# ANNA UNIVERSITY, CHENNAI

## UNDERGRADUATE CURRICULUM (UNIVERSITY DEPARTMENTS)

**Campus: CEG Campus, Anna University**

**Department: Department of Civil Engineering**

**Programme: B.E. GEOINFORMATICS**

**Regulations:** 2023 (Revised 2024), with effect from the AY 2024 – 25 to all the students of UG Programme.

## OVERVIEW OF CREDITS

| Sem | PCC | PEC | ESC | HSMC | ETC | OEC | SDC | UC | SLC | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| I | - | - | 7 | 11 | - | - | 4 | 1 | - | 23 |
| II | - | - | 6 | 14 | - | - | - | 1 | - | 21 |
| III | 11 | - | 7 | 4 | - | - | - | 2 | - | 24 |
| IV | 21 | - | 2 | - | - | - | 2 | - | - | 25 |
| V | 12 | 3 | - | - | 3 | 3 | 3 | 3 | - | 27 |
| VI | 6 | 9 | - | - | - | 3 | 3 | 3 | - | 24 |
| VII | 3 | 6 | - | - | 3 | - | 4 | 2 | 1 | 19 |
| VIII | - | - | - | - | - | - | 8 | - | - | 8 |
| Total | 53 | 18 | 22 | 29 | 6 | 6 | 24 | 12 | 1 | 171 |
| % of Category | 31.4 | 10.7 | 10 | 17.2 | 3.6 | 3.6 | 16 | 7.1 | 0.6 | 100 |

**CATEGORY OF COURSES**

**PCC – Professional Core Course**
**PEC – Professional Elective Course**
**ETC – Emerging Technology Course**
**OEC – Open Elective Course**
**SLC – Self Learning Course**
**ESC – Engineering Science Course**
**HSMC – Humanities Science and Management Course**
**SDC – Skill Development Course**
**UC – University Course**

***For Honours & Minor Degree, please refer the Regulations 2023 (Revised 2024).***

| SEMESTER – I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1 | EN23C01 | Foundation English | LIT | 2-0-2 | 4 | 3 | HSMC |
| 2 | MA23C01 | Matrices and Calculus | T | 3-1-0 | 4 | 4 | HSMC |
| 3 | PH23C01 | Engineering Physics | LIT | 3-0-2 | 5 | 4 | HSMC |
| 4 | ME23C01 | Engineering Drawing & 3D Modelling | LIT | 2-0-4 | 6 | 4 | SDC |
| 5 | EE23C02 | Fundamentals of Electrical and Electronics Engineering | LIT | 3-0-0 | 3 | 3 | ESC |
| 6 | CS23C04 | Programming in C | LIT | 2-0-4 | 6 | 4 | ESC |
| 7 | UC23H01 | தமிழர் மரபு /Heritage of Tamils | T | 1-0-0 | 1 | 1 | UC |
| 8 | - | NCC/NSS/NSO/YRC | L | 0-0-2 | 2 | - | UC |
| **TOTAL CREDITS** | | | | | | **23** | |

*** TCP –** Total Contact Period(s)

#**TYPE OF COURSE**

**LIT** – Laboratory Integrated Theory

**T** – Theory

**L** – Laboratory Course

**IPW** – Internship cum Project Work

**PW** – Project Work

**CDP** – Capstone Design Project

| SEMESTER – II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1 | EN23C02 | Professional Communication | LIT | 2-0-2 | 4 | 3 | HSMC |
| 2 | MA23C02 | Ordinary Differential Equations and Transform Techniques | T | 3-1-0 | 4 | 4 | HSMC |
| 3 | PH23C02 | Principles and Applications of Electromagnetic radiation in Remote Sensing | T | 3-0-0 | 3 | 3 | HSMC |
| 4 | CY23C01 | Engineering Chemistry | LIT | 3-0-2 | 5 | 4 | HSMC |
| 5 | ME23C04 | Markerspace | LIT | 1-0-4 | 5 | 3 | SDC |
| 6 | GI23201 | Geoinformatics Systems | LIT | 2-0-2 | 4 | 3 | ESC |
| 7 | UC23H02 | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology | T | 1-0-0 | 1 | 1 | UC |
| 8 | - | Audit Course–I | - | - | - | - | UC |
| **TOTAL CREDITS** | | | | | | **21** | |

| SEMESTER – III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1 | MA23C05 | Probability and Statistics | T | 3-1-0 | 4 | 4 | HSMC |
| 2 | CS23C02 | Computer Programming in Python | T | 3-0-2 | 5 | 4 | ESC |
| 3 | GI23301 | Spatial Database Management System | LIT | 2-0-2 | 4 | 3 | ESC |
| 4 | GI23302 | Surveying | LIT | 3-0-4 | 7 | 5 | PCC |
| 5 | GI23303 | Remote Sensing | LIT | 2-0-2 | 4 | 3 | PCC |
| 6 | GI23304 | Principles of Photogrammetry | LIT | 2-0-2 | 4 | 3 | PCC |
| 7 | UC23U01 | Universal Human Values | LIT | 1-0-2 | 3 | 2 | UC |
| **TOTAL CREDITS** | | | | | | **24** | |

| SEMESTER – IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1 | GI23401 | Cartography and GIS | LIT | 3-0-4 | 7 | 5 | PCC |
| 2 | GI23402 | Electronic Surveying | LIT | 3-0-4 | 7 | 5 | PCC |
| 3 | GI23403 | Digital Image Processing | LIT | 3-0-4 | 7 | 5 | PCC |
| 4 | GI23404 | Geodesy | T | 3-0-0 | 3 | 3 | PCC |
| 5 | GI23405 | Hyperspectral & Thermal Remote Sensing | LIT | 2-0-2 | 4 | 3 | PCC |
| 6 | GI23406 | Environmental Sciences and Sustainability | T | 2-0-0 | 2 | 2 | ESC |
| 7 | - | NCC Credit Course Level 2# | T | 2-0-0 | 2 | 2 # | - |
| 8 | - | Skill Development Course I | - | - | - | 2 | SDC |
| 9 | - | Audit Course–II | - | - | - | - | UC |
| **TOTAL CREDITS** | | | | | | **25** | |

| SEMESTER – V | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1 | GI23501 | Microwave Remote Sensing | LIT | 3-0-2 | 5 | 4 | PCC |
| 2 | GI23502 | Laser Scanning for Terrain Mapping | LIT | 3-0-2 | 5 | 4 | PCC |
| 3 | GI23503 | Spatial Analytics | LIT | 2-0-4 | 6 | 4 | PCC |
| 4 | - | Professional Elective I | T | 3-0-0 | 3 | 3 | PEC |
| 5 | - | Emerging Technology Course – I | T | 3-0-0 | 3 | 3 | ETC |
| 6 | - | Open Elective-I | T | 3-0-0 | 3 | 3 | OEC |
| 7 | - | Skill Development Course II | - | - | - | 2 | SDC |
| 8 | - | Industry Oriented Course I | - | - | - | 1 | SDC |
| 9 | UC23E01 | Engineering Entrepreneurship Development | LIT | 2-0-2 | 4 | 3 | UC |
| **TOTAL CREDITS** | | | | | | **27** | |
| **COURSES FOR HONOURS DEGREE** | | | | | | | |
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1. | GI23D01 | Capstone Design Project – Level I | CDP | 0-0-12 | 12 | 6 | SDC |
| **(OR)** | | | | | | | |
| 1. | - | Honours Elective – I | T | 3-0-0 | 3 | 3 | PEC |
| 2. | - | Honours Elective – II | T | 3-0-0 | 3 | 3 | PEC |
| **COURSES FOR MINOR DEGREE** | | | | | | | |
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1. | - | Minor Elective – I | T | 3-0-0 | 3 | 3 | PEC |
| 2. | - | Minor Elective – II | T | 3-0-0 | 3 | 3 | PEC |

| SEMESTER – VI | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1 | GI23601 | Geospatial Analysis with Python Programming | LIT | 1-0-4 | 5 | 3 | PCC |
| 2 | GI23602 | Spatial Data Adjustment | T | 3-0-0 | 3 | 3 | PCC |
| 3 | - | Professional Elective II | T | 3-0-0 | 3 | 3 | PEC |
| 4 | - | Professional Elective III | T | 3-0-0 | 3 | 3 | PEC |
| 5 | - | Professional Elective IV | T | 3-0-0 | 3 | 3 | PEC |
| 6 | - | Open Elective-II | T | 3-0-0 | 3 | 3 | OEC |
| 7 | - | Industry Oriented Course II | T | 1-0-0 | | 1 | SDC |
| 8 | - | NCC Credit Course Level 3# | T | 3-0-0 | 3 | 3 # | - |
| 9 | - | Skill Development Course III | - | - | - | 2 | SDC |
| 10 | UC23U02 | Sustainability Course | T | 3-0-0 | 3 | 3 | UC |
| | | | | **TOTAL CREDITS** | | **24** | |
| **COURSES FOR HONOURS DEGREE** | | | | | | | |
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1. | GI23D02 | Capstone Design Project – Level II | CDP | 0-0-12 | 12 | 6 | SDC |
| **(OR)** | | | | | | | |
| 1. | - | Honours Elective – III | T | 3-0-0 | 3 | 3 | PEC |
| 2. | - | Honours Elective – IV | T | 3-0-0 | 3 | 3 | PEC |
| **COURSES FOR MINOR DEGREE** | | | | | | | |
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| 1. | - | Minor Elective – III | T | 3-0-0 | 3 | 3 | PEC |
| 2. | - | Minor Elective – IV | T | 3-0-0 | 3 | 3 | PEC |

| SEMESTER – VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1. | - | Professional Elective V | T | 3-0-0 | 3 | 3 | PEC |
| 2. | - | Professional Elective VI | T | 3-0-0 | 3 | 3 | PEC |
| 3. | GI23701 | Web and Cloud Based GIS | LIT | 2-0-2 | 4 | 3 | SDC |
| 4. | GI23702 | Natural Resource Management with Geomatics | T | 3-0-0 | 3 | 3 | PCC |
| 5. | **-** | Emerging Technology Course - II | T | 3-0-0 | 3 | 3 | ETC |
| 6. | GI23703 | Survey and Mapping Project with Standards | LIT | 1-0-2 | 3 | 2 | UC |
| 7. | - | Industry Oriented Course III | - | - | - | 1 | SDC |
| 8. | GI23L01 | Self-Learning Course | - | - | - | 1 | SLC |
| | | | **TOTAL CREDITS** | | | **19** | |
| **COURSES FOR HONOURS DEGREE** | | | | | | | |
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1. | GI23D03 | Capstone Design Project – Level III | CDP | 0-0-12 | 12 | 6 | SDC |
| **(OR)** | | | | | | | |
| 1. | - | Honours Elective – V | T | 3-0-0 | 3 | 3 | PEC |
| 2. | - | Honours Elective – VI | T | 3-0-0 | 3 | 3 | PEC |
| **COURSES FOR MINOR DEGREE** | | | | | | | |
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1. | - | Minor Elective – V | T | 3-0-0 | 3 | 3 | PEC |
| 2. | - | Minor Elective – VI | T | 3-0-0 | 3 | 3 | PEC |

| SEMESTER – VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. NO.** | **COURSE CODE** | **COURSE NAME** | **COURSE TYPE#** | **PERIODS / WEEK** | | **CREDITS** | **CATEGORY** |
| | | | | **L-T-P** | **TCP*** | | |
| 1. | GI23801 | Project Work / Internship cum Project Work | PW/IPW | 0-0-16 | 16 | 8 | SDC |
| | | | | **TOTAL CREDITS** | | **8** | |

**TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 171**

## SKILL DEVELOPMENT COURSES (SDC)

| S. No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | ME23C01 | Engineering Drawing & 3D Modelling | SDC | 6 | 2 | 0 | 4 | 4 |
| 2. | ME23C04 | Marker space | SDC | 5 | 1 | 0 | 4 | 3 |
| 3. | - | Skill Based Course I | SDC | 3 | 1 | 0 | 2 | 2 |
| 4. | - | Skill Based Course II | SDC | 3 | 1 | 0 | 2 | 2 |
| 5. | - | Skill Based Course III | SDC | 3 | 1 | 0 | 2 | 2 |
| 6. | GI23701 | Web and Cloud Based GIS | SDC | 4 | 2 | 0 | 2 | 3 |
| 7. | GI23801 | Project Work / Internship cum Project Work | SDC | 16 | 0 | 0 | 16 | 8 |
| 8. | - | Industry Oriented Course I | SDC | - | - | - | - | 1 |
| 9. | - | Industry Oriented Course II | SDC | - | - | - | - | 1 |
| 10. | - | Industry Oriented Course III | SDC | - | - | - | - | 1 |
| | | | | | | | | **27** |

## SELF LEARNING COURSE (SLC)

| S. No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | GI23L01 | Self Learning Course | SLC | - | - | - | - | 1 |
| | | | | | | | | **1** |

## EMERGING TECHNOLOGY COURSES (ETC)

| S. No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | GI23E01 | AI/ML for Geoinformatics | ETC | 3 | 3 | 0 | 0 | 3 |
| 2. | GI23E02 | Geographic Information System for Climate and Disaster Risk Assessment | ETC | 3 | 3 | 0 | 0 | 3 |
| 3. | GI23E03 | Environmental Economics | ETC | 3 | 3 | 0 | 0 | 3 |
| 4. | GI23E04 | Waste management for circular economy | ETC | 3 | 3 | 0 | 0 | 3 |
| | | | | | | | | **6** |

**UNIVERSITY COURSES (UC)**

| S. No. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | UC23H01 | தமிழர் மரபு /Heritage of Tamils | UC | 1 | 1 | 0 | 0 | 1 |
| 2. | - | NCC/ NSS/ NSO/ YRC | UC | 2 | 0 | 0 | 2 | 0 |
| 3. | UC23H02 | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology | UC | 1 | 1 | 0 | 0 | 1 |
| 4. | - | Audit Course- I** | UC | 2 | 2 | 0 | 0 | 0 |
| 5. | GI23704 | Survey and Mapping Project with Standards | UC | 3 | 1 | 0 | 2 | 2 |
| 6. | UC23U01 | Universal Human Values | UC | 3 | 1 | 0 | 2 | 2 |
| 7. | - | Audit Course-II** | UC | 2 | 2 | 0 | 0 | 0 |
| 8. | UC23E01 | Entrepreneurship Development Course | UC | 3 | 3 | 0 | 0 | 3 |
| 9. | UC23U02 | Sustainability Course | UC | 3 | 3 | 0 | 0 | 3 |
| | | | | | | | **Total** | **12** |

**PROFESSIONAL ELECTIVE COURSES (PEC): VERTICALS**

| VERTICAL I (Surveying & Mapping) | VERTICAL II (Geospatial Data Analytics) | VERTICAL III (Image Processing and Analysis) | VERTICAL IV (GeoSpatial Applications) | VERTICAL V (Geodesy) | VERTICAL VI (Geo-Intelligence) |
|---|---|---|---|---|---|
| Terrestrial and Satellite Photogrammetry | GIS Customization and Scripting | Soft Computing Techniques | Environmental Geoinformatics | Advanced Geodesy | Digital Twins & BIM |
| GNSS Surveying | Location Based Geospatial Services | Polarimetry and Interferometry | Transportation Geomatics | Satellite Geodesy | Big Data Analytics for Geomatics |
| Terrestrial and Bathymetric Laser Scanning | Space Syntax | Pattern Recognition | Geomatics for Hydrology and Water Resources | Physical Geodesy | IoT Applications in Geomatics |
| Unmanned Aerial System (UAS) for Large Scale mapping | GIS based Utility and Asset Management | Raster Data Modelling | Geomatics for Disaster and Risk Mitigation | Geodetic Interferometry | Decision Support Systems for Geomatics |
| Underground and Hydrographic Surveying | GeoSpatial Modeling& Simulation | Agriculture and Forest Management using Geomatics | Satellite Meteorology | Geodetic Control Survey and Adjustment | Location Intelligence & Surveillance |
| Cadastral Surveying | Sustainable Development Goals and Geomatics | Spatial Statistics | Geomatics for ocean and Coastal Applications | Geodetic Astronomy | Geomatics for Smart Cities |

**Registration of Professional Elective Courses from Verticals:**

Professional Elective Courses will be registered from Semesters V to VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, more than one course is permitted from the same row, provided each course is enrolled in different semester.

The registration of courses for B.E./B.Tech (Hons) shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Hons) also. For more details on B.E./B.Tech (Hons) refer to the Regulations 2023, Clause 4.11.

## PROFESSIONAL ELECTIVE COURSES (PEC)
## SURVEYING & MAPPING (VERTICAL– I)

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | GI23001 | Terrestrial and Satellite Photogrammetry | PEC | 3 | 0 | 0 | 3 | 3 |
| 2 | GI23002 | GNSS Surveying | PEC | 3 | 0 | 0 | 3 | 3 |
| 3 | GI23003 | Terrestrial and Bathymetric Laser Scanning | PEC | 3 | 0 | 0 | 3 | 3 |
| 4 | GI23004 | Unmanned Aerial System (UAS) for Large Scale mapping | PEC | 3 | 0 | 0 | 3 | 3 |
| 5 | GI23005 | Underground and Hydrographic Surveying | PEC | 3 | 0 | 0 | 3 | 3 |
| 6 | GI23006 | Cadastral Surveying | PEC | 3 | 0 | 0 | 3 | 3 |

## GEOSPATIAL DATA ANALYTICS (VERTICAL– II)

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | GI23007 | GIS Customization and Scripting | PEC | 2 | 0 | 2 | 3 | 3 |
| 2 | GI23008 | Location Based Geospatial Services | PEC | 3 | 0 | 0 | 3 | 3 |
| 3 | GI23009 | Space Syntax | PEC | 3 | 0 | 0 | 3 | 3 |
| 4 | GI23010 | GIS based Utility and Asset Management | PEC | 3 | 0 | 0 | 3 | 3 |
| 5 | GI23011 | GeoSpatial Modeling& Simulation | PEC | 3 | 0 | 0 | 3 | 3 |
| 6 | GI23012 | Sustainable Development Goals and Geomatics | PEC | 3 | 0 | 0 | 3 | 3 |

## IMAGE PROCESSING AND ANALYSIS (VERTICAL– III)

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | GI23013 | Soft Computing Techniques | PEC | 2 | 1 | 0 | 3 | 3 |
| 2 | GI23014 | Polarimetry and Interferometry | PEC | 3 | 0 | 0 | 3 | 3 |
| 3 | GI23015 | Pattern Recognition | PEC | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4 | GI23016 | Raster Data Modelling | PEC | 3 | 0 | 0 | 3 | 3 |
| 5 | GI23017 | Agriculture and Forest Management using Geomatics | PEC | 3 | 0 | 0 | 3 | 3 |
| 6 | GI23018 | Spatial Statistics | PEC | 3 | 0 | 0 | 3 | 3 |

**GEOSPATIAL APPLICATIONS (VERTICAL– IV)**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | GI23C02 | Environmental Geoinformatics | PEC | 3 | 0 | 0 | 3 | 3 |
| 2 | GI23019 | Transportation Geomatics | PEC | 3 | 0 | 0 | 3 | 3 |
| 3 | GI23C03 | Geomatics for Hydrology and Water Resources | PEC | 3 | 0 | 0 | 3 | 3 |
| 4 | GI23C04 | Geomatics for Disaster and Risk Mitigation | PEC | 3 | 0 | 0 | 3 | 3 |
| 5 | GI23020 | Satellite Meteorology | PEC | 3 | 0 | 0 | 3 | 3 |
| 6 | GI23C05 | Geomatics for ocean and Coastal Applications | PEC | 3 | 0 | 0 | 3 | 3 |

**GEODESY (VERTICAL– V)**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | GI23021 | Advanced Geodesy | PEC | 3 | 0 | 0 | 3 | 3 |
| 2 | GI23022 | Satellite Geodesy | PEC | 3 | 0 | 0 | 3 | 3 |
| 3 | GI23023 | Physical Geodesy | PEC | 3 | 0 | 0 | 3 | 3 |
| 4 | GI23024 | Geodetic Interferometry | PEC | 3 | 0 | 0 | 3 | 3 |
| 5 | GI23025 | Geodetic Control Survey and Adjustment | PEC | 3 | 0 | 0 | 3 | 3 |
| 6 | GI23026 | Geodetic Astronomy | PEC | 3 | 0 | 0 | 3 | 3 |

**GEOINTELLIGENCE (VERTICAL– VI)**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1 | GI23027 | Digital Twins & BIM | PEC | 3 | 0 | 0 | 3 | 3 |
| 2 | GI23028 | Big Data Analytics for Geomatics | PEC | 3 | 0 | 0 | 3 | 3 |
| 3 | GI23029 | IoT Applications in Geomatics | PEC | 3 | 0 | 0 | 3 | 3 |
| 4 | GI23030 | Decision Support Systems for Geomatics | PEC | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | GI23031 | Location Intelligence & Surveillance | PEC | 3 | 0 | 0 | 3 | 3 |
| 6 | GI23032 | Geomatics for Smart Cities | PEC | 3 | 0 | 0 | 3 | 3 |

**LIST OF OPEN ELECTIVES**
**(TO BE OFFERED TO STUDENTS OF OTHER PROGRAMMES)**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | GI23901 | Photogrammetry | OEC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI23902 | Total Station and GPS Surveying | OEC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI23903 | Computer Vision and Satellite Image Processing | OEC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI23904 | Remote Sensing Concepts | OEC | 3 | 0 | 0 | 3 | 3 |

**MINOR PROGRAMME ON REMOTESENSING AND GIS**
**(TO BE OFFERED TO STUDENTS OF OTHER PROGRAMMES)**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | GI23033 | Remote Sensing | PCC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI23401 | Cartography and GIS | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI23501 | Microwave Remote Sensing | PCC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI23304 | Principles of Photogrammetry | PCC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI23402 | Electronic Surveying | PCC | 3 | 0 | 0 | 3 | 3 |
| 6. | GI23702 | Natural Resource Management with Geomatics | PCC | 3 | 0 | 0 | 3 | 3 |
| 7. | GI23403 | Digital Image Processing | PCC | 3 | 0 | 0 | 3 | 3 |

**EN23C01 FOUNDATION ENGLISH L T P C**
**2 0 2 3**

**COURSE OBJECTIVES:**

- To develop students' foundational skills in reading, writing, grammar and vocabulary to enable them to understand and produce various forms of communication.
- To enhance students' proficiency in reading comprehension, narrative and comparative writing.
- To comprehend and analyse descriptive texts and visual images
- To articulate similarities and differences in oral and written forms.
- To improve students' proficiency in reading and writing formal letters and emails.

