SYLLABUS

MSc GEOLOGY

(Specialization: Petroleum Exploration/ Geoinformatics)

SYLLABUS

(With effect from 2016-17 admitted batch)

ADIKAVI NANNAYA UNIVERSITY

RAJAHMUNDRY – 533 105, A.P., INDIA

www.nannayauniversity.info or www.aknu.info

ADIKAVI NANNAYA UNIVERSITY

M.Sc. Geology (Petroleum Exploration/Geoinformatics)

Subject Code	Subject Title	Periods/ week	Credits	Total Marks
1st year: I Semester				
GEO 101	Mineralogy	4	4	100
GEO 102	Igneous And Metamorphic Petrology	4	4	100
GEO 103	Structural Geology and Engineering Geology	4	4	100
GEO 104	Geomorphology and Remote sensing	4	4	100
GEO 105	Mineralogy lab	3	2	50
GEO 106	Igneous And Metamorphic Petrology lab	3	2	50
GEO 107	Structural Geology and Engineering Geology Lab	3	2	50
GEO 108	Geomorphology and Remote sensing lab	3	2	50
1st year : II Semester				
GEO 201	Sedimentology	4	4	100
GEO 202	Stratigraphy and Paleontology	4	4	100
GEO 203	Geochemistry	4	4	100
GEO 204	Economic Geology And Indian Mineral Deposits	4	4	100
GEO 205	Sedimentology lab	3	2	50
GEO 206	Stratigraphy and Paleontology lab	3	2	50
GEO 207	Geochemistry lab	3	2	50
GEO 208	Economic Geology And Indian Mineral Deposits lab	3	2	50
GEO 209	Field geology and report	2	2	50
2nd Year: III Semester				
Geo-informatics	**Petroleum Exploration**			
GPE 301: Mineral Exploration And Mineral Economics	GPE:301Mineral Exploration And Mineral Economics	4	4	100
GGF 302:Geographical Information System	GPE 302: Petroleum System & Coal Geology	4	4	100
GGF 303:Digital Image Processing	GPE303: Geophysical Exploration Methods	4	4	100
GGF 304: Photogrammetry	GPE 304:Sedimentary Basins Of India	4	4	100
GPE 305: Mineral Exploration and Mineral economics lab	GPE 305: Mineral Exploration and Mineral economics lab	3	2	50
GGF 306:GIS Lab	GPE 306: Petroleum System lab	3	2	50
GGF 307:Photogrammetry & DIP Lab	GPE 307: Geophysical Exploration methods Lab	3	2	50
GGF 308: Field mapping and report	GPE 308: Field geological mapping and report	2	2	50
2nd Year: IV Semester				
GPE 401: Hydrogeology and Environmental Geology	GPE 401: Hydrogeology & Environmental Geology	4	4	100
GGF 402: Advanced remote sensing	GPE 402: Well-site geology	4	4	100
GGF 403: Spatial data analysis and modeling	GPE 403: Seismic Methods of Exploration	4	4	100
GGF 404: Geoinformatics for Natural resources Management	GPE 404: Formation evaluation	4	4	100
GPE 405: Hydrogeology & Environmental Geology Lab	GPE 405 Hydrogeology & Environmental Geology lab	3	2	50
GGF 406: Advance Remote sensing & Spatial data analysis lab	GPE: 406 Well-site geology & Formation Evaluation lab	3	2	50
GGF 407: Geoinformatics for Natural resources lab	GPE 407 : Seismic methods of Exploration Lab	3	2	50
GPE/GGF 408: Project Work: (Dissertation: 50 marks & Viva-cum-presentation: 50 marks)			4	100
Grand Total			**100**	**2400**

Scheme of Examination

M.Sc., Geology (Petroleum Exploration/Geoinformatics)

(W.e.f. 2016-17 Admitted batch)

S. No	Evaluation		Total marks
I	**Theory**		
	Internal assessment (Two mid-exams: 15 Class tests/ assignments/ Presentation/Comprehensive viva: 5 Attendance: 5	25	100
	Semester end examination	75	
II	**Practical/Lab**		
	Internal Assessment	12	50
	Semester end Exam (Record:5, Viva:5, Practical/problem solving:28)	38	
III	Field mapping/geological mapping and report		
	Field work & Report:	25	50
	Viva	25	
III	Project Work		
	Dissertation	50	100
	Viva-cum - Presentation	50	

Field mapping/geological mapping and report:

In every semester, concerned subject teachers would take students to the field and make them trained.

M. Sc., GEOLOGY: I semester

Geo 101: MINERALOGY

UNIT –I: Introduction to Minerals. Classification of silicate minerals. Structure, chemistry, physical and optical properties of (a) Olivine Group (b) Garnet Group (c) Epidote Group (d) Aluminosilicate Group (e) Pyroxene Group

UNIT –II: Structure, chemistry, physical and optical properties of (a) Amphiboles Group (b) Clay minerals (c) Mica Group (d) feldspathoids group (e) Feldspars

UNIT –III: Isomorphism, Polymorphism. Structure, chemistry, physical and optical properties of silica minerals, Classification of nonsilicates, chemistry and paragenesis of Native elements, Oxides and Sulphides.

UNIT – IV: Chemistry and paragenesis of Carbonates, phosphates, Halides and Sulphate minerals. Gemstones and Semi-precious stones

Geo 105: Mineralogy Lab:

a) Megascopic and microscopic identification of important silicate and nonsilicate minerals.
b) Calculation of Mineral formula
c) Interpretation of X-ray diffractograms of common minerals
d) SEM photographs

TEXT BOOKS:

1. An Introduction to the rock forming minerals by W.A.Deer, R.A. Howie and J. Zussman
2. Dana's Text book of Mineralogy by W.E. Ford
3. Manual of Mineralogy by Klein, C. and Hurlbut, Jr.C.S
4. Descriptive Mineralogy by L.G. Berry and Mason.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, I Semester

Paper – I: Mineralogy

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carried 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Write in detail about the classification of silicate minerals with neat sketches?

OR

2. Write an essay on olivine group of minerals

3. Describe the structure, chemistry and optical properties of amphibole group of Minerals

OR

4. Write an essay on mica group of minerals

5. Write about the structure, chemistry, physical and optical properties of silica minerals ?

OR

6. Write an essay on native elements ?

7. Write in detail about chemistry and paragenesis of the Sulphide group of minerals?

OR

8. Write an essay on gem stones?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
    a. Chemistry of carbonate minerals
    b. Structure of pyroxenes
    c. Physical properties of non-silicate minerals
    d. Smictite group of minerals
    e. Isomorphism
    f. Give 3 mineral names and chemical composition from garnet group
    g. Give 3 mineral names and chemical composition from feldspar group
    h. Paragenesis of halides

Geo 102: IGNEOUS AND METAMORPHIC PETROLOGY

UNIT – I: Magma generation, Primary and modified magmas. Mantle Xenoliths. Differentiation and assimilation of magmas, Magma mixing. Plate tectonics in relation to petrology. Bowen's reaction series, phase equilibrium of single, binary and ternary silicate systems and crystallisation in the light of experimental works and petrogenetic importance.

UNIT – II: Criteria for classification of igneous rocks. Textural, mineralogical and chemical classification. Norm (CIPW) and Niggli values. Classification using multiple criteria, IUGS classifications. Petrographic provinces and associations. Mineralogy, texture and patrogenesis of major igneous rock types of granites, Basalts, ultramafic rocks, carbonotites, Lamprophyres, syenites, & Nepheline syenites.

UNIT – III: Metamorphic textures and structures. Isograds, characterstics of different grades and facies of metamorphism. Regional and contact metamorphism of politic and impure calcareous rocks. Material transport during metamorphism. P-T-t path in regional metamorphic terrains.

UNIT – IV: Metasomatism and granitization, migmatites. plate tectonics and metamorphism. Petrogenetic aspects of important rock suites of India, such as the Deccan traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, khondalites, gondites and granitoids

Geo 106: Igneous and Metamorphic petrology lab

1. Megascopic and microscopic study of igneous rocks.
2. Calculation of CIPW norms. Preparation of variation diagrams.
3. Megascopic and microscopic study of metamorphic rocks.
4. Geothermobarometric calculations.
5. Filed work to identify rocks and various structures

TEXT BOOKS:

1. Philpots A., 1992. Igneous and metamorphic petrology.
2. Best, M.G., 1986. Igneous and metamorphic petrology.
3. Yardley, B.W., 1989. An introduction to metamorphic petrology.
4. Raymond, L.A., 1995. Petrology.
5. Middlemost – Magmas and Magmatic rocks.
6. Turner & Verhoogom – Igneous & Metamorphic petrology.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, I Semester

Paper – II: Igneous And Metamorphic Petrology

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Write in detail about the magma generation and differenciation?

OR

2. Write an essay on bowen's reaction series and single silicate system phase equilibrium ?

3. Describe the criteria for classification of igneous rocks with an example ?

OR

4. Write an essay on Granitic rocks ?

5. Write about the structures and textures of metamorphic rocks ?

OR

6. Write an essay on regional metamorphism ?

7. Write in detail about plate tectonics and metamorphism ?

OR

8. Write an essay of charnockites ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. xenolith
   b. Assimalation
   c. Gneiss
   d. Carbonotites
   e. Anorthosites
   f. Impure calcareous rocks
   g. Distribution of duccan traps
   h. Binary magma

Geo 103: STRUCTURAL GEOLOGY AND ENGINEERING GEOLOGY

UNIT – I: Mechanical principles and properties of rocks and their controlling forces - Concept of stress and strain - Composition and resolution of forces - Principles of failure by rupture relation of rupture to strain - Two dimensional strain and stress analysis. Types of strain ellipses and ellipsoids, their properties and geological significance. Stress-strain relationships for elastic, plastic and viscous materials. Measurement of strain in deformed rocks. Behavior of minerals and rocks under deformation conditions. Principles of geological mapping and map reading.

UNIT – II: Classification of folds, faults and joints. Structural analysis of folds, cleavages, lineations, joints and faults, Superimposed mechanism; Mechanism of folding, faulting and progressive deformation. Determination of top of beds by primary features. Shear zones: brittle and ductile shear zones, geometry and products of shear zones; mylonites and cataclastics, their origin and significance. Unconformities and basement-cover relations; Structural behavior of igneous plutons, diapirs and salt domes.

