasture, horticulture, social forestry and afforestation; Grassland management, Joint forestry management Monitoring and evolution of watershed; Planning of watershed management activities: Preparation of action plan, administrative requirements.

References:

1. Watershed Management by JVS Murthy, - New age International Publishers.
2. Water Resource Engineering by R.Awurbs and WP James, - Prentice Hall Publishers.
3. Integrated watershed management – Rawat publications by – Rajesh Rajora.
4. Land and Water Management by VVN Murthy, - Kalyani Publications.
5. Irrigation and Water Management by D.K.Majumdar, Printice Hall of India

Elective papers - B2

FUEL GEOLOGY

UNIT I

Petroleum- its composition and different fractions; origin, nature and migration (primary and secondary) Of oil and gas; transformation of organic matter into kerogene; surface and subsurface occurrence of petroleum and gas.

UNIT II

Characteristics of reservoir rocks and traps (structural, stratigraphic and correlation); Prospecting for oil and gas, drilling and logging procedures; oil-bearing basins of India; geology of the productive oil fields of India; position of oil and natural gas in India; future prospects and the economic scenario

UNIT III

Coal- Definition and origin of kerogen and coal; sedimentology of coal bearing strata; rank, grade and type of coal; Indian and International classifications of coal; macroscopic ingredients and microscopic constituents; concept of maceral and microlitho types.

UNIT IV

Chemical characterization: proximate and ultimate analysis; coal petrology and its application in solving industrial and geological problems; preparation of coal for industrial purposes; coal carbonization (coke manufacture) coal gasification and coal hydrogenation Coal bed – methane: a new energy resource. Hydrocarbon evaluation.

UNIT V

Atomic fuel- Mode of occurrence and methods of prospecting and productive geological horizons in India; nuclear power stations of the country and future prospects; mud engineering, drilling fluid, gas sampling, mud logging , sample catching and its examination and interpretation.

References:

1. Taylour, G.H., Teichmuiler, M., Davis, A., Diessel, C.F.K. and others: - Organic Petrology
- 2.Selley, R.C.: -Elements of Petroleum Geology
- 3.Chandra, D., Singh, R.M and Singh, M.P.: -Textbook of Coal
- 4.Singh, M.P.: - Coal and Organic Petrology
- 5.Stach, E, Macknowsty, M.T.H; Taylor, H.H and others: - Stach's Textbook of Coal Petrology
- 6.Durrance, E.M.: -Radioactivity in Geology: Principles and Applications

ADVANCE REMOTE SENSING AND GIS & GPS

Unit 1

Fundamentals of Remote Sensing, Definition and principles of remote sensing, Electromagnetic spectrum, and its relevance, Types of remote sensing platforms: satellite, aerial, and ground-based Image acquisition and interpretation, and enhancement techniques, Environmental monitoring and change detection.

Unit 2:

Basics of hyperspectral imaging, Applications in mineralogy and lithology, Spectral unmixing and classification techniques, Introduction to SAR technology, Interferometry and differential SAR, Applications in terrain deformation and subsidence.

Unit 3:

Introduction to satellite navigation and GPS, GPS signal structure and satellite constellation, Differential GPS (DGPS) principles, GPS data collection techniques.

Unit 4:

Methods and techniques for integrating GPS data into GIS platforms, Application of GPS in geological field surveys and GIS-based mapping, Spatial analysis techniques using GPS and GIS in geological investigations, Real-time kinematic (RTK) GPS applications and monitoring geological processes.

Unit 5:

Principles and applications of LiDAR in 3D modelling and terrain analysis, Overview of emerging technologies, including hyperspectral and ultra-high-resolution remote sensing, Use of web-based GIS platforms and mobile applications in geological fieldwork, Research project exploring innovative applications of geospatial technologies in geological studies.

Suggesting readings:

1. "Remote Sensing and GIS for Geologists: A Comprehensive Guide" by Ian Alasdair Evans.
2. "Geographic Information Systems and Science" by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind.
3. "GPS for Geodesy" by J. Ashley, M. S. Lachapelle.
4. "Introduction to Remote Sensing" by Arthur P. Cracknell and Ladson Hayes.

Instrumentation Geology & Analytic Techniques

Unit 1

Remote Sensing, Satellite Image Acquisition, Image Preprocessing, GIS, GIS Data Sources and Collection, GIS Data Formats and Standards, Georeferencing and Spatial Analysis , Image Classification, Change Detection, Digital Cartography, Cadastral mapping & planning.

Unit 2

Overview of Geophysical Methods, Basics of Resistivity Survey, Instrumentation and Equipment, Field Procedures and Data Acquisition, Site Selection and Survey Planning, Data Acquisition Techniques, Data Quality and Troubleshooting, Data Processing Software, Resistivity Imaging Techniques, Advanced Resistivity Survey Techniques.

Unit 3

Overview of Surveying Techniques, Types of Surveying Instruments, Instrument Components and Operation, Total Station Setup and Calibration, Measurement Techniques with Total Station, Data Processing with Total Station Data, Introduction to DGPS and GPS, Field Techniques with DGPS and GPS, Data Integration and Mapping with DGPS and GPS, Real-time Kinematic (RTK) GPS.

Unit 4

Microscopic study of ores and minerals, Ore Identification Techniques, Ore Sampling and Preparation, Ore Petrography, Ore Microscopy, DBTM (Digital basement terrain model) & well inventory preparation.

Unit 5

Hydrochemical Study, Hydrochemical Analysis Techniques, Sampling Techniques in Hydrochemistry, Hydrochemical Data Interpretation, Isotope Geochemistry, Stable Isotopes in Hydrology, Radiogenic Isotopes.

Suggested Readings:

1. Wiley R. P. Gupta. 2016. Remote Sensing Geology, Springer F. F. Sabins, 2007.
2. Telford, W. M., Geldart, L.P. and Sheriff, R. E., 1990. Applied Geophysics, Cambridge
3. Lowri, W. Fundamentals of Geophysics, Cambridge University Press.
4. Atlas on methodology for Land Information System or Cadastral Survey & Mapping – Dr N. C. Gautam.
5. Ridley, John. (2013). Ore deposit geology. Cambridge University Press.
6. Barnes, H.L., 1979. Geochemistry of Hydrothermal Ore Deposits, John Wiley.
7. White, W. M. Isotope Geochemistry. Wiley Blackwell
8. White, W. M. Isotope Geochemistry. Wiley Blackwell

SEMESTER- 4

Disertation/ Thesis work