Ordinance, Regulations and Syllabus

for

M.Sc. Geophysics

(Semester System)

Self-Financing Mode

According to

New Education Policy (NEP)

Department of Geophysics

Institute of Earthand Environmental Sciences

Dr. Rammanohar Lohia Avadh University

Ayodhya-224001 (U.P.)

India

DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA

Structure of Syllabus for the

Program:M.Sc., Subject:Geophysics

Structure of Syllabus Developed by			
Name of BoS Convener/BoS Member	Designation	Department	College/ University
Prof C.K. Mishra	Dean	Faulty of Science	Dr RMLAU Ayodhya
Prof. Jaswant Singh	Director	Institute of Earth and environmental Sciences	Dr RMLAU Ayodhya
Dr.R.Bhatla	Professor& HOD	Geophysics	BHU, Varanasi
Dr. Uma Shankar	Professor	Geophysics	BHU, Varanasi
Dr. Arvind Kumar	Assistant Professor	Geophysics	Dr RMLAU Ayodhya
Dr. Shashi Kant Sah	Assistant Professor	Geophysics	Dr RMLAU Ayodhya

Course Code		Course Title	Credits	T/P	Evaluation	
					CIE	ETE
A	B	C	D	E	F	G
SEMESTER I (YEAR I)						
B240701T	CORE	Elements of Environment and Geology	4	T	25	75
B240702T	CORE	Geo-exploration & Surveying	4	T	25	75
B240703T	CORE	General Meteorology	4	T	25	75
B240704T	CORE	General Geophysics	4	T	25	75
B240705T	FIRST ELECTIVE (Subject Elective) (Select any one)	Mathematical and Numerical Methods	4	T	25	75
B240706T		Economic and Petroleum Geology	4	T	25	75
B240707P	SECOND ELECTIVE (Subject Elective) (Select any one)	Practical A	5	P	50	50
B240708P		Field Visit Practical B	5	P	50	50
SEMESTER II (YEAR I)						
B240801T	CORE	Geohydrology	4	T	25	75
B240802T	CORE	Seismology	4	T	25	75
B240803T	CORE	Communication Theory and Signal Processing	4	T	25	75

Note: Any one of the corresponding combinations of Two courses of Group A (Exploration Geophysics) or Group B (Meteorology)						
B240804T	CORE A	Group A: Seismic Methods	4	T	25	75
B240805T	CORE B	Group B: Physical Meteorology	4	T	25	75
B240806T	THIRD ELECTIVE (Generic Elective) (Select any one)	Natural Hazard and Disaster Management	4	T	25	75
B240807T		Computer Programming	4	T	25	75
B240808P	FOURTH ELECTIVE (Subject Elective) (Select any one)	Practical C	5	P	50	50
B240809P		Practical D	5	P	50	50
SEMESTER III (YEAR II)						
Note: Any one of the corresponding combinations of Two courses of Group A (Exploration Geophysics) or Group B (Meteorology)						
B240901T	CORE A	Group A: Geoelectrical Methods.	4	T	25	75
B240902T	CORE B	Group B: Climatology & Climate change	4	T	25	75
B240903T	CORE A	Group A: Gravity and Magnetic Methods	4	T	25	75
B240904T	CORE B	Group B: Agro-meteorology	4	T	25	75
B240905T	CORE A	Group A: Geo-electromagnetic Methods	4	T	25	75
B240906T	CORE B	Group B: Synoptic and Tropical Meteorology	4	T	25	75
B240907T	CORE A	Group A: Well Logging	4	T	25	75
B240908T	CORE B	Group B: Dynamic Meteorology	4	T	25	75
B240909T	FIFTH ELECTIVE (Subject Elective) (Select any one)	Petroleum Geophysics	4	T	25	75
B240910T		Applied Meteorology	4	T	25	75
B240911P	SIXTH ELECTIVE (Subject Elective) (Select any one)	Practical E	5	P	50	50
B240912P		Practical F	5	P	50	50
SEMESTER IV (YEAR II)						
B241001T	CORE	Physical Oceanography and Marine Geophysics	5	T	25	75
B241002T	CORE	Remote Sensing & GIS	5	T	25	75
B241003T	SEVENTH ELECTIVE (Subject Elective) (Select any one)	Stratigraphy	5	T	25	75
B241004T		Advanced Climatology	5	T	25	75
B241005P	RESEARCH PROJECT/ DISSERTATION	Major Research Project/ Dissertation	10	P	50	50

NOTE:

1. **Do not mark any Code/Information in Column-A, It will be indorsed by the University.**
2. T/Pin Column-Estands for **Theory/Practical**.
3. CIEin Column-Fstands for **'Continuous Internal Evaluation'** and depicts the maximum internal marks. Respective examination will be conducted by subject teacher.
4. ETEin Column-Gstands for **'External Evaluation'** and depicts the maximum external marks. Respective Examination will be conducted by the University.
5. Column-B defines the nature of course/paper. The word **CORE** herein stands for **Compulsory Subject Paper.**
6. Column-D depicts the credits assigned for the corresponding course/paper.
7. **First Elective:** It will be a Subject Elective. Students may select one of the two subject papers under this category.
8. **Second Elective:**It willdesignate a Practical Paper or equivalently a Field Visit orProject Presentation. In case of Field Visit, student is required to submit a detailed report of the visit for the purpose of evaluation. The report should include the observational features and benefits of the visit.In case of Project Presentation, the student may be assigned to go for a survey/practical or theoretical project/assignment or seminar with presentation.
9. **Third Elective:**It will be a Generic Elective. The student may study or receive training of the any subject of his interest (depends on the availability in his institution of enrollment). The Generic elective paper will be evaluated in two parts, first part (50 marks) would be a continuous internal evaluation (03 tests 20+20+10 marks) whereas the examination and evaluation of the second part (50 marks) would be arranged by the college itself (01 exam).
10. **Fourth Elective:**It will accommodate a practical paper or Industrial Training orProject Presentation. In case of Industrial Training, student may be allowed for the summer training and is required to submit a detailed training report including training certificate for the evaluation.
11. **Fifth Elective:**It will be a Subject Elective. Students may select one of the two subject papers under this category.
12. **Sixth Elective:**It will be a Practical Paper or equivalently aProject Presentation based on Survey/ Seminar/ Assignment. In case of Project Presentation, student has to submit an exhaustive report on respective topic and to face an open presentation for the evaluation.
13. **Seventh Elective:**It will be either Subject Elective or Practical Elective.
14. There will be a Major Research Project or equivalently aresearch-oriented Dissertationin Semester-IV. The student straight away will be awarded 05 credits if he publishes a research paper on the topic of Research Project or Dissertation.
15. Methodology for the practical examination and examiner appointment will be governedby theClause-13 of the NEP Guideline of RMLAU dated 27-06-2022 except the marks distribution for continuous internal evaluation and external evaluation.
16. The Hon'ble conveners may take flexibility to rearrange the credits of the papers as 4/5/6 as per need, but within the limit of 25 credits assigned for each semester.

Ordinance relating to newly adopted semester system in M.Sc. Geophysics, Faculty of Sciences, Institute of Earth and Environmental Sciences, Dr. Rammanohar Lohia Avadh University, Ayodhya

Ordinances:

1. A candidate who has passed B.Sc. with Maths & Physics, B.Sc(Hons.) in Electronics with Physics and Mathematics and B.E / B.Tech with Mathematics and Physics as two of the subjects at 10+2 two level from a recognized university. The eligibility for admission will be as per university rules and regulations.
2. Admissions will be made on merit of entrance test/merit of qualifying exam.
3. The course of M.Sc. Geophysics degree shall consist of two academic sessions and each session shall consist of two semesters.
4. A candidate successful at all four M.Sc. Geophysics course shall be admitted to semester examination after completing a regular course of study for at least 14 weeks in each semester.
5. A candidate successful at all four M.Sc. Geophysics semester examination as specified in the regulation will be awarded M.Sc. degree in Geophysics.

Regulations:

1- The examinations for semester system in M.Sc. Geophysics shall be by means of theory papers and practical as specified in the examination scheme which consists of:

(a) In the first semester there are four theory papers and two elective paper one is subject elective and another is practical/ field visit examination.

(b) In the second semester there is three theory paper , any one of the corresponding combinations of one courses of group A (Exploration Geophysics) or Group B (Meteorology), two elective paper one is Exploration Geophysics practical elective and another is Meteorology practical elective examination.

(c) In the third semester there is any one of the corresponding combinations of the four courses of group A (Exploration Geophysics) or Group B (Meteorology), two elective paper one is Exploration Geophysics practical elective and another is Meteorology practical elective examination.

(d) In the fourth semester there is two theory papers, one subject elective paper and project work/dissertation.

2- The name of the candidates successful in the semester system in M.Sc. in Geophysics examinations shall be arranged in the following classes.

(a) First class to those who secure 60% or more marks in aggregate.

(b) Second class to those who secure 45% or more marks in aggregate.

3- The pass marks in each semester shall be

(a) 30% marks in each theory papers subject to 40% marks in the total of the theory.

(b) 40% marks in practical examinations.

4- Intake- in this course will be of 20 students (Exploration Geophysics: 14; Meteorology: 06)

The Fee of the course will be of Rs.30.000.00 (Rs. Thirty thousand only) per year

Program/Class: Master in Geophysics	Year: First	Semester: I
Subject: Geophysics		
Course Code: B240701T	Course Title: Elements of Environment and Geology	

Course Objectives:

This course introduces students to environment concerns. Students are expected to learn about the formation of the earth sphere, Initial structure of the earth. Crystal system and how the minerals crystallized in different systems.