UNIT – III: Petrofabrics: Concepts, Types and elements, Field and laboratory techniques in petrofabric studies and Stereographic treatment; Plate tectonics and evolution of continental, oceanic crust, and sedimentary basins; Tectonics of Precambrian Orogenic Belts of India and formation of Mountain roots. Anatomy of orogenic belts with examples of Apline Himalayan, the Andes etc. Mechanical properties of rocks and soils.

Unit – IV: Site investigation, characterization and problems related to civil engineering projects: geological and geotechnical investigations for dams, reservoirs, spillways, tunnels, underground caverns, bridges, highways, shorelines. Tunnel types and Bridges types. Concrete aggregates: sources, alkali-aggregate reaction - Aseismic designing, seismicity in India and earthquake-resistant structures - Problems of groundwater in engineering projects - Geotechnical case studies of major projects in India

GEO 107: Structural Geology and Engineering geology Lab

- Preparation and interpretation of geological maps and sections.
- Structural problems concerning to economic mineral deposits.
- Recording and plotting of field data.
- Plotting and interpretation of petrofabric data using stereographic nets.
- Geological and geotechnical problems
- Field work to identify the rocks, out crop observation and to measure the attitude of beds and linear features and structures.

TEXT BOOKS:

1) Structural Geology by M.P. Billings.
2) Structural Geology and Tectonic Principles by P.C. Badgley.
3) Principles of Physical Geology by A. Holmes and D. L. Holmes.
4) Aspects of Tectonics focus on South Central India by K.S. Validya.
5) An outline of structural Geology by Bruce E. Hobbs.
6) Krynine: Principles of Engineering geology

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, I Semester

Paper – III: Structural Geology and Engineering Geology

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Define stress and stain and discuss strain ellipsoids ?

OR

2. Write about the mechanical properties of rocks and their controlling forces ?

3. Discuss about the folds and different types ?

OR

4. Write an essay on faults ?

5. Write about the concepts of petrofabrics ?

OR

6. Write about mechanical properties of rocks and soils ?

7. Write in detail about concrete aggregates ?

OR

8. Elaborate about seismicity in India ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Ductile deformation
   b. Young's modulus
   c. Stress ellipsoid
   d. Overthrust
   e. Oceanic crust
   f. Subduction zone
   g. Suspension bridge
   h. Alkali-aggregate reaction

Geo 104: Geomorphology and Remote sensing

Geomorphology: Unit-I: Basic principles of geomorphology. Denudation processes: Weathering, erosion, weathering products and soils – Profiles, types, duricrusts; Hill slopes characteristics and development, fluvial processes on hill-slopes, Slope analysis, River and drainage basin: Drainage pattern, Network characteristics. Mass wasting and landslides, classification, causes, prevention and rehabilitation. Geomorphological features of India and zones. concept of erosion cycle, concept of drainage basin. Topographic maps, drainage patterns and slopes - slope analysis and drainage basin analysis.

Unit–II: Geomorphic processes and resulting landforms: Landforms – role of lithology, peneplanation, endogenous and exogenous forces, climatic and tectonic factors and rejunevation of land forms; **Fluvial, Coastal, Glacial, Aeolian processes and landforms;** Landforms in relation to rock types – karst landscapes; Geomorphic indicators of neotectonic movements: Stream channel morphology changes, drainage modifications, fault reactivation, Uplift – subsidence pattern in coastal areas; Applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies; Geomorphology of India.

Remote sensing: Unit –III: Electromagnetic radiation – characteristics, remote sensing regions and bands; General orbital and sensor characteristics of remote sensing satellites; Spectra of common natural objects – soil, rock, water and vegetation. Aerial photos – types, scale, resolution, properties of aerial photos, stereoscopic parallax, relief displacement; Elements of photo and imagery pattern and interpretation; Principles of Photogrammetry.

Unit - IV

Digital image processing - characteristics of remote sensing data, preprocessing, enhancements, and classification; Remote sensing applications in Geology: interpreting structure and tectonics, Lithological mapping, mineral resources, natural hazards and disaster mitigation, groundwater potentials and environmental monitoring. Various systems of satellites and their interpretation for geological and other studies; space research in India; Thermal IR, Microwave Remote sensing and their applications. Introduction to GIS, spatial data models and Data structures, visualization and query of spatial data, over lay analyses, Geological applications using RS and GIS

Geo 108: Geomorphology and Remote sensing Lab

- Study of topographical maps
- Identification of different landforms from topographical maps, aerial photographs, imageries
- Satellite image annotation
- Study and use of Radiation thermometer
- Spectral Response pattern of different land cover objects/geological formations
- Ground data collection instruments
- Visual interpretation of aerial/thermal/satellite imagery/land use and land cover map
- Field work to study the topographic maps, map orientation and identify the land forms and geological information.

Text books:

1. Thornbury, WS, Principles of geomorphology, wiley eastern, New Delhi
2. Garner HF, 1974: origin of landscapes, Oxford University press
3. Leoplod LB, 1964: Fluvial processes in geomorphology, Euresia publishing house.
4. Campbell, J.B. (2002). Introduction to remote sensing, 3rd ed., The Guilford Press. ISBN 157230-640-8.
5. Jensen, J.R. (2007). Remote sensing of the environment: an Earth resource perspective, 2nd ed., Prentice Hall.
6. Lillesand, T.M.; R.W. Kiefer, and J.W. Chipman (2003). *Remote sensing and image interpretation*, 5th ed., Wiley. ISBN 0-471-15227-7.
7. Sabins, F.F.Jr., 1978: Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco.
8. Joseph, George Fundamentals of Remote Sensing Universities Press India
9. Lo.C.P. 1986: Applied Remote Sensing, Longman, London.
10. Bonham Carter, G.F. GIS for Geoscientists- Modelling with GIS, Elsevier, 1994.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, I Semester

Paper – IV: Geomorphology and Remote sensing

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Write about the principles of Geomorphology ?

OR

2. Define a drainage basin and discuss about drainage patterns with neat sketches ?

3. Discuss about the fluvial processes and resulting landforms ?

OR

4. Write an essay on aeolian processes and resulting landforms ?

5. Write an essay on characteristics of Electromagnetic radiation, remote sensing regions and bands ?

OR

6. Discuss about the elements of photo and imagery pattern and interpretation ?

7. Elaborate on applications of Remote sensing in Geology ?

OR

8. Discuss on space research in India ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Mass wasting
   b. Topographic map
   c. Karst topography
   d. Moraines
   e. Types of aerial photoes
   f. Soil spectra
   g. Thermal IR
   h. Microwave Remote sensing

Geo 201: SEDIMENTOLOGY

UNIT – I: History and development of sedimentology. Liberation and flows of sediments, processes of transport and generation of mechanical, chemical and biogenic sedimentary structures and controls on the sedimentary rock record. Origin of sedimentary rocks.

UNIT –II: Sedimentary textures, frame work matrix and cement of terrigenous sediments. Sedimentary environments and facies - Characteristics of continental**:** desert, fluvial, glacial, lacustrine, deltaic and transitional, lagoonal, littoral and barrier complex environments.

UNIT – III: Clastic sediments: gravel, sand and mud. Biogenic, chemical and volcanogenic sediments - Classification of conglomerates, sandstones and mudstones, and carbonate rocks - Provenance of sediments - Diagenesis and fluid flow - Diagenesis of mudstone, sand stone, limestone and Dolomites - Changes in mineralogy, fabric and chemistry.

UNIT- IV: Definition, measurement and interpretation of grain size: Wentworth scale, sieving and grain size parameters. Heavy minerals and its applications in provenance study. Field and laboratory techniques in sedimentology: recording of sedimentary structures, preparation of litho logs, rock and thin section staining. Paleocurrent analysis, applications of SEM, XRD and cathode luminescence studies

Geo 205: Sedimentology Lab

- Study of primary, secondary and biogenic sedimentary structures in hand specimens, of photographic atlases, field photographs and wherever possible on the outcrops.
- Pipette analysis – sand, silt and clay separation and estimation of percentages
- Size analysis – (sieving), calculation of grain size parameters.
- Heavy mineral- liquid separation-Bromoform method
- Graphical representation of data-Preparation of histograms, triangular coordinate diagrams and Shepard classification chart.
- Study of heavy minerals, Paleocurrent analysis
- Field work to identify the various rocks and sedimentary structures in field

TEXT BOOKS:

1. Bhattacharya, a and Chakraborti,C.,2000: Analyses of sedimentary successions, Oxford-IBH
2. Boggs Sam Jr.m1995: Principles of Sedimentology and Stratigraphy, Prentice Hall.
3. Sengupta S., 1997: Introduction to Sedimentology. Oxford-IBH
4. Nicholas,G.,1999: Sedimentology and Stratigraphy. Blackwell.
5. Friedman G.M.,and J.E Sanders: Principles of Sedimentology

References:

1. Allen, P., 1997: Earth surface Processes. Blackwell.
2. Davis, R.A.Jr., 1992: Depositional Systems. Prentice Hall.
3. Prothero, D.R. and Schwab, F., 1996: Sedimentary Geology, Freeman
4. Potter P.E & Pettijohn, F.J: Paleocurrents and Basin Analysis
5. Reineck, H.E and Singh,I.B 1980: Depositional Sedimentary Environments, Springer-Verlag.
6. Blatt H, Murray, G,V and Middleton,R.C.,1980: Origin and sedimentary Rocks

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, II Semester

Paper – I: Sedimentology

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Write about the history and development of sedimentology ?

OR

2. Write an essay on different types of sedimentary structures ?

3. Discuss about the sedimentary textures ?

OR

4. Give a detail note on sedimentary environments ?

5. Write an essay on clastic sediments ?

OR

6. Write an essay on limestones and dolomites ?

7. Write in detail about grain size analysis and its interpretations ?

OR

8. Give a detail note on heavy minerals and its applications in provenance study ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Mechanical transport
   b. Facies
   c. Diagenesis
   d. Litholog
   e. SEM
   f. Wentworth scale
   g. Graded bedding
   h. Ripple marks

Geo 202: STRATIGRAPHY AND PALEONTOLOGY

UNIT– I: Importance and principles of stratigraphy, geological time scale, Hutton's uniformitarianism – controls and development of stratigraphic record, Litho stratigrapghy, correlation and stratigraphic code. Bio stratigraphy: Review of current trends, Zonation and time significance.

UNIT – II: Magneto stratigraphy, Cyclostratigraphy and Event stratigraphy. Seismicstratigraphy and Sequence stratigrpahy, geochronology and Chrono-stratigraphy, Chemostratigraphy, Completeness and incompleteness of stratigraphic records.

