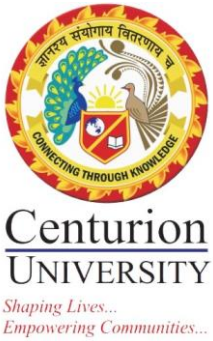
M. Sc. GEOINFORMATICS

(Two years programme)

Course Introduced: 2021

Syllabus Edited: 2022



School of Applied Sciences

Centurion University of Technology & Management, Odisha

Overview

Several aspects of space technology have already touched the life of common people, e.g., Google Earth, GPS-enabled Mobiles and day-to-day navigation, using maps. All the technologies behind these services, when put in one basket, can be justifiably described as "Geoinformatics". This includes satellite remote sensing, airborne remote sensing, photogrammetry, geographical information system (GIS), Global Positioning System (GPS), electronic surveying, laser scanning, mobile mapping, image processing, algorithms, data structures and computer programming. Geoinformatics or Geospatial technology touches around 80% of human activities knowingly or unknowingly.

Geoinformatics have high potential for better management and monitoring of day-to-day activities and short-term and long-term physical processes that affect our living environment. Besides finding the use in the day-to-day life of people, these technologies are becoming essential for a large number of application domains, e.g., environmental sciences, civil engineering, urban development and management, water resource, geology, navigation, disaster management, forest, coastal zones, mining operations, entertainment, and many more. Geomatics encompasses the practices related to developing, managing, interpreting or analysing geographically referenced data and includes everything that is 'spatial' in its characteristic and content. Geospatial information empowers the nation to understand its topography, natural resources and human capital and allows it to develop the requisite industrial policies to harness its resources.

Objective:

The 2-year master degree course – M. Sc. Geoinformatics is an interdisciplinary course with an aim to meet the increasing demand for qualified manpower in this rapidly developing field encompassing both pure and applied sciences. Application of Remote Sensing techniques using Geographic Information System (GIS) and Global Positioning System (GPS) with advance surveying has its place in various activities such as resources monitoring and evaluation, environmental monitoring and land use/land cover mapping etc. RS data products are increasingly being used for designing of plan at all the levels of nation building. The department has a separate vision for this course in becoming a Centre of excellence in Geomatics education and research thus to match the needs of ever increasing requirement of trained manpower in these fields and to cater to the need of the human society. It is our mission to impart quality education to students supported by large-scale hands- on-activity that

could make them capable of handling challenges of modern technologies and also to maintain super specialized research facilities to go hand in hand with the world's leading universities and research institutions.

Eligibility:

Bachelor degree in any Science graduate or BA in Geography.

Minimum 40% mark in bachelor degree

Carrier Prospective:

- **Indian Space Research Organization (ISRO) -** [Space Application Centre (SAC), Indian Institute of Remote Sensing (IIRS), ISRO State application Centre, Orissa Space Application Centre (ORSAC)].
- Survey of India (SOI)
- Indian Rice Research Institute (IRRI)
- Defence Research & Development Organization (DRDO)
- Urban Authorities of India
- Forest department [Odisha Forest Sector Development Project (OFSDP)]
- Chilika Development Authority (CDA)
- Odisha PVTG Empowerment Livelihood Improvement Programme
- Odisha Tribal Empowerment & Livelihoods Programme Plus
- Odisha State Disaster Management Authority (OSDMA)
- Bhubaneswar Municipality Corporation (BMC)
- Indian Institute of Mineral and Material Technology (IMMT)
- AABSys
- Institute for Spatial Planning and Community E-services (I SPACE)

Award

After finishing the course, the student will be award as **"Master of Science in Geoinformatics"** in his / her certificate.

SYLLABUS AS PER CBCS STRUCTURE

M.Sc. GEOINFORMATICS

CORE SUBJECT				
Sl. No.	**Code**	**Subject Name**	**T-P-P**	**Credits**
1.	CUTM2369	SURVEYING TECHNIQUES	**1-2-0**	**3**
2.	CUTM1060	GEOMETRIC MODELING	**0-3-0**	**3**
3.	CUTM2076	GEOSPATIAL DATA ANALYSIS IN PYTHON	**2-3-1**	**6**
4.	CUTM1059	DATABASE MANAGEMENT SYSTEMS	**2-1-0**	**3**
5.	CUTM2332	QUANTITATIVE METHODS	**2-2-2**	**6**
6.	CUTM2378	RESEARCH METHODOLOGY AND IPR	**2-0-2**	**4**
7.	CUTM2067	GEOLOGICAL REMOTE SENSING TECHNIQUE	**2-2-0**	**4**
8.	CUTM2068	MICROWAVE REMOTE SENSING AND APPLICATIONS	**2-2-0**	**4**
9.	CUTM2069	RS & GIS FOR URBAN AND REGIONAL PLANNING	**1-1-2**	**4**
10.	CUTM2070	GIS IN HEALTH	**2-2-0**	**4**
11.	CUTM1019	MACHINE LEARNING USING PYTHON	**1-2-1**	**4**
12.	CUTM2071	RS & GIS FOR HYDROLOGY AND WATER RESOURCES	**1-2-0**	**3**
13.	CUTM2072	APPLICATION OF GEO-INFORMATICS TO HAZARDS MONITORING AND MODELLING	**2-2-0**	**4**
14.	CUTM2073	GEOSPATIAL DATA INFRASTRUCTURE	**2-2-0**	**4**
15.	CUTM2074	RS & GIS FOR ENVIRONMENTAL ENGINEERING	**2-2-0**	**4**
16.	CUTM2075	RS & GIS FOR AGRICULTURE AND FORESTRY	**2-2-0**	**4**
TOTAL CREDITS				**64**

SKILL/DOMAIN/INTERNSHIP				
Sl. No.	**Code**	**Subject Name**	**T-P-P**	**Credits**
Domain	**ASCU2020**	**Aerial Surveying and Remote Sensing Applications**		**4-10-4**
1.	CUAS2020	REMOTE SENSING & DIGITAL IMAGE PROCESSING	**2-2-0**	**4**
2.	CUAS2021	GEOSPATIAL TECHNOLOGY AND ITS APPLICATION	**2-2-0**	**4**
3.	CUAS2022	PHOTOGRAMMETRY AND ITS APPLICATION	**0-2-0**	**2**
4.	CUAS2023	LIDAR REMOTE SENSING AND ITS APPLICATIONS	**0-2-0**	**2**
5.	CUAS2024	HYPER-SPECTRAL REMOTE SENSING AND ITS APPLICATION	**0-2-0**	**2**
6.	CUAS2025	PROJECT (Domain)	**0-0-4**	**4**
7.		SKILL	**4-0-0**	**4**

Sl. No.	**Code**	**Subject Name**	**T-P-P**	**Credits**
1.	CUTM2077	INTERNSHIP	**0-0-10**	**10**
		TOTAL		**10**
		Total Credit:	**64+18+4+10**	**96**

SURVEYING TECHNIQUES

Code	Course Title	Credit	T-P-PJ
CUTM2369	Surveying Techniques	3	1-2-0

Objectives:

- Apply the knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve well-defined surveying problems appropriate to the discipline. To study the temporary adjustment of survey instruments by standard methods.
- Technical Adeptness - Graduates will be technically adept in Surveying Technology as well as supporting math and science disciplines, allowing these graduates to assist professional land surveyors in various surveying and mapping projects. Their technical skills and knowledge will enable them to perform their work duties with a commitment to quality, timeliness, and continuous improvement.
- To do various field works with the help of Modern Instruments e.g. GNSS, Total station and GPR.
- To Carry out topographic survey.

Course Outcomes:

- Understand the basic principles of surveying for vertical, horizontal, linear and angular measurements to arrive at solutions to basic surveying problems.
- Understanding of surveying and using it in field of construction. Further draw contours to represent 3D data on plane figures.
- Capture geodetic data to process and perform analysis for survey problems with the use of electronic instruments.
- Design and implement different types of curves for deviating type of alignments, and applying surveying techniques to align highway and railway curves.
- Analyze type of survey operation required for problem solving in field to perform

Course outline:

Module-1 Introduction (2Th) HRS

Introduction to surveying: Classification and Principles of Surveying, Geodetic and Plane (Topographic) Surveying, Surveying Instruments, **Geometry of Ellipsoid:** Everest and WGS 84, Latitude and Longitude, Co-ordinate System and **Map Projection:** Polyconic Projection, Lambert Conformal Conic Projection, Universal Transverse Mercator Projection, **Map scale:** Fractional or ratio scale, Linear Scale, Graphical Scale.

Module-II Basic Survey Operations (2Th+6Pr) Hrs

Leveling: Concept and principles of levelling, Mean Sea Level, different types of levelling, their application, Source of error in Levelling (instrumental, natural, and personal) and elimination of errors.

Traversing: Traverse angle, Observation of Traverse Length, Selection of Traverse Station, Traverse Field Notes, Angle misclosure, Sources of error in traverse. Balancing angles, Computation of Azimuth or Bearing, Departure and Latitudes, Traverse adjustment, Rectangular co-ordinates.

Practices:

1. Calculation of RL using HI and Rise and fall method.
2. Traverse by Total Station.

Module-III Total station (2Th+6Pr) Hrs

Characteristics of Total Station /Electronics Total Station instrument, Function performed by Total Station, Parts of Total Station instrument, Handling and Setting up a Total station, Horizontal angle measurement, Vertical angle measurement, distance and angle measurement, Remote Elevation Measurement (REM), coordinate measurement, to view the data/ points collected, area calculation, data download. Source of error in total station.

Applications of Total Station: Detail survey i.e., data collection., Height measurement (Remote elevation measurement- REM, fixing of missing pillars (or) Setting out (or) Stake out, Resection. etc. Remote distance measurement (RDM) or Missing line measurement (MLM).