Course outcomes:

On completion of the course, the student should be able to:

- Describe and discuss major earth features, materials, structures and processes.
- Define and employ common geologic terminology and endogenous and exogenous geological processes.
- They will also able to understand various earth materials such as minerals, rocks and ores.
- Sedimentary processes (weathering, transportation and deposition).

Unit	Topics
I	Physical and Structural Geology: Introduction to geology, scope, sub-disciplines and relationships with other branches of science, weathering agents, landslides and volcanic activity; Representation of altitude, dip and strike, outcrops, outlier and inlier, folds, faults, unconformities, joints and their classification.
II	Environment: Introduction to Ecology and Environmental Sciences; Concept and Structure of Environment: Atmosphere, Hydrosphere, Lithosphere & Biosphere; Structure of Ecosystem, Sustainable Development, Environmental Impact Assessment: Introduction, Concept, aims, process of Impact Assessment.
III	Petrology: Rock- its definition, classification and distinguishing characteristics of Igneous, Sedimentary and Metamorphic rocks, elementary ideas regarding formation, texture and structure of Igneous, Sedimentary and Metamorphic rocks. Brief petrographic description and occurrence of igneous, sedimentary and metamorphic rocks.

Suggested Readings:

1. Berry & Mason: Mineralogy
2. Billings: Structural Geology
3. Mukherjee: A Text Book of Geology
4. Read &Rutley's: Elements of Mineralogy
5. Singh: Stuctural Geology: A Practical Approach 6. Smith: Minerals and Microscope 7. Tyrrell: Principles of Petrology

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: First	Semester: I
Subject: Geophysics		
Course Code: B240702T	Course Title: Geo-exploration & Surveying	

Course Objectives:

The main objective of this course is to introduce the students to the principles and techniques of different geophysical exploration methods such as gravity, magnetic, electrical, electromagnetic, radiometric and seismic methods.

Course outcomes:

On completion of the course, the student should be able to:

The student is expected to understand and apply the follow concepts:

- Acquire knowledge about the principles, tools, techniques and applications about different geophysical methods used for exploration purposes.
- Generalized Snell's law and its application to reflection and refraction studies.
- Reflection and Refraction survey design, data collection, data processing, and analysis.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Basic principles of geophysical exploration, Physical properties of minerals and rocks.
II	**Method:** Elements of SP, IP and resistivity methods, Wenner and Schlumberger configurations. Methods of resistivity profiling and sounding, Tagg's method of interpretation.
III	**Seismic Method:** Elementary principle of reflection and refraction methods, two layered reflection and refraction principles of geophysical exploration.
IV	**Gravity Method:** Stable and unstable gravimeters, Worden, Lacoste and Romberg, Hartley Askania and Gulf gravimeters, field procedure and reduction of gravity data.
V	**Magnetic Method:** Fluxgate and Proton Precession magnetometers. Anomalies due to point pole and dipole, field practices and corrections.
VI	Basic principles of electromagnetic and GPR methods.

Suggested Readings:

1. Dobrin &Savit: Introduction to Geophysical Prospecting
2. Parasnis: Principle of Applied Geophysics
3. Telford et al: Applied Geophysics
4. Sharma: Geophysical Prospecting for Geologists and Engineers
5. Israel & Krebs: Nuclear Radiation in Geophysics

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: First	Semester: I
Subject: Geophysics		
Course Code: B240903T	Course Title: General Meteorology	

Course Objectives:

The aim of this course is to enable students to understand the basic concepts of meteorology and weather events at planetary, synoptic and regional scale.

Course outcomes:

On completion of the course, the student should be able to:

- Basic concepts of atmospheric science. They will also be able to learn nature of atmosphere, clouds, precipitation and climate by which students will understand the Earth's surface system.
- Students will learn Physical principles that provide the foundation for meteorology that means Absorption, scattering, and transmission of radiation in the atmosphere, basic of cloud physics and precipitation process and some fundamental and apparent forces governing the atmosphere.
- Students will be able to use Atmospheric thermodynamic diagrams as tools in the forecasting of storm development.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	**Instrumentation:** Surface, self-recording and upper air meteorological instruments (mercury and ancroid barometer, barograph, air thermometers, bimetallic thermograph, psychrometer, hair hygrograph, cup anemometer.
II	Composition and structure of the atmosphere.
III	Evaporation, condensation, fog, cloud and precipitation, thunderstorm, supercell and multi cell structure, tornado.
IV	**Thermodynamics**: Thermodynamic principles, properties of dry and moist air, adiabatic processes, hydrostatic stability and instability.
V	Radiation: Solar and terrestrial radiation, laws of radiation, greenhouse effect, solar constant, geographical and seasonal distribution of solar radiation, direct beam normal flux at the earth's surface, direct beam insolation at the earth's surface, mean heat balance of the earth atmospheric system,
VI	Wind System: Geostrophic wind, gradient wind, thermal wind, cyclostrophic wind and inertial wind, land and sea breezes, mountain and valley winds.
VII	Air masses, front, jet stream, Extra tropical and tropical cyclones and anticyclones, western disturbances.
VIII	General Circulation of the Atmosphere: N.E. And S.W. Monsoon.

Suggested readings

1. Byers: General Meteorology IV edition
2. Cole: Introduction to Meteorology
3. Pettersen: Introduction to Meteorology
4. Banerjee &Upadhyay: Mausam Vigyan

5. Lutgens&Tarbuck: the atmosphere: An Introduction to Meteorology
6. Rama Sastry: Weather and Weather Forecasting
7. Das: The Monsoons
8. Wallace and Hobbs: Meteorology and Introductory Survey

Suggestive digital platforms web links

Program/Class: Master in Geophysics	**Year: First**	**Semester: I**
Subject: Geophysics		
Course Code: B240704T	**Course Title:** General Geophysics	

Course Objectives:

The main objective of this course is to introduce the students to fundamental aspects of the Earth, plate tectonics, various geological processes.

Course outcomes:

On completion of the course, the student should be able to:

- Understand basic characteristics of the Earth and Plate tectonic activities.
- Knowledge about natural hazards such as earthquakes, volcanoes etc. and their causes would be expected.
- Students will gain an in-depth understanding of the mechanics of the lithosphere, deformation, stress, fluid mechanics as it applies to the Earth's interior, including thermal convection.

Credits:4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks:40**

Unit	**Topics**
I	History of development and scope of geophysics, our universe and solar system, monistic and dualistic hypotheses for the origin of solar system, Kepler's law of planetary motion, planet and satellites of the system and their characteristics, shape and size of the earth, international gravity formula and rotation of the earth. Concept of isostasy, Airy, Heiskanan and Pratt-Hayford hypothesis.
II	Internal constitution of the earth, characteristics of lithosphere, and asthenosphere, causes of geodynamical process, continental drift, Ocean floor spreading, Plate tectonics and its geological implications, oceanic ridges, trenches and island arcs, triple junction, hot spots.
III	Origin of geomagnetic field, secular variations and westward drift, geomagnetic storms, geomagnetic time scale, Earth's current, sun spot, solar flares, lunar and solar variations.
IV	Importance of heat flow, thermal history of the earth, sources of heat generation and temperature distribution inside the earth. Radiometric dating principles and ages of rocks and the earth.

Suggested Readings:

1. Howell : Introduction to Geophysics

2. Stacey: Physics of the Earth
3. Gubbins: Seismology and Plate Tectonics
4. Condie: Plate Tectonics and Crustal Evolution
5. Lowrie: Fundamentals of Geophysics
6. Bird & Lacks: Plate Tectonics
7. Chapman: Earth's Magnetism
8. Jacobs: Core and Geomagnetism
9. Lilly R. J.: Whole Earth Geophysics.

Suggestive digital platforms web links

Program/Class: Master of Geophysics	**Year: First**	**Semester: I**
Subject: Geophysics		
Course Code: B240705T	**Course Title:** Mathematical and Numerical Methods	

Course Objectives:

The primary objective of the characteristics of the natural database and its manipulation and mathematical and computations rigors in frequent usages in geophysics.

Course outcomes:

On completion of the course, the student should be able to:

- Comprehend the database: its variability, manageability and mathematical treatment
- Get an idea about the decision-making systems
- Develop capabilities of understanding and interpreting numerical data
- Acquire knowledge and critical thinking skills to solve a real-world problem with appropriate data.
- Critically evaluate the opportunities and available methods for integrating earth science.

Credits:5	**First Elective**
Max. Marks: 25+75	**Min. Passing Marks:40**

Unit	**Topics**
I	Numerical Methods: Solution of algebraic and transcendental equations; Bisection and Newton-Raphson methods; Euler and Runga-Kutta methods.
II	Integral transforms: Fourier transform, Laplace transform, Hankel transform, and their applications in geophysics.
III	Solution of simultaneous linear equations; Non-linear system of equations and their application in solving geophysical problems.
IV	Interpolation Techniques: Newton and Lagrange formulae; Simpson rule method; Trapezoidal method; and Gaussian quadrature method.
V	Least square curve fitting; and straight line and polynomial fits.
VI	Numerical solution differential equations: Ordinary differential equation; Classification of linear partial differential equations, Finite difference and Element Methods, wave and diffusion equations; and applications in geophysics.

Suggested Readings:

1. Sastry: Introductory Methods of Numerical Analysis
2. Raja Raman: Numerical Analysis
3. Gerald: Applied Numerical Analysis
4. Geraldet.al.:FiniteElementSimulationinSurfaceandSubsurface Hydrology
5. Bath:MathematicalAspectsofSeismology

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: First	Semester: I
Subject: Geophysics		
Course Code: B240706T	Course Title: Economic & Petroleum Geology	

Course Objectives:

The aim of this course is to enable students to understand the basic concepts of ore deposit and petroleum geology. In view of the course being customized to the requirements of the hydrocarbon industry.