**UNIT I BASICS OF COMMUNICATION 6**

Reading - Telephone message, bio-note; Writing – Personal profile; Grammar – Simple present tense, Present continuous tense, wh-questions, indirect questions; Vocabulary – Word formation (Prefix and Suffix).

**LAB ACTIVITY: 6**

Listening – Telephone conversation; Speaking Self-introduction; Telephone conversation – Video conferencing etiquette

**UNIT II NARRATION 6**

Reading – Comprehension strategies - Newspaper Report, An excerpt from an autobiography; Writing – Narrative Paragraph writing (Event, personal experience etc.); Grammar – Subject-verb agreement, Simple past, Past continuous Tenses; Vocabulary – One-word substitution

**LAB ACTIVITY: 6**

Listening – Travel podcast; Speaking – Narrating and sharing personal experiences through a podcast

**UNIT III DESCRIPTION 6**

Reading – A tourist brochure, Travel blogs, descriptive article/excerpt from literature, visual images; Writing –Descriptive Paragraph writing, Grammar – Future tense, Perfect tenses, Preposition; Vocabulary – Descriptive vocabulary

**LAB ACTIVITY: 6**

Listening – Railway / Airport Announcements, Travel Vlogs; Speaking – Describing a place or picture description

**UNIT IV COMPARE AND CONTRAST 6**

Reading – Reading and comparing different product specifications - Writing – Compare and Contrast Essay, Coherence and cohesion; Grammar – Degrees of Comparison; Vocabulary – Transition words (relevant to compare and contrast)

**LAB ACTIVITY: 6**

Listening – Product reviews, Speaking – Product comparison based on product reviews - similarities and differences

**UNIT V EXPRESSION OF VIEWS 6**

Reading – Formal letters, Letters to Editor ; Writing – Letter writing/ Email writing (Enquiry / Permission, Letter to Editor); Grammar – Compound nouns, Vocabulary – Synonyms, Antonyms

**LAB ACTIVITY: 6**

Listening – Short speeches; Speaking – Making short presentations (JAM)

**TOTAL: 60 PERIODS**

**TEACHING METHODOLOGY**

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

**EVALUATION PATTERN**

Internal Assessment
- Written assessments
- Assignment

Lab assessment
- Listening
- Speaking

External Assessment
- End Semester Examination

**LEARNING OUTCOMES**

By the end of the courses, students will be able to

- Use appropriate grammar and vocabulary to read different types of text and converse appropriately.
- Write coherent and engaging descriptive and comparative essay writing.
- Comprehend and interpret different kinds of texts and audio visual materials
- Critically evaluate reviews and articulate similarities and differences
- Write formal letters and emails using appropriate language structure and format

**TEXT BOOKS:**

1. “English for Engineers and Technologists” Volume I by Orient Blackswan, 2022
2. “English for Science & Technology - I” by Cambridge University Press, 2023

**REFERENCES**

1. “Interchange” by Jack C.Richards, Fifth Edition, Cambridge University Press, 2017.
2. “English for Academic Correspondence and Socializing” by Adrian Wallwork, Springer, 2011.
3. “The Study Skills Handbook” by Stella Cortrell, Red Globe Press, 2019
4. www.uefap.com

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | | | | | √ | | √ |
| **CO2** | | | | | | | | | | √ | | |
| **CO3** | | | | | | | | | | √ | | √ |
| **CO4** | | | | | | | | | | √ | | |
| **CO5** | | | | | | | | | | √ | | √ |

| MA23C01 | MATRICES AND CALCULUS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- To develop the use of matrix algebra techniques in solving practical problems.
- To familiarize the student with functions of several variables.
- To solve integrals by using Beta and Gamma functions.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals.
- To acquaint the students with the concepts of vector calculus which naturally arise in many engineering problems.

**UNIT I MATRICES 9+3**

Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors- Cayley-Hamilton theorem (excluding proof) – Diagonalization of matrices - Reduction of Quadratic form to canonical form by using orthogonal transformation - Nature of a Quadratic form.

**UNIT II FUNCTIONS OF SEVERAL VARIABLES 9+3**

Limit, continuity, partial derivatives – Homogeneous functions and Euler's theorem - Total derivative – Differentiation of implicit functions – Jacobians -Taylor's formula for two variables - Errors and approximations – Maxima and Minima of functions of two variables – Lagrange's method of undermined multipliers.

**UNIT III INTEGRAL CALCULUS 9+3**

Improper integrals of the first and second kind and their convergence – Differentiation under integrals - Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions-Properties – Evaluation of single integrals by using Beta and Gamma functions..

**UNIT IV MULTIPLE INTEGRALS 9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals-
Evaluation of double and triple integrals by using Beta and Gamma functions.

**UNIT V VECTOR CALCULUS 9+3**

Gradient of a scalar field, directional derivative – Divergence and Curl – Solenoidal and Irrotational vector fields - Line integrals over a plane curve - Surface integrals – Area of a curved surface – Volume Integral - Green's theorem, Stoke's and Gauss divergence theorems (without proofs)– Verification and applications in evaluating line, surface and volume integrals.

**TOTAL: 60 PERIODS**

Laboratory based exercises / assignments / assessments will be given to students wherever applicable from the content of the course.

General engineering applications / branch specific applications from the content of each units wherever possible will be introduced to students.

Suggested Laboratory based exercises / assignments / assessments :

Matrices

1. Finding eigenvalues and eigenvectors
2. Verification of Cayley-Hamilton theorem
3. Eigenvalues and Eigenvectors of similar matrices
4. Eigenvalues and Eigenvectors of a symmetric matrix
5. Finding the powers of a matrix
6. Quadratic forms

Functions of Several Variables

1. Plotting of curves and surfaces
2. Symbolic computation of partial and total derivatives of functions

Integral Calculus

1. Evaluation of beta and gamma functions
2. Computation of error function and its complement

Multiple Integrals

1. Plotting of 3D surfaces in Cartesian and Polar forms

Vector Calculus

1. Computation of Directional derivatives
2. Computation of normal and tangent to the given surface

**OUTCOMES:**

CO 1 :Use the matrix algebra methods for solving practical problems.
CO 2 :Use differential calculus ideas on several variable functions.
CO 3 :Apply different methods of integration in solving practical problems by using Beta and Gamma functions.
CO 4 :Apply multiple integral ideas in solving areas and volumes problems.
CO 5 :Apply the concept of vectors in solving practical problems.

**TEXT BOOKS:**


1. Joel Hass, Christopher Heil, Maurice D.Weir "'Thomas' Calculus", Pearson Education., New Delhi, 2018.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, New Delhi, 2020.
3. James Stewart, Daniel K Clegg & Saleem Watson "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2023.


**REFERENCES:**


1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.
2. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, 5th Edition, New Delhi, 2017.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi , 2012.

6. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

**CO – PO Mapping:**

| Course Outcomes | PROGRAMME OUTCOMES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **P10** | **P11** | **P12** |
| CO1 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO2 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO3 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO4 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO5 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |

| PH23C01 | ENGINEERING PHYSICS | L | T | P | C |
|---|---|---|---|---|---|
| | (Common to all branches of B.E/B.Tech Programmes) | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES**

- To familiarize with crystal structure, bonding and crystal growth.
- To impart knowledge on Mechanics of Materials.
- To impart knowledge of oscillations, sound and Thermal Physics
- To facilitate understanding of optics and its applications, different types of Lasers and fiber optics.
- To introduce the basics of Quantum Mechanics and its importance.

**UNIT I CRYSTAL PHYSICS 9+6**

Crystal Bonding – Ionic – covalent – metallic and van der Walls's/ molecular bonding. Crystal systems - unit cell, Bravais lattices, Miller indices - Crystal structures - atomic packing density of BCC, FCC and HCP structures. NaCl, Diamond, Graphite, Graphene, Zincblende and Wurtzite structures - crystal imperfections- point defects - edge and screw dislocations – grain boundaries. Crystal Growth – Czocharalski method – vapor phase epitaxy – Molecular beam epitaxy- Introduction to X-Ray Diffractometer.

1. Determination of Lattice parameters for crystal systems.
2. Crystal Growth – Slow Evaporation method
3. Crystal Growth Sol – Gel Method

**UNIT II MECHANICS OF MATERIALS 9+6**

Rigid Body – Centre of mass – Rotational Energy - Moment of inertia (M.I)- Moment of Inertia for uniform objects with various geometrical shapes. Elasticity –Hooke's law - Poisson's ratio - stress-strain diagram for ductile and brittle materials – uses- Bending of beams – Cantilever - Simply supported beams - uniform and non-uniform bending - Young's modulus determination - I shaped girders –Twisting couple – Shafts. Viscosity – Viscous drag – Surface Tension.

4. Non-uniform bending -Determination of Young's modulus of the material of the beam.
5. Uniform bending -Determination of Young's modulus of the material of the beam
6. Viscosity – Determination of Viscosity of liquids.

**UNIT III OSCILLATIONS, SOUND AND THERMAL PHYSICS 9+6**

Simple harmonic motion - Torsional pendulum –- Damped oscillations –Shock Absorber -Forced oscillations and Resonance –Applications of resonance.- Waves and Energy Transport –Sound waves – Intensity level – Standing Waves - Doppler effect and its applications - Speed of blood flow. Ultrasound – applications - Echolocation and Medical Imaging. Thermal Expansion – Expansion joints – Bimetallic strip – Seebeck effect – thermocouple -Heat Transfer Rate – Conduction – Convection and Radiation.

7. Torsional pendulum-Determination of rigidity modulus of wire and moment of inertia of the disc
8. Melde's string experiment - Standing waves.
9. Ultrasonic interferometer – determination of sound velocity and liquids compressibility

**UNIT IV OPTICS AND LASERS 9+6**

Interference - Thin film interference - Air wedge- Applications -Interferometers–Michelson Interferometer -– Diffraction - CD as diffraction grating – Diffraction by crystals -Polarization - polarizers -– Laser – characteristics – Spontaneous and Stimulated emission- population – inversion - Metastable states - optical feedback - Nd-YAG laser, $CO_2$ laser, Semiconductor laser - Industrial and medical applications - Optical Fibers – Total internal reflection – Numerical aperture and acceptance angle – Fiber optic communication – Fiber sensors – Fiber lasers.

10. Laser - Determination of the width of the groove of the compact disc using laser.
    Laser Parameters
    Determination of the wavelength of the laser using grating
11. Air wedge -Determination of the thickness of a thin sheet/wire
12. Optical fibre - Determination of Numerical Aperture and acceptance angle
    -Determination of bending loss of fibre.
13. Michelson Interferometer (Demonstration)

**UNIT V QUANTUM MECHANICS 9+6**

Black body radiation (Qualitative) – Planck's hypothesis – Einstein's theory of Radiation - Matter waves–de Broglie hypothesis - Electron microscope – Uncertainty Principle – The Schrodinger Wave equation (time-independent and time-dependent) – Meaning and Physical significance of wave function - Normalization - Particle in an infinite potential well-particle in a three-dimensional box - Degenerate energy states - Barrier penetration and quantum tunneling - Tunneling microscope.

