



॥ सा विद्या या विमुक्तये ॥

# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड - ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'B++' grade

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शैक्षणिक वर्ष २०२४-२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार लागू केलेल्या विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर द्वितीय वर्षाचे सुधारीत (दुरुस्ती) अभ्यासक्रमाबाबत.

## परिपत्रक

जा.क्र.शै.-१ / परिपत्रक / एनईपीदुरुस्ती / S&T/2025-26 /68

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक १५ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीतील विषय क्रमांक १५/५९-२०२४ च्या अन्वये मान्यता दिल्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेअंतर्गत राष्ट्रीय शैक्षणिक धोरण-२०२० नुसार पदव्युत्तर द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२४-२५ लागू करण्यात आले आहे. तथापी वरील संदर्भीय परिपत्रकान्वये प्रकाशित केलेल्या अभ्यासक्रमामध्ये अभ्यासमंडळांनी किरकोळ दुरुस्ती करून अभ्यासक्रम सादर केला असून मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा यांच्या मान्यतेने दुरुस्ती केलेले अभ्यासक्रम लागू करण्यात येत आहेत.

01 M. Sc. II year Geophysics (Campus)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या [www.srtmun.ac.in](http://www.srtmun.ac.in) या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.:शै.-१ / एनईपी / विवरणविपदवी / २०२५-२६ / 254

दिनांक १७.१०.२०२५

सहाय्यक कुलसचिव  
शैक्षणिक (१-अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.

१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.

२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.

३) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.

४) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.

५) मा. प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.

६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.



**SWAMI RAMANAND TEERTH**  
**MARATHWADA UNIVERSITY, NANDED - 431 606**

□

**(Structure and Syllabus of Four Years Multidisciplinary Degree  
Program with Multiple Entry and Exit Option)**

**TWO YEAR MASTERS PROGRAMME IN**  
**Geophysics**

**Under the Faculty of**  
**Science and Technology**

Effective from Academic year 2023 – 2024  
(As per NEP-2020)

## **Forward by the Dean, Faculty of Science and Technology**

### **SAMPLE COPY (Need to be Modified)**

#### **From the Desk of the Dean:**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. L. M. Waghmare, Dean, Faculty of Science and Technology,  
Dr. M. K. Patil, Associate Dean, Faculty of Science and Technology,  
Swami Ramanand Teerth Marathwada University, Nanded**

***NOTE: - Need to be modified following guidelines of NEP-2020 and its outcome and Overall improvement in Education system***

## **-From Desk of Chairman, Board of Studies of the Subject Geophysics**

### **Preamble:**

Syllabus of M.Sc. Geophysics program offered by the School of Earth Sciences has been prepared as per the Credit Framework guidelines of National Education Policy (NEP) 2020 and considering the syllabi of the UPSC examination, MPSC examination, CSIR-NET examination and the requirements of the industry. The M.Sc. program in Geophysics is imparted to the students for two academic years consisting of four semesters. Candidates will be examined and evaluated on grade basis at the end of each semester in different theory and practical papers as per the credits offered by each course.

The M.Sc. Geophysics program consists of Core Courses, Electives Courses, Research Methodology, Publication Ethics and On Job Training. This two year program is of total 88 credits, with 22 credits for each semester. The program includes Core and Elective Courses. Students can choose one Elective Course per semester from the list of Elective Courses provided. Students are also encouraged to select Open Elective courses from National Educational Platforms such as MOOCS/NPTL/SWAYAM. If a student wishes, he/she can take a few extra courses, which will be considered as add-on credits.

In addition to class-room teaching and laboratory, the M.Sc. Geophysics program offers geophysical field training to the students. After completion of field training, students have to submit a filed report to the School. Intensive On Job Training /Internships in the nationally reputed institutes shall also be provided to the M.Sc. Geophysics students. The semester breaks can also be utilized for the geophysical field training and internships.

Students will be assessed through Continuous Assessment (CA) and End Semester Assessment (ESA). Mode of Continuous Assessment (CA) will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting Two Tests (Test I on 40% curriculum) and Test II (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his CA score. The End Semester Assessment (ESA) (80% of the Maximum Marks) will be based on paper-pen pattern and laboratory experiments/calculations.

Every M.Sc. Geophysics student has to mandatorily submit dissertation thesis. The Research Project/Dissertation is of 10 Credits, 4 Credits are in third semester and 6 credits are in fourth semester. The dissertation work is based on either new data generated for the proposed scientific problem *OR* based on available large global data sets using innovative ideas. The thesis should be based on sound methodology and well defined objectives. Through dissertation work the student should be well-versed with the literature on the chosen topic, independently define a scientific problem, carry out focused study on a research topic, analyze and interpret large data sets, independently write thesis / project proposal and present and defend the dissertation work. The Dissertation must be submitted by the end of fourth Semester with a Seminar presentation in the presence of faculty members, students and external examiners for the purpose of evaluation. The School of Earth Sciences strongly encourages the M.Sc. Geophysics students to publish their dissertation work in SCI journals.

**Prof. Dr. Dipak Baburao Panaskar**

**Chairman, Board of Studies of the Geology, Swami Ramanand Teerth Marathwada University, Nanded**



**Details of the Board of Studies Members in the subject .....  
under the faculty of Science & Technology of S.R.T.M. University,  
Nanded**

<b>Sr No</b>	<b>Name of the Member</b>	<b>Designation</b>	<b>Address</b>	<b>Contact No.</b>
1	<b>Dr. Dipak Baburao Panaskar</b>	<b>Senior Professor</b>	<b>School of Earth Sciences, S. R. T. M. University, Nanded</b>	<b>9403227259</b>
2	<b>Dr. Hari Shankarrao Patode,</b>	<b>Associate Professor</b>	<b>School of Earth Sciences, S. R. T. M. University, Nanded</b>	<b>9850209045</b>
3	<b>Dr. Shaikh MD Babar,</b>	<b>Professor</b>	<b>DSM 's College of Arts, Commerce and Science College, Parbhani</b>	<b>9890184699</b>
4	<b>Dr. Bhagwan Balasaheb Ghute,</b>	<b>Assistant Professor</b>	<b>Toshniwal Arts, Commerce &amp; Science College, Sengaon, Tq. Sengaon, Dist Hingoli.</b>	<b>9130006333</b>
5	<b>Dr. Udaykumar Laxmikant Sahu,</b>	<b>Assistant Professor</b>	<b>Toshniwal Arts, Commerce &amp; Science College, Sengaon, Tq. Sengaon, Dist Hingoli.</b>	<b>9860406757</b>
6	<b>Prof. D. C. Meshram</b>	<b>Professor</b>	<b>Department of Geology, S. P. Pune University, Pune</b>	<b>8275697166</b>
7	<b>Dr. A. N. Dongre</b>	<b>Associate Professor</b>	<b>Department of Geology, S. P. Pune University, Pune</b>	<b>9922410132</b>
8	<b>Dr. Sukanta Roy</b>	<b>Principal Scientist (F) &amp; Project Director</b>	<b>BGRL, Ministry of Earth Sciences, Karad</b>	<b>9490469980</b>
9	<b>Prof. A. R. Kulkarni</b>	<b>Professor</b>	<b>SIBER, Kolhapur</b>	<b>7588470146</b>
10	<b>Dr. T.Vijay Kumar Invitee member</b>	<b>Professor</b>	<b>SES, SRTMU</b>	<b>7972643417</b>