Practices:

4. Distance, angle and slope Measurements
5. Traverse adjustment (With help of software)
6. Area calculation using Total station
7. Height measurement (Remote elevation measurement- REM).
8. Fixing of missing pillars (or) Setting out (or) Stake out.
9. Preparation of contour maps using total station and surfer software.

Module IV: Global Positioning System (2Th+6Pra) Hrs.

Introduction of Global Navigation Satellite System (GNSS): GNSS Satellites: Galileo, NAVSTAR Global Positioning System (GPS), GLONASS and BeiDou Navigation Satellite System. Indian Regional Navigation System, Navigation with Indian Constellation (NivIK), Segments of GNSS/GPS: Control Segment, Space Segments, User Segment-operations of GPS; GPS signals and data; Geo-Positioning-Basic Concepts., accuracy, error sources and analysis, methodology for collection of data, adjustment computations and analysis.

Module V: Differential Global Positioning System (2Th+4Pra) Hrs.

Differential Global Positioning System: Method DGPS/DGNSS, Static and Rapid Static, Kinematic-Real time kinematic Survey, DGPS-GPS data processing and Accuracy, Real Time Kinematic Survey; data down loading and processing. Application of GPS in Surveying and Mapping, Navigation, Military, Location Based Services, Vehicle tracking, etc. Limitation of GPS & DGPS.

Module VI - Ground Penetrating Radar (2Th+4Pra) Hrs.

GPR Explain working principle of ground penetrating radar (GPR), Describe the type of antennas used with GPR for different type of underground material detection, Use ground penetrating radar until a predefined depth from sub-surface based on the conductivity of material. Explain use of sketch/single line diagram (SLD). Describe the use of GPS/DGP in sync with GPR to get all data populated on map. Describe the use of other Utility locator like electromagnetic locator and other utility locators.

Module VII - Cadastral Survey (2Th+4Pra) Hrs.

Cadastral map preparation methodology, unique identification number of parcel, position of existing control points and its types, Adjacent boundaries and features, Topology Creation and verification. Scale of Cadastral map, Cadastral Survey by Total Station.

Text Books:

1. Surveying Vol I & II, III B C Purnima, Laxmi Publication.
2. Surveying, volume 1&2 BY S.K.Duggal, TMH publisher.

Reference Books:

1. Surveying & Levelling by T.P Kanitkar& V S Kulkarni.
2. Elementary Surveying, by Charles D. Ghilani and Paul R. Wolf Pearson Publication

E Books:

1. Source of reference; NSQF

Online Source: NPTEL Videos (www.nptel.ac.in)

GEOMETRIC MODELING

Code	Course Title	Credit	T-P-PJ
CUTM1060	Geometric Modeling	3	0+3+0

Objectives

- To introduce the students to basic theory and concepts of Auto Cad, Revit and the classical methods for the analysis of building drawings.
- On completion of this course the students will be able to know the process of making sketches, dimensions, 3D Modeling and rendering.

Course Outcomes:

- Demonstrate use of CAD in Civil Construction, basic knowledge of operating software & commands, and benefit of civil developments in the construction industry. Do 2d &3d drafting /design with AUTO CAD software.
- Architectural modeling set up units & element properties, annotating, detailing,

Course outline:

MODULE 1 - 2D SKETCHES AND DIMENSIONING (4hrs)

1. Study for Drafting and Modeling – Coordinate systems (absolute, relative, polar). (1 Hr)
2. Drawing of a Section for a duplex building. (1 Hr)
3. Drawing of an elevation for a duplex building with dimensions. (2 Hrs)

MODULE 2 - 3D SKETCHES AND PROJECTION OF DUPLEX (3hrs)

4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning. (1 Hr)
5. Drawing front view, top view and side view of objects and projection of duplex building (2 Hrs)

MODULE 3 – BUILDING PLAN AND TRUSS (4hrs)

6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.) (2 Hrs)
7. Drawing of a simple steel truss. (1 Hr)
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc, (1 Hr)

MODULE 4 – INTRODUCTION OF REVIT ARCHITECTURE (3hrs)

9. Installing Autodesk Revit architecture and understanding the user interface. (1 Hr)
10. Creation of plan for a project by using level and sketching elements. (2 Hrs)

MODULE 5 - 3D MODELING WITH RIVET (7hrs)

11. Drawing isometric projection of simple objects. (1 Hr)
12. Creation of 3-D models of simple objects and obtaining 2-D multiview drawings from 3-D model. (2 Hrs)
13. Creation of 3d syphon, 3d canal fall, 3d water tank, 3d of trusts & 3d of foot over bridge. (2 Hrs)
14. Assembly drawing & attribute text - Annotation, block & w-block & leader. (2 Hrs)

MODULE 6 – WORKING WITH PROJECT AND WORK PLANES (04hrs)

15. Working with basic building components, site design and massing studies. (2 Hrs)

16. Setting color for wall, about sectioning libraries, basic knowledge of building. (2 Hrs)

MODULE 7 – ANNOTATION AND DETAILING AND RENDERING (04 hrs)

17. Creating text notes, grids, and levels. (1 Hr)
18. Working with label and detailing. (1 Hr)
19. Understanding the rendering workflow, using lights, and creating a lighting fixture. (1 Hr)
20. Displaying a light source in a view, controlling the position of a spotlight in a building model & adding plants and entourage. (2 Hr)

Text Books:

1. Groover M.P. and Zimmers E.W. Jr., "CAD/CAM, Computer Aided Design and Manufacturing",Prentice Hall of India Ltd, New Delhi, 1993.
2. Krishnamoorthy C.S.Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi,1993.
3. Sikka V. B., A Course in Civil Engineering Drawing, 4th Edition, S.K. Kataria and Sons, 1998.
4. George Omura, "Mastering in AUTOCAD 2002", BPB Publications, 2002.

Reference Books:

1. Shah.M.G., Kale. C.M. and Patki. S.Y., "Building Drawing with an Integrated Approach to Built.
2. Verma.B.P., "Civil Engineering Drawing and House Planning", Khanna Publishers, 1989.
3. Marimuthu V.M., Murugesan R. and Padmini S., "Civil Engineering Drawing-I", Pratheeba Publishers, 2008.
4. A Guide to building information modeling for Owners, Managers, Designers, Engineers, and Contractors, John Wiley and Sons. Inc., 200.

GEOSPATIAL DATA ANALYSIS IN PYTHON

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM 2076	GEOSPATIAL DATA ANALYSIS IN PYTHON	2-3-1	NIL

Objectives

- To understand the programming features of Python
- To learn the elements of python programming
- To learn python libraries
- To learn data visualisation using python

Course Outcomes:

- To read data using Python Functions
- To perform data visualisation using Python Libraries
- To learn problem solving using python

Course contents

Module-I **(4HrsTh+6Hrs Pra)**

Introduction to Python: Features, History, applications etc., Installation of anaconda cloud and Integrated Development Environment (IDE) window/Linux Operation system: Spyder, Jupiter Note Book, Pycharm, Eclipse etc.

Spyder IDE: Introduction Spyder, setting working Directory, Creating and saving a python script file, File execution, clearing console, removing variables from environment, clearing environment, Commenting script files etc.

Python Variables, Data Type, Keywords, Operators: Arithmetic and logical. Python Data Structure: Lists, Tuples, Dictionary, Sets.

Numpy: Array, Matrix and different operations, Linear algebra and analysis, Pandas data frame: Read & write Reading files (excel, CSV and txt etc.) data cleaning and analysis, Data elections & preprocessing, Data Visualization using matplotlib and seaborn library: Line plot, Scatter plot, Histogram, Bar plot, Box plot etc.

Module-II **(4HrsTh+4Hrs Pra)**

Pandas data frame: Read & write Reading files (excel, CSV and txt etc.) data cleaning and analysis, Data elections & preprocessing, Data Visualization using matplotlib and seaborne library: Line plot, Scatter plot, Histogram, Bar plot, Box plot etc., Geocoding.

Module III **(4HrsTh+4Hrs Pra)**

Introduction to Geopandas, Fiona, shapely and GDAL and Rasterio, PyGRASS and ArcPy**.** Data Structure, Geometric Object: Point, Line and polygon, Attribute and methods and Geo-data Frame ArcPy**.** Reading and Writing Files Geo-spatial Data, subset based on location, attribute and geometry. Indexing and extracting spatial feature using multi-criteria**.**

Module IV (4HrsTh+4Hrs Pra)

Geometric Manipulation, subset Operation: Union, Intersection, difference, Identity, overlay etc**.** Aggregation, Dissolve, Append, Merging of spatial feature data, Geospatial Feature Extraction, Vector, Shapefile, Join Operation, Open Street Map Integration, Spatial Databases, Spatial Clustering.

Module V **(4HrsTh+4Hrs Pra)**

Spatial Interpolation Techniques: Kernel Density Estimation (KDE), IDW Interpolation, TIN Interpolation, Spatial and Temporal Statistics from Raster Data. Spatial auto correction.

Module VI **(4HrsTh+4Hrs Pra)**

Making Map and plot: Choropleth Analysis and Mapping, Population density map, create legend, color manipulation and marginal annotations, Cloud GIS, Multi-Client Visualization.

Text Books

1. Programming Python: Powerful Object Oriented Programming; Mark Lutz; Shroff/O'Reilly; 2010.

2. Beginning Python: Using Python 2.6 & Python 3.1; James Payne; Wiley India; 2011.

DATABASE MANAGEMENT SYSTEMS

Code	Course Title	Credit	T-P-PJ
CUTM1059	Database Management Systems	3	2-1-0

Objectives

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database Modeling, relational, hierarchical, and network models.
- To understand and use data manipulation language to query, update, and manage a database.
- To develop an understanding of essential Peoperties of DBMS concepts such as: database security, integrity, concurrency.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course outcomes

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL
- Design ER-models to represent simple database application scenarios
- Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data
- Improve the database design by normalization
- Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Course content

Module-1: **DBMS Concepts** **[5 Hrs]**

Data Abstraction - Data models and data independence. Instances and Schemas. Components of a DBMS and overall structure of a DBMS- Life Cycle of a DBMS application- Database terminology.