14. Photoelectric effect – Determination of Planck's constant.
15. Black Body Radiation (Demonstration)
16. Electron Microscope (Demonstration)

**TOTAL: 75 PERIODS**

**COURSE OUTCOMES:**

After completion of the course, the students will be able to

**CO1:** Understand the significance of crystal structure and bonding. Learn to grow crystals.
**CO2:** Obtain knowledge on important mechanical and thermal properties of materials and determine them through experiments.
**CO3:** Conceptualize and visualize the oscillations and sound.
**CO4:** Grasp optical phenomenon and their applications in real life.
**CO5:** Appreciate and evaluate the quantum phenomenon.
**CO6** Develop skill set to solve engineering problems and design experiments.

**TEXT BOOKS:**


1. Raymond A. Serway, John W. Jewett, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2013.
2. D. Halliday, R. Resnick and J. Walker, Principles of Physics. John Wiley & Sons, 10th Edition, 2015.
3. N. Garcia, A. Damask and S. Schwarz, Physics for Computer Science Students, Springer-Verlag, 2012.

4. Alan Giambattista, Betty McCarthy Richardson and Robert C. Richardson, College Physics, McGraw-Hill Higher Education, 2012.

**REFERENCES:**

1. R. Wolfson, Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D. Kleppner and R. Kolenkow. An Introduction to Mechanics, McGraw Hill Education, 2017.

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | | 1 | | | | | | | |
| **CO2** | 3 | 2 | 1 | 1 | | | | | | | | |
| **CO3** | 3 | 2 | 1 | 1 | | | | | | | | |
| **CO4** | 3 | 2 | 1 | 1 | 1 | | | | | | | |
| **CO5** | 3 | 2 | 1 | 1 | 1 | | | | | | | |
| **CO6** | 3 | 2 | 1 | 2 | | | | | | | | |

| ME23C01 | ENGINEERING DRAWING AND 3D MODELLING | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 4 | 4 |

**COURSE OBJECTIVES**

After successful completion of this course, the students will be able to:

1. Understand and use the engineering curves in engineering applications and projection techniques to construct conic curves, points and lines.
2. Develop skills in projecting surfaces and solids and create 2D models using CAD software.
3. Develop skills in 3D projection and 3D modeling of simple parts manually as well as using CAD software.
4. Understand and apply sectioning techniques to solids and assemble components.
5. Develop skills in lateral surface development and sheet metal design.

**INTRODUCTION**

Manual drawing tools (Mini Drafter, Set Squares, Protractor, Compass, and different grades of pencil). **'**BIS' specifications and rules of Engineering Drawing – Arrows (2H thin line body, HB Filled head and L:W = 3:1 ratio), lettering (Digital fonts, font sizes pertaining to usage and representation), types of line and their syntax (Drawing based – Continuous thin & thick, dashed, dashed dotted and Application based – extension, dimensioning, construction, projection, reference, axis, section, hatching, and break lines), scaling (up, down and equal), and dimensioning. Placing and positioning the 'A3' size drawing sheet over the drawing table. Principal planes and projection, Division of line and circle in to equal parts, and construction of polygons

**UNIT i: ENGINEERING CURVES, PROJECTION OF POINTS AND LINES 6+12**

Construction of conic curves with their tangent and normal – ellipse, parabola, and hyperbola by eccentricity method

Construction of special curves with their tangent and normal – cycloid, epicycloid, and involute

Projection of points and I angle projection of lines inclined to both principal planes by rotating line method and trapezoidal rule – marking their traces.

**Lab exercises:** Study exercise – Introduction to Sketching (or) Drawing, and modification tools in CAD software (AutoCAD, CREO, CATIA, Solid Works, Inventor, Fusion 360)

**Activities based learning:** Identification of the curves used in the application given in the flash card, demonstration of the instantaneous centre of rotation of governors with respect to angle of inclination of the arms of the governors

**UNIT II PROJECTION OF SURFACES & SOLIDS, AND 2D MODELING 6+12**

Projection of surfaces inclined to both the principal planes – polygonal, trapezoidal, rhomboidal and circular

Projection of solids – prisms, pyramids, and axisymmetric solids when the axis inclined to both the principal planes – freely hanging – contour resting condition on either of the planes by rotating object method

**Lab exercises:** Construction of basic sketches – lines, circle, polygon, spline curves, coils, along with dimensioning. Familiarizing with geometric constraints and their types

**Activities based learning:** Making the solids using cardboards, shadow mapping and contour drawing at different orientation of the solids using torches,

**UNIT III 3D PROJECTION OF SOLIDS AND 3D MODELING OF SIMPLE PARTS 6+12**

Free hand sketching – I & III angle projections of engineering parts and components
Isometric projection of combination of solids – prisms, pyramids, axisymmetric solids, frustum
Perspective projection of prisms, pyramids and axisymmetric solids by visual ray method
**Lab exercises:** 3D Modeling and 2D drafting of machine parts
**Activities based learning:** Flipped classroom for Free hand sketching, Jig saw activity for Isometric projection, arts and crafts for perspective view

**UNIT IV SECTION OF SOLIDS AND SECTIONED DRAFTING OF ASSEMBLED COMPONENTS 6+12**

Section of simple and hollow solids – prisms, pyramids and axisymmetric solids, solids with holes/ slots when the section plane perpendicular to one principal plane and inclined to other principal plane ('On the axis' and 'from the axis' conditions)
Application based – section of beams (I, T, L, and C), section of pipe bracket, wood joints, composite walls, shells, flange of a coupling and other similar applications
**Lab exercises:** Assembly of parts with respect to engineering constraints, and sectioned drafting of assembled components
**Activities based learning:** Making of mitered joint in wood, sectioning the beams in different angles of orientation and identifying the true shape

**UNIT V LATERAL SURFACE DEVELOPMENT AND SHEET METAL DESIGN 6+12**

Lateral surface development of sectioned solids when the section plane perpendicular to VP and inclined to HP.
Application based – construction of funnel, chimney, dish antenna, door latch, trays, AC vents, lamp shade, commercial packaging boxes with respect to sectioning conditions and other similar applications
**Lab exercises:** Sheet metal design and drafting, drafting of coils, springs and screw threads
**Activities based learning:** Fabrication of funnels, chimney, lamp shade, boxes using card boards, ply woods, acrylics

**Total: 90 Hours**

**Note:** Activities based learning should not be covered in the regular class hours. It should be given as assignments to the group of maximum 3 members
**Question pattern suggestion:** Part – A (Either or type) (5 × 16 = 80) & Part – B (Compulsory) (1 × 20 = 20)

**COURSE OUTCOME:-**

After successful completion of the course, the students will be able to:

**CO1:** Construct and identify different types of conic curves and special curves, and project the points and lines pertaining to engineering applications
**CO2:** Project and visualize surfaces and solids in different orientations and utilize the CAD tools for designing.
**CO3:** Create and draft accurate 3D models and 2D drawings of machine parts manually as well as using CAD softwares
**CO4:** Determine the true shape of a sectioned solid and draft the assemble parts accordingly
**CO5:** Develop lateral surfaces of sectioned solids and design sheet metal components

**TEXTBOOKS:**

1. Engineering Drawing" by N S Parthasarathy and Vela Murali

2. Engineering Drawing and Graphics with Auto CAD" by Venugopal K

**REFERENCE BOOKS:**


1. "Basic Engineering Drawing: Mechanical Semester Pattern" by Mehta and Gupta
2. "Engineering Drawing" by Basant Agrawal and C M Agrawal
3. "Engineering Drawing With Auto CAD" by B V R Gupta
4. "Engineering Drawing" by P S Gill
5. "Engineering Drawing with an Introduction to AutoCAD" by Dhananjay Jolhe
6. "Engineering Drawing" by M B Shah
7. "Fundamentals of Engineering Drawing" by Imtiaz Hashmi
8. "Computer Aided Engineering Drawing" by S Trymbaka Murthy
9. "CAED : Computer Aided Engineering Drawing for I/II Semester BE/Btech Courses" by Reddy K B
10. "Computer-Aided Engineering Drawing" by Subrata Pal


| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 2 | | 1 | | | | 3 | 1 | | 3 | 3 | 3 | 2 |
| 2 | 3 | 3 | 2 | | 2 | | | | 3 | 2 | | 3 | 3 | 3 | 2 |
| 3 | 3 | 3 | 3 | 1 | 2 | | | | 3 | 3 | | 3 | 3 | 3 | 2 |
| 4 | 3 | 3 | 3 | 1 | 3 | | | | 3 | 3 | | 3 | 3 | 3 | 2 |
| 5 | 3 | 3 | 3 | 1 | 3 | | | | 3 | 3 | | 3 | 3 | 3 | 2 |

| EE23C02 | FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I BASIC ELECTRICAL CIRCUITS 9**

DC Circuits: Sources, Ohm's Law - Kirchhoff's Laws – Solution of DC circuits with Independent sources only (Steady state)

AC Circuits: AC Fundamentals: Waveforms, Average value, RMS Value, Impedance, Instantaneous Power, Real Power, Reactive Power and Apparent Power, Power Factor – Steady State Analysis of RL, RC and RLC Circuits.

**UNIT II AC and DC MACHINES 9**

Magnetic Circuits fundamentals – DC Machines: Construction, Working Principle, Types and Applications of DC Generator and Motor, EMF and Torque equation.

AC Machines: Construction, Working and Applications of Transformer, Three phase Alternator, Synchronous motor, Single and Three Phase Induction Motor and BLDC motor.

**UNIT III ANALOG AND DIGITAL ELECTRONICS 9**

Operation and Characteristics of electronic devices: PN Junction Diodes, Zener Diode, BJT, JFET and MOSFET– Operational Amplifiers (OPAMPs) : Characteristics and basic application circuits- 555 timer IC based astable and monostable multivibrator.

Basic switching circuits – Gates and Flip-Flops-Sample and hold circuit- R-2R ladder type DAC-Successive approximation based ADC.

**UNIT IV SENSORS AND TRANSDUCERS 9**

Solenoids, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, piezo electric crystals, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

**UNIT V MEASUREMENTS AND INSTRUMENTATION 9**

Functional Elements of an Instrument, Error analysis; Operating Principle - Moving Coil and Moving Iron Instruments, Power Measurement, Energy Meter, Instrument Transformers - CT and PT, Multimeter- DSO - Block Diagram Approach.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

Upon successful completion of the course, students should be able to:

**CO 1**: Compute the electric circuit parameters for simple problems.

**CO 2**: Explain the working principles and characteristics of electrical machines, electronic devices and measuring instruments.

**CO3**: Identify general applications of electrical machines, electronic devices and measuring instruments.

**CO 4**: Analyze the basic electrical and electronic circuits.

**CO 5**: Explain the types and operating principles of sensors and transducers.

**TEXT BOOKS:**

1. Kothari DP and Nagrath IJ, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, Second Editions, 2020.
2. Bhattacharya SK, “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition,2017
3. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.

**REFERENCES:**


1. Rajendra Prasad ‘Fundamentals of Electrical Engineering’, Third Edition, Prentice Hall of India, 2014.
2. Sanjeev Sharma ‘Basics of Electrical Engineering’ Wiley, 2019.
3. Doebelin, E.O., Measurements Systems – Application and Design’, McGraw Hill Publishing Co, 2019.
4. D.Roy Choudhury, Shail B. Jain, Linear Integrated Circuits, New age international Publishers, 2018.
5. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010


| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs & PSOs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| CO3 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| CO4 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| CO5 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| **CO/PO & PSO Average** | **2** | **2** | **1** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | | | | | | | | | | |

| ME23C04 | MAKERSPACE | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 4 | 3 |

**COURSE OBJECTIVES:**

1. To practice the usage of various tools towards assembly and dis-assembly of different items / equipment.
2. To make simple part / component using welding processes.
3. To train on the basic wiring practices of boards, machines, etc.
4. To provide a hands-on experience on the use of electronic components, equipment, sensors and actuators.
5. To expose to modern computer tools and advanced manufacturing / fabrication processes.