# Swami Ramanand Teerth Marathwada University, Nanded

## *Faculty of Science & Technology*

### *Credit Framework for Two Year PG Program*

#### Subject: Geophysics

Year & Level 2	Sem. 3	Major Subject		RM 5	OJT / FP 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
		(DSC) 3	(DSE) 4						
2	3	SGPY-CT2501 Magnetic Method (4 Cr) Theory  SGPY –CT2502 Hydrogeology (4 Cr) Theory  SGPY –CT2503 Seismology (4 Cr) Theory	SGPY –ET2501 Remote sensing (2 Cr) Theory  SGPY –EP2501 Remote sensing (1 Cr) Practical <b>OR</b> SGPY –ET2502 Geographical Information Systems (2 Cr) Theory  SGPY –EP2502 Geographical Information Systems (1 Cr) Theory	--	--	<b>SGPYRP2501 (4Cr) Research Project</b>	SGPY-CP2501 Magnetic Method (1 Cr) Practical  SGPY –CP2502 Hydrogeology (1 Cr) Practical  SGPY –CP2503 Seismology (1 Cr) Practical	22	44
	4	SGPY-CT2551 Well Logging (4 Cr) Theory  SGPY –CT2552 Seismic prospecting (4 Cr) Theory	SGPY-ET2551 Electro Magnetic Methods (3 Cr) Theory  SGPY-EP2551 Electro Magnetic Methods (1 Cr) Practical <b>OR</b> SGPY-ET2552 Radiometry and Nuclear Geophysics (3 Cr) Theory  SGPY-EP2552 Radiometry and Nuclear Geophysics (1 Cr) Practical	<b>SGPYPE2551</b> Publication Ethics (2Cr)	--	<b>SGPYRP2551 (6Cr) Research Project</b>	SGPY-CP2551 Well Logging (1Cr) Practical  SGPY –CP2552 Seismic prospecting (1 Cr) Practical	22	



## M. Sc. Second Year Semester III (Level 6.0 )

### Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
<b>Major</b>	SGPY CT2501	Magnetic Method	04	--	<b>04</b>	04	--
	SGPY CT2502	Hydrogeology	04	--	<b>04</b>	04	--
	SGPY CT2503	Seismology	04	--	<b>04</b>	04	--
<b>Elective (DSE)</b>	SGPY ET2501	Remote sensing OR	02	--	<b>02</b>	02	--
	SGPY ET2502	Geographical Information Systems					
<b>Research Project</b>	SGPYRP2501	Research Project	04	--	<b>04</b>	04	--
<b>DSC Practical</b>	SGPY CP2501	Magnetic Method	--	01	<b>01</b>	--	02
	SGPY CP2502	Hydrogeology	--	01	<b>01</b>	--	02
	SGPY CP2503	Seismology	--	01	<b>01</b>	--	02
<b>DSE Practical</b>	SGPY EP2501	Remote sensing OR	--	01	<b>01</b>	--	02
	SGPY EP2502	Geographical Information Systems					
<b>Total Credits</b>			<b>18</b>	<b>04</b>	<b>22</b>	<b>18</b>	<b>08</b>



## M. Sc. Second Year Semester III (Level 6.0)

### Examination Scheme

[20% Continuous Assessment (*CA*) and 80% End Semester Assessment (*ESA*)]

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA	CA (8)	ESA (9)	
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)			
<b>Major</b>	SGPY CT2501	Magnetic Method	20	20	20	80	--	--	100
	SGPY CT2502	Hydrogeology	20	20	20	80	--	--	100
	SGPY CT2503	Seismology	20	20	20	80	--	--	100
<b>Elective (DSE)</b>	SGPY ET2501	Remote sensing OR Geographical Information Systems	10	10	10	40	--	--	50
	SGPY ET2502				--				
<b>Research Project</b>	SGPYRP2501	Research Project	20	20	20	80	--	--	100
<b>DSE Practical</b>	SGPY CP2501	Magnetic Method	--	--	--	--	05	20	25
	SGPY CP2502	Hydrogeology	--	--	--	--	05	20	25
	SGPY CP2503	Seismology	--	--	--	--	05	20	25
<b>DSE Practical</b>	SGPY EP2501	Remote sensing OR Geographical Information Systems	--	--	--	--	05	20	25
	SGPY EP2502				--				



## M. Sc. Second Year Semester IV (Level 6.0)

### Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
<b>Major</b>	SGPY CT2551	Well Logging	04	--	<b>04</b>	04	--
	SGPY CT2552	Seismic prospecting	04	--	<b>04</b>	04	--
<b>Elective (DSE)</b>	SGPY ET2551	Electro Magnetic Methods	03	--	<b>03</b>	03	--
	SGPY ET2552	OR Radiometry and Nuclear Geophysics					
<b>Research Methodology</b>	SGPYPE2551	Publication Ethics	02	--	<b>02</b>	02	--
<b>Research Project</b>	SGPYRP2551	Research Project	06	--	<b>06</b>	06*	--
<b>DSC Practical</b>	SGPY P2551	Gravity methods	--	01	<b>01</b>	--	02
	SGPY P2552	Signal processing	--	01	<b>01</b>	--	02
<b>DSE Practical</b>	SGPY EP2551	Electro Magnetic Methods	--	01	<b>01</b>	--	02
	SGPY EP2552	OR Radiometry and Nuclear Geophysics					
<b>Total Credits</b>			<b>19</b>	<b>03</b>	<b>22</b>	<b>19</b>	<b>06</b>

\* See note at the end



## M. Sc. First Year Semester IV (Level 6.0)

### Examination Scheme

[20% Continuous Assessment (CA) and 80% End Semester Assessment (ESA)]

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9)  (10)
			Continuous Assessment (CA)			ESA	CA (8)	ESA (9)	
			Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)	Total I (7)			
<b>Major</b>	SGPY CT2551	Well Logging	20	20	20	80	--	--	100
	SGPY CT2552	Seismic prospecting	20	20	20	80	--	--	100
<b>Elective (DSE)</b>	SGPY ET2551	Electro Magnetic Methods OR	15	15	15	60	--	--	75
	SGPY ET2552	Radiometry and Nuclear Geophysics							
<b>Research Methodology</b>	SGPYPE2551	Publication Ethics	10	10	10	40	--	--	50
<b>Research Project</b>	SGPYRP2551	Research Project	--	--	--	150	--	--	150
<b>DSE Practical</b>	SGPY CP2551	Well Logging	--	--	--	--	05	20	25
	SGPY CP2552	Seismic prospecting	--	--	--	--	05	20	25
<b>DSE Practical</b>	SGPY EP2451	Electro Magnetic Methods OR	--	--	--	--	05	20	25
	SGPY EP2452	Radiometry and Nuclear Geophysics							

**Course Structure: Major 1 - Teaching Scheme**

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY CT2501	<b>Magnetic Method</b>	04	--	04	--	04

***Major 1 - Assessment Scheme***

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)				
SGPY CT2501	<b>Magnetic Method</b>	20	20	20	80	--	--	100

**SGPY CT2501: Magnetic Method (*Major 1*) (*Theory: 4 credits*) Curriculum Details**

**Course pre-requisite:**

- Basic Physical concepts of magnetism and geomagnetism

**Course objectives:**

- This course is intended to discuss about the magnetic field of the Earth, potentials and its applications in Geophysics. Magnetic field variations of Earth and its materials, concepts of magnetic methods, instrumentation, data acquisition, data processing, data analysis and interpretation of magnetic data and its applications. Concepts of palaeomagnetism and rock magnetism.