Course outcomes:

On completion of the course, the student should be able to:

The students learn to interpret various geological maps, prepare cross sections, geologic field mapping, basic understanding of geological materials, rock identification ,origin and evolution of landforms, fossils identification, in-depth understanding of the sedimentary structures and facies analysis, paleoclimatic and paleogeographic changes, origin and distribution of economic resources of the country etc.

Credits:5	Third Elective
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Economic Geology: Definition of ore, ore mineral and gangue, Classification of ore deposits, Chemical composition, diagnostic characters, usages and distribution in India of the following metallic and non-metallic minerals: Haematite, magnetite, pyrolusite, psilomalane, chromite, ilmenite, wolframite, cassiterite, chalcopyrite, boronite, galena, sphelerite, pyrite, bauxite sulphur, graphite, gypsum, fluorite, barite, magnesite, dolomite, apatite, calcite, kyanite, sillimanite, beryl, muscovite, kaolinite, halite and talc.
II	Petroleum Geology: Origin of petroleum; source rocks; reservoir rocks; reservoir pore spaces; reservoir traps. Migration and accumulation of oil and gas.
III	Geological modelling in petroleum exploration, Brief geological account of oil and gas fields in India: Assam, Gujarat, Tamil Nadu and Bombay Offshore.

Suggested readings

1. Jensen and Bateman: Economic Geology
2. Krishna Swami: India's Mineral Resources
3. Sharma & Ram: Introduction to India's Economic Minerals
4. Levorsen: Geology of Petroleum
5. Evans & Mathur: Oil in India
6. Krishman: Geology of India and Burma
7. Wadia: Geology of India.
8. Ravindra Kumar: Historical geology and stratigraphy of India
9. U. Prasad: Economic Geology.

Program/Class: Master in Geophysics	Year: First	Semester: I
Subject: Geophysics		
Course Code: B240707T	Course Title: Practical A	

Course Objectives:

The lab is designed to train the students in basic and some advanced techniques of geology and geophysics like Clinometer compass, drawing of geological sections,Determination of velocities and depth, Interpretation of resistivity sounding data.

Course outcomes:

After completion of this course, a student will be able to:

- Get practical knowledge of Qualitative and Quantitative Analysis geological sections.
- Learn physical properties pf rock forming minerals.
- Perform experiments of resistivity sounding data by Tagg's method.
- Acquaint with determination of velocities and depth.

Credits:5	Second Elective
Max. Marks: 50+50	Min. Passing Marks:40

Unit	Topics
I	1. Clinometer compass and its use for determination of dip and strike of different beds. 2. Geological problems on slope, dip and thickness of the beds. 3. Drawing of geological sections of the given maps. 4. Study of the physical properties of rock forming minerals (given in theory syllabus).
II	5. Interpretation of resistivity sounding data by Tagg's method. 6. Determination of velocities and depth of the interface by refraction method.

Program/Class: Master in Geophysics	Year: First	Semester: I
Subject: Geophysics		
Course Code: B240708T	Course Title: Field visit(Practical B)	

Course Objectives: The objective of this course is to apprise the field training is that the students will gain practical experience with various geophysical and meteorological techniques.

- To impart knowledge of geophysical field survey.
- To train the students to understand functioning of necessary instruments required during geophysical field survey

Course outcomes:

After completion of the course, a student will be able to:

1. Understand the basic concept of geophysical and meteorological field work and various instruments used in field Work
2. Understand various geological structures found at outcrops.
3. Understand fundamentals of geological processes and stratigraphic correlation.
4. Understanding observations and recording of important filed information and to classify various types of features procured from field study.

Credits:5	Second Elective

Max. Marks: 50+50	Min. Passing Marks: 40

Program/Class: Master of Geophysics	Year: First	Semester: II
Subject: Geophysics		
Course Code: B240801T	Course Title: Geohydrology	

Course Objectives:

The primary objective of the course is to introduce fundamental and advanced aspects of geophysical technology for exploration of groundwater management. In this course the students will study the fundamental concepts and principles of occurrence, movement and quality of groundwater, focusing on quantitative analysis.

Course outcomes:

On completion of the course, the student should be able to:

- Assess the role of water in Earth's climate
- Distinguish between confined & unconfined aquifers
- Hydraulic analysis of groundwater
- Geophysical methods of determining aquifer properties and hydraulics
- Hydrogeological cycles
- Apply Darcy's Law to groundwater flow and geological material interpretation;
- Use pump test data for groundwater flow applications.
- Develop skills in approaching complex problems involving flow and storage of groundwater
- Knowledge on geophysical technology for groundwater management.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Hydrological cycle, origin and age of groundwater, subsurface distribution of water, springs.
II	Hydrological Properties of Water Bearing Materials: Porosity, void radio, permeability, transmissivity, storativity, specific yield, specific retention, diffusivity, laboratory methods of determination of permeability.
III	Mode of occurrence of groundwater , classification of rock with respect to their water bearing characteristics, aquifers, aquicludes, aquitards, classification of aquifers and groundwater provinces.
IV	Movement of groundwater and aquifer performance tests, Darcy's law and its range of validity, theory of groundwater flow under steady and unsteady conditions, determination of permeability, transmissivity and storativity by discharging methods.
V	Precipitation, evaporation, evapo-transpiration, seepage, infiltration and runoff.
VI	Groundwater exploration, surface geological and geophysical methods of exploration, and subsurface geophysical methods.

VII	Hydro-geochemistry: Physical and Chemical characteristics of groundwater, classification of groundwater in respect to domestic, irrigation and industrial use, pollution of groundwater.
VIII	Ground Water Exploration and Management: Natural and artificial recharge of groundwater, water balance, analysis of hydrograph, conjunctive and consumptive use of groundwater.

Suggested Readings:

1. Worcester: A Text Book of Geomorphology
2. Todd: Groundwater Hydrology
3. Ward: Principles of Hydrology
4. Chow: Handbook of Applied Hydrology
5. Health & Trainer: Introduction to Groundwater Hydrology
6. Singh: Elements of Hydrology
7. Raghunath: Introduction to Hydrology
8. Tolman: Hydrology
9. Karanth: Development, Assessment and Management of Water Resources

Suggestive digital platforms web links

Program/Class: Master of Geophysics	**Year: First**	**Semester: II**
Subject: Geophysics		
Course Code: B240802T	**Course Title: Seismology**	

Course Objectives:

To impart basic knowledge of earthquakes, theory of seismic wave propagation and their application for studying the internal structure of earth.

Course outcomes:

On completion of the course, the student should be able to:

- Discuss the concept and limitations of basic theory for seismic wave propagation.
- Use principles of seismological instrumentation to select suitable equipment for various applications.
- Apply methods of forward modelling and inversion to locate earthquakes and infer earth structure.
- Account for how the inner structure of Earth can be derived from seismological data and discuss the uncertainty and resolution limitations of various methods.
- Locate the earthquake source and calculate in detail the mechanism from seismic observations.
- Seismic Micro-zonation.

Credits:4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks:40**

Unit	Topics
I	Introduction to earthquake phenomena and their causes, propagation characteristics of seismic waves, foreshocks and aftershocks, elastic rebound theory.
II	Earthquake source parameters, identification of seismic phases and their applications, group and phase velocities, intensity and magnitude scales, Focal mechanism solutions and its tectonic implicationsreflection of body waves, reflection of seismic waves from the free surface, site effect, attenuation studies of seismic waves.

III	Seismicity of India, Himalayas and global seismicity, induced seismicity seismic zonation, seismic zoning of India, seismic hazards and hazard analysis, seismic micro- zonation.
IV	Principle of electromagnetic seismograph, seismometers, accelerometers and strain meter seismographs, WWSSN stations, seismic arrays for detection of nuclear explosions.

Suggested Readings:

1. Aki and Richards: Quantitative seismology
2. Richter:Elementary Seismology
3. Bullen& Bolt: An Introduction to the Theory of Seismology
4. Lay and Wallace: Modern global seismology
5. Gutenberg: Internal Constitution of the Earth
6. Rikitake: Earthquake Prediction
7. Bath: Introduction to Seismology
8. Stein &Wysession: An Introduction to Seismology, Earthquakes and Earth structure

Suggestive digital platforms web links

Program/Class: Master in Geophysics	**Year: First**	**Semester: II**
Subject: Geophysics		
Course Code: B240803T	**Course Title:** Communication Theory and Signal Processing	

Course Objectives:

The main objective of the Geophysical signal processing is a method that through the use of computers aims to manipulate the acquired (raw) signal through the application of filters, algorithms, and transforms to make the wanted signal clearer in both the time and frequency domains.

Course outcomes:

On completion of the course, the student should be able to:

- Improvement of the signal-to-noise ratio
- Results representation in a convenient manner to facilitate geological and geophysical interpretation

Credits:4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks:40**

Unit	Topics
I	Introduction: Historical development of time series, classification of data, analogue and discrete signals, digitization, sampling interval and aliasing, wavelets, Z transform, linear system, Dirac delta function and impulse response of a linear system, impulse response function.
II	Convolution and Correlation Techniques: Different convolution methods, properties of Convolution, autocorrelation, cross-correlation, and their applications, time domain and frequency domain concepts.
III	Fourier series and Fourier transform, Hilbert transform, Walsh transform, orthogonal function and Dirichlet conditions, physical significance and interpretation of Fourier transform, properties of Fourier transform.
IV	Digital Filtering: Low, high and band pass filters, truncation of unit impulse response function, illustration of Gibb's phenomenon.

V	Weighting Functions (Windows): Hamming window, Hamming window and their comparison, triangular window, Bortlett window, practical applications of windows.
VI	Applications of Time Series in Geophysics and Meteorology.