UNIT –III: Introduction and advances in Micropalaeontology. Kingdoms of life. Stratigraphic distribution of major microfossil groups. Collection, separation and mounting of microfossils from surface and sub-surface sediments. Morphology, Ecology distribution and outline classification of Foraminifera. Role of Foraminifera in hydrocarbon exploration and Monitoring Coastal pollution.

UNIT – IV: Elementary ideas about the major morphological groups of Ostracoda, Radiolaria, Coccolithophores/ Calcareous Nanoplankton, pollen and spores and their stratigraphic and paleoecological significance Stable Isotopes and palaeoclimate. Taphonomy and paleobiogeography.

Geo 206: Stratigraphy and Paleontology Lab

1. Processing and preparation of samples for Microscopic study.
2. Identification of selected fossils/species of Foraminifera, Ostracoda and Radiolaria under stereo binocular Microscope with CCTV.
3. Study of Important microfossils from stratigraphic formations of India.
4. Study of SEM photographs of microfossils.
5. Construction of Biostratigraphic range charts and paleoenvironmental analysis of well sections.
6. Preparation of different stratigraphic distribution maps of India. Study of paleogeographic Maps.
7. Field work to know the stratigraphic sequence of rocks and identification of fossils

TEXT BOOKS:

1) Stratigraphic principles and practice, 1960. J. Marwin Weller. Harper and Row Publisher.
2) Haq, B.U and Boersma, A. 1978; Introduction to Marine Micropaleontology, Elsevier.
3) Boggs, Sam JR; 1995; Principles of sedimentology and stratigraphy Prentice Hall.

References:

1) Doyle, P and Bennet, M.R., 1996; Unlocking the stratigraphic Record. John Wiley.
2) Brenner, R.E and MC Hargue, T.R; 1988; Integrative Stratigraphy Concepts and applications Prentice Hall.
3) Prothero, D.R. 1988; Bringing fossils to life. An Introduction to palalo-biology. MC grew Hill.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, II Semester

Paper – II: Stratigraphy And Paleontology

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss about the principles of Stratigraphy ?

OR

2. Write an essay on Correlation and stratigraphic codes ?

3. Discuss about the magneto and cyclostratigraphy ?

OR

4. Give a detail note on chronology and chronostratigraphy ?

5. Write an essay on advances in micropaleontology ?

OR

6. Write an essay on foraminefora ?

7. Write in detail about ostrocoda fossils ?

OR

8. Give a detail note on roll of pollens and spores in stratigraphic and paleoecological studies ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Uniformarianism
   b. Facies
   c. Diagenesis
   d. Litholog
   e. SEM
   f. Wentworth scale
   g. Index fossil
   h. Chrono-stratigraphy

Geo 203: GEOCHEMISTRY

Unit-I: Concept of Geochemistry, Cosmic abundance of elements, geochemical evolution of the earth, Composition of meteorites, Structure and composition of the earth, primary differentiation of elements and Geochemical classification of elements.

Unit-II: Significance of Crystal chemistry in Geochemistry, isomorphism and diadochy camouflage, computing and admission of trace elements, Laws of thermodynamic, Gibbs free energy, Principles of Ionic substitution in minerals, Rare earth geochemistry and their abundance and mobility in crust.

Unit-III: Geochemical mobility under low and high P-T conditions; Geochemical Dispersion, Primary and Secondary dispersion patterns and their classification; Mineral/mineral assemblages as 'sensors' of ambient environments. Geochemistry of hydrosphere, biosphere and atmosphere, Geochemical cycles

Unit-IV: Mineral Stability; Water – rock interaction, Migration of elements in endogenic environment. Eh-pH – diagram and natural water environment. Radiogenic isotopes, Radioactive decay and growth; Basic ways of dating, Applications of isotopes in Geology

Geo 207: Geochemistry lab

- Sampling and sample preparation
- Methods of Preparation 'B' solution (Dissolution procedures)
- Determination of elemental concentration on Atomic absorption spectrometer.

TEXT BOOKS:

1. Principles of Geochemistry – Brian Mason & C.B. Moore Geochemistry – Gold Schmidt.
2. Introduction to Geochemistry – Kraws kopt, K.B., M.C. Graw Hill Applied Geochemistry – F.R. Siegel.
3. Stable Isotope Geochemistry – Springer verlag Principles of Isotope Geology – John willy Publication Faure, G; 1986.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, II Semester

Paper – III: Geochemistry

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss about the concept of geochemistry and geochemical evolution of earth ?

OR

2. Write an essay on Geochemical classification of elements ?

3. Discuss about the role of trace element in geochemistry ?

OR

4. Give a detail note on principles of ionic substitution in minerals ?

5. Write an essay on geochemical cycle ?

OR

6. Write an essay on geochemical mobility in low and high P-T conditions ?

7. Write in detail about migration of elements in endogenic environment ?

OR

8. Give a detail note on applications of isotopes in geology ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Composition of meteorites
   b. Primary differentiation
   c. Isomorphism
   d. Dispersion
   e. Radioactive decay
   f. Mineral stability
   g. Ionic substitution
   h. REE

Geo 204: ECONOMIC GEOLOGY AND INDIAN MINERAL DEPOSITS

UNIT – I: Nature of ore bearing fluids, Principles of formation of mineral deposits – Role of pressure and temperature in ore-bearing fluids – Metallogenic epochs and provinces – geological thermometers. Processes in formation of mineral deposits, porphyries and Scarn deposits.

UNIT –II: Ore microscope – preparation of polished section – physical properties of ore minerals under reflecting microscope – form, colour, hardness, reflectivity – reflection pleochroism, etch test etc. Structures and textures of ore minerals – Application of ore microscopic studies in ore dressing.

UNIT – III: Geological setting mode of occurrence, genesis, distribution and uses of chromite, manganese, iron, copper- lead- zinc, bauxite and placers. Ceramic and Cement Industries, Abrasives and Minerals used in Glass Industry and their distribution in India.

UNIT – IV: Geological setting mode of occurrence, genesis, distribution and uses of coal, barites, clays, limestones, mica, phosphates, precious and semi-precious stones. Gold, Silver, Rare Earth Minerals and Refractory minerals.

Geo 208: Economic geology and Indian Mineral deposits lab

1. Megascopic identification of ore minerals.
2. Identification of ore minerals under ore microscope.
3. Field visits to mineral deposits/mining areas

TAXT BOOKS:

1. Economic Minerals Deposits – Bateman, A.M. and Jenson, M.L.
2. Ore Deposits – Park Jr. C.F. and MacDiarmid, R.A.
3. Ore Deposits in India – Gokhale, K.V.G.K. and Rao, T.C.
4. Industrial Minerals and rocks in India – Deb, S.
5. Ore Deposits – Lindgren, W.
6. Ore Petrology – Stanton, R.L.
7. Ore Microscopy – Cameron, E.C.
8. Ore texture and their intergrowths – Ramdohr, P.

Geo 209: Field geology and Report

Introduction to topographic maps, map orientation, different types of compasses and their use, different types of rocks observations in the field and learning and measurement of attitude of beds, observation of outcrops, Study of landforms in the field and identification in the maps

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, II Semester

Paper – IV: Economic Geology And Indian Mineral Deposits

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss about the metallogenic epochs and provinces ?

OR

2. Write an essay on ore bearing fluids and principles of mineral deposits ?

3. Discuss about the physical properties of ore minerals under microscope ?

OR

4. Give a detail note on structures and textures of ore minerals ?

5. Write an essay on chromite deposits ?

OR

6. Write an essay on placer deposits ?

7. Write an essay on coal deposits ?

OR

8. Give a detail note on precious stones ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Sublimation
   b. Thermometer
   c. Genesis of bauxite
   d. Uses of bauxite
   e. Mica distribution
   f. Clay varieties
   g. Use of barites
   h. Reflectivity

SYALLABUS FOR
MSc GEOLOGY (PETROLEUM EXPLORATION)

SECOND YEAR

GPE 301: MINERAL EXPLORATION AND MINERAL ECONOMICS

UNIT -1: Methods of Surface and subsurface exploration, prospecting for economic minerals, Reconnaissance survey, Geological mapping, guides to ore search, Types of sampling and sampling errors, Drilling techniques – diamond drilling, shaft sinking, drifting, cross cutting, winging, stoping Room and drilling, top slicing, sublevel caving and block caving, Ore beneficiation: Size reduction – crushing, secondary and tertiary crushers, rotary breakers, tumbling mills, grinding mills, stirred mills, grinding, role of particle size, classification, enrichment of mineral content by washing, gravity separation, froth flotation, magnetic separation, water treatment, Jiggs, shaking tables, leaching, upgrading of minerals by sedimentation, flocculation, slurry handling.

UNIT -2: Ore deposits and Plate tectonics, Occurrence of ore body, relationship with the host rock, textures, structures and paragenesis of ores, Geological prospecting for metallic and non metallic mineral deposits – Bauxite, Chromites, Coal, Copper, Lead and Zinc, Manganese, Phosphates. Geobotanical and Geochemical methods used in Mineral Exploration.

UNIT -3: Geophysical methods of prospecting for metallic and non metallic mineral deposits – Gravity method, Electrical methods, Magnetic methods, Radioactivity methods, Borehole logging method – Instrumentation and Principles. Geological, Geomorphological, and Remote Sensing techniques. Duties of Mining Geologist, Preparation of Mine plans. Geological work at an operating mine. Open Cast and Underground mining, ocean bottom mining. Alluvial mining.

UNIT -4: Demand & Supply of minerals, conservation and substitution of minerals strategic, critical and essential minerals, changing pattern on mineral consumption and economy in India. National Mineral Policy, Mineral based industries in Andhra Pradesh. Marine mineral resources and Law of Sea. Disposal of Industrial and Radioactive Waste. Operation and Environment – Introduction, Dust, Dust control measures, Noise, Noise reduction measures, Ear protection, Mining hazards – mine inundation, fire and rock burst.

GPE 305: Mineral Exploration and Mineral Economics Lab

1. Problems on average assay values, problems on ore reserve estimation.
2. Grade maps and lithofacies mpas and their interpretation.
3. Plotting of the assay values.
4. Anomaly maps and their interpretation.
5. Geophysical data interpretation in mineral exploration
6. Field visits to open-cast/Underground mines and geological interpretations.