**Course outcomes:**

- At the end of the course the student will get knowledge about geomagnetism, magnetic field and its applications. The student will be adept to use magnetic methods in the geoexploration, resource evaluation, evolution of the Earth and geological mapping.

**Curriculum Details: (There shall be FOUR Modules in each course)**  
**SGPY CT2501 : Magnetic Methods Curriculum Details: (There shall be FOUR Modules in each course)**

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
<b>1.0</b>		<b>Concepts of Earth's Magnetic field</b>	
	1.1	Earth's main magnetic field, origin and distribution, Elements Geomagnetic field Coulombs law of magnetic force and fields, magnetic moments.	<b>15</b>
	1.2	Intensity of magnetization, magnetic potential, Units of measurement, Laboratory determination of susceptibility	
	1.3	Origin and concept of magnetic anomalies, concepts of Induced and Remnant magnetism. Concepts of Palaeomagnetism, NRM, magnetic reversals	
	1.4	Introduction to geological time scale, applications of Paleomagnetism-Anisotropic Magnetic Susceptibility (AMS), concepts and definitions. IGRF	
<b>2.0</b>		<b>Instrumentation</b>	
	2.1	Principle of magnetic prospecting, Magnetic prospecting Instruments: Flux gate magnetometers, vertical and total field magnetometers, Proton- precision magnetometers.	<b>15</b>
	2.2	Ground magnetic survey procedure	
	2.3	Air borne and ship borne magnetic surveys	
	2.4	Magnetic data collection process and its corrections	
<b>3.0</b>		<b>Data interpretation</b>	
	3.1	Regional & residual separation	<b>15</b>
	3.2	Upward and downward continuation techniques	
	3.3	Qualitative and quantitative Interpretation of magnetic data, Magnetic anomalies over simple geometric bodies and irregular bodies, depth rule.	
	3.4	Poissons relation gravity and magnetic potential field	
<b>4.0</b>		<b>Inversion and Applications</b>	
	4.1	Principles of Inversion and Modeling.	<b>15</b>
	4.2	Inversion of magnetic anomalies of simple geometric bodies	
	4.3	Inversion of 2D polygonal bodies, magnetic interfaces, time domain and frequency domain techniques	
	4.4	Applications of magnetic method for geological mapping and exploration	
		<b>Total</b>	<b>60</b>

### ***Text Books and Reference Books:***

1. Applied Geophysics, W.W.Telford, et. al.
2. Introduction to Geophysical prospecting, M.B.Dobrin and Savit.
3. Gravity and magnetics in oil prospecting, L.L.Nettleton
4. Gravity and magnetic methods, Rao, B.S.R and Murthy, I.V.R
5. Gravity and magnetic Interpretation in Exploration Geophysics, I.V.RadhakrishnaMurthy
6. Interpretation theory in Applied Geophysics, F.S.Grant and West
7. Environmental Magnetism By Roy Thompson and Frank Oldfield
8. Anisotropic Magnetic Susceptibility By Tarling and Hrouda
9. Principles and Appliatins of Paleomagnetism By D.H. Traling
10. Online material

### **Practicals : SGPY CP2501: Magnetic Methods (1 Credit)**

<b>Course Code</b>	<b>Course Name (Paper Title)</b>	<b>Teaching Scheme (Hrs.)</b>		<b>Credits Assigned</b>		
		<b>Theory</b>	<b>Practical</b>	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
<b>SGPY CP2501</b>	<b>Magnetic Method</b>	--	02	00	01	01

**Problems based on Geomagnetism, Paleomagnetism and Polar wandering curve will be addressed under this course and also to model magnetic response due to different subsurface bodies.**

### **Text books and reference Books**

1. Applied Geophysics, W.W.Telford et. Al
2. Introduction to Geophysical prospecting, M.B.Dobrin

**Course Structure:** *Major 1 - Teaching Scheme*

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY CT2502	Hydrogeology	04	--	04	--	04

*Major 1 - Assessment Scheme*

Course Code (2)	Course Name (3)	Theory				ESA (7)	Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			CA (8)		ESA (9)		
		Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)					
SGPY CT2502	Hydrogeology	20	20	20	80	--	--	100	

**SGPY CT2502: Hydrogeology (Major 2) (Theory: 4 credits)**  
***Curriculum Details***

**Course pre-requisite:**

- Basic (10+2) knowledge of chemistry and physics and must have completed basic courses on geology and rock properties.

**Course objectives:**

1. To understand the hydro-geological cycle.
2. Occurrence of groundwater on the planet earth.
3. To study the groundwater aquifers, hydro geological properties, and movement of groundwater.
4. Exploration of groundwater occurrence in different geological formations.
5. To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organizations/Pvt. organizations
6. To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization.

**Course outcomes:**

1. At the completion of the course student would be able to
2. Understand Water-bearing formations.
3. Understand and model the flow of groundwater.
4. Explain chemistry of groundwater as controlled by natural and anthropogenic processes.
5. Detect groundwater potential and understand its management.
6. Analyze water for different chemical components.
7. Graphically represent variations groundwater chemistry.

**SGPY CT2502 Hydrogeology Curriculum Details: (There shall be FOUR Modules in each course)**

<b>Module No.</b>	<b>UnitNo.</b>	<b>Topic</b>	<b>Hrs. Required to cover the contents</b>
<b>1.0</b>		<b>Concepts of Hydrogeology</b>	
	1.1	Hydrological cycle; Occurrence and distribution of groundwater	<b>15</b>
	1.2	Aquifer classification and characteristics of aquifers	
	1.3	Hydrological properties of rocks-Porosity, permeability	
	1.4	hydraulic conductivity, specific yield, storage coefficient, transmissibility, hydraulic resistivity, hydraulic diffusivity.	
<b>2.0</b>		<b>Aquifer characteristics</b>	
	2.1	Classification of rocks from hydrological view- Properties	<b>15</b>
	2.2	groundwater conditions in different geological formations	
	2.3	Aquifer parameter analysis; Darcy's Law in homogenous and heterogenous media; Bernoulli equation; Reynold's number	
	2.4	pumping test and aquifer evaluations; Coastal conditions- seawater intrusion and its control	
<b>3.0</b>		<b>Ground water management</b>	
	3.1	Groundwater management; methods of recharge; artificial recharge; water budgeting and evaluation of perennial yield	<b>15</b>
	3.2	Urbanization and demands on water	
	3.3	Water logging and conjunctive use; excessive use and alkalinity-saltation; Methods of water conservation; sustainable watershed development	
	3.4	groundwater level fluctuations; land subsidence; impact of global climate change on groundwater	
<b>4.0</b>		<b>Analysis of groundwater</b>	
	4.1	Chemical characteristics of groundwater in relation to various uses – domestic, industrial and irrigation; Radioisotopes in hydro-geological studies	<b>15</b>
	4.2	Groundwater contamination and problems of arsenic, fluoride and nitrates.	
	4.3	Groundwater exploration: Surface investigation of groundwater - geologic, remote sensing, electrical resistivity, seismic, gravity and magnetic methods	
	4.4	sub-surface investigation of groundwater - test drilling, resistivity logging, spontaneous potential logging, radiation logging	
		<b>Total</b>	<b>60</b>