**LIST OF ACTIVITIES** **1L,4P**

**(A). Dis-assembly & Assembly Practices**

i. Tools and its handling techniques.

ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.

iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.

iv. Dis-assembly and assembly of a Bicycle.

**(B). Welding Practices**

i. Welding Procedure, Selection & Safety Measures.

ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.

iii. Hands-on session of preparing base material & Joint groove for welding.

iv. Hands-on session of MAW, GMAW, GTAW, on Carbon Steel & Stainless Stell plates / pipes, for fabrication of a simple part.

**(C). Electrical Wiring Practices**

i. Electrical Installation tools, equipment & safety measures.

ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box,

iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.

iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

**(D). Electronics Components / Equipment Practices**

i. Electronic components, equipment & safety measures.

ii. Dis-assembly and assembly of Computers.

iii. Hands-on session of Soldering Practices in a Printed Circuit Breaker.

iv. Hands-on session of Bridge Rectifier, Op-Amp and Transimpedance amplifier.

v. Hands-on session of integration of sensors and actuators with a Microcontroller.

vi. Demonstration of Programmable Logic Control Circuit.

**(E).Contemporary Systems**

i. Demonstration of Solid Modelling of components.

ii. Demonstration of Assembly Modelling of components.

iii. Fabrication of simple components / parts using 3D Printers.

iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

**TOTAL: 75 Periods (15 Lecture + 60 Practical)**

**COURSE OUTCOMES:**

Upon the successful completion of the course, students will be able to:

CO1: Assemble and dis-assemble various items / equipment.
CO2: Make simple parts using suitable welding processes.
CO3: Setup wiring of distribution boards, machines, etc.
CO4: Utilise the electronic components to fabricate a simple equipment, aided with sensors and actuators.
CO5: Take advantage of modern manufacturing practices.

**REFERENCES:**


1. Stephen Christena, Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics, Crestline Books, 2014.
2. H. Lipson, Fabricated - The New World of 3D Printing, Wiley, 1st edition, 2013.
3. Code of Practice for Electrical Wiring Installations (IS 732:2019)
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 7th ed. (Indian edition), 2017.
5. Mazidi, Naimi, Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson India, 1st edition 2013.
6. Visualization, Modeling, and Graphics for Engineering Design, D.K. Lieu, S.A. Sorby, Cengage Learning; 2nd edition.

**UC23H01** **தமிழர் மரபு** **L T P C**
**1 0 0 1**

**அலகு I மொழி மற்றும் இலக்கியம்**: **3**
இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

**அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**: **3**
நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

**அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**: **3**
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

**அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்**: **3**
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

**அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**: **3**
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**


1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The

Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**UC23H01** **HERITAGE OF TAMILS** **L T P C**
**1 0 0 1**

**UNIT I LANGUAGE AND LITERATURE 3**

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III FOLK AND MARTIAL ARTS 3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS 3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**


1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**NCC Credit Course Level 1***

| **UC23P01** | **(ARMY WING) NCC Credit Course Level - I** | **L T P C**<br>**2 0 0 2** |
|---|---|---|

| | | |
|---|---|---|
| **NCC GENERAL** | | **6** |
| NCC 1 | Aims, Objectives & Organization of NCC | 1 |
| NCC 2 | Incentives | 2 |
| NCC 3 | Duties of NCC Cadet | 1 |
| NCC 4 | NCC Camps: Types & Conduct | 2 |
| **NATIONAL INTEGRATION AND AWARENESS** | | **4** |
| NI 1 | National Integration: Importance & Necessity | 1 |
| NI 2 | Factors Affecting National Integration | 1 |
| NI 3 | Unity in Diversity & Role of NCC in Nation Building | 1 |
| NI 4 | Threats to National Security | 1 |
| **PERSONALITY DEVELOPMENT** | | **7** |
| PD 1 | Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving | 2 |
| PD 2 | Communication Skills | 3 |
| PD 3 | Group Discussion: Stress & Emotions | 2 |
| **LEADERSHIP** | | **5** |
| L 1 | Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour 'Code | 3 |
| L 2 | Case Studies: Shivaji, Jhasi Ki Rani | 2 |
| **SOCIAL SERVICE AND COMMUNITY DEVELOPMENT** | | **8** |
| SS 1 | Basics, Rural Development Programmes, NGOs, Contribution of Youth | 3 |
| SS 4 | Protection of Children and Women Safety | 1 |
| SS 5 | Road / Rail Travel Safety | 1 |
| SS 6 | New Initiatives | 2 |
| SS 7 | Cyber and Mobile Security Awareness | 1 |

**TOTAL : 30 PERIODS**

**NCC Credit Course Level 1***

| **UC23P02** | **(NAVAL WING) NCC Credit Course Level – I** | **L T P C**<br>**2 0 0 2** |
|---|---|---|
| **NCC GENERAL** | | **6** |
| NCC 1 | Aims, Objectives & Organization of NCC | 1 |
| NCC 2 | Incentives | 2 |
| NCC 3 | Duties of NCC Cadet | 1 |
| NCC 4 | NCC Camps: Types & Conduct | 2 |
| **NATIONAL INTEGRATION AND AWARENESS** | | **4** |
| NI 1 | National Integration: Importance & Necessity | 1 |
| NI 2 | Factors Affecting National Integration | 1 |
| NI 3 | Unity in Diversity & Role of NCC in Nation Building | 1 |
| NI 4 | Threats to National Security | 1 |
| **PERSONALITY DEVELOPMENT** | | **7** |
| PD 1 | Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving | 2 |
| PD 2 | Communication Skills | 3 |
| PD 3 | Group Discussion: Stress & Emotions | 2 |
| **LEADERSHIP** | | **5** |
| L 1 | Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code | 3 |
| L 2 | Case Studies: Shivaji, Jhasi Ki Rani | 2 |
| **SOCIAL SERVICE AND COMMUNITY DEVELOPMENT** | | **8** |
| SS 1 | Basics, Rural Development Programmes, NGOs, Contribution of Youth | 3 |
| SS 4 | Protection of Children and Women Safety | 1 |
| SS 5 | Road / Rail Travel Safety | 1 |
| SS 6 | New Initiatives | 2 |
| SS 7 | Cyber and Mobile Security Awareness | 1 |

**TOTAL : 30 PERIODS**

**NCC Credit Course Level 1***

| **UC23P03** | **(AIR FORCE WING) NCC Credit Course Level – I** | **L T P C**<br>**2 0 0 2** |
|---|---|---|
| **NCC GENERAL** | | **6** |
| NCC 1 | Aims, Objectives & Organization of NCC | 1 |
| NCC 2 | Incentives | 2 |
| NCC 3 | Duties of NCC Cadet | 1 |
| NCC 4 | NCC Camps: Types & Conduct | 2 |
| **NATIONAL INTEGRATION AND AWARENESS** | | **4** |
| NI 1 | National Integration: Importance & Necessity | 1 |
| NI 2 | Factors Affecting National Integration | 1 |
| NI 3 | Unity in Diversity & Role of NCC in Nation Building | 1 |
| NI 4 | Threats to National Security | 1 |
| **PERSONALITY DEVELOPMENT** | | **7** |
| PD 1 | Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving | 2 |
| PD 2 | Communication Skills | 3 |
| PD 3 | Group Discussion: Stress & Emotions | 2 |
| **LEADERSHIP** | | **5** |
| L 1 | Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code | 3 |
| L 2 | Case Studies: Shivaji, Jhasi Ki Rani | 2 |
| **SOCIAL SERVICE AND COMMUNITY DEVELOPMENT** | | **8** |
| SS 1 | Basics, Rural Development Programmes, NGOs, Contribution of Youth | 3 |
| SS 4 | Protection of Children and Women Safety | 1 |
| SS 5 | Road / Rail Travel Safety | 1 |
| SS 6 | New Initiatives | 2 |
| SS 7 | Cyber and Mobile Security Awareness | 1 |

**TOTAL : 30 PERIODS**

**EN23C02 PROFESSIONAL COMMUNICATION L T P C**
**2 0 2 3**

**COURSE OBJECTIVES:**

- To read and comprehend different forms of official texts.
- To develop students' writing skills in professional context.
- To actively listen, read and understand written and oral communication in a professional context.
- To comprehend and analyse the visual content in authentic context.
- To write professional documents with clarity and precision

**UNIT I CAUSE AND EFFECT 6**

Reading – Newspaper articles on Social and Environmental issues; Writing – Instructions, Cause and effect essay; Grammar - Modal verbs; Vocabulary – Cause and effect, Idioms

**LAB ACTIVITY: 6**

Listening and Speaking – Listen to news reports and summarise in oral form.

**UNIT II CLASSIFICATION 6**

Reading – An article, social media posts and classifying based on the content; Writing – Definition, Note making, Note taking (Cornell notes etc.) and Summarising; Grammar – Connectives; Vocabulary – Phrasal verbs

**LAB ACTIVITY: 6**

Listening and speaking: Social interaction (Conversation including small talk)

**UNIT III PROBLEM AND SOLUTION 6**

Reading – Visual content (Tables/charts/graphs) for comprehension; Writing - Problem and Solution Essay; Grammar – If conditionals; Vocabulary – Sequential words.

**LAB ACTIVITY: 6**

Listening – Group discussion; Speaking – Participating in a group discussion

**UNIT IV REPORT 6**

Reading – Formal report on accidents (industrial/engineering); Writing – Industrial Accident report; Grammar – Active and passive voice, Direct and Indirect speech; Vocabulary – Numerical adjectives.

**LAB ACTIVITY: 6**

Listening / watching – Television documentary and discussing its content, purpose etc.

**UNIT V JOB APPLICATION AND INTERVIEW 6**

Reading - Job advertisement and company profile; Writing – Job application (cover letter and CV) Grammar – Mixed Tenses; Vocabulary – Collocations related to work environment

**LAB ACTIVITY: 6**

Listening – Job interview; Speaking – Mock interviews

**TOTAL: 60 PERIODS**

**TEACHING METHODOLOGY**

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

**EVALUATION PATTERN**

Internal Assessment
- Written assessments
- Assignment

Lab Assessment
- Group discussion (Peer assessment)
- Listening

External Assessment
End Semester Examination

**LEARNING OUTCOMES**

By the end of the courses, students will be able to

- To apply appropriate language structure and vocabulary to enhance both spoken and written communication in formal contexts.
- Comprehend different forms of official documents
- Write professional documents coherently and cohesively.
- Interpret verbal and graphic content in authentic context
- Analyse and evaluate verbal and audio visual materials.

**TEXT BOOKS:**

1. “English for Engineers and Technologists” Volume 2 by Orient Blackswan, 2022
2. “English for Science & Technology - II” by Cambridge University Press, 2023.