TEXT BOOKS:

1. Mining Geology by MC Kinstry Geochemical Mineral Bachi Viva.
2. Field Geology by Lahee.
3. Mineral Economics by Sinha & Sharma.
4. Practical Manual of exploration & prospect by S.K. Babu.
5. Geo-Chemistry in Mineral Exploration by Hakess/ Webb.
6. Will's Mineral Prospecting Technology – An Introduction to the practical aspects of ore treatment and mineral recovery. 8th Edition, by Barry A. Will's (Elsvier Pub.)

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – I: Mineral Exploration And Mineral Economics

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss about the sampling methods and sampling errors in assaying of mineral deposits?

OR

2. Write an essay on ore beneficiation ?

3. Write about geological prospecting for chromite deposits ?

OR

4. Give a detail note on application of Geobotanical and geochemical methods in mineral exploration ?

5. Write an essay on application of electrical methods in mineral exploration study ?

OR

6. Give a detail note on geomorphological and remote sensing techniques in mineral exploration?

7. Write an essay on changing pattern of mineral consumption and strategies ?

OR

8. Give a detail note on Mining Hazards?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
    a. Geological guides
    b. Random sampling
    c. Geobotany
    d. Anomaly
    e. Logging
    f. Critical minerals
    g. P and S waves
    h. Qualitative interpretation

GPE 302: Petroleum system and Coal Geology

Petroleum System:

Unit I: Definitions and Introduction to Petroleum system. History and development of Petroleum exploration and development. Characteristics of hydrocarbons. Occurrence of petroleum - pools, fields and provinces. Occurrence of Oil and gas in India and world. Source rocks and their Properties.

Unit II: Origin, generation, migration and accumulation of Oil and gas: Kerogen maturation - biogenic and thermal effect - Diagenesis, Catagenesis, metagenesis – TTI concept – migration and accumulation of oil and gas. Evaluation and analysis of kerogen and bitumen. Reservoir rocks and their Properties; Reservoir fluids and its characteristics -Tilted OWC.

Unit III: Traps and seal rocks: structural, stratigraphic and combination traps; cap rocks thickness vs. effectiveness, transgressive shales as cap rocks; Geochemical programme for petroleum exploration; Biomarkers: source rock and oil correlation, oil and oil correlation using biomarkers; Petroleum reserves and estimation.

Coal Geology:

Unit IV: Origin of coal – classification, ranking and grading of coal - coal petrography - coal resources of India – Coal reserves in India and world - Introduction to Gas hydrates and coal bed methane

GPE 306: Petroleum system lab

- Study of cores;
- Preparation of geological maps and sections, and derivation of geological history in relation to petroleum prospects;
- Calculation of oil reserves; Exercises on maturation studies, source rocks and reservoir rocks
- Preparation of Stratigraphic cross sections, Development of stratigraphic panel (Fence) diagrams. Intertounging diagrams.
- Structure contour map, location of oil and gas.
- Isopach and Isolith maps, Identification of Megascopic coal samples
- Visits to oil rig sites/exploratory wells

Books recommended:

1. North, F.K. (1985): Petroleum Geology, Allen Unwin.
2. Selley, R.C. (1998): Elements of petroleum geology, Academic Press.
3. Tissot, B.P. and Welte, D.H. (1984): Petroleum formation and occurrence, Springer–Verlag.
4. Hunt, J.M. (1996): Petroleum geochemistry and geology (2nd Ed.), Freeman, San Francisco.
5. Ravi Bastia, Geologic settings and petroleum Systems of India' east coast offshore basins-concepts and application.
6. Chandra, D. Singh, R.M and Sing M.P: 2000: Text book of Coal (Indian Context). Tara Book ageney, Varanasi.
7. Sing, M.P. (Ed), 1998: Coal and origanic petrology, Hindustan pub. Corp. New Delhi.
8. P.K. Bhowmick, phanerozoic petroliferous Basins of India. KDMIPE, ONGC, Dehradm.
9. Kotur S. Narasimhan and A.K. Mukherjee; Gondwana coals of India; Allied publishers limited.
10. Applied Petroleum Geochemistry - Bordenave, M.L. (Ed.) (1993): Editions Technip, Paris.
11. Surface Geochemistry in Petroleum Exploration - S. A. Tedesco (1994), Springer-Verlag.
12. The Biomarker Guide (Vol.1 and 2) - Peters, K.E., Walters, C.C., Moldowan, J .M. (2005): Cambridge Univ. Press.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – II: Petroleum System & Coal Geology

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss the history and development of petroleum exploration and development ?

or

2. What are the types of source rocks ? Give a brief note on their properties ?

3. Give in detail about the maturation of kerogen ?

or

4. Write a note on migration and accumulation of oil and gas ?

5. Write in detail about the Traps and seal rocks ?

or

6. Describe the geochemical program for petroleum exploration ?

7. Write an essay on origin of Coal ?

or

8. Discuss about the origin of coal and rank and grading of coal ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Petroleum pool
   b. Petroleum province
   c. Diagenesis
   d. Kerogen
   e. Cap rock
   f. Biomarker
   g. Gas hydrate
   h. Coal bed methane

GPE 303: Geophysical Exploration Methods

UNIT – I :**Gravity and magnetic methods of exploration**: Gravity field of the earth - factors effecting the gravity field of the earth; Rock densities - factors controlling rock densities; Concept of Gravitational/Newtonian potential - concept of gravity anomaly; Magnetic field of the earth - induced and remnant magnetizations - magnetic elements and magnetic anomalies - magnetic potential – dependence of magnetic anomalies on latitude and orientation; Magnetic susceptibility in rocks and factors controlling them - magnetic classification of minerals and rocks; Concept of generalized equations for the magnetic anomalies. **Gravity and magnetic prospecting instruments**: Static gravimeters – astatization – astatic gravimeters - zero-length spring - Worden & Lacoste Romberg gravimeters; Nuclear, fluxgate, optical pumping and squid magnetometers; Gradient measurements; Airborne and marine magnetometry - orientation mechanisms.

UNIT – II: **Gravity and magnetic data acquisition**: Ground gravity and magnetic surveys - planning for mineral, hydrocarbon and groundwater exploration and regional geological mapping - Establishment of gravity and magnetic base stations; Marine gravity and magnetic survey planning; Airborne survey procedures; **Gravity and magnetic data reduction**: Gravimeter drift correction – Reduction of gravity data; Bouguer density – in-situ determination; Reduction of magnetic data; Airborne and shipborne gravimetry and magnetometry - horizontal and vertical accelerations - Eotvos correction; Regional and residual anomalies – Methods for their separation; Upward and downward continuation and vertical derivative calculations and their role in gravity and magnetic data interpretation; **Interpretation of gravity and magnetic anomalies** - Qualitative interpretation – Identification of structural features and litho contacts from anomaly maps; Quantitative interpretation – methods of interpretation of anomalies: Thumb rules, characteristic curves, curve matching and logarithmic analysis; Concepts of forward and inverse modeling techniques of gravity and magnetic anomalies.

UNIT – III: **Electrical methods of exploration**: Electric conduction in rocks - electrical properties of rocks and minerals - factors affecting resistivity; Archies Law, isotropy and anisotropy; Electrical fields, current and potential due to point and dipole sources, Ohm's Law; Principle of resistivity surveying - Wenner, Schlumberger, dipole- dipole, half Schlumberger, Lee partition arrays - geometric factors; Concepts of apparent and true resistivities - ideal conditions for both; Sounding and profiling field procedures - apparent resistivity profiles over multi layered earth (A,Q,K,H Types); Interpretation - empirical methods, full curve and partial curve matching techniques.
Self potentials techniques: Origin of self potentials, SP field procedures, interpretation of SP anomalies due to sphere and sheet; Induced polarization method: Origin of IP; Time domain and frequency domain operations, relation between time and frequency domain measurements, IP sounding and profiling, plotting of results, pseudo sections, interpretation; spectral IP.

UNIT – IV: **Electromagnetic methods**: EM induction, Maxwell's equations, skin depth; primary-secondary field relations, elliptic polarization, real and imaginary components; Artificial source methods - classification frequency domain EM, Turam, VLEM and Slingram methods, principles, field procedures, quantitative interpretation; time domain EM, general field procedures, interpretation of surface transient method data. VLF, Ground penetrating radar techniques, Field procedures and interpretation. **Airborne EM methods**: Phase component and quadrature systems, passive airborne EM systems, AFMAG and VLF; noise in AEM systems; **Natural source methods**, Telluric currents, origin, principles and field procedures, interpretation; Magneto Telluric field characteristics, field procedures.

Text Books/Reference books:

1. Philip Kearey and Michael Brooks, An introduction to geophysical exploration, 2000, Blackwell Science.
2. Telford W. M. et. al., Applied Geophysics, 1988, Oxford & IBH Publishing Co. Pvt . Ltd., New Delhi.
3. Milton B.Dobrin and Carl H.Savit, Introduction to Geophysical Prospecting, 1988, McGraw-Hill International Edition, Geology Series, New Delhi

GPE 307: Geophysical Exploration methods Lab

1. Reduction of gravity and magnetic data.
2. Regional-residual separation by graphical, grid and least-square methods.
3. Second derivative and continuation calculations using coefficients.
4. Forward modeling of gravity and magnetic anomalies of simple geophysical models – study of the properties of the anomaly profiles.
5. Interpretation of anomalies of the models in (4) through thumb rules and through characteristic curves
6. Forward modelling of two-dimensional bodies using graticules
7. Demonstration of modelling and inversion of gravity and magnetic anomalies of sedimentary basins, two-dimensional bodies of irregular geometry and faults.
8. Calculation of effective induced magnetization in two-dimensional bodies
9. Calculation of resultant magnetization for three-dimensional bodies and effective resultant magnetization in two-dimensional bodies.
10. Calculation of SP anomalies of a sheet.
11. Interpretation of SP anomalies of sheets from characteristic curves.
12. Interpretation of resistivity data over a two layered earth by curve matching
13. Interpretation of two layer earth – resistive and conductive substratum – 45^0 asymptote.
14. Calculation of apparent resistivity over 3 layer earth for A, Q, K and H type models through computer programs.
15. Interpretation of resistivity data using full curve matching.
16. Interpretation of resistivity data using partial curve matching.
17. Plotting of IP results- pseudo depth section.
18. Field visits for doing geophysical surveys

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – III: Geophysical Exploration methods

(Effective from the Admitted Batch of 2016-2017)

Time: 3 Hrs Max. marks: 75

SECTION – A

Each question carries 15 marks

Answer all questions (15 X 4 = 60 marks)

1. Write in detail about the factors effecting the rock densities and rock susceptibilities.

OR

2. Explain the working principles of static and astatic gravimeters. Describe the Locaste and Romberg gravimeter.

3. Explain how ground gravity and magnetic surveys are conducted for regional geological mapping and hydrocarbon explanation.