**Text Books:**

1. Geochemistry, Groundwater and Pollution by C.A.J. Appelo
2. Geophysical Prospecting For Groundwater by Sankar Kumar Nath
3. Ground Water and Wells by F.G. Driscoll
4. Ground Water by H.M. Raghunath
5. Ground Water Hydrology by D.K. Todd
6. Groundwater Geochemistry by J. Merkel Broder
7. Groundwater Geophysics in Hard Rock by Prabhat C. Chandra
8. Groundwater Prospecting and Management by H. P. Patra, Shyamal Kumar Adhikari, and Subrata Kunar
9. Hydrogeology by S.N. Davies and R.J.N. De-West
10. Modern Groundwater Exploration: Discovering New Water Resources in consolidated Rocks Using Innovative Hydrogeologic Concepts, Exploration, Drilling, Aquifer Testing and Management Methods by Jay H. Lehr and Robert A. Bisson

**Practicals : SGPY CP2502: Hydrogeology (1 Credit)**

**In Laboratory:** Megascopic identification and description of hydrological properties of rocks. Hydrological problems, hydrochemical analysis of water, plotting the Gibb's diagrams, Piper Tri-linear diagrams etc.

**In Field:** Study of weathering pattern with respect to percolation of surface water in to the ground water, study of primary and secondary porosity of rock formation; Well inventory etc.

**Text books and reference Books**

1. Ground Water by H.M. Raghunath
2. Ground Water Hydrology by D.K. Todd

**Course Structure: Major 1 - Teaching Scheme**

Course Code (2)	Course Name (3)	Theory				ESA (7)	Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			CA (8)		ESA (9)		
		Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)					
SGPY CT2503	Seismology	20	20	20	80	--	--	100	

***Major 1 - Assessment Scheme***

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY CT2503	Seismology	04	--	04	--	04

**SGPY CT2503: Seismology (*Major 1*) (*Theory: 4 credits*)**  
***Curriculum Details***

**Course pre-requisite:**

Basic Physical concepts of elastic properties of different materials, internal structure of the Earth

**Course objectives:**

- The objective is to provide knowledge about earthquakes; mechanisms-interpretation, seismology imparts solid foundation in principles of seismic wave generation and propagation through theory and applications of modern analysis techniques, seismic data acquisition techniques and Data interpretation techniques.

**Course outcomes:**

- At the end of the course, students will be able to derive fundamental seismological equations from first principles, model earthquake sources using seismic waveforms and identification of different phases and modelling Earth structure with multiple techniques and acquire skills in seismological data acquisition.

**Curriculum Details:** *(There shall be FOUR Modules in each course)*

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
<b>1.0</b>		<b>Principles of wave Propagation</b>	
	1.1	Elasticity, Stress-strain relation, Principal and deviatoric stress	<b>18</b>
	1.2	Waves on a string, SHM, seismic wave, Snells Law, Fermats Principle, Huygens Principle, Seismic wave equation	
	1.3	Reflection and Transmission coefficients, Introduction to different wave patterns- body	
	1.4	surface and related waves, phase and group velocity, dispersion	
<b>2.0</b>		<b>Earthquakes and Seismicity</b>	
	2.1	Introduction to earthquake phenomena, concept of focus, focal depth, epicentre, intensity and magnitude scales and energy of earthquakes	<b>12</b>
	2.2	foreshocks and aftershocks, elastic rebound theory	
	2.3	seismicity of India, global seismicity, seismic zoning of India	
	2.4	concept of inhomogeneity and anisotropy, types and causes of earthquakes	
<b>3.0</b>		<b>Propagation Characteristics</b>	
	3.1	Seismic ray theory for spherically stratified earth and velocity structure from travel time data, propagation and characteristics of body waves, , different phases of body waves and their applications,	<b>15</b>
	3.2	surface waves, group and phase velocities	
	3.3	Structural aspects like faulting, fracture and their effects on wave propagation, reflection of body waves	
	3.4	focal mechanism solutions and tectonic implications	
<b>4.0</b>		<b>Instrumentation</b>	
	4.1	Instruments- Principle of electromagnetic seismograph, displacement meters, velocity meter, WWSSN stations, seismic arrays for detection of nuclear explosions, wide band seismometry, strong motion seismograph.	<b>15</b>
	4.2	Broad band seismometers and sensors, Short period seismometers and related analysis of seismograms	
	4.3	analog and digital	
	4.4	Seismic data recorders	
		<b>Total</b>	<b>60</b>

### ***Text Books and Reference Books:***

1. Introduction to seismology by Seth and Stein
2. Fundamentals of Geophysics, William Lowrie
3. An Introduction to Seismology, Earthquakes and Earth structure By Stein & Wyssession
4. Engineering Seismology By Agarwal
5. Modern Global Seismology, Thorne Lay and Wallace
6. Internal Constitution of the Earth By Gutenberg
7. Introduction to Seismology by Bath
8. The Earth, Jeffreys.S.H.
9. Elementary Seismology, Charles.F. Richter
10. An introduction to the theory of seismology, Bullen. K.E. and Bolt
11. Quantitative seismology: theory & methods, Aki. K. and Richards
12. An introduction to the theory of seismology P Shearer
13. Online material

### **Practicals : SGPY CP2503: Seismology (1 Credit)**

#### **Problems based on**

1. Acoustic impedance
2. Reflection coefficient
3. Transmission coefficient
4. stress tensor
5. strain tensor
6. Modelling of travel time of Seismic phases
7. Poisson's ratio,
8. Wave velocities, frequency and wavelength
9. Geometric Attenuation

### **Text books and reference Books**

1. An introduction to the theory of seismology P Shearer
2. Introduction to seismology by Seth and Stein

**Course Structure:** *Major 1 - Teaching Scheme*

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY ET2501	Remote sensing	02	--	02	--	02

*Major 1 - Assessment Scheme*

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)				
SGPY ET2501	Remote sensing	10	10	10	40	--	--	50

## **SGPY ET2501: Remote Sensing (DSE )(Major 1) (Theory: 2 credits) Curriculum Details**

### **Course pre-requisite:**

Basic (10+2) understanding of science

### **Course objectives:**

- To attain fundamental knowledge of basics of Remote Sensing.
- To identify different features with the help of Photo-interpretation Elements.
- To apply Remote Sensing knowledge for different applications in Earth Sciences.