**REFERENCES:**

1. “Communicative English for Engineers and Professionals” by Bhatnagar Nitin, Pearson India, 2010.
2. ”Take Off – Technical English for Engineering” by David Morgan, Garnet Education, 2008. 3. “Advanced Communication Skills” by Mathew Richardson, Charlie Creative Lab, 2020.
4. www.uefap.com

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | | | | | √ | | √ |
| **CO2** | | | | | | | | | | √ | | √ |
| **CO3** | | | | | | | | | | √ | | √ |
| **CO4** | | | | | | | | | | √ | | √ |
| **CO5** | | | | | | | | | | √ | | √ |

| MA23C02 | ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORM TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To make the students to understand the Laplace transforms techniques.
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series.
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.
- To develop Z- transform techniques in solving difference equations.

**UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+3**

Homogeneous linear ordinary differential equations of second order -superposition principle - general solution- Particular integral - Operator method - Solution by variation of parameters - Method of undetermined coefficients - Homogeneous equations of Euler–Cauchy and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

**UNIT II LAPLACE TRANSFORMS 9+3**

Existence theorem - Transform of standard functions – Transform of Unit step function and Dirac delta function – Basic properties - Shifting theorems - Transforms of derivatives and integrals – Transform of periodic functions - Initial and Final value theorem - Inverse Laplace transforms- Convolution theorem (without proof) – Solving Initial value problems by using Laplace Transform techniques.

**UNIT III FOURIER SERIES 9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Computation of harmonics.

**UNIT IV FOURIER TRANSFORMS 9+3**

Fourier integral theorem – Fourier transform pair - Fourier sine and cosine transforms – Properties – Transform of elementary functions – Inverse Fourier Transforms - Convolution theorem (without proof) – Parsevals's identity.

**UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3**

Z-transform – Properties of Z-transform – Inverse Z-transform – Convolution theorem – Evaluation of Inverse Z transform using partial fraction method and convolution theorem - Initial and final value theorems – Formation of difference equations – Solution of difference equations using Z - transform.

**TOTAL: 60 PERIODS**

Laboratory based exercises / assignments / assessments will be given to students from the content of the course wherever applicable.
Branch specific / General Engineering applications based on the content of each units will be introduced to students wherever possible.

Suggested Laboratory based exercises / assignments / assessments :

Ordinary differential equations

1. Symbolic computation of linear ordinary differential equations
2. Solving System of simultaneous linear differential equations using ODE SOLVER

Laplace transforms

1. Symbolic computation of Laplace transform and Inverse Laplace transform
2. Plotting Laplace transforms

Fourier Series

1. Symbolic computation of Fourier Coefficients
2. Computation of harmonics
3. Plotting truncated Fourier Series

Fourier Transform

1. Symbolic computation of Fourier Transforms
2. Plotting truncated Fourier Transforms

Z – transform

1. Symbolic computation of Z-Transforms

**OUTCOMES:**

CO1 :Solve higher order ordinary differential equations which arise in engineering applications.

CO2 :Apply Laplace transform techniques in solving linear differential equations.

CO3 :Apply Fourier series techniques in engineering applications.

CO4 :Understand the Fourier transforms techniques in solving engineering problems.

CO5 :Understand the Z-transforms techniques in solving difference equations.

**TEXT BOOKS:**


1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 45th Edition, New Delhi, 2020.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.


**REFERENCES:**


1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
2. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”,Narosa Publications, 5 th Edition, New Delhi, 2017.

4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi , 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

**CO – PO Mapping:**

| Course Outcomes | PROGRAMME OUTCOMES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **P10** | **P11** | **P12** |
| CO 1 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO 2 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO 3 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO 4 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| CO 5 : | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |

| PH23C02 | PRINCIPLES AND APPLICATIONS OF ELECTROMAGNETIC RADIATION IN REMOTE SENSING (Geo-Informatics) | L T P C 3 0 0 3 |
|---|---|---|

**OBJECTIVES:**

- To understand the fundamentals of electromagnetic radiation, and physical laws.
- To understand the concepts needed for EMR interaction with earth's atmosphere and surface.
- To gain knowledge about the optic and acoustic waves in remote sensing.
- To understand the basics of gravitation and the physics behind it, and to introduce satellites and its effectiveness in earth monitoring.
- To understand the different types of sensors and its detection mechanism

**UNIT I ELECTROMAGNETIC RADIATION 9**

Electro-Magnetic Radiation (EMR) and its Characteristics (Introduction to EMR, properties of wave: magnitude, phase) –Propagation and Sources of EMR - Transverse nature of EM wave - EM spectrum, waves or particles - Radiation laws: Kirchhoff's law, Planck's Law, Stefan-Boltzmann Law, Wein's Displacement Law, The Inverse Square Law- Radiance, Emissivity.

**UNIT II EMR INTERACTION WITH MATTER 9**

Introduction to atmosphere, atmospheric composition – Dielectric constant and Refractive index - EMR interaction with atmosphere: Absorption, Scattering, Reflection, Refraction - Laws governing propagation through various media – Atmospheric window, spectroscopy of molecules - radiative transfer theory – Characteristic of Earth's cover type: vegetation, water, soil.

**UNIT III WAVE AND THERMAL IMAGING 9**

Optical vs thermal Remote Sensing (Polarization and Coherence)-Basics and operating principle of Seismic reflection: phase and amplitude - Doppler Effect - Microwave: Active and Passive sensing, RADAR: Radar Cross Section, GPR, and LIDAR.

**UNIT IV GRAVITATION AND NAVIGATION 9**

Newton's law of gravitation, Gravitational field, and potential – Variation of 'g' as a function of height – Escape velocity - Kepler's law – Types of satellites –Orbits- Physics for Navigation Systems: INS, and GPS (Atomic Clocks) – Perturbing forces and their impact on navigations.

**UNIT V SENSORS 9**

Photoelectric effect - Cathode ray tube, Charge couple devices: basic principles, operational mechanism, calibration, and processing - Types and Working principles of Radio signal devices– Antenna, Transmitters, losses during transmission, amplifiers, converters, and receivers.

**OTAL: 75 PERIODS**

**OUTCOMES:**

After completion of this course, the students should be able to:

**CO1:** Comprehend the basic properties of electromagnetic radiation.
**CO2**: Understand the phenomena involved during the EMR interaction with the earth's atmosphere and surface.
**CO3**: Grasp the physics principles behind remote sensing.
**CO4**: Identify the external parameters and concepts needed for error-free navigation.
**CO5**: Appreciate various physics concepts involved in obtaining precise images.

**REFERENCES:**


1. D.J. Griffiths, Introduction to Electrodynamics, Cambridge University Press, Cambridge, 2017.
2. Nathan Ida, Engineering Electromagnetics, Springer, Heidelberg, 2021.
3. An Introduction to Atmospheric Physics – David G. Andrews
4. Physics for Scientists and Engineers with Modern Physics by Raymond A. Serway (Author), John W. Jewett (Author)
5. Manual of Remote Sensing – Robert A Ryerson and Andrew N. Rencz
6. Electronic Imaging in Astronomy: Detectors and Instrumentation- Ian S. McLean


**CO-PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| **AVg.** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |

**CY23C01 ENGINEERING CHEMISTRY L T P C**

**3 0 2 4**

## UNIT I WATER TECHNOLOGY

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD, BOD, and heavy metals. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, Calgon, and carbonate treatment. External conditioning – demineralization. Municipal water treatment (screening, sedimentation, coagulation, filtration, disinfection-ozonolysis, UV treatment, chlorination), Reverse Osmosis – desalination.

**PRACTICAL:**

- Estimation of HCl using $Na_2CO_3$ as the primary standard
- Determination of alkalinity in the water sample.
- Determination of hardness of water by EDTA method.
- Determination of DO content of water sample by Winkler's method.

## UNIT II NANOCHEMISTRY

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties (optical, electrical, mechanical, magnetic and catalytic). Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro-spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Applications of nanomaterials – medicine including AYUSH, automobiles, electronics, and cosmetics.

**PRACTICAL:**

- Preparation of nanoparticles by Sol-Gel method/sonication method.
- Preparation of nanowire by Electrospinning.
- Study of morphology of nanomaterials by scanning electron microscopy

## UNIT III CORROSION SCIENCE

Introduction to corrosion – chemical and electrochemical corrosions – mechanism of electrochemical and galvanic corrosions – concentration cell corrosion-soil, pitting, inter-granular, water line, stress and microbiological corrosions-galvanic series-factors influencing corrosion- measurement of corrosion rate. Electrochemical protection – sacrificial anodic protection and impressed current cathodic protection. Protective coatings-metallic coatings (galvanizing, tinning), organic coatings (paints). Paints: Constituents and functions.

**PRACTICAL:**

- Corrosion experiment-weight loss method.
- Salt spray test for corrosion study.
- Corrosion prevention by electroplating.
- Estimation of corroded Iron by Potentiometry/UV-visible spectrophotometer

## UNIT IV ENERGY SOURCES

Electrochemical cell, redox reaction, electrode potential – oxidation and reduction potential. Batteries – Characteristics; types of batteries; primary battery (dry cell), secondary battery (lead acid, lithium-ion battery) and their applications. Emerging energy sources – metal hydride battery,

hydrogen energy, Fuel cells – $H_2$-$O_2$ fuel cell. Supercapacitors –Types and Applications, Renewable Energy: solar heating and solar cells. Recycling and disposal of batteries.

**PRACTICAL:**

- Study of components of Lead acid battery.
- Measurement of voltage in a photovoltaic cell.
- Working of $H_2 – O_2$ fuel cell

**UNIT V POLYMER CHEMISTRY**

Introduction: Functionality-degree of polymerization. Classification of polymers (Source, Structure, Synthesis and Intermolecular forces). Mechanism of free radical addition polymerization. Properties of polymers: Tg, tacticity, molecular weight-number average, weight average, viscosity average and polydispersity index (Problems). Techniques of polymerization: Bulk, emulsion, solution and suspension. Compounding and Fabrication Techniques: Injection, Extrusion, Blow and Calendaring. Polyamides, Polycarbonates and Polyurethanes – structure and applications. Recycling of polymers.

**PRACTICAL:**

- Determination of molecular weight of a polymer using Ostwald viscometer.
- Preparation of a polymer.
- Determination of molecular weight by Gel Permeation Chromatography.

**TOTAL: 75 PERIODS**

**COURSE OUTCOMES:**

**CO1:** To demonstrate knowledge of water quality in various industries and develop skills in analyzing water quality parameters for both domestic and industrial purposes.

**CO2:** To identify and apply fundamental concepts of nanoscience and nanotechnology for engineering and technology applications, and to develop skills in synthesizing nanomaterials and studying their morphology.

**CO3:** To apply fundamental knowledge of corrosion protection techniques and develop skills to conduct experiments for measuring and preventing corrosion.

**CO4:** To study the fundamentals of energy storage devices and develop skills in constructing and experimenting with batteries.

**CO5:** To recognize and apply basic knowledge of different types of polymeric materials and develop skills in preparing and determining their applications for futuristic material fabrication needs.

**TEXT BOOKS:**

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. Dara S.S., “A Textbook of Engineering Chemistry”, Chand Publications, 2004.
4. Laboratory Manual - Department of Chemistry, CEGC, Anna University (2023).