Module-2: Data Modeling **[5Hrs]**

Basic concepts- Types of data models- Conceptual, physical and logical database models- E-R data

model and Object-oriented data model. Components of ER Model- ER Modeling symbols. Entity and entity sets- Relations and relationship sets- E-R Diagrams- Reducing E-R Diagrams into tables.

Practice

Assume we have the following application that models soccer teams, the games they play, and the players in each team. In the design, we want to capture the following:

• We have a set of teams, each team has an ID (unique identifier), name, main stadium, and to which city this team belongs.
• Each team has many players, and each player belongs to one team. Each player has a number (unique identifier), name, DoB, start year, and shirt number that he uses.
• Teams play matches, in each match there is a host team and a guest team. The match takes place in the stadium of the host team.
• For each match we need to keep track of the following:
• The date on which the game is played
• The final result of the match
• The players participated in the match. For each player, how many goals he scored, whether or not he took yellow card, and whether or not he took red card.
• During the match, one player may substitute another player. We want to capture this substitution and the time at which it took place.
• Each match has exactly three referees. For each referee we have an ID (unique identifier), name, DoB, years of experience. One referee is the main referee and the other two are assistant referee.
Design an ER diagram to capture the above requirements. State any assumptions you have that affects your design (use the back of the page if needed). Make sure cardinalities and primary keys are clear.

Module-3: Relational DBMS Model [5 Hrs]

Basic concepts, Attributes and domains- Intention and extensions of a relation- concept of integrity

and referential constraints- Relational Query Languages (Relational algebra and relational calculus (Tuple and domain relational calculus).

Module-4: Relational Database Design [6 Hrs]

Notion of normalized relations- Normalization using Functional Dependency- First Normal form- Second Normal Form- Third Normal form- BCNF.

Practice

Perform NF on the given table

Module-5: SQL [6 Hrs]

Structure of a SQL query- DDL and DML, TCL- SQL queries and sub queries- Tables, views and indexes.

Practice

To study DDL-create and DML-insert commands.

(i) Create tables according to the following definition.

CREATE TABLE DEPOSIT (ACTNO VARCHAR2(5) ,CNAME VARCHAR2(18) , BNAME VARCHAR2(18) , AMOUNT NUMBER(8,2) ,ADATE DATE);

CREATE TABLE BRANCH(BNAME VARCHAR2(18),CITY VARCHAR2(18)); CREATE TABLE CUSTOMERS(CNAME VARCHAR2(19) ,CITY VARCHAR2(18));

CREATE TABLE BORROW(LOANNO VARCHAR2(5), CNAME VARCHAR2(18), BNAME VARCHAR2(18), AMOUNT NUMBER (8,2));

(ii) Insert the data as shown below.

DEPOSIT, BRANCH, CUSTOMERS, BORROW

(1) Describe deposit, branch.

(2) Describe borrow, customers.

(3) List all data from table DEPOSIT.

(4) List all data from table BORROW.

(5) List all data from table CUSTOMERS.

(6) List all data from table BRANCH.

(7) Give account no and amount of depositors.

(8) Give name of depositors having amount greater than 4000.

(9) Give name of customers who opened account after date '1-12-96'.

Module-6: Aggregate functions **[4 Hrs]**

Set Operations, predicates and joins, Set Membership- Tuple variables- Set comparison- Database modifications using SQL.

Practice

Create the below given table and insert the data accordingly.

Create Table Job (job_id, job_title, min_sal, max_sal)

COLUMN NAME DATA TYPE

job_id Varchar2(15)

job_title Varchar2(30)

min_sal Number(7,2)

max_sal Number(7,2)

Create table Employee (emp_no, emp_name, emp_sal, emp_comm, dept_no)

COLUMN NAME DATA TYPE

emp_no Number(3)

emp_name Varchar2(30)

emp_sal Number(8,2)

emp_comm Number(6,1)

dept_no Number(3)

Create table deposit(a_no,cname,bname,amount,a_date).

COLUMN NAME DATA TYPE

a_no Varchar2(5)

cname Varchar2(15)

bname Varchar2(10)

amount Number(7,2)

a_date Date

Create table borrow(loanno,cname,bname,amount).

COLUMN NAME DATA TYPE

loanno Varchar2(5)

cname Varchar2(15)

bname Varchar2(10)

amount Varchar2(7,2)

Insert following values in the table Employee.

emp_n emp_name emp_sal emp_comm dept _no

101 Smith 800 20

102 Snehal 1600 300 25

103 Adama 1100 0 20

104 Aman 3000 15

105 Anita 5000 50,000 10

106 Sneha 2450 24,500 10

107 Anamika 2975 30

Insert following values in the table job.

Insert following values in the table deposit.

Perform following queries

(1) Retrieve all data from employee, jobs and deposit.

(2) Give details of account no. and deposited rupees of customers having account opened between dates 01-01-06 and 25-07-06.

(3) Display all jobs with minimum salary is greater than 4000.

(4) Display name and salary of employee whose department no is 20. Give alias name to name of employee.

(5) Display employee no,name and department details of those employee whose department lies in(10,20)

To study various options of LIKE predicate

(1) Display all employee whose name start with ‘A’ and third character is ‘ ‘a’.

(2) Display name, number and salary of those employees whose name is 5 characters long and first three characters are ‘Ani’.

(3) Display the non-null values of employees and also employee name second character should be ‘n’ and string should be 5 character long.

(4) Display the null values of employee and also employee name’s third character should be ‘a’.

(5) What will be output if you are giving LIKE predicate as ‘%_%’ ESCAPE ‘\’

To Perform various data manipulation commands, aggregate functions and sorting concept on all created tables.

(1) List total deposit from deposit.

(2) List total loan from karolbagh branch

(3) Give maximum loan from branch vrce.

(4) Count total number of customers

(5) Count total number of customer’s cities.

(6) Create table supplier from employee with all the columns.

(7) Create table sup1 from employee with first two columns.

(8) Create table sup2 from employee with no data

(9) Insert the data into sup2 from employee whose second character should be ‘n’ and string should be 5 characters long in employee name field.

(10) Delete all the rows from sup1.

(11) Delete the detail of supplier whose sup_no is 103.

(12) Rename the table sup2.

(13) Destroy table sup1 with all the data.

(14) Update the value dept_no to 10 where second character of emp. name is ‘m’.

(15) Update the value of employee name whose employee number is 103.

To study Single-row functions.

(1) Write a query to display the current date. Label the column Date

(2) For each employee, display the employee number, job, salary, and salary increased by 15% and expressed as a whole number. Label the column New Salary

(3) Modify your query no 4.(2) to add a column that subtracts the old salary from the new salary. Label the column Increase

(4) Write a query that displays the employee’s names with the first letter capitalized and all other

letters lowercase, and the length of the names, for all employees whose name starts with J, A, or M. Give each column an appropriate label. Sort the results by the employees' last names.

(5) Write a query that produces the following for each employee:

earns monthly

(6) Display the name, hire date, number of months employed and day of the week on which the employee has started. Order the results by the day of the week starting with Monday.

(7) Display the hiredate of emp in a format that appears as Seventh of June 1994 12:00:00 AM.

(8) Write a query to calculate the annual compensation of all employees (sal+comm.).

Displaying data from Multiple Tables (join)

(1) Give details of customers ANIL.

(2) Give name of customer who are borrowers and depositors and having living city nagpur

(3) Give city as their city name of customers having same living branch.

(4) Write a query to display the last name, department number, and department name for all employees.

(5) Create a unique listing of all jobs that are in department 30. Include the location of the department in the output

(6) Write a query to display the employee name, department number, and department name for all employees who work in NEW YORK.

(7) Display the employee last name and employee number along with their manager's last name and manager number. Label the columns Employee, Emp#, Manager, and Mgr#, respectively.

(8) Create a query to display the name and hire date of any employee hired after employee SCOTT.

Module-7: Transaction Management [8 Hrs]

Subqueries, Manipulating Data, Transaction management and Concurrency control

Practice

To apply the concept of Aggregating Data using Group functions.

(1) List total deposit of customer having account date after 1-jan-96.

(2) List total deposit of customers living in city Nagpur.

(3) List maximum deposit of customers living in bombay.

(4) Display the highest, lowest, sum, and average salary of all employees. Label the columns

Maximum, Minimum, Sum, and Average, respectively. Round your results to the nearest whole number.

(5) Write a query that displays the difference between the highest and lowest salaries. Label the column DIFFERENCE.

(6) Create a query that will display the total number of employees and, of that total, the number of employees hired in 1995, 1996, 1997, and 1998

(7) Find the average salaries for each department without displaying the respective department numbers.

(8) Write a query to display the total salary being paid to each job title, within each department.

(9) Find the average salaries > 2000 for each department without displaying the respective department numbers.

(10) Display the job and total salary for each job with a total salary amount exceeding 3000, in which excludes president and sorts the list by the total salary.

(11) List the branches having sum of deposit more than 5000 and located in city bombay.

To solve queries using the concept of sub query.

(1) Write a query to display the last name and hire date of any employee in the same department as SCOTT. Exclude SCOTT

(2) Give name of customers who are depositors having same branch city of mr. sunil.

(3) Give deposit details and loan details of customer in same city where pramod is living.

(4) Create a query to display the employee numbers and last names of all employees who earn more than the average salary. Sort the results in ascending order of salary.

(5) Give names of depositors having same living city as mr. anil and having deposit amount greater than 2000

(6) Display the last name and salary of every employee who reports to ford.

(7) Display the department number, name, and job for every employee in the Accounting department.

(8) List the name of branch having highest number of depositors.

(9) Give the name of cities where in which the maximum numbers of branches are located.

(10) Give name of customers living in same city where maximum depositors are located.