### **Course outcomes:**

- After the completion of the course student would be able to
- Explain the Fundamental principles of Remote Sensing.
- Explain basic properties of Remote Sensing, Data acquisition, Storage and Processing.
- Identify different features with the help of Photo interpretation Elements.
- Apply the knowledge of Remote Sensing for applications in different fields.
-

**Curriculum Details: (There shall be FOUR Modules in each course)**

<b>Module No.</b>	<b>UnitNo.</b>	<b>Topic</b>	<b>Hrs. Required to cover the contents</b>
<b>1.0</b>		<b>Introductuon to Arieal Photography</b>	
	1.1	Introduction to Remote Sensing, Definition, Characteristics of EMR, Platforms	7
	1.2	Fundamentals of Aerial Photography	
	1.3	History of Aerial Photographs	
	1.4	Types of Aerial Photographs- Vertical and Oblique Photographs	
<b>2.0</b>		<b>Instrumentation</b>	
	2.1	Aerial Cameras, Flying Plan, Photogrammetry -- Basic Geometric Characteristics- Scale, Overlap, Tilt, Distortion and Displacement of Aerial Photographs,	8
	2.2	Advantages and Disadvantages of Aerial Photographs	
	2.3	EMR and its interaction with matter, Reflection, Absorption, Transmission, Scattering	
	2.4	Concept of Signatures- Photo Interpretation Elements.	
<b>3.0</b>		<b>Remote Sensing - 1</b>	
	3.1	Principles of Remote Sensing, Process of Remote Sensing	7
	3.2	Indian Remote Sensing Programme	
	3.3	Types of Satellites- Sun-synchronous and Geostationary Satellites,	
	3.4	Launch Vehicles- PSLV, GSLV, Payloads, Active and Passive Remote Sensing	
<b>4.0</b>		<b>Remote Sensing - 2</b>	
	4.1	Classification of Remote Sensors	8
	4.2	Resolution- Spatial, Spectral, Radiometric, Temporal, Microwave Sensors, SLAR	
	4.3	Digital Image Processing- Image Classification, Supervised and Unsupervised Classification, Image Enhancement, Filtering, PCA etc.	
	4.4	Interpretation of Visual and Digital data, Applications in Geology	
		<b>Total</b>	<b>30</b>

***Text Books and Reference books:***

1. Image Interpretation in Geology by Drury
2. Introduction to Remote Sensing by J. B. Campbell
3. Photogrammetry by Miller and Miller
4. Principles & Applications of Photogeology by S. N. Pande

5. Remote Sensing & Image Interpretation by T. M. Lillesand and W. K Ralph
6. Remote Sensing in Geology by Siegal
7. Remote Sensing: Principles and Interpretation by F. F. Sabins

### **Practicals : SGPY EP2501 Remote sensing (1 Credit)**

1. Toposheet Reading
2. Calculation of the Scale of Aerial photograph and Satellite Imagery.
3. Identification of different features from the Aerial photograph with the help of Photo-interpretation Elements.
4. Identification of different features from Satellite Imagery with the help of Photointerpretation Elements.
5. Study of Drainage patterns from Aerial Photograph/Satellite Imagery.
6. Preparation of Land use/Land cover Map from Aerial Photograph/Satellite Imagery.
7. Calculation of Land use/Land cover percentage from Aerial Photograph/ Satellite Imagery

### **Text books and reference Books**

1. Image Interpretation in Geology by Drury
2. Principles & Applications of Photogeology by S. N. Pande

### **Course Structure: Major 1 - Teaching Scheme**

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY ET2502	Geographical Information system	02	--	02	--	02

### ***Major 1 - Assessment Scheme***

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)				
SGPY ET2502	Geographical Information system	10	10	10	40	--	--	50

**SGPY ET2502: Geographical Information system\_(DSE)**  
*(Major 1) (Theory: 2 credits) Curriculum Details*

**Course pre-requisite:**

- Basic understanding Geology, Geography and Physics (10 / 10+2 level)

**Course objectives:**

1. Introduce the students to the fundamental concepts of GIS and GPS technologies
2. It will make them familiar with the most essential GIS techniques with hands on practical experience.
3. Students will learn about creation and organization of spatial and non-spatial data.
4. Learn and use different GIS based techniques to identify and solve the natural, environmental and community problems.
5. Learn application of GIS and GPS in geology.

**Course outcomes:**

- After the completion of the course student would be able to
  1. Differentiate between different data types in GIS.
  2. Georeference the spatial data and work on spatial and non-spatial database.
  3. Describe various GIS tools and techniques.
  4. Explain the fundamental principles behind GPS technology.
  5. Visualize GIS outputs in different dimensions.
  6. Create digital GIS maps.
  7. Apply spatial data analysis for various applications to deal with geological problems

**Curriculum Details:** *(There shall be FOUR Modules in each course)*

<b>Module No.</b>	<b>UnitNo.</b>	<b>Topic</b>	<b>Hrs. Required to cover the contents</b>
<b>1.0</b>		<b>Introduction to GIS</b>	
	1.1	Introduction to GIS, Definition, History of GIS	<b>7</b>
	1.2	Scope and Importance of GIS, Development of GIS	
	1.3	Components of GIS	
	1.4	Data models in GIS - Raster data model, Vector data model, basic entities of GIS: line, point and polygon,	
<b>2.0</b>		<b>GIS-1</b>	
	2.1	Geodatabase, Map Projection, Types and Need of projection system, Spatial and Attribute data	<b>8</b>
	2.2	Acquisition of spatial data: Scanning, Georeferencing, concept of layer	
	2.3	digitizing, error detection and correction	
	2.4	DBMS	
<b>3.0</b>		<b>GIS-2</b>	
	3.1	Global Positioning Systems, History and developments in GPS	<b>7</b>
	3.2	Trilateration process, types of GPS, GPS Surveys	
	3.3	Mapping and layout, Image processing	
	3.4	General processes involved in image processing, mosaic, subset, Point interpolation techniques: Krigging, IDW, , , ,	
<b>4.0</b>		<b>GIS-3</b>	
	4.1	Data analysis, network analysis	<b>8</b>
	4.2	DEM and DTM	
	4.3	Thematic maps	
	4.4	Geological Applications of GIS and GPS technology	
		<b>Total</b>	<b>30</b>

## **Practicals : SGPY EP2502: Geographical Information System (1 Credit)**

1. Geo-referencing of image.
2. Base layer preparation.
3. Error detection and correction.
4. Preparation of geodatabase and editing data.
5. Use of GPS instrument to collect way-point data
6. Map Projections.
7. Importing GPS data into the computer using software.
8. Mosaiking.
9. Subsetting.
10. Point Interpolation techniques: Krigging, IDW.
11. Preparation of DEM/DTM.
12. Preparation of thematic maps
13. Practical based on geological applications of GIS.
14. Practical based on geological applications Google Earth

### ***Text Books and Reference books:***

1. An Introduction to Geographical Information Systems by I. Heywood, S. Cornelius and S. Carver
2. Concepts Techniques of Geographical Information Systems by C. P. Lo and A. W. Yeung
3. Geographical Information Systems and Science by P. A. Longley, M. F. Goodchild, D. J. Maguire and D. W. Rhind
4. Fundamentals of Geographic Information Systems by M. N. Demers
5. Introduction to Geographic Information Systems by K. T. Chang
6. Introduction to Global Positioning Systems by Ahmed E. L. Rabbany
7. Introductory Digital Image Processing by J. R. Jensen
8. Textbook of Remote Sensing and Geographic Information System by M. Anji Reddy
9. Principles of Geographical Information Systems by P. A. Burrough and R. A. McDonnell
10. The GIS Book by G. B. Korte