Suggested Readings:

1. Silvia & Robinson: Deconvolution of Geophysics Time Series in the Exploration for Oil and Natural Gas
2. Robinson &Trietel: Geophysical Signal Analysis
3. Kanasevich: Time Sequence Analysis in Geophysics
4. Bath: Spectral Analysis in Geophysics
5. Oppenheim & Schafer: Digital Signal Processing
6. Papoulis: The Fourier Integral and its Applications

Suggestive digital platforms web links

Program/Class: Master in Geophysics	**Year: Firat**	**Semester: II**
Subject: Geophysics		
Course Code: B240804T	**Course Title:**Group ASeismic Method	

Course Objectives:

This course is a survey of the application of seismic methods to hydrocarbon exploration, investigations of the lithosphere and environmental investigations of the shallow subsurface. Topics include physical principles of seismic wave propagation, and acquisition, processing, and interpretation of seismic reflection and refraction data.

Course outcomes:

On completion of the course, the student should be able to:

The student is expected to understand and apply the follow concepts:

- Generalized Snell's and its application to reflection and refraction studies.
- Reflection survey design, data collection, data processing, and analysis.
- Refraction survey design, data collection, data processing, and analysis.
- Geological interpretation of reflection and refraction seismic data.
- Structural interpretation of seismic data.

Credits:4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks:40**

Unit	Topics
I	Historical development and background of refraction and reflection methods. Difference between refraction and reflection surveys. System of observations for reflection and refraction surveys. Propagation of seismic waves in homogeneous/ inhomogeneous media, waveforms and their characteristics, N-layered case, continuous increase of velocity. Refraction data interpretation.
II	Amplitude and frequency response characteristics of geophone, critical and optimum damping, seismic amplifier and its frequency response, principle of maganatic tape recording, digital multiplexed recording and shot moments, principles of binary gain ranging amplifier and floating point, dynamic range, automatic gain control circuit, programmable gain control, timing system and recording formats (SEG-A, SEG-B and SEG-C).

III	Seismic data enhancement and test shooting, explosive and non-explosive sources of seismic energy for P-wave, seismic operation on land, common depth point technique, special weathering shots and noise analysis, elevation, weathering and dynamic corrections in refraction and reflection data, random and non-random noises, grouping of geophones, diffraction and its analysis, controlled source seismic sounding.
IV	Inverse filtering of seismic data, hidden layer problem, sequence of seismic data processing, determination of average seismic velocities, principles of tomography, synthetic seismograms.
V	Analysis of multiples and ghost reflections, processing of seismic data, imaging of 2- D and 3-D seismic data, time and depth sections, record surface and reflection surface, presentation of seismic records, vertical and horizontal resolution.
VI	Mapping of geological structures (faults, reef, pinchouts, and anticlines), migration techniques (classical and modern), wave equation migration, and pit falls of seismic interpretations.

Suggested Readings:

1. Clarbout:FundamentalsofGeophysicalProspecting
2. Telfordet.al.:Appliedgeophysics
3. Sheriff:SeismicStratigraphy
4. Dobrin&Savit: IntroductiontoGeophysicalProspecting
5. Waters:ReflectionSeismology
6. Sheriff&Geldart:ExplorationSeismology

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: First	Semester: II
Subject: Geophysics		
Course Code: B240805T	Course Title: Group B: Physical Meteorology	

Course Objectives:

The main objectives of this course are to:

- To give insight of the composition of the atmosphere.
- Be aware of the effects of radiation on the Earth's atmosphere
- To make them understand the processes involved in maintaining the heat balance in Earth's atmosphere
- Be aware of the general circulation and different types of Air Masses.

Course outcomes:

On completion of the course, the student should be able to:

- Remember the composition of earth's atmospheres
- Understand the difference between solar and terrestrial radiation
- Understand the mean heat balance of the earth.
- Apply the knowledge of Lapse rate to understand the development of clouds.
- Describe and discuss major earth features, materials, structures and processes.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Radiation: Laws of radiation, nature of solar radiation, solar constant, geographical and

	seasonal distribution of solar radiation, direct beam normal flux at the earth's surface, direct beam insolation at the earth's surface,; radiative heating and cooling, radiative equilibrium and the stratosphere, mean heat balance of the earth atmospheric system, poleward transport of energy, fundamental link with general circulation.
II	Cloud Physics: Atmospheric aerosols and condensation nuclei, nucleation, physics of initial stages of condensation, curvature and solution effect, growth and evaporation of cloud droplets by diffusion, the physics of precipitation in warm clouds, collision coalescence theory, collection efficiency, terminal velocity, precipitation from mixed clouds, Bergeron and Findeisen's theory, artificial cloud seeding of warm and cold clouds. Artificial cloud seeding.
III	Atmospheric Optics: Attenuation of light, refraction, scattering, turbidity, optical phenomena, rainbow, halo, corona, glory, mirage etc., atmospheric and terrestrial refraction, looming, towering, stooping, sinking.
IV	Radar Meteorology: Basic radar equation, wavelengths used for detection of cloud, thunderstorm and cyclone, PPI and RHI scopes, meteorological applications of radar, radar echoes, estimation of precipitation, rain water content and upper winds using radar.
V	Atmospheric Ozone: Mechanism of formation and destruction, measurement of ozone, Dobson's ozone spectrometer, ,Umkehr effect, vertical distribution of ozone, ozone-weather relationships, ozone hole
VI	Atmospheric Electricity: Electrical field of the earth in fair and disturbed weather, atmospheric ionization, air-earth electric current and its maintenance, supply current, theories of charge generation and separation in thunderstorm, lightning discharges.
VII	Satellite Meteorology: Equation of orbital motion, types of meteorological satellites, description of important sensors on board, visible and infrared data and their interpretation, identification of typical weather systems from cloud picture, estimation of winds, vertical temperature and humidity profile and rainfall from satellite observations, tropical cyclone grading using Dvorak's technique.

Suggested Readings:

1. Johnson: Physical Meteorology
2. Mason: Physics of Cloud
3. Dobson: Exploring the Atmosphere
4. Retallack: Compendium of Meteorology v. I, Part-III, Physical Meteorology. W.M.O. 364.
5. Baton: Radar Observes the Weather
6. Kidder &Vonder Harr: Satellite Meteorology
7. Taba: Ozone Observations an Introduction and their Meteorological Applications, W.M.O. Technical Note No. 36, W.M.O. No. 108
8. Haltiner& Williams: Numerical Prediction and Dynamic Meteorology

Suggestive digital platforms web links

Program/Class: Master of Geophysics	Year: First	Semester: II
Subject: Geophysics		
Course Code: B240806T	Course Title: Natural Hazard and Disaster Management	

Course Objectives:

This course aims to develop the students' knowledge about Hazard, disaster and its management.

Course outcomes:

On completion of the course, the student should be able to:

- comprehend the database: its variability, manageability and mathematical treatment

Credits:5	Third Elective
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Introduction to Natural Hazards, various type of hazards, assessment and risk calculation, mitigation and development of geo data base for a Decision Support system for strategic planning, relief and rehabilitation.
II	Earthquake Hazard: Status earthquake occurrence and its geographical distribution; brief of various earthquake hazards. Forecasting and prepared ness. Assessment and calculation of seismic hazard and risk. Seismic zoning and microzonation.
III	Land slide and subsidence: Classification of landslides, causes of landslides, identification, prevention and control of landslides.
IV	Subsidence: Types, causes and related hazards
V	Flood: causes, magnitude and frequency of floods, nature and extent of flood hazards
VI	Coastal Hazard: Tropical cyclone, Tsunami, coastal erosion, prevention, remedies and planning Volcanic Hazard: Effects, activity, prediction and management.

Suggested Readings:

1. Bolt , B.A., Horn, W. L. Macdonald, G. A. and Scott, R. F.,Geological Hazar
2. Donald, R., Geology and Society.
3. Gupta, H. K. and Rastogi, B. K. , Dams and Earthquake, Elsevier
4. Keller, E. A., Environmental Geology, Merill Publ.
5. Powers of Nature , National Geographic Publ.ds
6. Bell, F.G. (1999): Geological Hazards. Routledge, London.
7. Bryant, E. (1985): Natural Hazards. Cambridge University Press.
8. Modh, S. (2010) Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: First	Semester: II
Subject: Geophysics		
Course Code: B240807T	Course Title: Computer Programming	

Course Objectives:

The aim of this course is to enable students to understand the fundamentals of computers, various hardware and software, operating systems, computer languages and their applications in geophysics.

Course outcomes:

On completion of the course, the student should be able to:

- Understand the basics of computer, hardware, software, operating systems, and computer languages.
- They will get familiar with various productivity software and geophysical software. Students will also learn basic concepts of numerical modelling, Fortran and MATLAB

Credits:5	Third Elective
Max. Marks: 50+50	Min. Passing Marks:40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-2-0

Unit	Topics
I	Introduction to computer architecture, Operating System, UNIX/LINUX operating System: system organization, commands and file systems.
II	Types of Programming Language, Introduction of FORTRAN: preliminaries, data types, expression and statements, iterative statements, input/output statements.
III	Object Oriented Programming: Procedure oriented programming (POP); Object Oriented programming (OOP); paradigm concept of object and class, reusability, encapsulation and polymorphism.
IV	C++An Object-Oriented language: Class, object, constructor, destructor, operator over loading, function overloading,
V	Fundamental of MATLAB and Python.