OR

4. Describe in detail the role of upward and downward continuation operations in gravity and magnetic data interpretation.

5. Explain various forms of conduction of electricity through rocks and various factors affecting rock resistivities.

OR

6. What is self potential? Describe origin of self potentials. Mention the limitations and applications of SP method.

7. What is meant by vector and scalar potentials? Describe EM fields in time and frequency domain.

OR

8. Describe in detail classification of airborne EM methods ad describe INPUT airborne method.

9. Answer any five from the following. Each question carries 3 marks.
   (a) Gravity and magnetic anomalies.
   (b) Magnetic classification of minerals and rocks.
   (c) Archie's and Ohm's laws.
   (d) Induced polarization
   (e) Forward modeling of gravity and magnetic anomalies
   (f) Dipole-dipole and Half Schlumberger arrays.
   (g) VLEM
   (h) Telluric currents.

GPE 304: SEDIMENTARY BASINS OF INDIA

UNIT-I: Basins Classification and Depositional Environments: Tectonic Basin Classification, Tectonics and Basin Filling, Basin Morphology and Depositional Environments. **Basin Evolution and Sediments:** Rift basins, Continental Margin and Slope Basins, Intracontinental Sag Basins. Deep-Sea Trenches, Foreland, Back arc and Retro arc Basins, Remnant and Foreland Basins, Collision – Related Basins, Pull-Apart Basins, Basin-type Transitions (Polyphase Basins)

UNIT-II: Basin mapping methods: Structure and isopach contouring, Lithofacies maps, Geophysical techniques, Clastic petrographic data, Computer mapping methods, Stratigraphic cross sections, Paleocurrent analysis, Remote sensing. **Depositional systems and sequence stratigraphy:** Stratigraphic architecture, Nonmarine depositional systems, Coastal depositional system. Clastic shelves and associated depositional systems, Carbonate and evaporate depositional systems, Clastic depositional systems of the continental slope, rise and basin plain, Sequence stratigraphy.

UNIT-III: Stratigraphy, Structure and Tectonics of Onshore and Offshore Sedimentary basins of East Coast of India with special reference to – Bengal Basin – Mahanadi - Krishna and Godavari - Cauvery – Cuddapah – Vindhyan and Rajasthan basins

UNIT-IV: Stratigraphy, Structure and Tectonics of Onshore and Offshore Sedimentary basins of West Coast of India with special reference to Assam shelf – Himalayan foot hills - Kutch – Saurastra – Narmada – Cambay Bombay high, Kerala – Konkan Offshore Basins.

TEXT BOOKS:

1. Einsele G 1992 Sedimentary Basins. Springer Verlag.
2. Miall A 2000 Principles of Sedimentary Basin analysis.
3. Sengupta S 1997. Introduction to Sedimentology oxford – IBH.
4. Petrol ferrous Basins of India, ONGC, Petroleum Asia Journal.

GPE/GGF 308: Field geological mapping and report

Measurement of planar linear geologic features, simple geologic contact tracing, plotting of data with different symbols in the map
In addition to the field reports prepared from the concerned subject, the student has to do geological mapping selecting an area of study.

Geoinformatics course: in addition to the geological mapping, they have to do field mapping and digital conversion and submit the report

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – IV: Sedimentary Basins Of India

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. What is the classification of basins and its environments ?

or

2. Discuss about the basin evolution and sediments

3. Give in note on basin mapping methods ?

or

4. Discuss about the sequence stratigraphy ?

5. Write in detail about the Bengal basin ?

or

6. Write an essay on Cauvery basin ?

7. Write an essay on Narmada basin ?

or

8. Discuss about the konkan off-shore basins ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Basin filling
   b. Basin-type transition
   c. Lithofacies
   d. Non-marine deposition
   e. Vindhyan basin structure
   f. Kutch basin stratigraphy
   g. Tectonic of assam shelf
   h. Mahanadi off shore geology

GPE 401: Hydrogeology and Environmental Geology

UNIT-I: Occurrence and distribution of Ground Water: Origin of Water - Hydrologic cycle - Hydrological properties of rocks, Porosity, Specific yield, Specific Retention, Hydraulic Conductivity, Storativity, and Transmissivity - Vertical Distribution of Ground Water - Types of Aquifers, Unconfined, Confined, Semi - Confined & Perched - Springs; Hydrothermal phenomena. - Water Table Contour maps; Water Table fluctuations and causative factors;

UNIT-II: Darcy's law and its Application; Determination of Permeability in laboratory and in field; Steady State, Unsteady State and Radial Flow equations; Tracer Studies; Pumping Tests- Methods, Estimation of T & S by Theis, Jacob and Theis Recovery Methods, Specific Capacity Method by Slither's Method. Groundwater exploration methods

UNIT-III: Types of wells, Drilling Methods, Pumping equipment - Physical and Chemical properties of groundwater; Quality criteria for domestic, irrigation and industrial uses; Graphical presentation of Water quality data; Sources of pollution; Sea water intrusion and its controls; Problems of Arsenic, Fluoride and Nitrate; Radioisotopes for Ground Water Studies. Overexploitation and Ground Water Mining; Rain water Harvesting and artificial recharge methods, Groundwater provinces of India, Watershed Basin Management.

UNIT-IV: Geoenvironmental hazards, volcanoes, earthquakes, floods and coastal hazards – land desertification, degradation and management – soil erosion causes and management – impact of mining activities on the environment – global warming, water contamination, waste disposal and management

GPE 405: Hydrogeology & Environmental geology lab

1. Hydrogeological surveys in the field
2. Problems on vertical electrical sounding and interpretation of the data.
3. Well loss estimation from stop drawdown test and graphical presentation of chemical data.
4. Water analysis.
5. Classification of suitable water for drinking, irrigation and industrial purposes.
6. Presentation of chemical data and plotting chemical classification diagram.
7. Evaluation of ground water pollution.
8. Field work for groundwater study and water quality assessment

TEXT BOOKS:

1. Ground water Hydrology by Todd. D.K. John Wiley & Sons. New York.
2. Hydrogeology by Karanth. K.R. Tata Mc Graw Hill Publ Co New Delhi.
3. Ground water assessment. Development and Management by Karanth K.R. Tata Mc. Graw Hill Publ. Co. New Delhi.
4. Hydro Geology by Davis S.N. and Dewiest, R.J.M. John wiley & Son New York.
5. Ground Water by Raghunath. H.M. Wiley Eastern Ltd. New Delhi.
6. Ground water Resources evaluation by Walton. W.C. Mc Graw Hill Publ. Co. New Delhi.
7. Ground water Hydrology by Bouwer H. Mc Graw Hill Book Co. New Delhi.
8. Keller, E.a., 1978. Environmental Geology. Bell and Howell, USA.
9. Submanian, V., 2001. Text book in environmental Science, Narosa Publication, New Delhi.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, IV Semester

Paper – I: Hydrogeology & Environmental Geology

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Write an essay on hydrological cycle ?

or

2. Describe the vertical distribution of ground water and types of aquifers ?

3. Define the darcy's law and discuss the applications of darcy's laws ?

or

4. Write a note on various methods of groundwater exploration ?

5. Write about various types of wells and discuss methods of drilling for groundwater development ?

or

6. What is rainwater harvesting and discuss various methods of artificial recharging ?

7. Write an essay floods and coastal hazards ?

or

8. Discuss about the soil erosion, causes and controlling measures ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Confined aquifer
   b. Specific yield
   c. Water table contour map
   d. Tracer technique
   e. Sea water intrusion
   f. Arsenic problem
   g. Global warming
   h. Land desertification

GPE 402: Well site Geology

Unit 1: Exploration strategy and well prognosis: sequence of search and exploration work, prognostication, classification and categorization of reserves, classification of drilling locations, economic analysis of an exploratory project – Duties and responsibilities of wellsite geologist: rig site information, wellsite materials and pre-well responsibilities - Well-program or Geo-technical order.

Unit 2: Drilling methods: cable tool, rotary, dyna, directional, pellet impact, simultaneous drilling methods and offshore drilling technology - Drilling fluids: function of drilling fluid, composition of drilling fluid, basic classification of drilling fluids, complications and important equations

Unit 3: Cuttings and its analysis: cuttings description and preparation of lithology, sample types and its shipping, cutting analysis - coring and core analysis: conventional and sidewall coring, core point selection, coring procedure, core retrieval and core packing, core analysis – lithology/striplog preparation, preparation and drafting of lithology, interpretation of lithology

Unit 4: Casing and cementing: types of casing, casing accessories, running casing string, casing and cementation plan, cementing, annular leakages, channeling causes and preventive methods, use of centralizers, scratchers and turbulators - Factors influencing well completion methods, different methods of completion, perforation, well testing, workover programmes, well abandonment.