## M. Sc. Second Year Semester IV (Level 6.0)

### Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
<b>Major</b>	SGPY CT2551	Well Logging	04	-	04	04	--
	SGPY CT2552	Seismic prospecting	04	-	04	04	--
<b>Elective (DSE)</b>	SGPY ET2551	Electro Magnetic Methods	03	-	03	03	--
	SGPY ET552	OR Radiometry and Nuclear Geophysics					
<b>Research Methodology</b>	SGPYPE2551	Publication Ethics	02	-	02	02	--
<b>Research Project</b>	SGPYRP2551	Research Project	06	-	06	06*	--
<b>DSC Practical</b>	SGPY CP2551	Gravity methods	--	01	01	--	02
	SGPY CP2552	Signal processing	--	01	01	--	02
<b>DSE Practical</b>	SGPY EP551	Electro Magnetic Methods	--	01	01	--	02
	SGPY EP2552	OR Radiometry and Nuclear Geophysics					
<b>Total Credits</b>			<b>19</b>	<b>03</b>	<b>22</b>	<b>19</b>	<b>06</b>

\* See note at the end

**Course Structure: Major 1 - Teaching Scheme**

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY CT2551	Well Logging	04	--	04	--	04

***Major 1 - Assessment Scheme***

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)				
SGPY CT2551	Well Logging	20	20	20	80	--	--	100

**SGPY CT2551: Well Logging (*Major 1*) (*Theory: 4 credits*)**  
***Curriculum Details***

**Course pre-requisite:**

- Basics of physical properties of electricity, magnetism, sound, radio activity, of different materials

**Course objectives:**

- The main objectives of the course are to introduce the students to the fundamental concepts of well logging and its interpretation. To provide detail knowledge to read well-logs, apply the necessary corrections, and perform well log interpretations for hydrocarbon bearing formations.

**Course outcomes:**

- After completion of the course students are expected to acquire knowledge in various well logging tools and its interpretation. These skills are useful in Oil exploration and resource evaluations.

**Curriculum Details: (There shall be FOUR Modules in each course)**

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
<b>1.0</b>		<b>Basics of Well Logging</b>	
	1.1	Introduction: Drilling of a Well. Drilling Fluids. Mud Filtrates	15
	1.2	Invasion Profile Logging Unit. Depth Control. Well Pressures	
	1.3	Bore Hole Environment, Formation Factor. Porosity & Water saturations, Occurrences of Hydrocarbons, Minerals and Water,	
	1.4	Tool design and Tool Principles.	
<b>2.0</b>		<b>Electrical Logs</b>	
	2.1	Electrical logging: S.P Log: Origin, Static SP, Shale Base Line, SP in various aquifers, Determination of $R_w$ , Conventional Resistivity Logs	15
	2.2	Normal, Lateral Curves, Focused Logs: Latero Log - 3. Latero Log-7 DLL, SFL and Comparative study, Induction Log: DIL, HRI-High Resolution Induction Log. Micro Log, Micro & Micro Latero Log, Micro SFL	
	2.3	Determination of $R_{mf}$ , $R_{xo}$ & $R_t$ . Dip meter. Side Wall Coring,	
	2.4	Logging for Ground Water, Coal & Minerals	
<b>3.0</b>		<b>Radioactive and Sonic Logs</b>	
	3.1	Radioactive Logs: Principles of Radioactivity, Counters, Gamma Ray Log Statistical Variations, Neutron - Gamma,, Neutron - Neutron Logs, Thermal Decay logs, Density Log, Identification of Lithology, & Porosity	15
	3.2	CMR Log: and identification of free fluids. MDT and introduction PLT survey	
	3.3	Sonic Logs: Transit Time, Sonic Velocities, Sonic Porosities Cementation. Cased Hole Logs	
	3.4	Identification of Water, Minerals and Hydrocarbons and fractures	
<b>4.0</b>		<b>Interpretation and Application</b>	
	4.1	Interpretation of Log data: Lithology & Porosity determination from cross plots. Permeability determination, M-N Plots	15
	4.2	Common Sedimentary rocks. Clean and Shaly formations, Cross Plots Techniques	
	4.3	Quick look interpretation and detailed interpretation of Clean sands and Shaly sands, Water Saturation	
	4.4	Application of Logging for Hydrocarbon zones, Mineral Zones, water Zones and Coal	
		<b>Total</b>	<b>60</b>

***Text Books & Reference Books:***

1. **Fundamentals of Well log Interpretation (Vol 1 & Vol 2) by O Serra**
2. **Well logging for Earth Scientists Darwin Ellis and Julian Singer**
3. **Formation Evaluation, E J Lynch**
4. **Induction Logging, Plusynin.**
5. **Log Interpretation Principles and Charts, Schlumberger**
6. **Schlumberger Documents,**
7. **Development and Exploitation of Oils and Gas Fields, Murovyer and Andiasevrentnal**
8. **Handbook of Well Log Analysis, S J Peterson.**
9. **Online material**

**Practicals : SGPY CP2551: Well Logging (1 Credit)**

1. **Calculatin of water saturation at formation depth using Archies equation**
2. **Calculation of formation factor of cylindrical sandstone**
3. **Calculation of volume of shale of the gamma ray log**
4. **Calculation of volume of shale from the given log**
5. **Calculation of porosity of carbonate reservoir**
6. **Calculation of porosity of the formation having sandstone matrix**
7. **Identify the gas zone with proper explanation**
8. **Calculation of porosity using density log formula and plot the graph**
9. **Calculation of apparent resistivity between the layers**

**Text books and reference Books**

1. **Fundamentals of Well log Interpretation (Vol 1 & Vol 2) by O Serra**
2. **Well logging for Earth Scientists Darwin Ellis and Julian Singer**

**Course Structure:** *Major 1 - Teaching Scheme*

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY CT2552	Seismic Prospecting	04	--	04	--	04

*Major 1 - Assessment Scheme*

Course Code (2)	Course Name (3)	Theory				ESA (7)	Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (9)		CA (8)		
		Test I (4)	Test II (5)	Avg of (T1+T2) /2 (6)		CA (8)			
SGPY CT2552	Seismic Prospecting	20	20	20	80	--	--	100	

**SGPY CT2552: Seismic Prospecting (*Major 1*) (Theory: 4 credits) Curriculum Details**

**Course pre-requisite:**

- Basic Physical concepts of elastic wave propagation and physics of the Earth

**Course objectives:**

- The objective is to train the student in the seismic prospecting methods using reflection and refraction techniques. The course is to provide knowledge about artificial seismic energy generation techniques, seismic wave propagation and seismic reflection/refraction prospecting methodologies. The course also aims at data acquisition, data processing, and analysis and interpretation techniques associated with different seismic prospecting methods.