**REFERENCES:**

1. Schdeva M.V., “Basics of Nano Chemistry”, Anmol Publications Pvt Ltd, 2011.
2. Friedrich Emich, “Engineering Chemistry”, Medtech, 2014.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science” New AGE International Publishers, 2009.
4. Vogel’s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

**CO - PO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | - | - | - | - | 3 | - | - | - | - | - |
| **CO2** | 3 | - | 2 | - | 2 | - | 3 | - | - | - | - | - |
| **CO3** | 3 | 3 | 2 | - | 2 | - | 3 | - | - | - | - | - |
| **CO4** | 3 | 3 | - | - | - | - | 3 | - | - | - | - | - |
| **CO5** | 3 | - | - | - | - | - | 3 | - | - | - | - | - |
| **Avg** | 3 | 3 | - | - | - | - | 3 | - | - | - | - | - |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**CS23C04** **PROGRAMMING IN C** **L T P C**
**2 0 4 4**

## UNIT I BASICS OF C PROGRAMMING 6+12

Introduction to programming paradigms –- Structure of C program - C programming: Data Types - Constants - Keywords - Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements - Decision making statements - Switch statement.

### PRACTICALS

1. Designing programs with algorithms/flowchart
2. Programs for i/o operations with different data types

### SUGGESTED ACTIVITIES:

- EL - Programs using integer type, arithmetic operators and basic input/output.
- EL - Programs using other data types and operators.
- EL: Programs using else-if, switch

## UNIT II LOOP CONTROL STATEMENTS AND ARRAYS 6+12

Iteration statements: For, while, Do-while statements, nested loops, break & continue statements - Introduction to Arrays: Declaration, Initialization - One dimensional array -Two dimensional arrays – Searching and sorting in Arrays – Strings – string handling functions - array of strings

### PRACTICALS

1. Programs using various operators
2. Programs using decision making and branching statements
3. Programs using for, while, do-while loops and nested loops.
4. Programs using arrays and operations on arrays.
5. Programs implementing searching and sorting using arrays
6. Programs implementing string operations on arrays

### SUGGESTED ACTIVITIES:

- EL: Programs using while, for,do-while, break, continue, enum.
- EL - Programs using arrays and operations on arrays.
- EL - Programs implementing string operations on arrays.
- EL - Programs using functions.

## UNIT III FUNCTIONS AND POINTERS 6+12

Modular programming - Function prototype, function definition, function call, Built-in functions – Recursion – Recursive functions - Pointers - Pointer increment, Pointer arithmetic - Parameter passing: Pass by value, Pass by reference, pointer and arrays, dynamic memory allocation

### PRACTICALS

1. Programs using functions
2. Programs using recursion
3. Programs using pointers & strings with pointers
4. Programs using Dynamic Memory Allocation

### SUGGESTED ACTIVITIES:

- EL - Programs using recursion.
- EL - Programs using pointers and arrays, address arithmetic.
- EL - Programs using Dynamic Memory Allocation, two dimensional arrays and pointers.
- EL - Programs using Pointers and strings.

**UNIT IV STRUCTURES AND UNION 6+12**

Storage classes, Structure and union, Features of structures, Declaration and initialization of structures, array of structures, Pointer to structure, structure and functions, typedef , bit fields , enumerated data types, Union.

**PRACTICALS**

1. Programs using Structures
2. Programs using Unions
3. Programs using pointers to structures and self-referential structures.

**SUGGESTED ACTIVITIES:**

- EL - Programs using structures and arrays.
- EL - Programs using Pointers to structures, Self-referential structures.

**UNIT V MACROS AND FILE PROCESSING 6+12**

Preprocessor directives – Simple and Conditional macros with and without parameters - Files - Types of file processing: Sequential and Random access – File operations – read, write & seek.

**PRACTICALS**

1. Programs using pre-processor directives & macros
2. Programs to handle file operations
3. Programs to handle file with structure

**SUGGESTED ACTIVITIES:**

- EL - Programs using file operations in real-world applications

**TOTAL: 90 (30+60) PERIODS**

**TEXT BOOKS:**


1. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.


**REFERENCE BOOKS:**


1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.
2. Ashok N Kamthane, Programming in C, Pearson, Third Edition, 2020
3. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
4. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C'" McGraw-Hill Education, 1996.
6. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition,

Pearson Education, 2013.

**COURSE OUTCOMES:**

Upon completion of the course, the students will be able to

**CO1**: Write simple C programs using basic constructs.

**CO2**: Design searching and sorting algorithms using arrays and strings.

**CO3**: Implement modular applications using Functions and pointers.

**CO4**: Develop and execute applications using structures and Unions.

**CO5**: Illustrate algorithmic solutions in C programming language using files.

**Total Hours: 90 (30+60)**

**CO-PO MAPPING**

| CO | PO 1 | PO 2 | P O3 | PO 4 | P O5 | P O6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO 11 | PO1 2 | PSO 1 | PSO 2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 2 | 3 | 1 | 3 | 2 | 1 | - | - | - | 2 | - | 3 | 1 | 2 | 2 |
| **2** | 2 | 1 | 1 | 3 | 2 | 1 | - | - | - | - | - | 3 | 1 | 2 | 2 |
| **3** | 2 | 2 | 1 | 3 | 2 | 1 | - | - | 3 | - | 3 | 3 | 1 | 2 | 2 |
| **4** | 2 | 1 | 1 | 3 | 2 | 1 | - | - | 3 | - | 3 | 3 | 1 | 2 | 2 |
| **5** | 2 | 3 | 1 | 3 | 2 | 1 | - | - | - | 2 | 3 | 3 | 1 | 2 | 2 |

1 - low, 2 - medium, 3 – high

**GI23201 GEOINFORMATICS SYSTEMS L T P C**
**2 0 2 3**

**COURSE OBJECTIVES:**

- To introduce the information concepts and systems used in Geoinformatics.
- To familiarize with the geospatial data portals and services.
- To familiarize with the GIS and satellite data applications.

**UNIT I INTRODUCTION TO GEOSPATIAL SYSTEMS 6**

Fundamental principles of electromagnetic radiation and its interaction with matter- Overview of remote sensing technologies, GIS and GPS - Key components of GIS: Hardware, Software, Data, People and Methods - Operating systems- File operations

**UNIT II GEOSPATIAL DATA SERVICES 6**

Overview of geospatial data sources- Data formats- Open data principles and policies- Data acquisition and Storage-Overview of key open land data sources,-Land use and land cover datasets-Digital elevation models (DEMs)

**UNIT III GEOPORTALS 6**

Fundamental computer network concepts - Network layers- Types of networks- Network Components- Network Protocols - Geospatial Data Protocols- Introduction to Web GIS - Interactive Mapping and Visualization -Data transportation through network protocols

**UNIT IV SATELLITE APPLICATIONS 6**

Overview of techniques of image processing- Interpretation of Satellite imagery- Applications in agriculture, forestry, water resources management, urban planning and disaster management

**UNIT V GIS APPLICATIONS 6**

Integrating Open data with GIS-Applications of Open Data for real world applications: urban planning, environmental monitoring, disaster response, and public health.

**LABORATORY EXERCISES 30**

1. Introduction to Remote Sensing Sensors and resolution
2. Creating GeoPDF with geotagged photographs
3. Exploring open data sources
4. Exploring open data portals
5. Creating Story maps using Google Earth

**TOTAL: 60 PERIODS (30 (THEORY) + 30 (PRACTICAL))**

**COURSE OUTCOMES:**

**CO1:** Understand the fundamental Geospatial Concepts and their significance.
**CO2:** Utilize Geospatial Data Sources and Open Data Principles
**CO3:** Ability to acquire Proficiency in Geoportals
**CO4:** Apply satellite data to a practical problems.
**CO5:** Integrate open data with GIS Applications.

**TEXT BOOKS:**


1. Bradley A. Shellito, “Introduction to Geospatial Technology”, W. H. Freeman; Third edition, 2015.
2. Daniel McInerney Pieter Kempeneers, “Open Source Geospatial Tools: Applications in Earth Observation”, Springer, 2015.
3. Tyler Mitchell, "Web Mapping Illustrated: Using Open Source GIS Toolkits", O′Reilly, 2005.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 4 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |

- 1 : low, 2 : medium, 3 : high,

**UC23H02** **தமிழரும் தொழில்நுட்பமும்** **L T P C**
**1 0 0 1**

**அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்**: **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

**அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**: **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

**அலகு III உற்பத்தித் தொழில் நுட்பம்**: **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

**அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்**: **3**

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

**அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்**: **3**

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**


1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்
   கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: InternationalInstitute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**UC23H02** **TAMILS AND TECHNOLOGY** **L T P C**
**1 0 0 1**

**UNIT I WEAVING AND CERAMIC TECHNOLOGY 3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3**

Designing and Structural construction House & Designs in household materials during Sangam Age -Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period -Type study (Madurai Meenakshi Temple)- Thirumalai NayakarMahal -ChettiNadu Houses, Indo-Saracenic architecture at Madras during British Period.

**UNIT III MANUFACTURING TECHNOLOGY 3**

Art of Ship Building - Metallurgical studies -Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stonebeads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

**UNIT IV AGRICULTURE ANDIRRIGATION TECHNOLOGY 3**

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompuof Chola Period,Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing -KnowledgeofSea -Fisheries – Pearl - Conche diving - Ancient Knowledge ofOcean -KnowledgeSpecificSociety.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCEBOOKS**


1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்
   கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: InternationalInstitute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

| MA23C05 | PROBABILITY AND STATISTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.
- To understand the basic concepts of sampling distributions and statistical properties of point and interval estimators.
- To apply the small/ large sample tests through Tests of hypothesis.
- To understand the concept of analysis of variance and use it to investigate factorial dependence.

**UNIT I ONE-DIMENSIONAL RANDOM VARIABLES 9+3**

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a random variable.

**UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9+3**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

**UNIT III ESTIMATION THEORY 9+3**

Sampling distributions – Characteristics of good estimators – Method of Moments – Maximum Likelihood Estimation – Interval estimates for mean, variance and proportions.

**UNIT IV TESTS OF SIGNIFICANCE 9+3**

Type I and Type II errors – Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances $-\chi^2$ test for goodness of fit – Independence of attributes.

**UNIT V DESIGN OF EXPERIMENTS 9+3**

Completely Randomized Design – Randomized Block Design – Latin Square Design – $2^2$ factorial design.

**TOTAL: 60 PERIODS**

Laboratory based exercises / assignments / assessments will be given to students from the content of the course wherever applicable.

Branch specific / General Engineering applications based on the content of each units will be introduced to students wherever possible.

**SUGGESTED LAB EXERCISES**

1. Data exploration using R
2. Visualizing Probability distributions graphically
3. Evaluation of correlation coefficient

4. Creating a Linear regression model in R
5. Maximum Likelihood Estimation in R
6. Hypothesis testing in R programming
7. Chi square goodness of fit test in R
8. Design and Analysis of experiments with R

**OUTCOMES:**

CO1: Can analyze the performance in terms of probabilities and distributions achieved by the determined solutions.
CO2: Will be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
CO3: Provides an estimate or a range of values for the population parameter from random samples of population.
CO4: Helps to evaluate the strength of the claim/assumption on a sample data using hypothesis testing.
CO5: Equips to study the influence of several input variables on the key output variable.

**TEXT BOOKS:**


1. Irwin Miller and Marylees Miller, "John E. Freund's Mathematical Statistics with applications", Pearson India Education, Asia, 8th Edition, 2014.
2. Walpole, R.E., Myers R.H., Myres S.L., and Ye, K. "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2024.


**REFERENCES:**


1. Richard A. Johnson, Irwin Miller, John Freund "Miller & Freund's Probability and Statistics for Engineers", Person Education, 8th Edition, 2015.
2. Ross, S.M. "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier,
   New Delhi, 5th Edition, 2014.
3. Spiegel, M.R., Schiller, J., Srinivasan, R.A. and Goswami, D. "Schaum's Outline of Theory and Problems for Probability and Statistics", McGraw Hill Education, 3rd Edition, Reprint, 2017.
4. Devore, J.L. "Probability and Statistics for Engineering and the Sciences", Cengage Learning, 9th Edition, 2016.