GPE 405: Wellsite geology & Formation evaluation Lab

1. Preparation of GTO,
2. Well construction and design, Plotting of lithology and drilling time (litholog),
3. Calculation of lag time,
4. Study of drill cutting samples, conventional cores and side wall cores for lithology,
5. Plotting of inclinometer data and computation of vertical shortening and horizontal drift,
6. Identification of pay horizons through well site geological analysis,
7. Calculation of cement slurry volumes,
8. Determination of porosity of a sediment core sample

Formation Evaluation lab

9. Use of Porosity-Resistivity plots for estimation of water saturation.
10. Estimation of HC saturation using Archie's equation.
11. Estimation of Formation water salinity from SP log.
12. Use of Density-Neutron cross plots for lithology and porosity identification.
13. Shaly sand interpretation using cut offs for estimation of pay thickness.
14. Identification of fluids and contributing layers from flow meter and temperature logs.
15. Field visits to oil-rig sites and exploratory wells

Books recommended:

1. Formation evaluation and wellsite geological techniques, Bhagwan sahay, awadhesh rai and manoj kumar ghosh 1983, ONGC publication.
2. Wellsites geologist's handbook, Donald McPhater 1983, Pennwell corporation, 80pp.
3. The wellsite guide – an introduction to geological wellsite operations, Bernhard W. seubert, 1995, published on-lie PT petroPEP Nusantara.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – II: Wellsite geology

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss about the exploration strategies and economic analysis of an exploratory project?

or

2. Give a note on duties and responsibilities of wellsite geologist ?

3. Describe various methods of drilling methods in off shore ?

or

4. Write a note on functions of drilling fluids and its basic classifications ?

5. Describe the well cuttings and its analysis ?

or

6. Discuss various types of coring and coring procedure ?

7. Write in detail about the casing types, accessories and casing plans ?

or

8. Describe various methods of well completion ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Categorization of reserves
   b. Pre-well responsibilities
   c. Pellet impact
   d. Complications in drilling fluids
   e. Cuttings description for igneous rocks
   f. Core packing
   g. Channeling causes
   h. Well testing

GPE 403: SEISMIC METHOS OF EXPLORATION

UNIT – 1:Propagation characteristics of seismic waves in media: types of seismic waves – Body waves, surface waves; Elastic wave velocities of rocks - factors affecting elastic wave velocities – attenuation of seismic energy, anisotropy, acoustic impedance, ray paths in layered media, reflection and refraction of seismic waves at interfaces, Snell's law, critical refraction, diffraction, dispersion, multiples, ghost reflections and reverberations, phases, Zeoppritz equations. Seismic detectors – Geophones, hydrophones – detector arrays and array response - marine seismic streamer; Seismic energy sources: Explosive and non-explosive sources - dynamite, vibroseis, thumper, land air-gun, sparker, boomer, airgun, water gun - controlled explosions - shot control - source arrays - penetration signatures of various energy sources.

UNIT – 2: Seismic reflection surveys: Geometry of reflected ray paths, travel time curves and calculation of layer parameters – single and multiple horizontal and dipping reflectors, ray paths for multiple reflections; Multichannel reflection surveying – multichannel reflection survey design – vertical and horizontal resolutions - split spread and end-on spreads - common depth point surveying - display of reflection data – reflection seismogram; Corrections applied to seismic traces – static and dynamic corrections and velocity analysis; Steps involved in the reflection data processing and migration of reflection data; Interpretation of reflection seismic data – structural analysis – stratigraphic analysis; Marine seismic surveying: Single and multichannel marine reflection surveying; Vertical seismic profiling; Application of seismic reflection method.

UNIT-3: Seismic refraction surveys: Geometry of refracted ray paths, travel time curves and calculation of layer parameters – Single and multiple horizontal and dipping planar refractors - faulted planar refractors - hidden layer problem; Refraction survey geometries - field layouts and shooting procedures for land 2d surveys - fan shooting, broad-side shooting, long refraction profiles etc.; Concept of delay time, dipping layer case, interpretation of reversed and unreversed profiles, delay time method, plus-minus method; Normal and dip move outs - stacking, interval, rms, and NMO velocities - discrete and continuous velocity changes; Weathering and elevation corrections; Display of refraction seismograms; Marine refraction survey procedures; Application of refraction method in oil exploration, and engineering problems.

UNIT-4: Seismic 3d surveys: Introduction to 3d layouts - swath, brick, odds and evens, zig-zag, button patch, full range 3d and loop survey; Marine 2d and 3d shooting - single and two streamer systems, alternate shooting, circle shooting, 3D bottom cable survey, multiple streamers, marine sonobuoy surveys. Seismic sections, plotting, display, events, isochronal and isopach maps, identification of geological structures, structural and stratigraphic traps - pitfalls in interpretation. Hydrocarbon indicators, bright spots, seismic attributes, AVO, reflector curvature, AVO attributes and interpretation. Seismic stratigraphy: Introduction - stratigraphic patterns, depositional patters and lithology - seismic sequence - seismic facies - reflection character - simple and complex reflection configuration - seismic reflection character analysis.

Text Books/Reference books:

1. Philip Kearey and Michael Brooks, An introduction to geophysical exploration, 2000, Blackwell Science.
2. Telford W. M. et. al., Applied Geophysics, 1988, Oxford & IBH Publishing Co. Pvt . Ltd., New Delhi.
3. Milton B.Dobrin and Carl H.Savit, Introduction to Geophysical Prospecting, 1988, McGraw-Hill International Edition, Geology Series, New Delhi

GPE 406: Seismic methods of exploration Lab

1. Identification of phases of a seismic wave incident at an interface.
2. Interpretation of Travel-Time curves for horizontal interfaces.
3. Interpretation of Travel-Time curves for dipping interfaces.
4. Identification of fault from Travel-Time curves and estimation of body parameters.
5. Blind zone problem – Forward calculation.
6. Calculation of Geophone array response.
7. Few more exercises

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – III: Seismic Methods Of Exploration

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

SECTION – A

Each question carries 15 marks

Answer all questions (15 X 4 = 60 marks)

1. Describe various types of seismic waves. Explain in details various factors affecting elastic wave velocities.

OR

2. What is meant by a geophone? Describe in detail the working principle of geophone and types of geophones. Write about the seismic amplifiers and tape recorders.

3. Describe field procedures involved in ground seismic reflection data collection and various shot geophone arrays.

OR

4. Write about steps involved in seismic reflection data collection and migration of seismic reflection data.

5. Write about field layouts and shooting procedures for land 2d seismic refraction surveys.

OR

6. Application of refraction method in oil exploration, and engineering problems.

7. (a) Describe various dire hydrocarbon indicators. (b) AVO attributes and interpretation.

OR

8. Describe marine seismic surveys with single and two streamer systmes.

9. Answer any five from the following. Each question carries 3 marks.
   (a) Reflection and refraction of seismic waves.
   (b) Normal and Dip move outs.
   (c) Swath shooting.
   (d) Static correction.
   (e) Stacking and RMS velocities
   (f) CDP and CMP surveys.
   (g) Seismic reflection character analysis.

GPE 404: FORMATION EVALUATION

UNIT-1: Petrophysical parameters – porosity - water saturation – permeability - formation factor - formation temperatures - resistivity index - formation factor porosity relationships; Borehole environment – distribution of resistivities around the borehole; Data acquisition - surface equipment – wire line (cable) - down hole equipment – tools – sensors – detector – signals – electrical pulse – digital; Open hole and cased hole operations - logging while drilling (LWD).

UNIT-2: Electrical logging: SP log, resistivity logging, historical development, conventional systems, focused systems, normal, lateral, laterolog, induction log, micrologging devices, need for development, data processing, depth corrections, borehole effects and corrections, borehole compensation, other environmental corrections, invasion effects, fluid effects, log quality control; Acoustic logging developments and various acoustic logging techniques; Radioactive logging: Nuclear logging – Neutron-Density logging, developments, gamma ray and natural gamma ray spectroscopy logs (NGS), new developments, dipmeter, Carbon-Oxygen logging, pulsed neutron log, cement bond log.

UNIT-3: Determination of porosity from resistivity and non-resistivity porosity tools, density, neutron-sonic logs, lithology and porosity from cross-plots, determination of fluid saturation from resistivity porosity cross plots, permeability from logs, Quick look interpretation techniques, identification of clean, shaly and hydrocarbon bearing zones, minerals. Computer processed interpretation (CPI) software. Complex reservoir and fractured reservoir interpretation, formation fluid sampling, MDT, SFT, sidewall casing.

UNIT-4: Production logging – fundamentals of production logging – applications – categories – tools – temperature, radioactive tracer and flow meter tools; Composite log, parameters, preparation, analysis, pore pressure prediction, exponent, shale density; Well completion - well completion techniques, perforation and tools for perforation; Applications of formation evaluation.

Coal Bed Methane: Environments of deposition of coal beds, coal grades, concept of cleats, maceral composition of coal, drilling for coal bed methane, core studies, logging of coal beds and evaluation, dewatering and CBM production, estimation of gas in place.

Text Books/Reference books:

1. Payton, C.E, 1977, Seismic stratigraphy – Applications to hydrocarbon exploration, Memoir of the American association of petroleum geologists 26, Tulsa, Oklahoma.
2. Robert E Sheriff, 1982, Seismic stratigraphy, The English Book Depot, Dehra Dun
3. Oz Yilmaz, 2001, Seismic data analysis, Society of Exploration Geophysicists, Tulsa, Oklahoma, USA.
4. Edward J. Lynch, Formation evaluation.
5. Log interpretation principles, Schlumberger document.

Practicals:

1. Use of porosity – resistivity plots (Hingle and pickett), for estimation of water satisfaction.
2. Estimation of hydrocarbon saturation using Archies equation.
3. Estimation of formation water salinity from SP log.
4. Using Density-Neutron cross plots for lithology and porosity identification.
5. Shaly sand interpretation using cut offs for estimation of pay thickness (phi, S_w, V_{sh}).
6. Identification of fluids and contributing layers from flow meter and temperature logs.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, IV Semester

Paper – IV: Formation Evaluation

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss about the petrophysical parameters ?

or

2. Explain the openhole and cased hole operations and LWD ?

3. Describe the data processing techniques ?

or

4. Give a note on nuclear logging ?

5. Explain various methods of determination of porosity from resistivity and non-resistivity tools ?

or

6. Discuss about the computer processed interpretation softwares ?

7. Write an essay on laboratory methods for determining petrophysical parameters ?

or

8. Discuss about the coal bed methane ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Downhole equipment
   b. Formation factor
   c. Acoustic logging
   d. Induction log
   e. MDT
   f. Neutron-sonic log
   g. Reservoir saturation tools
   h. Production logging

GPE/GGF 408: PROJECT WORK

The student will be attached with a field oriented project work under the supervision of the department staff. The student has to complete the field and laboratory investigations during the tenure of the semester and has to submit the project report and has to face the project viva voce. The project work has to get initiated from the end of the first year summer vacation period.

He has to take up the work in consultation with the designated project director. If necessary, he may be attached to any National/ State Earth Science organizations.

SYALLABUS FOR
MSc GEOLOGY (GEOINFORMATICS)

SECOND YEAR

GGF 302: Geographical Information System

Unit I :Introduction to GIS Spatial Analysis – Spatial Elements, Spatial Measurement Level, Spatial Location and Reference, Spatial Patterns, Geographic Data Collection,Methods of attribute data collection, House hold interviews, Market surveys, designing data collection forms. Populations and Sampling Schemes, Making Inferences from Samples.

Unit II: Cartographic and GIS Data Structures – Computer Database Structures for Managing Data, Hierarchical Data Structures, Network Systems, Relational Database Management Systems, Graphic Representation of Entitles and Attributes, GIS Data Models for Multiple Coverage's, Raster Models, Storing of Raster Data, Vector Models.