**Course outcomes:**

- At the end of the course, students will acquire all the necessary knowledge in seismic prospecting. This knowledge will be useful in oil exploration programs and mineral exploration programs as well as estimating the depth to the bedrock

**Curriculum Details: (There shall be FOUR Modules in each course)**

<b>Module No.</b>	<b>UnitNo.</b>	<b>Topic</b>	<b>Hrs. Required to cover the contents</b>
<b>1.0</b>		<b>Introduction</b>	
	1.1	Introduction to seismic prospecting, elasticity principles: Normal strains, shearing strains, Hook's law, Elastic moduli, wave equations, Huygen's & Fermat's Principles, wave characteristics- refraction, reflection, diffraction, attenuation & absorption of seismic waves	<b>10</b>
	1.2	acoustic impedance, reflection and transmission coefficients	
	1.3	Elastic wave velocities of rocks: velocity inversion, low velocity layer	
	1.4	Concept of blind zone, hidden layer	
<b>2.0</b>		<b>Sources and Receivers</b>	
	2.1	Electromagnetic geophone and its performance, damping coefficient, hydrophones, analog data acquisition, amplifiers, filters, gain control and recording types	<b>15</b>
	2.2	Seismic energy sources for land and marine surveys. Dynamite thumper, vibrosies, land air gun, pinger, boomer, sparker, airgun, water gun. Controlled explosions,	
	2.3	source arrays, energy content, frequency, pulse length and resolution, penetration,	
	2.4	signatures of energy sources. Digital data acquisition	
<b>3.0</b>		<b>Seismic Refraction</b>	
	3.1	Seismic Refraction surveys: Field procedures, fan shooting, broad side shooting, inline profiling, long refraction profiles, reversed and unreversed profiles, marine refraction surveys, sonobuoy surveys.	<b>15</b>
	3.2	Reduction of refraction data, interpretation of refraction data, analysis of refraction records	
	3.3	interpretation of reversed and unreversed profiles, delay time methods, forward modeling, masked layers and hidden layers	
	3.4	crustal seismology, engineering surveys, exploration for ground water, application in mining industry	
<b>4.0</b>		<b>Seismic Reflection</b>	
	4.1	Seismic Reflection surveys: Field procedures, .	<b>20</b>
	4.2	Reflection data processing, static and dynamic corrections, velocity determination	
	4.3	Preparation of seismic sections migration, analysis of analog records, automatic processing of digital seismic data, different methods of migration, Geological interpretation	
	4.4	Application of reflection method for exploration for oil and gas, groundwater, coal, mineral deposits, gas hydrates, etc., engineering applications, crustal studies, structural and stratigraphic traps, identification of geological structures like anticlines, faults, salt domes etc	
		<b>Total</b>	<b>60</b>

### ***Text Books & Reference Books:***

1. Applied Geophysics, W.W.Telford, et. al.
2. Introduction to Geophysical prospecting, M.B.Dobrin and Savit.
3. Introduction to geophysical exploration, Keary Brooks
4. Exploration seismology, Sheriff. R.E.
5. Reflection Seismology by Kenneth Waters
6. Seismic stratigraphy-application to hydrocarbon exploration Ed. By Charles Payton.
7. Shear wave exploration, SH Danbom and SN Domenico
8. Multicomponent seismology in petroleum exploration, RH Tathamz and MD cCormack
9. Fundamentals of seismic tomography, Lo and Inderweisen
10. Reservoir studies, SEG publication.
11. Seismic exploration fundamentals, J.A.Coffeen.
12. A hand book for seismic data acquisition, Brain J Evans
13. Online material

### **Practicals : SGPY CP2552: Seismic Prospecting (1 Credit)**

1. Synthetic computation of Direct and Refracted waves for horizontal interface
2. Synthetic computation of Reflected waves horizontal interface
3. Travel time modelling of Direct and Refracted waves for horizontal interface
4. Travel time modelling of Direct and Refracted waves for Dipping interface from reverse shooting
5. Computation of depth to the interface from crossover distance
6. Computation of depth to the interface from intercept time
7. Nmo correction
8. Finding the optimum geophone spacing to cancel the ground roll
9. Estimating the stacking velocity

### **Text books and reference Books**

1. Introduction to geophysical exploration, Keary Brooks
2. Introduction to Geophysical prospecting, M.B.Dobrin

**Course Structure: Major 1 - Teaching Scheme**

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY ET2551	Electromagnetic Methods	03	--	03	--	03

***Major 1 - Assessment Scheme***

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)				
SGPY ET2551	Electromagnetic Methods	15	15	15	60	--	--	75

## **SGPY ET2551: Electromagnetic Methods (*Major 1*) (Theory: 3 credits) Curriculum Details**

### **Course pre-requisite:**

Basic Physical concepts of electromagnetism, Maxwell's equations, conductivity and magnetic properties of Earth materials

### **Course objectives:**

The objective is to train the student in the electromagnetic methods using both natural and artificial sources. The course is to provide knowledge about various methods using electromagnetic principle. The course also aims at data acquisition, data processing, and analysis and interpretation techniques associated with different Electromagnetic prospecting methods. The objective is to train the student in the electromagnetic methods using both natural and artificial sources. The course is to provide knowledge about various methods using electromagnetic principle. The course also aims at data acquisition, data processing, and analysis and interpretation techniques associated with different Electromagnetic prospecting methods.

### **Course outcomes:**

At the end of the course, students will acquire all the necessary knowledge in electromagnetic methods used in the exploration. This knowledge will be useful in mineral exploration programs and geological Mapping

**Curriculum Details: (There shall be *FOUR* Modules in each course)**

<b>Module No.</b>	<b>UnitNo.</b>	<b>Topic</b>	<b>Hrs. Required to cover the contents</b>
<b>1.0</b>		<b>Natural Source EM</b>	
	1.1	Basic concept of Electromagnetic induction, Maxwell's equations, plane wave characteristics, wave number, impedance, skin depth	<b>12</b>
	1.2	primary-secondary field relations, elliptic polarization, real and imaginary components, response function	
	1.3	Methods of measurement for different source-receiver configuration. Components in EM measurements	
	1.4	Introduction to natural source EM methods	
<b>2.0</b>		<b>Artificial Source EM</b>	
	2.1	Artificial source methods, classification frequency domain EM	<b>13</b>
	2.2	Turam, VLEM and Slingram methods principles, field procedures, quantitative interpretation	
	2.3	time domain EM	
	2.4	general field procedures, interpretation of surface transient method data	
<b>3.0</b>		<b>VLF &amp; GPR</b>	
	3.1	EM sounding, geometric and parametric soundings	<b>15</b>
	3.2	field procedures, interpretation	
	3.3	VLF; ground penetrating radar	
	3.4	Airborne EM methods, passive airborne EM systems, AFMAG and VLF;	
<b>4.0</b>		<b>Applications</b>	
	4.1	application of EM Methods in mineral,	<b>5</b>
	4.2	application of EM Methods ground water exploration	
	4.3	application of EM Methods geological mapping	
	4.4	application of EM Methods engineering problems	
		<b>Total</b>	<b>45</b>

***Text Books and Reference books:***

1. Applied Geophysics, Telford, et. al., revised edition
2. The magnetotelluric method, Theory and practice by Chave and Jones
3. Mining Geophysics, Parasnis
4. Philip Kearey and Michael Brooks, An introduction to geophysical exploration, 2000, Blackwell Science.