Manipulating Data

(1) Give 10% interest to all depositors.

(2) Give 10% interest to all depositors having branch vrce

(3) Give 10% interest to all depositors living in Nagpur and having branch city bombay.

(4) Write a query which changes the department number of all employees with empno 7788's job to employee 7844'current department number.

(5) Transfer 10 Rs from account of anil to sunil if both are having same branch.

(6) Give 100 Rs more to all depositors if they are maximum depositors in their respective branch.

(7) Delete depositors of branches having number of customers between 1 to 3.

(8) Delete deposit of vijay.

(9) Delete borrower of branches having average loan less than 1000.

To apply the concept of security and privileges.

To study Transaction control commands

TEXT BOOKS

Database Management Systems: Raghu Ramakrishnan

ORACLE PL/SQL Programming – Scott Urman BPB Publications.

REFERENCES

Database Systems Concepts – Henry F Korth, Abraham Silberschatz.

Database Management Systems – Alexis Leon, Mathews Leon – Leon, Vikas Publications

QUANTITATIVE METHODS

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2332	QUANTITATIVE METHODS	6	2-2-2	NIL

2. Objectives

- To acquaint the students with different application of quantitative techniques in business decision making.

3. Course outcomes

Understand statistical inference in relation to international business decision-making Convey the results of quantitative analysis

4. Evaluation Systems

Internal & External Examination of Theory Component	***Component***	***% of Marks***	***Method of Assessment***
	Internal Test-1	*15%*	*Online examination*
	Internal Test-2	*15%*	*Report and Presentation*
	Attendance and Assignment	*10%*	*Report*
	End Sem. Test	*60%*	*Written examination*
Internal & External Examination of Practice & Project components	*Internal Practice and Project*	*50%*	*Report and Viva*
	External Practice and Project	*50%*	*Viva-Voice*
		100%	

5. Course Outline

Unit: I - Overview of Statistics (4Hrs Th + 2 Hrs Pra + 2 Hrs Proj)

Nature, Scope and limitations of statistics; uses of statistics to business and industrial activities, Statistical Data –primary and secondary data, Collection of data, Classification and tabulation of data, Diagrammatic and graphic representation of data.

Unit-II- Measurement of Central Tendency & Dispersion (4 Hrs Th + 3Hrs Pra + 3 Hrs Proj)

Data Measure of Central Tendency: Introduction, Meaning of quantitative technique, Measures of central tendency (Averages), Arithmetic mean,

Median, Mode.

Unit-III- Measurement of Central Tendency & Dispersion (4 Hrs Th + 3Hrs Pra + 3 Hrs Proj)

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation.

Unit: IV- Discrete Random Variable and its Distribution: (4 Hrs Th + 3Hrs Pra + 3 Hrs Proj)

Discrete random variables, Expectation of discrete random variables, Variance and Standard Deviation of discrete random variables, Binomial distribution, Poisson distribution.

Unit: V- Continuous Random Variable and its Distribution: (4 Hrs Th + 3Hrs Pra + 3 Hrs Proj)
Continuous random variables, Expectation of continuous random variables, Variance and Standard Deviation of continuous random variables, Normal Distribution

Unit- VI- Regression and Correlation Analysis: (4 Hrs Th + 3Hrs Pra + 3 Hrs Proj)
Regression and Correlation Analysis: Coefficient of Correlation, Co-variance independent random variables, linear regression of two variables.

Unit- VII- Sampling and Hypothesis Test: (6 Hrs Th + 2Hrs Pra + 2 Hrs Proj)
Sampling: Introduction, sampling methods, Sampling distribution, standard error, typeI and II error, Estimation, properties of good estimator, Confidence limit. Hypothesis: Basics of hypothesis testing, Errors in hypothesis testing, Hypothesis test (one population mean), Null hypothesis, Alternating hypothesis.

Text Book:

1. Gupta .S.C and Kapoor .V.K, *"Fundamentals of Mathematical Statistics"*, Sultan Chand and sons, Reprint 2003.
2. Gupta .S.C, and Kapoor, V.K, "*Fundamentals of Applied Statistics"*, Sultan Chand and sons, 2003.
3. Veerarajan.T, "*Probability Statistics and Random Processes"*, TMH, First reprint, 2004.
4. J. K. Sharma "Business Statistics", Pearson Education India, ISBN: 8177586548, 9788177586541

Reference Books:

1. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.

2. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.

RESEARCH METHODOLOGY AND IPR

Code	Subject Name	Type of course	T-P-Pr (Credit)
CUTM2378	**Research Methodology and IPR**	Theory + Project	**(2-0-2)**

Objectives

- To develop an appropriate framework for research studies
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of the ethical dimensions of conducting applied research.
- To Demonstrate enhanced Scientific writing skills
- warn the common mistakes in the field of research methodology.
- To make expertise in academic writing, patenting

Course Outcomes

- Search, select and critically analyse research articles and papers
- Formulate and evaluate research questions
- Develop the ability to apply the methods while working on a research project work
- Describe the appropriate statistical methods required for a particular research design
- Choose the appropriate research design and develop appropriate research hypothesis for a research project

Module 1: Elementary Research Methodology

Research Concept, Objective, characteristics, Steps and Significance of Research, Arbitrary and Scientific Research, Research approaches. Types of research: Historical, Descriptive, Analytical, Case Study, Quantitative vs. qualitative, Conceptual, Empirical Action Research, Research Methods vs Methodology. Research Problems: Selection and definition of the research problems, formulating a research problem, identifying variables and Constructing hypothesis; Choosing a mentor, lab and research question; maintaining a lab notebook; Selection of problems - stages in the execution of research

Module II: Academic Writing and Presentation

Technical writing skills - types of reports; layout of a formal report; standard of Journal (Impact Factor, Citation Index), Scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

Module III: Scientific communication skills

Concept of effective communication- setting clear goals for communication; determining outcomes and results; barriers to effective communication; non-verbal communication- importance of body language, power of effective listening; Presentation skills - formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Computing skills for scientific research - web browsing for information search.

Module IV: Introduction to IPR

Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; plant variety protection and farmers rights.

Module V: Types of Patents

Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; filing of a patent application; role of a Country Patent Office; precautions before patenting-disclosure/non-disclosure - patent application- forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications.

PROJECTS

1. Write a review article and submit to a journal
2. Write a book chapter/ book for publishing

3. Write an original article for a journal

Books:

1. Geoffrey Marczyk, David DeMatteo, David Festinger (2005) Essentials of Research Design and Methodology, John Wiley & Sons, Inc.
2. Carol Ellison (2010) ***McGraw-Hill's ConcisevGuide to WritingvResearch Papers***, McGraw-Hill
3. Kothari CR (2016) ***Research Methodology: Methods and Techniques***, New Age Pvt Ltd
4. Ganbawale RM, (2017) ***Bioststistics and Research Methodology***, New Central Book Agency
5. Sinha, S.C. and Dhiman, A.K., (2002). ***Research Methodology***, Ess Ess Publications. 2 volumes.
6. Trochim, W.M.K., (2005). ***Research Methods: the concise knowledge base***, Atomic Dog Publishing. 270p.
7. Wadehra, B.L. (2000). ***Law relating to patents, trademarks, copyright designs and geographical indications***. Universal Law Publishing.
8. Neuman, W.L. (2008). ***Social research methods: Qualitative and quantitative approaches,*** Pearson Education

GEOLOGICAL REMOTE SENSING TECHNIQUES

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2067	GEOLOGICAL REMOTE SENSING TECHNIQUES	4	2-2-0	NIL

2. Objectives

To study the spectral characteristics of Rocks and Minerals.
To study the remote sensing for geological structures mapping
To study the remote sensing for Lithological mapping
To understand geological survey techniques and GIS integration

3. Course Outcomes

To study the role of remote sensing and GIS Tools in Earth Sciences.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module – I: SPECTRAL PROPERTIES OF ROCKS AND MINERALS (4HrsTh+4Hrs Pra)

Reflectance Properties of Rocks, minerals in visible, NIR, MIR, SWIR, TIR and Microwave regions Laboratory spectroscopy - laboratory and field spectral data comparative studies, Spectral reflection curves for important Rocks, Minerals.

Module – II: GEOLOGICAL STRUCTURE AND APPLICATIONS (4HrsTh+4Hrs Pra)

Significance of Geological structures, Role of aerial photographs, Photo interpretation characters of photographs and satellite images, structural mapping, Fold, fault, Lineaments, Direction circular features. Intrusive rocks, rock exposure, Fractures and Joints, Rose diagram. Digital image processing for structural mapping.

Module – III: LITHOLOGICAL MAPPING (4HrsTh+4Hrs Pra)

Introduction on Igneous rocks, sedimentary rocks, metamorphic rocks, mapping of regional scale lithological units, Image Characters of igneous rocks, sedimentary and metamorphic rocks, examples. Digital image processing of various rock types, resolution and Scale of lithological mapping and advantages.

Model – IV: GEOMORPHOLOGICAL MAPPING (4HrsTh+4Hrs Pra)

Significance of landform, Geomorphological guide, interpretation and image/photo characters, Tectonic landforms, Fluvial landforms, Denudation landforms, Volcanic landforms- Aeolian landforms, Coastal landforms. Importance of ground truth and geological field data collection.

Model–V:
GEOLOGICAL SURVEY TECHNIQUES AND DATA INTEGRATION (4HrsTh+4Hrs Pra)

Geophysical survey, surface investigation, subsurface investigation, Gravity survey, Seismic survey, refraction methods, reflection methods, applications, Magnetic survey and Electrical resistivity survey, self-potential methods, potential drop methods, resistivity values, data interpretation, Curve fitting, GIS data generation , integration and analysis.