Suggested readings

1. Raja Raman: Fortran Programming
2. Ram Kumar: Programming with Fortran 77
3. M.G. Venkateshmurthy: Introduction to UNIX and Shell programming
4. John Hubbard: Programming in C^{++}
5. Yashwant Kanetkar: C^{++} programming
6. Hanselman, D. and Littlefield, B. (2011). Mastering Matlab. Prentice Hall.
7. Moler, C. (2004). Numerical Computing with Matlab. SIAM.
8. Van Loan, C.F. and Fan, K.Y.D. (2010). Insight Through Computing: A Matlab Introduction to Computational Science & Engineering. SIAM.
9. Middleton, G.V. (2000). Data Analysis in the Earth Sciences using Matlab. Prentice-Hall

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: First	Semester: II
Subject: Geophysics		
Course Code: B240808T	Course Title: Practical C	

Course Objectives:

The lab is designed to train the students in basic and some advanced techniques of Geohydrology, seismology and Seismic method.

Course outcomes:

After completion of this course, a student will be able to:

- Get practical knowledge of Qualitative and Quantitative Analysis rainfall, porosity, permeability.
- Learn physical properties of rock.
- Perform experiments of resistivity sounding data.
- Acquaint with determination of intensity and seismicity of earthquake.
- b value determination.

Credits:4	Fourth Elective
Max. Marks: 50+50	Min. Passing Marks: 40

Unit	Topics
I	1. Determination of average rainfall. 2. Determination of evaporation and evapotranspiration. 3. Determination of storativity coefficient and transmissivity. 4. Determination of porosity and permeability.
II	5. Locating the epicenter of an earthquake using earthquake data. 6. To prepare the intensity map and find out the epicenter and focal depth for an earthquake. 7. Study of spatio-temporal patterns using seismic data and estimation of b-value using seismicity data 8. To find the acceleration and magnitude of an earthquake with the help of isoseismal map.
III	9. Interpretation of seismic records and plotting section. 10. Determination of velocity. 11. Preparation of structural maps. 12. Exercises on NMO calculation.

Suggested Readings:

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: First	Semester: II
Subject: Geophysics		
Course Code: B240809T	Course Title:Practical D	

Course Objectives:

The lab is designed to train the students in basic and some advanced techniques of Geohydrology, seismology and physical meteorology.

Course outcomes:

After completion of this course, a student will be able to:

- Get practical knowledge of Qualitative and Quantitative Analysis rainfall, porosity, permeability.
- Learn physical properties of rock.
- Numerical computation in radiation, atmospheric optics, cloud physics.
- Interpretation of Satellite Imageries

Credits:4	FourthElective
Max. Marks: 50+50	Min. Passing Marks: 40

Unit	Topics
I	1. Determination of average rainfall. 2. Determination of evaporation and evapotranspiration. 3. Determination of storativity coefficient and transmissivity. 4. Determination of porosity and permeability.
II	5. Locating the epicenter of an earthquake using earthquake data. 6. To prepare the intensity map and find out the epicenter and focal depth for an earthquake. 7. Study of spatio-temporal patterns using seismic data and estimation of b-value using seismicity data 8. To find the acceleration and magnitude of an earthquake with the help of isoseismal map.
III	9. Measurement of total amount of atmospheric ozone by Dobson's ozone spectrophotometer Data 10. Numerical computation in radiation, cloud physics, satellite meteorology and radar meteorology. 11. Interpretation of Satellite Imageries.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240901T	Course Title: Group A-Geoelectrical Methods.	

Course Objectives:

The primary objective of the Geoelectrical method is to determine the electrical properties of rock layers beneath the soil surface by injecting an electrical current into the ground. This course will explain the geoelectric concept in several methods namely Self Potential (SP), Resistivity and Induced Polarization (IP) and its application in mining, hydrogeology, geotechnical and environmental exploration.

Course outcomes:

On completion of the course, the student should be able to:

- Students will gain experience in geoelectric exploration planning from planning, data acquisition, processing and interpretation of geoelectric data so that a basic understanding of concepts and techniques.
- Students are able to master the concepts, principles and techniques of system design, process or application of Geoelectrical component (Resistivity, Self-Potential and Induced Polarization)
- Implement it procedurally starting from data retrieval, processing, subsurface geological conditions and modeling to resolve deep-seated geophysical engineering issues deeply in mine, hydrogeological, geotechnical and environmental exploration

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	General: Electrical properties of rocks & minerals and their determinations, fundamentals of direct current flow, relationship between point and line pole potential distribution.
II	D.C. Resistivity Methods: Potential distribution at the surface of horizontally stratified earth.
III	Vertical Electrical Sounding: Interpretation of resistivity VES data, empirical methods for interpretation of resistivity sounding data.
IV	Electrical Profiling: Profiling near a vertical contact and thin vertical dykes and discussion of the expected apparent resistivity curves.
V	Self-Potential Method, Induced Polarization Method and Electrical Resistivity Tomography (ERT): Basic Principles, Theory and applications.

Suggested Readings:

1. Bhattacharya &Patra: D.C.: Geoelectric Sounding: Principles and Interpretation
2. Kuntez: Principles of Direct Current Resistivity Prospecting
3. Keller &Frischknecht: Electrical Methods in Geophysical Prospecting

4. Nostrand & Cook: Interpretation of Resistivity Data
5. Wait: Over-voltage Research and geophysical application
6. Koefoed: Geosounding Principe-I: Resistivity Sounding Measurements
7. Patra & Nath: Schlumberger Geoelectric Sounding in Ground Water
8. Ghosh: The Application of Linear Filter theory to the Direct Interpretation of Geoelectrical Resistivity Measurements

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240902T	Course Title: Group B-Climatology & Climate Change	

Course Objectives:

The main objectives of this paper are designed to help students gain a scientific understanding of the physical aspects of Earth's climate system and the factors that influence climate change.

Course outcomes:

On completion of the course, the student should be able to:

- Identify the basic forces and processes that govern global weather and climatic conditions
- Describe and explain the distribution of various climatic types over the surface of the earth
- Identify both anthropogenic and natural causes of climate change
- Evaluate the positive and negative implications of proposed global warming mitigation strategies
- Explain the current theory regarding the depletion of stratospheric ozone and its consequences

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	World distribution of isolation, air temperature, mean sea level pressure and wind, effect of land and ocean on circulation, diurnal and annual variations of surface air temperature at different latitudes and over the globe, upper air circulation over the whole world.
II	World distribution of precipitation, effects of continents, oceans and topography on rainfall, diurnal and annual variation of precipitation, world distribution of atmospheric perils.
III	Air masses, their classifications, source regions, modification and associated weather. Extra-tropical cyclones, their origin and associated weather.
IV	Climatic Classification: Koppen and Thornthwait schemes applicable to India.
V	Indian Climatology: Principal seasons of India, annual and seasonal rainfall and its variability. General Circulation Features over India during different seasons. Definition and concept of drought, aridity, drought indices and drought assessment.
VI	Monsoons: Monsoon regions in the tropics, causes of monsoon, the Indian summer monsoons, rainfall distribution, elements of the monsoon system, monsoon variability, onset and advancement of monsoon, withdrawal, fluctuations in monsoon activity, active, weak and break monsoon conditions, intra seasonal and inter-annual variability of summer monsoon.
VII	Climatic change: Climatic changes and cycles, elements of microclimatology, Climatic system-an overview, observed climate variability and change, physical climate processes and feedback, detection and projection of future climate scenario.

Suggested Readings:

1. Sellers: Physical Climatology

2. Trewartha: Introduction to Climates
3. Haurwitz & Austin: Climatology
4. I.M.D. Forecasting Manuals
5. Lockwood: World Climatology

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240903T	Course Title: Group A-Gravity and Magnetic Methods	

Course Objectives:

The theory of potential field of the earth, acquisition, data processing and interpretation of subsurface structures from gravity and magnetic field anomaly data.

Course outcomes:

On completion of the course, the student should be able to:

- Apply the concept and technology of gravity and magnetic methods in describing subsurface conditions.
- Design the acquisition, processing and interpretation of gravity and magnetic exploration data

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Basic Theory: Magnetic elements I.G.R.F., inverse square law, concept of potential, Poisson's and Laplace's equations.
II	Instrumentation: gravity prospecting instruments: borehole and airborne gravimeters, magnetic prospecting instruments, Rubidium vapour magnetometer, Optical Pumping Magnetometer
III	Data Acquisition and Correction: Aeromagnetic surveys, plan of the field surveys, station spacing, corrections for gravity and magnetic data.
IV	Calculation of derivatives, continuation methods, polynomial fitting for regional- residual separation of gravity and magnetic anomalies, filter theory and filtering of potential field data, Gravity and Magnetic anomalies over spheres, cylinders, dykes, faults and sheets, depth estimation, curve matching techniques.
V	Gravity and magnetics for the exploration of the minerals, oil/gas and groundwater.

Suggested Readings:

1. Grant & West: Interpretation Theory in Applied Geophysics
2. Nettleton: Gravity and Magnetics in Oil Prospecting
3. Rao& Murthy: Gravity and Magnetics
4. Dobrin &Savit: Introduction to Geophysical Prospecting
5. Telford et al.: Applied Geophysics
6. Murthy & Mishra: Interpretation of Gravity and Magnetic Anomalies in Space and Frequency Domain

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240904T	Course Title: Group B - Agro-Meteorology	

Course Objectives:

- To acquire the basic knowledge of climate and weather and its impact on agriculture.
- To understand roles of agrometeorology in agriculture and its relation to other areas of agriculture.
- To acquaint with recent developments in agrometeorology with historical development of climate change.