Unit III: **GIS Data Input -**Input Devices, Raster, Vector, Reference Frameworks and Transformation, Map Preparation and the Digitizing Process, Methods of Vector Input, Method of Raster Input, Remote sensing - Raster Data Input - External Databases. **Data Storage and Editing -** Storage of GIS Databases, Editing the GIS Database, Detecting and Editing Errors of Different Types, Entity Errors: Vector, Attribute Errors: Raster and Vector, Dealing with Projection Change - Edge Matching, Conflation and Rubber Sheeting, Templating, Concept of Database.

Unit IV : **GIS Design and Implementation -** GIS Design, Internal and External GIS Design Questions, Software Engineering Approach, System Design Principles, System Development Waterfall Model, Structured Designed Model, Technical Design, Cost/Benefit Issues, Data and Applications Requirements Models, Formal GIS Design Methodology, The Spiral Model. Rapid Prototyping, Database Design Study Area, Scale, Resolution, and Level of Detail, Classification, Coordinate System and Projection.

GGF 306: GIS lab

1. Basic GIS (Introduction to various GIS software including Open source).
2. Digitization - Point, Line, Polygon and Surface Data
3. Building topology – measuring distance and area
4. Adding attribute data – querying on attribute data
5. Onscreen digitization - Data Conversion – Vector to Raster, Raster to Vector
6. GPS concepts, types, modes of coordinate collection, GPS survey, inputting GPS data into computer

Text Books:

1. **Fundamentals of GIS** by MICHAEL N DEMERS – MN DEMERS, Published by John Wiley & Sons Inc
2. **Geographic Information System- An Introductory** – Jeffrey Star and John Estates – Pretence Hall Inc.
3. **Basic Readings in Geographic Information System –** Marble, D.F and Calkins, H.W – Spad Systems Ltd.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – II: Geographical Information System

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Write Notes on Spatial Location and Reference Systems? What is their significance in GIS

(or)

2. Give an account of various methods of Geographic data collection

3. Write Notes on Relational Database Management Systems (RDBMS)

(or)

4. How the geographic entities and attributes can be represented in a database

5. Explain the procedure and process flow involved in geospatial data digitization and map preparation?

(or)

6. With neat diagrams, list out the different types of vector and attribute errors?

7. Write notes on software engineering approach with reference to developing GIS application?

(or)

8. What is waterfall model? What are the steps involved in it ?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any FIVE of the following

   a) Significance of spatial patterns
   b) Market surveys
   c) What is ‘Raster Model’? and how data can be stored using the raster models?
   d) Network systems
   e) What is rubber sheeting in GIS?
   f) Write short notes on ‘Coordinate system and Projection.
   g) Spiral model
   h) Write short notes on Hierarchical Data Structures.

GGF 303: DIGITAL IMAGE PROCESSING

Unit I: Digitization, Multispectral digital imaging using various sensors, digital frame camera data collection, digital images and types - histogram and its significance, univariate descriptive image statistics Multi variate image statistics, feature space plots, geo-statistical analysis. Image processing systems, software and hardware components; input and output devices; image display, pre processing corrections of satellite images, Mosaic and rectification – image matching

Unit II: Image enhancement, spectral profiles, contrast stretching, linear, non-linear and logarithmic contrast stretching, Gaussian stretch, histogram equalization and histogram matching, image reduction and magnification, band rationing, generation of different types of color composites, filtering in spatial domain.

Unit III: principal component analysis, first principal component, successive principal components and computing principal components, decorrelation stretch. Hue saturation and intensity transformation, resolution merge. vegetation indices, filtering in spectral domain, Fourier analysis and Fast Fourier transform.

Unit IV: Basic concepts of pattern recognition, supervised classification: classification scheme, training site selection and statistics extraction, feature selection. parallelepiped classification, minimum distance to mean classifier maximum likely hood classification. Unsupervised classification: clustering analysis, Fuzzy classification, object oriented image segmentation. classification accuracy assessment and problems in image classification – data fusion, knowledge classifier – digital change detection, change detection algorithms.

GGF 307: Photogrammetry & DIP Lab

Photogrammetry:

1. Testing stereo vision
2. Use of Lens stereoscope and Mirror stereoscope
3. Visual interpretation of aerial photographs
4. stereoscopic viewing of stereo-pairs
5. Determination of vertical exaggeration
6. Use of Parallax Bar for height calculation from aerial photographs
7. Calculation of scale of the photographs
8. Marking Principal point and conjugate principal point on the stereopairs

DIP Lab

1. Reading and Displaying satellite data from BIL, BSQ and BIP Formats
2. Generating False Colour Composite (FCC)
3. Extracting area of Interest (AOI)
4. Generating Histogram of various bands
5. Georeferencing the base image
6. Geometric correction of satellite image
7. Enhancement using Band ratio and NDVI
8. Enhancement using different Filtering techniques 9.Unsupervised Classification
9. Supervised Classification
10. Classification using Neural Network and Fuzzy Logic
11. Accuracy Assessment
12. Change detection study

Text books:

1 Introductory digital image processing – a remote sensing perspective by John R. Jenson.
2 Nag P and Kudrat M: Digital remote sensing, concept publications, New Delhi
3 Fundamentals of digital image processing, Jain Anil K,PHI publishers, New Delhi, 2007
4 Digital image processing, Gonzalez RC and Woods RE., Peorson/Prentice-Hall, New Delhi, 2002

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – III: Digital Image processing

(Effective from the Admitted Batch of 2013-2014)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. a) What is histogram and its significance in image analysis?
   b) Name the popular image processing software. Write short notes on software, hardware & other peripherals required for establishment of image processing lab.

OR

2. a) Explain the preprocessing corrections of satellite images.
   b) Explain image rectification. Write short notes on cubic convolution resampling algorithm.

3. a) What is image enhancement? How it is different from image classification?
   b) Write short notes on histogram equalization and logarithmic contrast stretch.

OR

4. a) Explain lowpass and high pass filtering with some examples.
   b) Generation of different types of colour composites and band rationing

5. Explain the procedure to compute principle component images for multispectral satellite images.

OR

6. What is resolution merge? Explain Hue, Intensity & saturation method of image fusion.

7. Explain step by step procedure for maximum likelihood classification of satellite image.

OR

8. What is meant by classification accuracy assessment? Explain object oriented image segmentation.

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any FIVE of the following

   a. Digital change detection
   b. Mosaic
   c. Fuzzy classification
   d. Filtering in spatial domain
   e. Vegetation indices
   f. Spectral profile
   g. Fuzzy logic
   h. Multivariate image statistics

GGF 304: Photogrammetry

Unit I Fundamentals of Photogrammetry and Photo interpretation: – types of photographs; Vertical photographs – principal point; scale; Stereoscopy; Vertical exaggeration – factors involved and determination; Overlap: Forelap and sidelap, flight planning: Aerial and digital photographs, Geometric elements of vertical aerial photographs; Relief Displacement on vertical aerial photographs;

Unit II Parallax and parallax measurement: – monoscopic and stereoscopic methods; Determination of horizontal ground length, direction and angles from photo coordinates; Aerial mosaics: comparison with maps; Elements of aerial photo interpretation **Introduction to Analytical Photogrammetry**: – Image measurements, Control points, Collinearity condition, Coplanarity condition, Space resection by collinearity, Space intersection by collinearity, Analytical Stereo model, Analytical Interior Orientation, Analytical Relative Orientation, Analytical Absolute Orientation, Analytical Self-calibration.

Unit III Principles of Softcopy Photogrammetry: – System Hardware, Image measurements, Orientation procedures, Epipolar geometry, Digital image matching, Automatic production of digital elevation model and Orthophotos. DEM quality assessment, Applications of Digital photogrammetry in GIS.

Unit IV Ground Control for Aerial Photogrammetry & Aerotriangulation: – Traditional field survey methods of establishing horizontal & vertical controls. Ground control surveys by GPS, Pass Points for Aerotriangulation, Sequential construction of Strip model from Independent models, Independent model Aerotriangulation by simultaneous Transformations, Bundled Adjustment, Bundled Adjustment by GPS control, Triangulation with Satellite images, Computational strategies for triangulation. Principles of LIDAR and its applications

Textbooks

1. Digital Photogrammetry – A Practical course, 2nd Edition, by Linder, Wilfried, Springer, 2006, XIV, 214p, 53 illus, with CD-ROM and a pair of 3-D glasses, ISBN : 3-540-29152-0.
2. Paul R Wolf and Bon A. Dewitt, Elements of Photogrammetry (3ed), Mc Graw Hill
3. Mannual Photogrammetry – ALBERT D
4. Manual of Photogrammetry, McGlone, C., Edward, M. and Bethel, J, American Society for Photogrammetry and Remote Sensing, Bethesda, MaryLand, USA. 2005

References:

1. Aerial photographic interpretation, Lueder, D.R., McGraw Hill Book Co., 1959
2. Remote sensing and Image interpretation, Lillesand and Keifer, John Wiley and Sons, 2000
3. Leica Photogrammetry Suite – Orthobase and Orthobase Pro User Guide, Leica Geosystems, GIS & Mapping, Atlanta, USA, 2003

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – IV: Photogrammetry

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Discuss various types of photographs and factors involved in vertical exaggeration determination?

or

2. Describe the geometric elements of vertical aerial photographs and discuss the relief displacement?

3. Give in note on parallaz and parallax measurement ?

or

4. Discuss about the Analytical photogrammetry ?

5. Write in detail about the applications of digital photogrammetry in GIS ?

or

6. Write an essay on Digital image matching and automatic production of fdigital elevation model ?

7. Write an essay on traditional field survey methods of establishing horizontal and vertical controls ?

or

8. Discuss about the principles of LIDAR and its applications?

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. Principle point
   b. Flight planning
   c. Control point
   d. System hardware
   e. GPS
   f. Pass point
   g. Stereoscopy
   h. Coplanarity

GGF 402: ADVANCED REMOTE SENSING

Unit I Thermal Remote Sensing: Thermal radiation principles, interaction of thermal radiation with terrain elements, IR detection and imaging technology, thermal sensors and scanners, airborne IR surveys, satellite thermal IR images, spatial resolution and ground coverage, thermal IR broad band scanner and multispectral scanner, geometric characteristics of across track and along track IR imageries, distortions and displacements, radiometric calibration of thermal scanners, interpretation of thermal IR imagery, thermal inertia mapping, applications of thermal remote sensing .