6. TEXT BOOK

1. John J. Qu , Wei Gao, MenasKafatos , Robert E. Murphy, Vincent V. Salomonson, "*Earth Science Satellite Remote Sensing"*, Springer 2007.
2. Gupta .R.P, "*Remote sensing Geology"*, Springer, 2003.
3. Jean-yvesscanvk, "*Aerospatial Remote Sensing in Geology"*, A.A. Balakarma, Netherlands, 1997.
4. Drury .S.A, "*Image interpretation in Geology"*, Chapman and Hall, London. 1993.
5. Pandey .S.N, "*Principles and Applications of Photogeology"*, Wiley eastern. 1987.

MICROWAVE REMOTE SENSING AND APPLICATIONS

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM 2068	MICROWAVE REMOTE SENSING AND APPLICATIONS	4	2-2-0	NIL

2. Objectives

1. To study basics of Microwave Remote Sensing
2. To Understand parameters of radiometry and Antenna functions
3. To understand RADAR principles

4. To learn Microwave data processing
5. To study Microwave remote sensing Applications

3. Course Outcomes

To study the RS & GIS data for microwave and Remote Sensing.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outlines

Module – I: BASICS OF MICROWAVE REMOTE SENSING (4HrsTh+4Hrs Pra)

Fundamentals – EMR-Electromagnetic Spectrum - Microwave Band Designation Microwave interaction with atmospheric constituents, Earth's surface, vegetation, and ocean.

Module – II: RADIOMETRY & ANTENNA SYSTEMS (4HrsTh+4Hrs Pra)

Basics - Theory of Radiometry - Sensors applications in atmosphere, ocean and land. Antenna – Types and Functions of different types of antenna.

Module – III: RADAR (4HrsTh+4Hrs Pra)

Radar-Real and synthetic aperture radars, - Principles - different platforms and sensors, System parameters, Target parameters, Radar equation measurement and discrimination, Airborne Data products and selection procedure - SEASAT, SIRA, SIRB, ERS , JERS, RADARSAT missions.

Model – IV: RADAR DATA PROCESSING (4HrsTh+4Hrs Pra)

Radar grammetry, Image processing, SAR Interferometry – Polarimetry- Interpretation of microwave data - Physical mechanism and empirical models for scattering and emission, volume scattering.

Model – V: APPLICATIONS OF MICROWAVE REMOTE SENSING (4HrsTh+4Hrs Pra)
Geological interpretation of RADAR –sites-default-files, Application in Agriculture -forestry, Hydrology - ice studies – land use mapping and ocean related studies.

6. TEXT BOOK

1. Charles Elachi and Jakob Van 2y, "*Introduction to the Physics and Techniques of Remote Sensing",* Wiley Interscience, A John Wiley and sons Inc., 2006.
2. Robert M. Haralick and Simmonett, "*Image Processing for Remote Sensing",* 1983
3. Robert N. Colwell, "*Manual of Remote Sensing Volume 1"*, Americal Society of Photo - grammetry 1983.
4. Travett .J. W, "*Imaging Radar for Resources Surveys",* Chapman and Hall, London 1986.
5. Ulaby .F.T, Moore .R.K, Fung .A.K, "*Microwave Remote Sensing; active and passive"*, Vol. 1, 2 and 3, Addison – Wesley publication company 2001

RS & GIS FOR URBAN AND REGIONAL PLANNING

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2069	RS & GIS FOR URBAN AND REGIONAL PLANNING	4	1-2-1	NIL

2. Objectives

1. To study the RS & GIS data
2. To study the Mapping for Urban and Regional areas
3. To study GIS Tool in Urban Planning

3. Course Outcomes

1. The students will learn different tools using urban planning.
2. The students will handle different case study using image processing and GIS tools

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module – I: REQUIREMENTS FOR URBAN & REGIONAL PLANNING (4HrsTh+4Hrs Pra)

Relevance of remotely sensed data for Urban & Regional Analysis and Planning - Identification of settlement features from aerospace images - Visual and digital analysis techniques - Scale and Resolution concepts - Scope and limitations.

Module – II: URBAN & REGIONAL MAPPING (4HrsTh+4Hrs Pra)

Regional Mapping - City Mapping - Intra - city Mapping-Methodology - Base map preparation - Delineation of area - Change Detection and mapping - classification - Urban fringe - CBD - Urban sprawl - Case studies.

Module – III: SUSTAINABLE DEVELOPMENT PLANS (4HrsTh+4Hrs Pra)

Regional plan - Master plan - Detailed Development plan - Objective and contents - Delineation of planning area - Methodology - Integrated plans - Case studies.

Model – IV: URBAN STUDIES (4HrsTh+4Hrs Pra)

Urban growth analysis - Slum development - House typology - Site selection for urban development - Density analysis - Population estimation - Transportation network analysis - Case studies.

Model – V: GIS IN URBAN MODELLING (4HrsTh+4Hrs Pra)

GIS - Data Input - Storage - Retrieval - Suitability of GIS software for urban analysis - Modelling with GIS - Decision support systems for urban studies.

6. TEXT BOOK

1. Brench .M.C, "*City Planning & Aerial Information"*, Harvard University, Cambridge, 1971.
2. Margaret Roberts, "*An Introduction to Town Planning Techniques"*, Hutchinson, London 1980.
3. Gautam N.C, "*Urban land use Interpretation through Arial Photograph Interpretation"*, NRSA.
4. *"IRS RS Applications to Urban Planning and Development",* Institute of Remote Sensing.

GIS IN HEALTH

1. Nomenclature

Code	Subject Name	Type of course	Credit	T-P-P	Prerequisite
CUTM2070	GIS IN HEALTH	T+P	4	2-2-0	NIL

2. Objectives

The course is on geospatial analysis methods in health and to the kinds of problems for which these methods are appropriate.

The course is appropriate as an elective for those who may have no background in human sciences but who have fair knowledge in RS and GIS and interested in questions of the health of populations in geographic context.

3. Course Outcomes

At the end of the course the student will be able to understand

Techniques used for disease ecology mapping and disease mapping

The usefulness of GIS for location allocation of health resources

The tools for development of Health GIS systems

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

UNIT I: MAPPING DISEASE ECOLOGY (4HrsTh+4Hrs Pra)

Disease types and causes – environmental and social factors – genetic and chronic aspects – gender and occupational bias – time and space factors in disease distribution – life cycle, statistical curves and modelling – hazards, disasters, accidents and health. Health Care and Delivery Systems: Health Care Systems and Delivery in India; Medical Services and Facilities, Health Information and Planning; Issues and Prospects – Ecosystem Approach, The issue, The Approaches, Lessons and Successes – Future Directions.

UNIT II: GEOSPATIAL DATA FRAMEWORK (4HrsTh+4Hrs Pra)

Disease records and geo-referencing – birth, movements and permanency – individuals, families and communities – problems of address coding and digitization – the privacy of records – risk and vulnerability – short term and long term trends – resurgence – historical records and reliability.

UNIT III: DISEASE MAPPING (4HrsTh+4Hrs Pra)

Spatial patterns of disease – mapping causal factors – endemic and epidemic zonation – tests for spatial clustering and fragmentation – applications of RS and GIS in disease mapping – deterministic stochastic and uncertainty models -vulnerability and comforts.

UNIT IV: HEALTH ANALYSIS (4HrsTh+4Hrs Pra)

GIS for Analysis of Health. Choosing and applying analytical methods for mapping, modeling and analyzing health and disease, including point pattern analysis, surface analysis, overlay analysis, network analysis, and cluster and regression analysis.

Case studies of Odisha State.

UNIT V: HEALTH AND WEB-GIS (4HrsTh+4Hrs Pra)

Sharing disease data and web" ontology requirements and applications – open source service environments – methods of XML aid OGC services" web map context, services and processing (WMS. WMC and VVPS)" web service quality and SDI.

TEXT BOOKS:

Phillips, D.R. Health and Health Care in the Third World, Longmans Scientific. London, 1990

Levine, A.J Viruses, Scientific American, New York, 1992.

Ellen K. Cromley, Sara L. McLafferty 2011 , GIS and Public Health, Second Edition, Guilford Press, ISBN 9781609187507 – CAT# Y124676, 2nd Edition.

Massimo Craglia (Editor), Ravi Maheswaran (Editor) (2004) GIS in Public Health Practice, CRC Press, 1st Edition

REFERENCES:

1. Ravi Maheswaran and Massimo Craglia, GIS in Public Health Practice, Boca Raton, CRC Press, 2004.
2. Lai C, Ann S.H Mak. "GIS for Health and the environment: Development in Asia Pacific Region, Berlin, 2000.
3. Anthony C Gatrell "GIS and Health, Markku Loytonen, European Science Foundation, 1998.
4. Cromley, E.K. & McLafferty, S.L. (2012) GIS and Public health. 2nd Edition. Guilford Press. New York. pp 503. ISBN 978-1-60918-750-7. Available from the vendor of your choice or from Amazon.com - GIS and Public Health(link is external).

MACHINE LEARNING USING PYTHON

Course Code	Course Title	Credit	T-P-PJ
CUTM1019	Machine Learning using Python	4	1-2-1

Objectives

- Understand the meaning, purpose, scope, stages, applications, and effects of ML.
- Explore important packages of python, such as numpy, scipy, OpenCV and scikit-learn.

Course outcome

- Students will able to Create and incorporate ML solutions in their respective fields of study.

Course outlines

Module 1 – Application and Environmental-setup (12 hrs)

- Applications of Machine Learning In different fields (Medical science, Agriculture, Automobile, mining and many more).
- Supervised vs Unsupervised Learning based on problem Definition.
- Understanding the problem and its possible solutions using IRIS datasets.
- Python libraries suitable for Machine Learning (numpy, scipy, scikit-learn, opencv)
- Environmental setup and Installation of important libraries.

Module 2 - Regression (8 hrs)

- Linear Regression
- Non-linear Regression
- Model Evaluation in Regression
- Evaluation Metrics in Regression Models
- Multiple Linear Regression
- Feature Reduction using PCA
- Implementation of regression model on IRIS datasets.