Course outcomes:

On completion of the course, the student should be able to:

- Articulate and retain knowledge relevant to Meteorology
- Gain the information of weather and climate which are considered as basic input in agricultural planning.
- Explain Weather hazards, Weather forecasting and impact of climate change on agriculture.
- Acquaint with the meteorological instruments and recording the observation from the agrometeorological observatory.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Meaning and scope of agricultural meteorology, Intent and extent of agricultural meteorology, plant physiology, long term and short-term modifications of growth process, avoidable and unavoidable dangers, Agro-meteorological observations and microclimatic measurements.
II	Solar Radiation and Plants: Reflection, transmission and absorption, incoming, outgoing and net radiation, Spectral distribution of solar radiation and physiological response to plants, Light distribution in canopy, Phototropism and Photoperiodism: Meteorological factors in photosynthesis.
III	Environmental Temperature and Plants: Effect of low and high ambient temperature, soil temperature and factors affecting them, thermal properties of soil, soil moisture and its measurement, weekly water balance, water use and plant growth, evaporation and evapo-transpiration, wind effect on evapo-transpiration, wind damage to plants.
IV	Climatic Requirements of Important Crops: Rice, wheat, cotton, soyabean and sugarcane, pearlmilet, groundnut and mustard.
V	Plant and Crop Diseases: The effect of weather on pathogenic agents- Insects, Fungi, Bacteria, Bacilli and Virus, combating plant diseases, natural and artificial methods, the integrated campaign, insect against insects.
VI	Meteorological Hazards and Agriculture: Frost and frost fighting methods, hail damage and hail modification method, wind damage and wind breakers, Agricultural drought, its severity and management, flood damage and flood fighting.
VII	Composition, structure and physical properties of soils, simple classification of soils, soil air, soil erosion, soil improvement devices and drainage.

VIII	Agro-meteorological forecasts systems, short, medium and long range forecasts, yield forecasts model, introduction to crop stimulation model, and a brief outline of remote sensing in agriculture.

Suggested Readings:

1. Smith: Methods in Agricultural Meteorology
2. Seemannet. al.: Agrometeorology
3. Vitchewich: Agrometeorology
4. WMO Compendium of lecture notes
5. Mavi: Introduction to Agrometeorology

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240905T	Course Title:Group A- Geo-Electromagnetic Methods.	

Course Objectives:

The primary objective of the Electromagnetic method to determine the physical characteristics of rocks below the soil surface by utilizing electric fields and magnetic fields. This course will explain the electromagnetic concept in several methods, namely magneto telluric (MT) method, Ground Penetrating Radar (GPR), Very Low Frequency (VLF), and its application in energy exploration, mining, hydrogeology, geotechnical and environment.

Course outcomes:

On completion of the course, the student should be able to:

- Students will gain experience in electromagnetic exploration planning from planning, data acquisition, processing and interpretation of geoelectric data so that a basic understanding of concepts and techniques will help students compete in the world of work. Activities will be carried out in group work so that students are able to think critically and train in team work to achieve common goals.
- Students are able to master the concept, principles and techniques of system design, process or application component of Electromagnetic Method (GPR, VLF, and MT) and implement it procedurally starting from data retrieval, processing, subsurface geology and modeling to resolve deep-seated geophysical issues.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Basic Principles and Theory: Maxwell's equations, electromagnetic potential and wave equations, boundary conditions, long wavelength approximation, depth of penetration, electromagnetic field due to straight wire, rectangular and circular loops, elliptical polarizations, amplitude and phase relations, real (in phase) and imaginary (quadrature) components.
II	Methods of Prospecting: Bieler Watson method, Dip angle methods-fixed vertical loop transmitter, broadside and shoot back methods, two frame method, compensator method,

	Turam method, Moving source-receiver methods- horizontal loop (Slingram) method, AFMAG and VLF methods, Airborne EM systems- rotary field method, INPUT method, EM profiling and sounding.
III	Interpretation: Principles of EM similitude and modeling, response of conducting sphere to uniform alternating magnetic field and infinitely long horizontal cylinder to line source, response of sheet conductors to dip angle, Turam and horizontal loop EM systems, dip angle characteristic curves and phasor diagrams for horizontal loop EM system for sheets, effect of overburden on EM anomalies, Principles and practices of Ground Penetrating Radar
IV	Magnetotelluric (MT) method: Origin and characteristic of MT fields, MT instrumentation, field practices, MT effect over a conducting half space and two layer model.

Suggested Readings:

1. Parasnis: Mining Geophysics
2. Grant & West: Interpretation Theory in Applied Geophysics
3. Telford et. al: Applied Geophysics
4. Patra&Mallick: Geosounding Principles Vol.II
5. SEG Publication: Mining Geophysics Vol. II

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240906T	**Course Title: Group B**-Synoptic and Tropical Meteorology	

Course Objectives:

The main objectives of this course are to:

- Be aware of the effects of radiation on the Earth's atmosphere
- To make them understand the processes involved in maintaining the heat balance in Earth's atmosphere
- To give an overview of synoptic meteorology.

Course outcomes:

On completion of the course, the student should be able to:

- Remember the composition of earth's atmospheres
- Understand the difference between solar and terrestrial radiation
- Understand the mean heat balance of the earth.
- Apply the knowledge of Lapse rate to understand the development of clouds.
- Understand the various optical phenomenon in the atmosphere.
- Describe and discuss major earth features, materials, structures and processes.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Meaning and scope of synoptic meteorology, Plotting of synoptic observations on different

II	Maps, analysis of surface and upper air charts, vertical time section and cross section analysis.
III	Scales of Atmospheric Weather Systems: Primary, secondary and tertiary circulations.
IV	Kinematics of horizontal motion, characteristics of wind fields, construction of streamlines, isotach, trajectories, relation between stream line and trajectories, Blatons equation.
V	Jet streams, their classification and characteristics, PFJ, STJ, TEJ, low level jet stream of Asian monsoon, structure, formation, maintenance and associated weather, ,.
VI	Principle of Weather Prediction: Short range, medium range and long range weather prediction, limits of predictability, forecast evaluation.
VII	Tropical Meteorology: Mean tropical atmosphere, equatorial trough (ITCZ), basic currents, trade wind inversion, easterly waves and their dynamical aspects, formation and forecasting of easterly waves, QBO.
VIII	Tropical cyclones, classification of tropical disturbances, global climatology, life cycle, surface and upper air structure, thermal structure, the eye and wall cloud, rainfall, energy aspects, theories of formation, CISK, detection, movement tracks, recurvature, Fujiwara effect, forecasting, storm surges, cyclone warning.
IX	Monsoons: Monsoon regions in the tropics, causes of monsoon, the Indian summer monsoons, rainfall distribution, elements of the monsoon system, monsoon disturbances, MTC, monsoon variability, onset and advancement of monsoon, withdrawal, fluctuations in monsoon activity, active, weak and break monsoon conditions, intra seasonal and inter-annual variability of summer monsoon, biweekly and 30-50 day oscillation (MJO), southern oscillation and El Nino, , PDO, AMO, NAO, monsoon rainfall and teleconnections, long range prediction of monsoon, monsoon over China, S.E. Asia, N. Australia, east and west Africa.
X	General Circulation Features over India during other seasons: Winter seasons, western disturbances, cold waves, fog, Pre Monsoon Seasons: different convective phenomenon, Norwesters and tropical storms, Post monsoon Season: N.E. Monsoon, tropical storms and their differences with tropical storms of pre monsoon season.

Suggested Readings:

1. Richl: Tropical Meteorology
2. Palmen& Newton: Atmospheric Circulation System
3. Reiter: Jet Stream Meteorology
4. Ramage: Monsoon Meteorology
5. Saucier: Principles of Meteorological Analysis
6. Wiin-Nielson: Compendium of Meteorology, Vol. I, Part 3, Synoptic Meteorology, Geneva, W.M.O. No. 364.
7. Asnani: Tropical Meteorology,Vol. I and II
8. Das: Monsoons, Geneva, WMO No. 613
9. Keshavamurty& Sankar Rao: The Physics of Monsoons
10. Tarakanov: Tropical Meteorology
11. Krishnamurthi: Compendium of Meteorology, Vol. II, Tropical Meteorology, Geneva, W.M.O. No,364

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240907T	Course Title: Group A-Well Logging	

Course Objectives:

The primary objective of this course examines basic concepts of formation assessment, borewell environment, working principles and well logging measurements.
To impart knowledge of application of Geophysical Technology to oil and gas fields development and exploitation

Course outcomes:

On completion of the course, the student should be able to:

- Apply well logging concepts for formation evaluation.
- Properties of nature of potential self-log data, gamma ray and resistivity.
- Properties of log data properties of density, sonic, neutron and porosity.
- Properties of log data properties Magnetic resonance imaging (NMR) and Borehole imaging.
- Integrate well logging data with seismic data, understand mechanical rock concepts.

Credits:4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-2-0	

Unit	Topics
I	Objectives of well logging. Reservoir Rocks: Clastic and carbonate rocks. Reservoir Properties: Porosity, permeability, fluid saturation, need of drilling fluids and its properties, invasion process and various profiles, classification of formation evaluation methods, objective of well logging methods, logging operational field system and its procedure.
II	Electric-Logging: Spontaneous Potential (SP) logging: Spontaneous potentials in boreholes and its sources, SP curves and its interpretation, Non-focussed, focused and induction logging principles and sondes.
III	Radiation Well Logging: Gamma ray logging, details of the radiation logging, density or gamma-gamma logging, principle of the neutron-gamma logging, neutron-epithermal-neutron logging, neutron-thermal-neutron logging.
IV	Other Miscellaneous Logging Techniques: Acoustic velocity (Sonic) logging, Cement Bond Log (CBL), Litho-density Tool (LDT), Thermal log, caliper or section gauge log, NMR Log
V	Application of well logging to ground water, mineral and petroleum resources.