Unit II Microwave Remote Sensing: Basic Concepts of Micro Wave Remote Sensing – Active and passive microwave remote sensing - RADAR- definition and development, Radar Systems –airborne and space borne SLRs and their components, radar wavelengths, scattering theory, RADAR equation, spatial resolution and theoretical limits, azimuth resolution, real aperture and synthetic aperture RADAR systems, geometric characteristics of radar imagery and transmission characteristics of radar signals, SLR stereoscopy and RADARgrammetry, RADAR return and image significance, image registration, baseline determination, satellite radar systems and images, image processing, RADAR image interpretation. SAR interferometry- principle, image processing, differential SAR interferometry, factors affecting SAR interferometry, Applications of RADAR soil response, vegetation response, water and ice response, urban area response.

Unit III Passive Microwave Remote Sensing: Basics – physics of RADAR waves, spectral characteristics of RADAR waves, microwave radiometers, passive microwave scanners and sensors, applications in atmosphere, ocean and land. LiDAR: Introduction, interpretations and applications

Unit IV Hyper-spectral Remote Sensing: Hyper-spectral Imaging: Hyper spectral concepts, data collection systems, calibration techniques, data processing techniques; preprocessing, N-dimensional scatter-plots, Special angle mapping, Spectral mixture analysis, Spectral Matching, Mixture tuned matched filtering, Classification techniques, airborne and space-borne hyper-spectral sensors, applications. High resolution hyper-spectral satellite systems: Sensors, orbit characteristics, description of satellite systems, data processing aspects, applications.

GGF 406: Advanced Remote sensing & Spatial Data analysis lab

Advanced RS: Identification of crop patterns,
Mapping of environmental factors (Vegetation, Erosion),
LULC classification, Change detection study
Other advanced analysis

Spatial data analysis Lab

Buffering, Overlay operations (point in polygon, line in polygon, polygon in polygon)
Raster data analysis (union, intersect, clip, dissolve)
Preparation of TIN and DEM
Spatial interpolation technique (Voronoi polygon, kriging)

Text books:

1 Burney, S.S 1988: Application Of Thermal Imaging, Adam Hilger Publications.
2 C Matzler (ed), 2006 Thermal microwave radiation-applications for remote sensing -The institution of engineering and technology publication, London, 555p
3 Robert N Colwell **Manual of Remote sensing** Volume1, American Society of Photogrammetry 1983.
4 Iain H Woodhouse 2006: Introduction to microwave remote sensing, CRC press, 370 pp
5 Eugene A Sharkov (2003): Passive microwave remote sensing of the Earth: physical foundations, springer publisher, 613pp
6 Fawaz T Ulaby, Richard K Moore and Adrian K Fung (1986): **Microwave Remote Sensing active and passive**, Vol. 1, 2 and 3 Addison – Wesly Publication company 1981, 1982, and 1986.

References:

1. Hord R.Michel, 1986: Remote Sensing Methods and Application, John Wiley and Sons.
2. Floyd M. Henderson; Principles & Applications of Imaging Radar, John Wiley & Sons, N.Y.
3. Travett J W: **Imaging Radar for Resources surveys**, Chapman and Hall, London 1986.
4. Marcus Borengasser, William S Hungate, Russell Watkins 2007: Hyperspectral remote sensing: principles and applications, CRC Press, 119 pp

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, IV Semester

Paper – I: Advanced Remote sensing

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. What is Thermal Remote Sensing? Write in detail about the thermal radiation principles.

(OR)

2. Write notes on applications of Thermal IR remote sensing?

3. Write about the active and passive microwave remote sensing.

(OR)

4. Write notes on advantageous of RADAR over optical remote sensing techniques and applications of RADAR.

5. Give an account of spectral characteristics of the RADAR waves.

(OR)

6. What is LiDAR? Write about LiDAR data interpretation and applications

7. What is hyper-spectral remote sensing or imaging? .

(OR)

8. Mention some of the airborne and space-borne hyper-spectral sensors.

Section –B **5 X 3 = 15**

Each question carries 3 marks

9. Answer any five of the following
   a. Name some of the thermal sensors and scanners?
   b. What is the difference between real aperture and synthetic aperture RADAR systems?
   c. Name three microwave radiometers?
   d. Orbit characteristics of hyper-spectral remote sensing satellites?
   e. What is SAR interferometry and it's application?
   f. Discuss Spatial resolution and ground converage?
   g. Write RADAR equation?
   h. Write about passive microwave remote sensor?

GGF 403: Spatial data analysis and modeling

Unit I : **Introduction**: Spatial data and spatial data analysis, concepts of space and time, layers and coverages, representation of geographic features in vector and raster models, point, line polygon, thematic characteristics of spatial data, significance of spatial analysis, overview of the tools for analysis.

Unit II: **Vector data analysis**: Buffering, overly operations, point in polygon, line in polygon, polygon in polygon, distance measurement, pattern analysis, single layer operations: feature identification, extraction, classification and manipulation, multi layer operations: union, intersection, difference.
Raster data analysis: data analysis environment, map algebra, grid based operations, local operations, neighborhood operations, focal, zonal and global operations, cost surface analysis, other raster data operations, comparison of vector and raster based data analysis.

Unit III : **Surface analysis**: data for terrain mapping and analysis, terrain mapping, slope and aspect, surface, curvature, raster versus TIN, view shed analysis, parameters of view shed analysis, spatial interpolation: elements of spatial interpolation, global methods, local methods, kriging, comparison of spatial interpolation.

Unit IV: **Geocoding and dynamic segmentation**: geocoding, application of geocoding, dynamic segmentation, application of dynamic segmentation; Path analysis and network applications: path analysis, application of path analysis, network, putting together an network, network application; GIS models and modeling: basic elements of GIS modeling, binary models, index models, regression models, process models, role of spatial models, explanative, predictive and normative models.
Web-GIS: Introduction, developments in databases, types of Web GIS, server based and client based Web GIS, Network based web GIS, application of Web GIS, basic concepts of object oriented GIS, mobile GIS, 3D GIS, knowledge based GIS.

Text books:

1 Fundamentals of GIS by Michael N Damers, published by John Wiley and Sons Inc.
2 Environmental modeling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Steyaert.
3 Introduction of Geographical Information Systems by Kand-Tsung Chang (Tata Mcgraw-Hill Edition).
4 An introduction to Geographical Information systems, Ian Hewook, Sarah Cornelius, Steve Carver and Srinivasa Raju, Pearson Education.
5 GRASS GIS, Markus Neteler and Halena Metasova, Springer publishers, 2008

Reference books:

1 Web based GIS – land slide inventory by Brett Brose
2 GIS for Web developers by Scott Davis
3 Connecting our world: GIS web services by Winnie Tang & John Selwood.

Model Question Paper

Adikavi Nannaya University, Rajahmundry

M. Sc Geology, III Semester

Paper – III: Spatial Data analysis and Modeling

(Effective from the Admitted Batch of 2016-2017)

Time: 3Hrs **Max. Marks: 75**

Section – A **15 X 4 = 60**

Each question carries 15 marks.

Answer four questions, choosing ONE from each Unit.

1. Write notes on representation of geographic features in vector and raster models.

(OR)

2. What is the significance of spatial analysis?

3. Write in detail about the multi layer operations.

(OR)

4. What are the significance of grid based operations raster data analysis.

5. Write notes on various spatial interpolation techniques.

(OR)

6. Write about the Raster versus TIN models for surface analysis

7. What is geocoding? Write about the different applications of geocoding? .

(OR)

8. Describe in detail about the Server based and Client based Web GIS applications.

Section –B 5 X 3 = 15

Each question carries 3 marks

9. Answer any five of the following
   a. What is the difference between layers and coverages?
   b. What are spatial data entities?
   c. Write about the importance of overly operations in GIS?
   d. Mention two applications of cost surface analysis?
   e. What is kriging?
   f. Define slope and aspect?
   g. Write about predictive and normative models?
   h. Write applications of webGIS?

GGF 404: GEOINFORMATICS FOR NATURAL RESOURCES MANAGEMENT

Unit I : **Natural Resources Development**: Role of aerial photographs, satellite remote sensing, GPS and GIS in resource evaluation, Remote sensing techniques for identification of rocks and minerals; mapping of geological structures; surface manifestation of minerals and their identification; spectral properties of minerals; role of thermal and hyperspectral remote sensing in mineral exploration. Case studies

Unit II: Agricultural resources: Spectral behavior of soils; Mapping of soils using multispectral images; Remote sensing in Land use / land cover mapping; estimations of crop area, yield and its monitoring, **Forest resources:** mapping of forest classification and change detection, forest management information systems (FMIS), forest fire forecasting and risk area mapping.

Unit III: Water resources: surface water and groundwater resources: mapping and monitoring of watersheds, tanks and reservoirs; hydrogeomorphic mapping and identification of groundwater potential zones, case studies **Ocean resources:** estimation of sea-surface temperature; primary productivity and potential fishing zones

Unit IV: Geoinformatics applications in disaster mapping and mitigation; Risk zone mapping: earthquakes – identification of geological structures like faults; volcanic activity – thermal imaging for monitoring temperature changes; Geoinformatics analysis of potential zones for landslides; avalanches; and floods. Mapping of disaster affected areas for rescue and mitigation; damage assessment; GIS-based decision support systems for disaster management– Case studies

GGF 407: Geoinformatics for Natural resources management Lab

Watershed mapping
Soil mapping and classification
Hydrogeomorphological mapping
Riskzone mapping
Lanslide mapping
Forest mapping
Hazard assessment
Identification and mapping of drainage
Wetlands mapping

Text books:

1. Remote sensing for earth resources 2nd Edition, (ed) D.P. Rao, AEG Publ., Hyderabad, 1999
2. Remote Sensing imagery for natural resources monitoring: a guide for first time users, D.S.
3. Wlike and J.T. Finn, Columbia University Press
4. Geoinformatics for environmental management by M. Anji Reddy, BS publications
5. Remotely sensed cities by Victor Mesev, Taylor and Francis, USA.
6. Geographic Information systems for transportation: principles and applications by Harvey J.
7. Miller, Shih- lung shaw, Oxford University press, 2001
8. GIS in land and property management by peter wyatt and martin ralphs, spon press, Taylor& Francis group, 2003
9. Geographical Information systems-Principles & technical Issues, Vol. 1&2, by paul A. Longley, Michael F. Good child et al.