Module 3 - Classification **(24 hrs)**

- Defining Classification Problem with IRIS datasets.
- Mathematical formulation of K-Nearest Neighbour Algorithm for binary classification.
- Implementation of K-Nearest Neighbour Algorithm using sci-kit learn.
- Classification using Decision tree.
- Construction of decision trees based on entropy.
- Implementation of Decision Trees for Iris datasets .
- Classification using Support Vector Machines.
- SVM for Binary classification
- Regulating different functional parameters of SVM using sci-kit learn.
- SVM for multi class classification.
- Implementation of SVM using Iris datasets .
- Implementation of Model Evaluation Metrics using sci-kit learn and IRIS datasets.

Module 4 - Unsupervised Learning **(12 hrs)**

- Defining clustering and its application in ML .
- Mathematical formulation of K-Means Clustering.
- Defining K value and its importance in K-Means Clustering.
- Finding appropriate K value using elbow technique for a particular problem.
- Implementation of K-Means clustering for IRIS datasets Projects
- To be defined based on respective study area of student.

Text Book:

1. EthemAlpaydin, Introduction to Machine Learning, Second Edition, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012.

Web Resource:

1. https://towardsdatascience.com/beginners-guide-to-machine-learning-with-python-b9ff35bc9c51

RS & GIS FOR HYDROLOGY AND WATER RESOURCES

1. Nomenclature

Code	Subject Name	Type of course	Credit	T-P-P	Prerequisite
CUTM2071	RS & GIS FOR HYDROLOGY AND WATER RESOURCES	T+P	3	1-2-0	NIL

2. Objectives

To study the basic knowledge of hydrologic data
To study the watershed characters and applications
To study the hydrological disaster and role of remote sensing & GIS
To study the ground water resources mapping by remote sensing & GIS
To study the surface water resources mapping by remote sensing & GIS

3. Course Outcomes

To study and understand application of RS and GIS techniques for hydrology and water resources.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outlines

Module – I: HYDROLOGICAL COMPONENETS (4HrsTh+4Hrs Pra)

Hydrological cycle, Estimation of various components of hydrological cycle, rainfall, runoff, evaporation, transpiration, evapotranspiration, crop evapotranspiration, depression and interception loss, infiltration and percolation losses.

Module – II: WATERSHED CHARECTERS (4HrsTh+4Hrs Pra)

Watershed, types, divide, catchment, command area, stream types, influent, effluent, ephemeral, non-perennial. Drainage network, different pattern, morphometric analysis, linear, area, relief aspects. GIS applications for watershed analysis.

Module – III: HYDROLOGICAL STIDIES (4HrsTh+4Hrs Pra)

Hydrological aspects- mapping and monitoring, management mapping of snow covered area and glacial outburst, soil moisture estimation, Optical and microwave remote sensing techniques, drought zonations, Agricultural, meteorological and hydrological, flood mapping pre and post flood area estimation and control measures –GIS applications for hydrological disaster studies

Model – IV: GROUNDWATER RESOURCES APPLICATIONS (4HrsTh+4Hrs Pra)

Types of Aquifers formations confined and unconfined aquifers Assessment of Groundwater potential zones and Groundwater mapping. Site selection for recharge structures- Hydrogeological Mapping GIS applications to ground water studies

Model – V: SURFACE WATER RESOURCES APPLICATIONS (4HrsTh+4Hrs Pra)

Surface water bodies, lakes, reservoirs, ponds, rivers, channels, mapping- change detection, Water harvesting structures, in-situ and Ex-situ, Mapping and monitoring of catchment and command area, Water logging and salt affected area mapping, Reservoir Sedimentation, sedimentation control. GIS applications to surface water studies

6. TEXT BOOK

1. Raghunath .H.M, "*Hydrology – Principles – Analysis – Design",* New Age International Publishers, New Delhi. 2006 .
2. Ramasamy .S.M, "*Remote sensing in water resources",* Rawat publications, New Delhi ,2005.
3. Murty.V.V.N, "*Land and Water Management Engineering"*, Kalyani Publishers, New Delhi – 2002.

4. Agarwal C.S and Garg.P.K, "*Text Book on Remote Sensing in Natural Resources, Monitoring and Management",* Wheeler publishing Co & Ltd., New Delhi, 2010.

APPLICATION OF GEO-INFORMATICS TO HAZARDS MONITORING AND MODELLING

1. Nomenclature

Subject Name	Code	Credit	T-P-P	Prerequisite
CUTM2072	Application of Geo-informatics to Hazards Monitoring and Modelling	4	2-2-0	NIL

2. Objectives

To study the basic knowledge of Hazards
To study the about natural and environmental hazards
To study the damage estimation after hazards.

3. Course Outcomes

To **s**tudy and understand the applications of RS and GIS techniques for Natural, Environmental and Coastal hazards.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outlines

Module I : Overview of Hazards (4HrsTh+4Hrs Pra)

Introduction to natural hazards, impact and mitigation in Global and Indian context. An overview of geological hazards with special emphasis on causes and consequences. An overview of flood hazards and climate change issues. An overview of drought hazards and climate change issues. An overview of *Environmental hazards* and land degradation with special emphasis on extents, cause and consequences. An overview of *coastal hazards*. An overview of snow avalanche, GLOF and glacier related hazards and their assessment using geospatial inputs. An overview of urban and associated hazards.

Module II: Geological Hazards Modelling and Analysis (4HrsTh+4Hrs Pra)

Fundamental of landslide hazard assessment, Landslide hazard zonation and vulnerability analysis using spatial modelling technique. Early warning system and disaster preparedness, Flood inundation depth, vulnerability and risk assessment, Generation of Geospatial database for flood hazards for analysis & assessment.

Module III : Drought Monitoring and Desertification (4HrsTh+4Hrs Pra)

Concepts and definition of drought and importance of drought assessment, Fundamentals of agro-meteorology. Meteorological drought indicates, Remote sensing for droughts monitoring and assessment. Definition and processes for climate change impact assessment on droughts and desertification.

Practice:

1. Computation of meteorological drought and drought indices.
2. Vegetation condition Index for drought monitoring.
3. Mapping decertification lands/indicates.

Module IV : Forest fire and damage assessment (4HrsTh+4Hrs Pra)

Forest fire monitoring and active fire retrieval using LEO and geostationary satellite data. Forest fire risk modelling and fire spread modelling. Forest damage and assessment.

Practice:

1. Forest fire risk assessment.
2. Object based image analysis for forest fire damage.

Module V: Costal hazard mapping and Modelling (4HrsTh+4Hrs Pra)

Mapping monitoring and modelling of costal vulnerability / hazards (salt water intrusion and oil spill). Modelling cyclones and prediction (tracking, landfall determination, and inundation) and impact assessment (damage and loss estimation) and mitigation issues. Monitoring and modelling of tsunami.

Practice:

1. Shoreline Change Analysis
2. Coastal Vulnerability Index analysis
3. Monitoring and modelling of Tsunami.

Module VI: Extreme event analysis and air pollution studies (4HrsTh+4Hrs Pra)

Rainfall estimation / perdition and extreme event analysis. Study of haze and dust storm. Modelling of atmospheric pollution and impact on human health. Fog detection and monitoring using satellite data.

Module VII: Urban vulnerability, risk modelling and industrial hazards (4HrsTh+4Hrs Pra)

Seismic risk assessment in urban areas and building codes for earthquake resistant designs. Urban flood hazard and vulnerability modelling. Geospatial modelling for urban pollution is dispersion and modelling. Urban micro and heat islands: role of EO data.

Practice:

1. Urban seismic risk assessment.
2. Urban flood hazard and vulnerability modelling.
3. Urban micro climate heat island: role of EO data.

Referred Books

1. Barrett, E.C. & Brown (1991). Remote Sensing for Hazard Monitoring and Disater Assessment: Marine and Costal Applications In The Mediterranean Region. Philadelphia: Gordon and Breach Scence Punlishers.

2. Burrough, P.A. (1976). Principles of Geographic Information System for Land Assessment,. Oxford: Clarandon Press.
3. Cutter, S., Boruff, L., Bryan, J., & Shirley, W.L. (2003). Social Vulnerability to Environmental Hazards", Social Science Quarterly, 84 (2), 242-261.
4. Kogan., F. N. (2000). Contribution of Remote Sensing to Drought Early Warning. NOAA, NESDIS.
5. Komecny, G. (2003). Geoformation: Remote Sensing, Photogrammetry and GIS. New Delhi: Taylor and Francis.

GEOSPATIAL DATA INFRASTRUCTURE

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2073	Geospatial Data Infrastructure	4	2-2-0	NIL

2.Objectives

Discuss the applicability and accessibility of spatial data at all levels

Understand the fundamentals about GeoSDI and its role in decision making

Describe critically the factors that influence the development of a GeoSDI

Practice data retrieval from GeoSDIs and combine it in a GIS environment

3. Course Outcomes

Identify GeoSDI requirements and stakeholders

Understand the GeoSDI architecture that enables the availability of data at distinct levels

Use and manage web services, namely metadata catalogues and map services

4. Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	

External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outlines

Module I: GIS & Geo-visualization **(4HrsTh+4Hrs Pra)**

Introduction to GIS and Geo-visualization, Models and structures - Advanced models and structures (3D, temporal), Data acquisition (GPS, RS, field surveying), Precision and quality of data, Reference systems and transformations, Spatial Databases, Spatial analysis and modelling of phenomena, Geo-visualization (cartography).

Module II: GeoSDI **(4HrsTh+4Hrs Pra)**

Introduction to GeoSDI, Definition, GeoSDI components, GeoSDI hierarchy (local, regional, national, trans-national), GeoSDI applications, Environmental protection, Risk management, Organizational dimension of GeoSDI, Laws, policies, institutions, people, Standards, specifications and metadata for spatial data, Public data, CRS, units, JRC, INSPIRE, etc. Public participation, VGI, Spatial data issues in the region of Australia, NewZealand and India.