Suggested Readings:

1. Lynch: Formation Evaluation
2. Wyllie: Fundamentals of Well Log Interpretation
3. Vaish : Geophysical Well Logging : Principles and Practices
4. Schlumberger: Schlumberger Log Interpretation Principles/ Applications
5. Schlumberger: Schlumberger Log Interpretation Charts

6. Serra: Fundamentals of Well - Log Interpretation
7. Pirson: Hand book of Well log Analysis for Oil and Gas Formation Evaluation
8. Deveton: Log analysis of subsurface Geology: Concepts and Computer Methods.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	**Year: Second**	**Semester: III**
Subject: Geophysics		
Course Code: B240908T	**Course Title: Group B-Dynamic Meteorology**	

Course Objectives:

The main objectives of this course are to:

- To give insight of the mathematics and kinematics involved in atmospheric flow
- Be aware of the dynamics of atmospheric flow.
- To make them understand the equation of motion and continuity.

Course outcomes:

On completion of the course, the student should be able to:

- Remember the equation of motion and continuity
- Understand the difference between the different kinds of flow
- Apply the knowledge of kinematics and dynamics to find out the areas of convergence and divergence
- Analyse the horizontal and vertical variations of wind flow.

Credits:4	**Core Compulsory**
Max. Marks: 25+75	**Min. Passing Marks:40**

Unit	Topics
I	Thermodynamics of water vapour and Moist Air, equation of state of moist air, adiabatic processes of saturated air and moisture variables.
II	Thermodynamics Diagrams: General considerations, emagram, tephigram, skew T/ log P diagram, stuve diagram, choice of a diagram, CAPE and Convective Inhibition Energy (CINE).
III	Hydrostatic Equilibrium: Hydrostatic equation, hydrostatic of homogeneous, isothermal, constant lapse rate and dry adiabatic atmosphere, standard atmosphere.
IV	Fundamental forces, gravitation and gravity, geo-potential
V	Equation of motion in cartesian, natural and isobaric coordinate systems, scale analysis of the equations of motion.
VI	Continuity equation in cartesian, isobaric and spherical coordinate.
VII	Balanced Motion: Inertial wind, geostrophic wind, Rossby number, gradient wind, cyclostrophic wind and thermal wind.

VIII	Viscosity and Turbulence: Fundamental laws of viscosity, equations of mean motion in turbulent flow, mixing length theory, planetary boundary layer, , Ekman layer, Richardson number, Raynold's number, Froud number.
IX	Circulation and Vorticity: Kelvin's circulation theorem, Bjerknes theorem, potential vorticity, vorticity equation, divergence equation, Tendency equation, BjerknesHolmboe theory, isallobaric wind.

Suggested Readings:

1. Hess: Introduction to Theoretical Meteorology
2. Pisharoty: Thermodynamic Diagram and some of Their Uses (IMD Tech. Note)
3. Gordon: Introduction to Dynamic Meteorology
4. Holton: An Introduction to Dynamic Meteorology
5. Haltiner: Numerical Weather Prediction
6. Haltiner&Martin : Physical and Dynamic Meteorology
7. Haltiner& William: Numerical Weather Prediction and Dynamic Meteorology
8. AskelWiin-Nielsen: Compendium of Meteorology, Vol. I. Dynamic Meteorology, W.M.O. No. 364.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B240909T	Course Title: Petroleum Geophysics	

Course Objectives:

The main objectives of this course are to:
1.To impart basic knowledge about Petroleum geophysics.
2. To train the students to understand the processes of formations of different sedimentary basins and significance of hydrocarbons.

Course outcomes:

On completion of the course, the student should be able to:

- The students will learn about the geophysical techniques and data interpretation involved in finding oil and gas.
- Understand sedimentation history of different sedimentary basins of India
- AVO analysis
- VSP

Credits:4	Fifth Elective
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Shear wave prospecting, seismic source energy for S-wave, splitting of shear wave. Shear wave velocity and relationship between Vs and Vp for different materials. Application of shear wave in processing and interpretation of seismic data.
II	Data acquisition for vertical seismic profiling (VSP), 3D-VSP and its applications. Multi-component seismic data acquisition for recording of P and S waves.
III	4-D seismic, passive seismic. AVO/AVA analysis, splitting of P wave energy into P and S seismic reflected and refracted waves, Zoeppritz equations. Offset dependent reflectivity.

Suggested Readings:

1. Clarbout:Fundamentals ofGeophysicalProspecting
2. Telfordet.al.:AppliedGeophysics
3. sheriff:SeismicSratigraphy
4. Dobrin&Savit: IntroductiontogeophysicalProspecting
5. Waters:ReflectionSeismology
6. Sheriff&Geldart:ExplorationSeismology
7. FundamentalsofgeophysicalinterpretationsbyLaurenceR. LinesandR.T.Vavrick.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B2409010T	Course Title: Applied Meteorology	

Course Objectives:

The aim of this course is to enable students to understand the advance concepts of meteorology and weather events, aviation meteorology, Maritime meteorology, Atmospheric Transport and Diffusion.

Course outcomes:

On completion of the course, the student should be able to:

- They will also be able to learn nature of atmosphere, clouds, precipitation and climate by which students will understand the Earth's surface system.
- Students will learn Physical principles that provide the foundation for meteorology that means meteorological observations and forecasts required for aircraft,special observations from ship at sea weather bulletins for shipping, storm warning bulletins, storm signals at ports.

Credits:5	Fifth Elective
Max. Marks: 50+50	Min. Passing Marks:40

Unit	Topics
I	Aviation meteorology: Requirements of climatological data for sitting of runways, meteorological observations and forecasts required for aircraft operations, organization of KAO, DGCA and air traffic control, coordination between MFT and ATC, special observations for aviation, METAR, SPECT, TREND, SIGMENT, aviation forecasts and warnings, documentation and briefing for national and international flights, aviation climatology.
II	Maritime Meteorology: Voluntary observing flight routine and special observations from ship at sea weather bulletins for shipping, storm warning bulletins, storm signals at ports, weather routing of ships, climatological atlas for oceanic regions, atlas of storm tracks.
III	Environmental Pollution: Extent of pollution, atmospheric ventilation, meteorological factors affecting the concentration of pollutants, monitoring for prevention control of pollution UNEP.
IV	Atmospheric Transport and Diffusion: Classical diffusing theory (K-theory), similarity theory, theory of turbulence, Plum rise, short term modelling and prediction technique for pollutants.
V	Effects of air pollution on climate, human health.

Suggested readings

1. Stern: Air pollution
2. HMSO, London: Handbook of Aviation Meteorology
3. Munn: Biometeorology
4. WMO Note: Urban Climatology
5. WMO Technical Note: Air Pollutants, Meteorology and Plant Injury.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	**Year: Second**	**Semester: III**
Subject: Geophysics		
Course Code: B2409011T	**Course Title:** PracticalE	
Course Objectives:		
The lab is designed to train the students in basic and some advanced techniques of electrical, gravity, magnetic, electromagnetic and well logging.		
Course outcomes:		
After completion of this course, a student will be able to: • Get practical knowledge of Qualitative and Quantitative Analysis of various geophysical data. • Learn physical properties of rock. • Perform experiments ofelectrical data. • Perform experiments of gravity and magnetic data. • Perform experiments ofelectromagnetic and well log data.		
Credits:5		**Sixth Elective**
Max. Marks: 50+50		**Min. Passing Marks:40**

Unit	Topics
I	1. Plotting of equipotential traces and current lines for a point source. 2. Interpretation of profiling data. 3. Interpretation of field resistivity sounding curves.
II	4. Determination of density by Nettleton method. 5. Handling of gravimeter and its calibration. 6. Structure contouring from subsurface information 7. Computation of gravity effect of a sphere, horizontal cylinder and fault. 8. Computation of effect of a magnetic dipole of finite length, sphere and horizontal cylinder.
III	9. Computational of dip angle response over sheet type bodies. 10. Analysis of dip angle data and its interpretation. 11. Computation of Turam profiles over sheet type bodies. 12. Reduction of Turam data and its interpretation. 13. Interpretation of Slingram profiles over sheet conductors using phasor diagrams. 14. Interpretation of MT data
IV	15. Qualitative interpretation of well logs and their correlation 16. Computation of porosity. 17. Computation of formation factor. 18. Computation of water saturation. 19. Computation of oil saturation. 20. Applications of cross plots for estimation of various parameters.
Suggestive digital platforms web links	

Program/Class: Master in Geophysics	Year: Second	Semester: III
Subject: Geophysics		
Course Code: B2409012T	Course Title:Practical F	

Course Objectives:

The lab is designed to train the students in basic and some advanced techniques of climatology, agrometeorology, synoptic and tropicalmeteorology.