5. Outline of Geophysical Prospecting, M.B. Ramchandra Rao.
6. Field Geophysics, John Milsom
7. Foundation of Geophysical Electromagnetic theory and methods by Michael S Zhdanov

### **Practicals : SGPY EP2551 Electromagnetic methods (1 Credit)**

#### **Problems based on**

- 1. Skin depth estimation**
- 2. VLF**
- 3. GPR**
- 4. MT/CSAMT/AFMAG/SLINGRAM/TURAM**

#### **Text books and reference Books**

1. Applied Geophysics, Telford, et. al., revised edition
2. An introduction to geophysical exploration by Philip Kearey and Michael Brooks, 2000, Blackwell Science.

**Course Structure: Major 1 - Teaching Scheme**

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SGPY ET2552	Radiometry and Nuclear Geophysics	03	--	03	--	03

***Major 1 - Assessment Scheme***

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)				
SGPY ET2552	Radiometry and Nuclear Geophysics	15	15	15	60	--	--	75

## **SGPY ET2552: Radiometry and Nuclear Geophysics (*Major 1*) (Theory: 3 credits) Curriculum Details**

### **Course pre-requisite:**

Basic Physical concepts of Radioactivity and radioactive properties of Earth materials

### **Course objectives:**

The objective is to train the student in the Radiometry and Nuclear Geophysics. The course is to provide knowledge about various methods using Radioactivity principles. The course also aims at data acquisition, data processing, and analysis and interpretation techniques associated with different Nuclear Geophysics methods.

### **Course outcomes:**

At the end of the course, students will acquire all the necessary knowledge in Nuclear Geophysical methods used in the exploration. This knowledge will be useful in mineral, Oil exploration programs and for geological Mapping

**Curriculum Details: (There shall be *FOUR* Modules in each course)**

<b>Module No.</b>	<b>UnitNo.</b>	<b>Topic</b>	<b>Hrs. Required to cover the contents</b>
<b>1.0</b>		<b>Introduction</b>	
	1.1	Introduction to radiometric and nuclear geophysical methods	<b>12</b>
	1.2	Brief review of radioactive transformations and equilibrium.	
	1.3	Natural and artificial radioactive elements. Stable and radioactive isotopes in nature. Radiation Sources, Units of Radioactivity.	
	1.4	Isotopic neutron sources generator and nuclear reactor as a source of neutrons. Elementary concepts of safety considerations in handling of gamma and neutron sources	
<b>2.0</b>		<b>Radiometry</b>	
	2.1	Radiation detectors and basic equipment's: Geiger-Muller and proportional counters, scintillation detectors-NaI (TI) gamma ray spectrometer. Outlines of semiconductor radiation detectors	<b>11</b>
	2.2	Elements of neutron detectors. Principles of counting systems - total and differential counting, Basic principles of alpha, beta and gamma methods	
	2.3	Laboratory Radiometric analysis: Beta gamma method. Gamma spectrometric technique for U, Th, K determinations. Alpha spectral analysis, Emanation methods of analysis	
	2.4	Application of radiometric methods for radioactive and non-radioactive ores	
<b>3.0</b>		<b>Gamma Rays</b>	
	3.1	Evaluation of anomalies, Gamma radiation techniques in Nuclear Geophysics	<b>13</b>
	3.2	Gamma absorption method for determination of rock densities and estimation of total heavy elements	
	3.3	Gamma scatter principle for the estimation of insitu densities and ore assaying	
	3.4	Field applications of method in mine workings and boreholes	
<b>4.0</b>		<b>Neutron</b>	
	4.1	Introduction to Neutron methods	<b>9</b>
	4.2	Neutron-Neutron absorption and scatter principles	
	4.3	Field applications for moisture and porosity estimations	
	4.4	Principles of application of the n-gamma method for determinations of elements such a Fe, Cr,Ni,Cl in the laboratory and in logging investigations	
		<b>Total</b>	<b>45</b>

### ***Text Books and Reference books:***

1. Applied Geophysics, Telford, et. al., revised edition
2. The magnetotelluric method, Theory and practice by Chave and Jones
3. Mining Geophysics, Parasnis
4. Philip Kearey and Michael Brooks, An introduction to geophysical exploration, 2000, Blackwell Science.
5. Outline of Geophysical Prospecting, M.B. Ramchandra Rao.
6. Field Geophysics, John Milsom
7. Foundation of Geophysical Electromagnetic theory and methods by Michael S Zhdanov

### **Practicals : SGPY EP2552 Radiometry and Nuclear Geophysics (1 Credit)**

#### **Problems based on Radiometry and Nuclear Geophysics with different radioactivity data sets.**

#### **Text books and reference Books**

1. VLS Bhimasankaram (1974) Radiometric methods of Exploration, Published by CEG.
2. VLS Bhimasankaram, EI Savenko, and N. Venkat Rao (1973) Laboratory and field Methods of radiometry and nuclear geophysics, published by CEG
3. VLS Bhimasankaram, N. VenkatRao, K. Sreeramamurti and EI Savenko (1985) Principles and Methods of Nuclear Geophysics, Published by AEG.
4. W.M. Telford, L.P. Geldart and R.E. Sheriff (1990) Applied Geophysics publishedby Cambridge University Press.

**SGPYRP2551: Research Project**  
**(Dissertation Thesis: 4 credits & Presentation: 2 credits)**

*Major 1 - Assessment Scheme*

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)				
SGPY RP2551	Research Project (Dissertation Thesis)	--	--	--	100	--	--	100

**Pre-requisites:**

Completed all required credits of Theory and Practicals.

**Course objectives:**

1. To independently work on a scientific problem.
2. To able to generate new data OR able to synthesize and analyze available large global data sets.
3. To interpret the data and derive scientifically robust conclusions.
4. To learn software required for thesis work.
5. To develop the writing skills based on research pattern/report writing which is useful in research institutes / govt. organizations / Pvt. organizations.
6. To develop the analytical and interpretative skills so that he/she will be competent enough to get job in this field of specialization.

**Thesis (4 Credits):**

Every Post-graduate student has to mandatorily submit dissertation thesis. The dissertation work is based on either new data generated for the proposed scientific problem OR based on available large global data sets using innovative ideas. The thesis should be based on sound methodology and well defined objectives.

## SGPYRP2551: Presentation based on SGPYRP551 (2 Credits)

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)				
SGPY RP2551	Research Project (Presentation)	--	--	--	50	--	--	50

### Course outcomes:

At the completion of the course students would be able to

1. Well versed with the literature on the chosen topic.
2. Independently define a scientific problem.
3. Carry out focused study on a research topic.
4. Analyze and interpret large data sets.
5. Independently write thesis / project proposal.
6. Present and defend the scientific work.

Every student has to present his/her thesis in open house and defend their work.

**Note:** There will be interaction hours between the concerned guide and the student towards successfully completing the Research Project as contact hours as per the requirement of the research Problem.

### Guidelines for Course Assessment:

- A. Continuous Assessment (CA) (20% of the Maximum Marks):** This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting Two Tests (Test I on 40% curriculum) and Test II (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his CA score (col 6).
- B. End Semester Assessment (80% of the Maximum Marks):** 1. ESA Question paper will consists of 6 questions, each of 20 marks. 2. Students are required to solve a total of 4 Questions. 3. Question No.1 will be compulsory and shall be based on entire syllabus. 4. Students need to solve ANY THREE of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

\*Note: Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45 lectures.

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