MODULE III: Data for GeoSDI **(4HrsTh+4Hrs Pra)**

Data feeding for GeoSDI for environmental management, Connection to global geographical data websites, Cost free data, Satellite imagery, Meteorological data, Elevation data, Land use data, Population data, Road data, Using metadata to assess data quality, Centralizing real time data, Most common systems based on sensors with real time data collection, Hardware fundamentals, Meteorological sensors networks, Tide gauges, Participatory and mobile crowdsource data, Sensor types and capabilities, Applications and Problems of crowdsource data.

Model IV: GEOSDI Business Analysis **(4HrsTh+4Hrs Pra)**

Web Services, Web Services, Web services standards / protocols, Geoportals, geo-visualization, dashboards, Web service composition, service oriented architectures, Client examples, Business Analysis Benefits, Global and national environmental strategies and legal frameworks Required data for activities subject to legal environmental constraints, Economical evaluation, Costs of the infrastructure Costs of operation, Possible strategies to generate income, Business models, Types of contracts, Citizens as data suppliers, Project management concepts (AGILE).

Model V: Sustainable Development, Future Direction for SDI Development (4HrsTh+4Hrs Pra)

The Effect on Government, The Role for SDIs, The Case for E-Governance, Covering the SDI Landscape, SDI Development Issue.

6. TEXT BOOK

1. SDI Cook Book, 2012
2. Developing Spatial Data Infrastructures From Concept to Reality Edited ByIan P. Williamson, Abbas Rajabifard, Mary-Ellen F. Feeney, 2018

RS & GIS FOR ENVIRONMENTAL ENGINEERING

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2074	RS & GIS FOR ENVIRONMENTAL ENGINEERING	4	2-2-0	NIL

2.Objectives

To study the basic Environmental aspects and satellites.
To study the RS & GIS application in soil degradation.
To study the RS & GIS application in water pollution.
To study the RS & GIS application in Air quality.
To understand the RS & GIS application in Environmental management.

3. Course Outcomes

The outcome of this subject is to know how to prepare different environmental hazards map air pollution map water pollution map etc. To prepare different modelling using software's.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

UNIT I - BASICS (9 hours)

Water- Air-Land-Marine Environment Global Climatologic, urban Environment Environmental satellites GEOS, NOAA, AVHRR, CZCR Monitoring land, water, atmosphere and ocean using Remote Sensing Data. Water- Air-Land-Marine Environment Global Climatologic, urban Environment:

UNIT II - SOIL DEGRADATION (9 hours)

Spectral characteristics of soil- Soil formation- classification of soils- soil survey interpretation and mapping- impact of agricultural and industrial activity on soil properties. RS & GIS in assessing Soil salinity- alkalinity- water logging studies- soil erosion- types and estimation -control measures.

UNIT III - WATER QUALITY AND GROUND WATER POLLUTION (9 hours)

Spectral characteristics of water- classification of water quality -Data base creation and quality modeling using GIS. Aquifer Vulnerability -Intrinsic and specific vulnerability- contaminant transport model.

UNIT IV - AIR QUALITY AND COASTAL STUDIES (9 hours)

Atmosphere: Chemicals, Particulate matters present in the atmosphere, allowable limits, Remote Sensing techniques - Monitoring atmosphere constituents- air pollution- industrial activity, modeling using GIS - Ecology studies- Coastal color monitoring- marine studies

UNIT V - ENVIRONMENTAL MANAGEMENT (9 hours)

Revenue management-environment and ecological concerns- Resource development in remote areas- Impacts of anthropogenic activity- Solid Waste management- Forest classification Mapping – Biomass estimation - Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status.

REFERENCES

1. Lilliesand .T.M and Kiefer .R.W, "Remote Sensing and Image Interpretation", John Wily and sons, 1994.
2. Burrough .P.A and McDonnell .R.A, "Principles of Geograj1JhicaJ Information Systems", Oxford University Press, 1988.
3. Lintz .J and Simonet, "Remote Sensing of Environment", Addison Wesley Publishing Company, 1994.

RS & GIS FOR AGRICULTURE AND FORESTRY

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2075	**RS & GIS FOR AGRICULTURE AND FORESTRY**	4	2-2-0	NIL

2.Objectives

To study the Spectral characteristics of Vegetation

To study the integrated analysis of GIS in agriculture and forest development

3. Course Outcomes

The outcome of this subject is to know how to prepare Biomass estimation, forest fire map etc. To prepare different modelling using software's.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

UNIT I - SPECTRAL CHARACTERISTICS OF LEAF (9 hours)

Structure of leaf - Spectral behavior of leaf – Vegetation indices – NDVI, TVI, SVI, PCA – Vegetation classification and mapping - Estimation of Leaf area index, Biomass estimation – Estimation of terrestrial carbon assimilation in forests - case studies.

UNIT II - FOREST MAPPING (9 hours)

Forest type and density mapping and forest stock mapping using RS technique - factors for degradation of forests – deforestation/afforestation/. Change detection in forests - case studies

UNIT III - BIODIVERSITY CHARACTERIZATION MAPPING (9 hours)

Forestry – Forest taxonomy – Linnaeus classification - Biodiversity characterization – Forest fire risk zonation – wildlife habitats suitability analysis - case studies.

UNIT IV - AGRICULTURAL APPLICATIONS (9 hours)

Identification of crops -acreage estimation -production forecasting - pests and disease attacks through remote sensing -crop stress detection due to flood and drought - catchments and command area monitoring.

UNIT V - SOIL APPLICATIONS **(9 hours)**

Soil survey and land use classification - water logging - characters of saline, alkali soils - soil erosion – types – Estimation of soil loss from USLE using Remote sensing and GIS - Wasteland development.

REFERENCES

1. Steven .M.D and clark .J.A, "Applications of Remote Sensing in Agriculture", Butterworths, London 1990.

2. Remote Sensing Applications Group", Space Applications Centre, Crop Average and production Estimation (CAPE): An Anthology from January 1986 - June 1996. (Publications in Journals, Seminars I Symposium proceedings), Ahmedabad, August 1996.

3. Negi .S.S," A Handbook of forestry. International Book distributors", Dehradun, 1986. Space Applications Centre, Manual of procedure for Forest mapping and Damage Detection using satellite data, Ahmedabad, 1990.

DOMAIN

Aerial Surveying and Remote Sensing Applications

Course Title	Code	Type of course	T-P-PJ	Prerequisite
Aerial Surveying and Remote Sensing Applications	ASCU2020	Theory + Practice + Project	4 - 10 - 4	Nil

Courses Division:

1. **Remote Sensing & Digital Image Processing** **(2-2-0) 45Hours**
2. **Geospatial Technology and its Application** **(2-2-0)45Hours**
3. **Photogrammetry and its Application** **(0-2-0) 25Hours**
4. **Lidar Remote sensing and its Applications** **(0-2-0) 25Hours**
5. **Hyper-spectral Remote Sensing and its Application** **(0-2-0) 25Hours**
6. **Project** **(0-0-4) 54Hours**

Objectives:

- Apply the principles of Remote Sensing and GIS to collect, map and retrieve spatial information.
- Plan, assess and evaluate natural and manmade systems using geospatial models and methods.
- Use geospatial tools and techniques for natural resources planning and management.

Course Outcomes:

- Identify specific data and methodologies for effective mapping and evaluation of natural resources.
- Develop geospatial models and tools to address the social and engineering problems
- Design multi-criteria geospatial systems for decision-making process
- Work in a team using geospatial tools and environment to achieve project objectives.
- Pursue lifelong learning for professional advancement

Evaluation System: As per university norms

Remote Sensing and Digital Image Processing

Subject Name	Code	Type of course	Credit	T-P-P	Prerequisite
Remote Sensing and Digital Image Processing	CUAS2020	T+P	4	2-2-0	NIL

Module: I Basic Concept of Remote Sensing (4+6) Hours

Introduction of Remote Sensing: Principles of RS and its Type; Energy sources and Radiation principles, Pixel, DN value, Energy equation; EMR and Spectrum; EMR interaction with Atmosphere; scattering, Absorption, Atmospheric window, Black body radiation; EMR interaction with earth surface features, reflection, absorption, emission and transmission, Spectral signature; Interaction with vegetation, soil, water bodies; Advantage of RS over conventional method, Limitation, Ideal remote sensing.

Practice:

1. Installation of Image Processing software's
2. Download satellite data from GLOVIS / Earth Explorer / Bhuvan etc.
3. Layer stacking
4. LUT and Image Subset
5. Spectral Signature mapping (soil, vegetation, water)

Module: II Digital Image **(2+3) Hours**

Data acquisition: Procedure, Reflectance and Digital numbers; Intensity, Reference data, Ground truth, Analog to digital conversion, FCCs, TCC, Platforms and sensors; orbits ,types, Resolutions; Image Interpretation; visual- Interpretation keys.

Practice:

1. FCCs and TCC
2. Resolution
3. Image Interpretation

Module: III Satellite Information and Principles **(2+3) Hours**

Land observation satellites, characters and applications; PSLV, GSLV, Satellite, Platform Types; LANDSAT series; IRS series; IKONOS Series; QUICKBIRD series; Weather/Meteorological satellites; INSAT series, NOAA, Applications, Marine observation satellites; OCEANSAT

Practice:

1. Image filtering and Band ratioing
2. Mosaicking

Module: IV Image Acquisition and Format **(2+4) Hours**

Digital Image Processing; Export and import, Data formats; BSQ, BIL, BIP, Run length encoding, Image Compression Data products.

Practice:

1. Export and Import

2. Histogram
3. Subset using AOI

Module: V Image Processing (3+4) Hours

IMAGE RECTIFICATION; Pre-processing and Post processing Geometric distortion; sources and causes for distortion, rectification, GCP, Resampling, Image registration; Radiometric distortion; sources and causes, atmospheric correction.