Course outcomes:

After completion of this course, a student will be able to:

- Get practical knowledge of Qualitative and Quantitative Analysis of various meteorological data.
- Learn meteorological parameter.
- Perform experiments of rainfall variabilities.
- Numerical weather forecasting
- Analysis of synoptic system

Credits:5	Sixth Elective
Max. Marks: 50+50	Min. Passing Marks:40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-6

Unit	Topics
I	1. Basic analysis of global distribution of mean climatic parameters. 2. Computation of weighted and running means of a time series. 3. Computation of rainfall variabilities and coefficient of variation. 4. Computation of climatic types according to Koeppen and Thornthwaite.
II	5. Computation of various components of weekly water balance during crop growing period and assessment of agricultural drought. 6. Computation of evaporation, evapo-transpiration and potential evapo-transpiration using various methods. 7. Forecasting of crop yield on the basis of weather parameters. 8. Crop phenol-logical changes and heat unit requirement of the crops. 9. Prediction of minimum temperature and frost under Eastern UP condition. 10. Medium range weather forecast and preparation of agro-meteorological advisory bulletins for farmers.
III	11. Plotting and analysis of constant pressure charts. 12. Plotting and analysis of vertical time section and cross section chart. 13. Streamline and isotach analysis.
IV	14. Analysis of tephigram: (a) Computation of derived parameters, LCL, CCL, LFC, CAPE and CINE (b) Computation of precipitable water content, (c) Computation of heights of pressure surfaces by adiabatic and isothermal methods, (d) Study of stability and instability of various layers and forecasting of fog, thunderstorm, etc., (e) Determination of height of tropo-pause, thickness of isothermal and inversion layers etc. 15. Computation of geostrophic vorticity, geostrophic wind. 16. Computation of atmospherics parameters using computer programming.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: IV
Subject: Geophysics		
Course Code: B241001T	Course Title: Physical Oceanography and Marine Geophysics	

Course Objectives:

The main objectives of the course are to introduce the students to basic concepts of marine science and associated geophysical phenomena. The course is also aimed to introduce morphological features, sediment nature, interactions of ocean water with various spheres of the Earth and life in marine environment.

Course outcomes:

On completion of the course, the student should be able to:

- Understand various concepts of marine science, physical and chemical nature of seawater, nature of sediment as well as life in ocean.
- The students will also understand vital nature of ocean in atmospheric condition and for the life in the Earth.
- To get the idea about the mechanism of ocean circulation and deep-water formation

Credits:5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Physical properties of Sea Water: Chlorinity, salinity, thermal properties, density, pressure, optical properties, transmission of sound, water masses.
II	Acquisition of Ocean Data: Salinity measurements, Nansen bottle, light in sea, measurement of SST, reversing thermometers, Bathy thermograph, current meters.
III	Ocean Currents: Hydrodynamic equations of motion, inertia currents, geostrophic currents in homogeneous and stratified ocean; relative and slope currents, Ekman theory, the major surface current systems of the ocean, upwelling and sinking with special reference to Indian ocean and their effects.
IV	Waves: Wave velocity, group velocity, theory of surface gravity waves, short and long waves, generation and growth of wind waves, long waves in canals, standing waves in closed basins, tsunami.
V	Tides: Tide generating forces, principal harmonic components, theories of tides, description and types of tides, prediction of tides, tidal gauges.
VI	Ocean and Seas: classification, growth and decline of ocean basins, turbidity currents, submarine sedimentation and stratigraphy, physiography and divisions of the sea floor, continental shelves, slopes, aprons and abyssal planes, occurrence of mineral deposits and hydrocarbon in offshore.
VII	Gravity and magnetic Surveys: Types of magnetometer used in a survey ship, towing cable and fish, data collection their reduction and interpretation, underwater gravity measurements, ship borne gravimeters, problems with shipborne gravity measurements, survey procedure, data reduction and interpretation.

VIII	Seismic Surveys: Marine energy sources, Pinger, Boomer, Sparker, exploder cook etc. hydrophones active section and streamer towing gear, shooting methods near offshore and offshore exploration techniques, Analysis and interpretation of seismic data.

Suggested Readings:

1. Duxbury: The Earth and its Oceans
2. WMO No.364: Marine Meteorology
3. Sverdrup, Johnson & Fleming: The Oceans
4. Defant: Physical Oceanography, Vols. I and II
5. McLellen: Elements of Physical Oceanography
6. Jacob, Russel&Willson: Physics and Geology
7. Dobrin&Savit: Introduction to Geophysical prospecting
8. Telford et.al.: Applied Geophysics

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: IV
Subject: Geophysics		
Course Code: B241002T	Course Title: Remote Sensing & GIS	

Course Objectives:

The primary objective of the course provides fundamental understanding and working knowledge of the principles and applications of remote sensing and GIS that is fundamental to understand the Earth system.

Course outcomes:

On completion of the course, the student should be able to:

- Explain the principles of remote sensing and its application.
- Develop capabilities of understanding and interpreting remote sensing data
- Acquire knowledge and critical thinking skills to solve a real-world problem with appropriate remote sensing data and processing methods
- Critically assess the strengths and weaknesses of remote sensing instruments and platforms for a variety of application scenarios
- Critically evaluate the opportunities and available methods for integrating remote sensing and GIS.

Credits:5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Fundamentals of Remote Sensing: Energy sources, principles of solar and terrestrial radiation, laws of radiation, energy interactions, spectral patterns and signatures.
II	Types of sensors, photographic and TV cameras, visible and infrared sensing, radiometer, side looking radar.
III	Development in remote sensing platforms, constant level and tethered balloons, aircrafts, rockets and satellites.

IV	Developments of satellites and remote sensing developments in India.
V	Application in geological mapping and mineral resource evaluation, concepts of GIS and applications.
VI	Application to water resources evaluation and soil moisture determination; watershed parameters, physiographic measurements, surface water, flood plain delineation, precipitation, ice and snow monitoring.
VII	Kepler's laws of planetary motion, circular and elliptical orbits of satellites, polar, geosynchronous and geostationary satellites.
VIII	Remote sensing application in meteorology, visible and infrared pictures of clouds, recognition of various clouds and weather systems, estimation of surface temperature and cloud tops, vertical profiles of temperature and water vapour, wind estimation.

Suggested Readings:

1. Barret & Curtis: Introduction to Environmental Remote Sensing.
2. Lillesand & Kiefer: Remote Sensing and Image Interpretation.
3. Reeves (Ed.): Manual of Remote Sensing, Vols. I and II, American Soc. Photogrammetry.
4. Siegal &Gellospie: Remote Sensing in Geology.
5. Teekshadulu&Rajan: Remote Sensing, Indian Academy of Sciences.
6. Kidder &VonderHaar: Satellite Meteorology an Introduction.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	**Year: Second**	**Semester: IV**
Subject: Geophysics		
Course Code: B241003T	**Course Title: Stratigraphy**	

Course Objectives:

The main objectives of this course are to:

- To impart basic knowledge about seismic Stratigraphy.
- To train the students to understand the processes of formations of different sedimentary basins and significance of hydrocarbons.

Course outcomes:

On completion of the course, the student should be able to:

- The students will learn about the geophysical techniques and data interpretation involved in finding oil and gas.
- Understand stratigraphy and sedimentation history of different sedimentary basins of India

Credits:5	**Seventh Elective**
Max. Marks: 25+75	**Min. Passing Marks:40**

Unit	Topics
I	Stratigraphy: Principles of Stratigraphy, elements of stratigraphic classification; geological time scale.

II	Basic concepts of sequence Stratigraphy and seismic stratigraphy Geophysical methods of stratigraphic correlation. Physical and structural divisions of Indian subcontinent and their characteristics
III	Classification, lithology and economic importance of the following: Dharwar supergroup of Karnataka, Cuddapah supergroup of Andhra Pradesh, Vindhyan Supergroup of Son valley, Gondwana Supergroup of peninsular India and Tertiary of Assam, Siwaliks of Himalaya.

Suggested Readings:

1. Clarbout:Fundamentals ofGeophysicalProspecting
2. Telfordet.al.:AppliedGeophysics
3. sheriff:SeismicSratigraphy
4. Dobrin&Savit: IntroductiontogeophysicalProspecting
5. Waters:ReflectionSeismology
6. Sheriff&Geldart:ExplorationSeismology
7. FundamentalsofgeophysicalinterpretationsbyLaurenceR. LinesandR.T.Vavrick.

Suggestive digital platforms web links

Program/Class: Master in Geophysics	Year: Second	Semester: IV
Subject: Geophysics		
Course Code: B241004T	Course Title: Advanced Climatology	

Course Objectives:

The main objectives of this paper are designed to help students gain a scientific understanding of the physical aspects of Earth's climate system and the factors that influence climate change.

Course outcomes:

On completion of the course, the student should be able to:

- Identify the basic forces and processes that govern global weather and climatic conditions
- Describe and explain the distribution of various climatic types over the surface of the earth
- Identify both anthropogenic and natural causes of climate change

Credits:5	Seventh Elective
Max. Marks: 25+75	Min. Passing Marks:40

Unit	Topics
I	Climatic classification based on atmospheric circulation and geographical conditions. Genetic classification, classification based on the effect originated at the surface. Types of climate, Various classifications of climate, Koepen, thornthwaite, Handdeletc
II	Function and physical description of the climates of the different continents and ocean.
III	Radiation properties of natural surfaces, radiation in crops forest canopies, cities, vertical variation and distribution of various climatic elements, heat exchange and conduction near soil surface, atmospheric pollution.
IV	Elements of bioclimatology, urban building climatology, climatic change, fundamental meteorological factors affecting the climate, past climate revealed by meteorological observation, methods of palaeoclimatology, possible causes of climatic change, influence of man on climatic changes, climatological statistics.

V	Introduction to climate system, role of greenhouse gases, global warming, climatic change and its impacts on agriculture
VI	Physical processes in general circulation.

Suggested Readings:

1. Miller: Climatology
2. Lamb: Climate Present, Past and Future
3. Barry & Parry: Synoptic Climatology
4. Stringer: Fundamentals of Climatology
5. Winter School on Climate Change and its Impacts, IIT- Delhi.

Suggestive digital platforms web links

Program/Class: Master in Geography	Year: Second	Semester: IV
Subject: Geophysics		
Course Code:B241005T	**Course Title:** Major Research Project/ Dissertation	

Course Objectives:

The objective of this course is to appraise the student with various research and development techniques used in different branches of geophysics.

Course outcomes:

After completion of this course, a student will be able to identify the potential research problem, prepare synopsis of a defined research problem and interpret the acquired data.

Credits:5	**Core Compulsory**
Max. Marks: 100	**Min. Passing Marks:40**