Practice: (Spectral Python and ENVI)

1. Geometric correction
2. Radiometric correction
3. Atmospheric correction

Module: VI Image Classification (4+4) Hours

IMAGE CLASSIFICATION; Classification techniques, types, Supervised and Un-supervised; Principal Component Analysis (PCA); Image Enhancement; Accuracy assessment.

Practice:

1. PCA analysis (spectral Python and ENVI)
2. NDVI, DVI, NDWI calculation
3. Image classification in Spectral angel Mapper
4. MNF Ratoing
5. Supervised Classification(spectral Python and ENVI)
6. Un-supervised Classification(spectral Python and ENVI)
7. Image Enhancement(ENVI)
8. Accuracy Assessment(ENVI)

Module: VI Remote Sensing and Its application (3+4) Hours

Microwave RS and its application; Thermal RS and its application; Optical RS and its application; Sensor and its types.

Practice: Using Spectral Python

1. Application of microwave remote sensing (Structural Trend line mapping)

2. Application of thermal remote sensing and case study(Land surface Temp.estimation)
3. Application of optical remote sensing and case study

Geospatial Technology and its Application

Subject Name	Code	Type of course	Credit	T-P-P	Prerequisite
Geospatial Technology and its Application	CUAS2021	T+P	4	2-2-0	NIL

Module I: GIS & Cartography (2+4) Hours

Components of GIS, Types of Data in GIS, Scale Application of GIS, Advantage and limitation of GIS. History and development of Cartography; Definition, scope and concepts of cartography, Characteristics of Map; Categories of maps, Methods of mapping, relief maps, thematic maps.

Practice:

1. Symbology (generalization, symbology, and colour effect, change symbology and use transparency in creative ways) using GRASS and QGIS

Geo-referencing (Map to Image and Image to Image), Projection, Data base creation: Digitization using Point, line and polygon, Edit, Clip, Intersect, Union, Merge, Join and subset. Attribute table editing

2. Google Earth (Convert Shape file to KML Format and KML File to shape file, Import data into Google earth, Bhuvan view, Extract data From Google Earth, Extract Point Data, Extract Polygon data, Extract line data, overlaying an image into Google earth)

Module: II Data analysis tools(2+4) Hours

Raster data spatial analysis, Network analysis, Vector operations and analysis, Data editing, Primary and secondary data. Data model and data structure, Geodatabase and metadata, GIS data model,

Overlay analysis, Network modeling, Data Structure Models, Spatial interpolation; measurement and analysis methods, Advantage and disadvantage.

Practice:

1. Linking of spatial and Non-spatial data and queries, Joining tabular data with the feature attribute data, Non-spatial query, Spatial query, Spatial join, Vector based spatial analysis, Raster based spatial data analysis
2. Buffering and Creation of Contour
3. Network Analysis

Module: III Multi-criteria analysis and decision making (3+4) Hours

Principles and elements of multiple-criteria decision making, Classification of Multiple-criteria Decision Problem: Multi-objective Vs Multi-attribute, Decision Alternatives and constraints, Criterion weighting, Decision rules, Multiple-criteria decision making in spatial data analysis.

Introduction to AHP, Basic Principles of AHP, Effect Table, Pair Wise comparison, Consistency, Weightage, performance score, Case studies involving AHP

Practice:

1. Mapping accident locations using Linear Referencing technique.
2. Preparation of raster layers for Multicriteria Analysis
3. Solving a spatial problem using Multicriteria Analysis (Spatial AHP)

Module: IV Digital Elevation Model (DEM) (2+4) Hours

Concept of DEM, Various techniques to generate DEM, Importance of spatial resolution to DEM, Integration of DEM to satellite data, Common derivatives of DEM, Slope, Aspects, TIN, Sources of DEM, Laminations and future of DEM.

Practice:

1. Google earth to DEM, 3D Map preparation, Contour to DEM, TIN and Aspect
2. DEM based surface Hydrology modeling,
3. LiDAR classification, DEM from LiDAR

Module: V Geospatial Technology for Water resources Engineering (3+4) Hours

Watershed, types, divide catchment, command area, stream types, Drainage network, different pattern; morphometric analysis, Bifurcation ratio analysis; Assessment of **Groundwater potential zones** and Groundwater mapping; Site selection for recharge structures, Hydrogeological Mapping GIS applications to ground water studies.

Practice:

1. Mapping of catchment, command area
2. Drainage network analysis
3. Morphometric analysis
4. Mapping of Groundwater potential zones

Module: VI Geospatial Technology for Environmental Engineering (3+4) Hours

Monitoring atmosphere constituents; air pollution, industrial activity, modeling using GIS, Resource development in remote areas, Impacts of anthropogenic activity, Solid Waste management; Water Pollution, Shortest path Identification, Network analysis.

Practice:

1. Air pollution mapping
2. Solid waste management
3. Water pollution

Photogrammetry and Application

Subject Name	Code	Type of course	Credit	T-P-P	Prerequisite
Photogrammetry and Application	CUAS2022	T+P	2	0-2-0 25Hours	NIL

Practice Experiments:

3.1 Scale determination from aerial photo

3.2 Aerial photo Interpretation

3.3 Use of Parallax bar and determination of Height from stereo pair

3.4 Satellite DEM and ortho Image generation

3.5 Primary and additive colour creation

3.6 Stereo test

3.7 Mosaic

3.8 Stereoscopic vision

3.9 Relief displacement

3.10 Analog to digital conversion, Orientation of stereo model and Determination of Height

3.11 Aerial mapping using DRONE

3.12 Mosaicking of aerial Photo

3.13 Correction and rectification

3.14 DTM generation Image correction ,Link between GIS and Digital Photogrammetry and Ortho Image generation

LIDAR Remote Sensing and Application

Subject Name	Code	Credit	T-P-P	Prerequisite
LIDAR Remote Sensing and Application	CUAS2023	2	0-2-0 25Hours	NIL

Practice Experiments:

4.1 Download of LIDAR data

4.2 Layer stacking

4.3 Data Validation

4.4 Georeferencing Technology

4.5 Boresight Calibration - Lidar Data Pre-processing

4.6 Project Coverage Verification - Review Lidar Data against Field Control

4.7 Lidar data errors and rectifications, - processes calibration of Lidar data - artifacts and anomalies - Lidar Error Budget.

4.8 Noise Removal and other sensor-related artifacts - Layer Extraction - Automated Filtering

4.9 Manual Editing and Product Generation – Surface Editing - Hydrologic Enforcement

4.10 Breaklines, Contours, and Accuracy Assessment

4.11 Topographic Mapping, flood inundation analysis, line-of-sight analysis

4.12 Forestry, various types of LIDAR sensors-, vegetation metric calculations - specific application software.

4.13 Corridor mapping system, data processing and quality control procedures.

4.14 Modelling

Hyperspectral Remote Sensing and Application

Subject Name	**Code**	**Type of course**	**Credit**	**T-P-P**	**Prerequisite**
Hyperspectral Remote Sensing and Application	CUAS2024	T+P	2	0-2-0 25Hours	NIL

Practice Experiments:

5.1 Introduction to ENVI, Python and Downloading, Displaying, and Analyzing Hyperspectral Imagery

5.2 Atmospheric Correction of Hyperspectral Imagery.

5.3 MNF ratioing from Hyperspectral(EO1)

5.4 Hyperspectral Image Classification Using Spectral Angle Mapper (SAM) & Spectral Feature Fitting (SFF).

5.5 Hyperspectral Imagery Classification Using an Unsupervised Neuron fuzzy System.

5.6 Application of Hyperspectral Imagery in Geological Studies.

5.7 Hyperspectral Signatures & Feature Fitting.

5.8 Hyperspectral Remote Sensing for Agriculture and soil Studies.

5.9 Hyperspectral Remote Sensing for Forestry Applications.

5.10 Hyperspectral Remote Sensing for Urban Studies.

5.11 Mineral identification from Hyperspectral imagery

5.12 Python Programming for Hyperspectral data analysis.

Project

Subject Name	Code	Credit	T-P-P	Prerequisite
Project	CUAS2025	4	0-0-4	NIL

List of Projects:

1. Flood inundation mapping and Risk Evaluation using Geospatial Technology.

2. Landslide Hazard mapping using GIS and RS.

3. Land use and Land cover Dynamics using Earth observation Technology.

4. Mangrove change detection study using Multi-Temporal satellite data.

5. Solid waste management and shortest path identification using GIS Technology.

6. Watershed management using GIS Technology.

7. Identification Mineral mapping using GIS and RS.

8. Crop Health Monitoring using Geospatial Technology.

9. Identification of Hydrocarbon Locales using space inputs and Geospatial Technology.

10. Ground water exploration using GIS and RS Techniques.

11. Interlinking of River using GIS Technology.

12. Biomass estimation using Space Technology.

13. Land surface Temperature mapping using RS Technology.

14. Climate Change study using Earth Observation Technology.

15. Erosion and Accretion study of Shorelines and its impact in coastal habitats.

Students take up group projects and deal the following activities during the project. The project Report should contain below gate process.

Step 1: Functional Planning of the project and Objective Identification

Step 2: Literature Review

Step 3: Preparation of Flow chart for Methodology

Step 4: Layer creation and GIS analysis

Step 5: Identifying the possible Risks involved (specific to the project)

Step 6: Report writing

INTERNSHIP

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2077	INTERNSHIP	10	0-0-10	NIL

2. Objectives

The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings, which will facilitate development of a new/improved product, process for the benefit of the society.

3. Course Outcomes

1. To undertake research in an area related to the program.
2. Publication is mandatory in peer review journal

5. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Review 1	10	
	Review 2	15	
	Review 3	25	
	Total	50	
External Examination	Final	50	
Total		100	

6. Course outline

M.Sc. internship should be socially relevant and research oriented ones. Each student is expected to do an individual project. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project. Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.