**CO – PO Mapping:**

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **P10** | **P11** | **P12** |
| **CO1 :** | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| **CO2 :** | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| **CO3 :** | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| **CO4 :** | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |
| **CO5 :** | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 3 |

**CS23C02** **COMPUTER PROGRAMMING IN PYTHON** **L T P C**
**3 0 2 4**

**COURSE OBJECTIVES:**

- To understand fundamental structural programming concepts and problem-solving process.
- To solve problems using modular programming and decomposition techniques.
- To solve problems using data structures and abstraction techniques.
- To create programming solutions using libraries and packages.
- To design solutions to domain problems using programming problem-solving techniques.

**UNIT I – STRUCTURED PROGRAMMING** **9+6**

Problem-Solving Strategies. Basic Problem-Solving Tools: Flowcharts, Pseudocode. Introduction to Programming Languages and Development Environments. Programming. Basic Concepts and Syntax: Variables, Identifiers, Data Types: Primitive Types and Strings, Statements, Operators, Expressions and its evaluation, Operator Precedence, Basic Arithmetic Operations. Principles of Structured Programming – Control Structures: Sequence, Selection, Iteration and Branching.

**PRACTICALS:**

- Design algorithms for simple computational problems
- Create Pseudo-code and Flow charts for simple computational problems
- Create Python programs using simple and nested selective control statements
- Create Python programs using simple and nested sequence & iterative control statements
- Create Python programs to generate series/patterns using control statements

**UNIT II – MODULARITY AND DECOMPOSITION** **9+6**

Principles of Modular and Decomposition. Functions: Defining functions –Argument types – Function Name-spaces – Scoping: Global and Non-local. Principles of Recursion: Base case and Recursive cases – Develop and Analyze Recursive functions: Factorial, Fibonacci. Principles of First-Class and Higher-Order functions: Lambda functions – Functions as arguments.

**PRACTICALS:**

- Create Python programs using functions
- Create python program using recursion
- Create Python programs using lambda functions
- Create Python programs using first-class functions
- Create Python programs using higher-order functions

**UNIT III – DATA STRUCTURES AND ABSTRACTIONS** **9+6**

Principles of Data Structures and Abstractions. String Methods and Manipulations,.Lists: List Operations and Methods, List comprehensions, Nested List comprehensions, Matrix operations using Lists. Tuples and sequences. Sets and Operations. Dictionaries: Dictionary operations, Dictionary comprehensions, Nested Dictionary comprehensions. Comparing Data Structures.

Search and Sort Data Structures. Principle of Functional Programming and Tools : map, filter, and reduce.

**PRACTICALS:**

- Create Python programs for strings manipulations.
- Design Python programs using Lists, Nested Lists and Lists comprehensions
- Create Python programs using Tuples, Nested Tuples, and Tuple comprehensions
- Create Python programs creating Sets and performing set operations
- Create Python programs using Dictionary, Nested Dictionary and comprehensions
- Create Python programs by applying functional programming concepts

**UNIT IV – LIBRARIES AND MODULES** **9+6**

Exceptions: Syntax errors, Exceptions, Exception types, Handling exceptions, Raising exceptions. Files: File Path, Type of files, opening modes, Reading and Writing text files, Handling other format Data files. Modules: Creating Modules, import and from statements, Executing modules as scripts, Standard modules. Packages and Importing from packages

**PRACTICALS:**

- Design Python programs to handle errors and exceptions
- Create, import, and use pre-defined modules and packages
- Create, import, and use user-defined modules and packages
- Create Python programs to perform various operations on text files
- Create Python programs to perform various operations on other data file formats.

**UNIT V – SIMPLE PROBLEM SOLVING TECHNIQUES IN PROGRAMMING** **9+6**

Data Structures for Problem Solving: Stack, Queue. Principles of Divide and Conquer: Binary Search. Principles of Greedy Algorithms: Minimum Coin Change Problem. Case studies on programming application of problem-solving techniques in different fields of engineering.

PRACTICALS:

- Create python programs to implement stack and queue.
- Create python programs to implement binary search.
- Create python programs to solve minimum coin change problem.
- Case study on developing python solution to a domain specific problems.

**TOTAL = 45 + 30 = 75 PERIODS**

**COURSE OUTCOMES**

1. Understand fundamental structural programming concepts and problem-solving process.
2. Solve problems using modular programming and decomposition techniques.
3. Solve problems using data structures and abstraction techniques.
4. Create programming solutions using libraries and packages.
5. Design solutions to domain problems using programming problem-solving techniques.

**TEXT BOOKS**

1. Reema Thareja, Python Programming using Problem Solving Approach, Oxford University
   Press, First Edition, 2017.
2. S. Sridhar, J. Indumathi, V. M. Hariharan, Python Programming, Pearson Education, First Edition, 2023

**REFERENCE BOOKS**


1. Paul Deitel, Harvey Deitel, Python for Programmers, Pearson Education, 2020.
2. John V Guttag. Introduction to Computation and Programming Using Python, With Application to Computational Modeling and Understanding Data. Third Edition, The MIT Press, 2021
3. Mark Lutz, Learning Python, 5th Edition, O'Reilly Media, Inc.
4. Python official documentation and tutorial, https://docs.python.org/3/
5. Numerical Python official documentation and tutorial, https://numpy.org/


**CO's-PO's & PSO's MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | POS | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 2 | | 2 | | 1 | | | | | | | | 1 | 1 | |
| **2** | 2 | | 2 | | 1 | | | | | | | | 1 | 1 | |
| **3** | 2 | 1 | 2 | | 1 | | | | | | | | 1 | 1 | |
| **4** | 2 | 1 | 2 | 1 | 1 | | | | | | | | 1 | 1 | |
| **5** | 2 | 1 | 2 | 1 | 1 | | | | | | | | 1 | 1 | |
| **Avg** | 2 | 1 | 2 | 1 | 1 | | | | | | | | 1 | 1 | |

**1 - low, 2 - medium, 3 - high, '-' - no correlation**

**GI23301 SPATIAL DATABASE MANAGEMENT SYSTEM**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**UNIT I INTRODUCTION 6L, 2P**

Data - Information - File system vs DBMS - Database management systems - Database architectures, users and administrators - Classification of database management systems - Spatial data - Points, Lines, Polygons - Definition of SDBMS - User classes of SDBMS - Multilayer architecture of SDBMS - GIS and SDBMS.

**PRACTICALS:**

- Basics of Database - Field, Record, table and relationships concepts on file type database
- Server / client operations - Starting / Shutdown of server - Client user creation - client connection over network

**UNIT II SPATIAL CONCEPTS AND DATA MODELS 6L,**

Field based mode - Object based model - Spatial data types - Operations on spatial objects - Entity relationship model (ER Model) - Relational model - Constraints and normal forms of relational model - Mapping ER model to relational model - ER model with spatial concepts - Object-oriented data modeling with unified modeling language (UML).

**PRACTICALS:**

**UNIT III QUERY LANGUAGE 6L, 12P**

SQL - Data definition - Data manipulation - Basic structure of SQL - Set operations - Aggregate Functions - Simple queries - Spatial vs non spatial - Nested sub queries - Complex queries - Views - Trigger - OGIS standard for extending SQL - Example spatial SQL queries - Object relational SQL.

**PRACTICALS:**

Data Definition of Tables -Creation, Deletion and Modification of definition

Data Manipulation -Insert, delete and modify table data

Simple Queries - On single table -Linking with multiple tables - With simple conditions

Views - Creation of views - Querying on views

Data Control of Tables and Views - Defining different constraints - Handling different permissions on tables and views

**UNIT IV SPATIAL STORAGE AND INDEXING 6L, 4P**

Disk geometry - Buffer manager - Field - Record - File - File structure - Clustering - Basic concepts of file organizations, indexing - Spatial indexing - Grid files - R tree - Concurrency support - Spatial join index - Database recovery techniques - Database security.

**PRACTICALS:**

Index on tables

Database triggers

**UNIT V SPATIAL DATABASE SYSTEMS AND APPLICATION DESIGN AND DEVELOPMENTS 6L, 12P**

Exploring spatial geometry - Organizing spatial data - Spatial data relationships and functionalities of any one commercial and one FOS SDBMS each - Application program and user interfaces.

**PRACTICALS:**

Spatial data creation  Creation of simple geometries (point, line and polygon) on database

Indexing and viewing spatial data
Topological querying on spatial data
Geometrical functions and analysis  Area and length, Buffer, Union and intersection

**TOTAL: 30L + 30P = 60 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course ,the student is expected to

**CO1:** Understand the concepts, classification, architectures of DBMS, SDBMS.
**CO2:** Provide the information on field based, object based, ER, Relational and UML models.
**CO3:** Enable the SQL, extended SQL for handling spatial and non-spatial queries.
**CO4:** Show the methods of storing, indexing, database recovery and data security concepts.
**CO5:** Give the design and development environment of spatial data.

**TEXTBOOKS:**


1. Nikos Mamoulis, “Spatial Data Management”, Springer Nature, 2022, ISBN: 978-3-031-01884-8.
2. Shashi Shekhar, Sanjay Chawla, ”Spatial Databases: A Tour”, Prentice Hall, 1st edition, 2003.
3. Philippe Rigaux, Michel Scholl, Agnès Voisard, “Spatial Databases: With Application to GIS”, The Morgan Kaufmann Series in Data Management Systems, Elsevier, 2001.


**REFERENCES:**


1. Avi Silberschatz, Henry F Korth, Sudarshan S, “Database System Concepts”, 7th edition, McGraw Hill, 2020.
2. Ravikanth V Kothuri, Albert Godfrind, Euro Beinat, “Pro Oracle Spatial for Oracle Database 11g”, Apress, 2019.
3. Regina, LeoHsu, “PostGIS in Action”, Oreilly & Associates Inc., 3rd edition, 2021.
4. Vijay Gandhi, James Kang, Shashi Shekhar, “Spatial Databases” Minnesotaunivminneapolis dept of electrical and computer engineering, 2007.
5. Albert K W Yeung & BrentHall G, ”Spatial Data and Spatial Database Systems”, 2007.


**CO-PO & PSO MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 2 | - | 1 | 2 | 3 | - | - | - | - | - | - | 2 | 2 | 1 | 1 |
| **2** | 2 | 2 | 3 | 3 | 3 | - | - | - | 1 | - | - | 2 | 1 | 1 | 1 |
| **3** | 2 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 3 | 3 | 3 |
| **4** | 2 | 1 | 2 | 2 | 3 | 1 | - | - | - | - | - | 2 | 1 | 2 | 1 |
| **5** | 2 | 2 | 3 | 3 | 2 | 2 | - | - | 1 | - | - | 3 | 1 | 2 | 2 |
| **AVg.** | 2 | 2 | 2 | 3 | 3 | 2 | - | - | 1 | - | - | 2 | 2 | 2 | 2 |

- 1 : low, 2 : medium, 3 : high,

**GI23302** **SURVEYING** **LT PC**
**3 0 4 5**

**UNIT I FUNDAMENTALS AND CONVENTIONAL SURVEYING**
**9L, 12P**

Definition - Classifications - Basic principles - Equipment and accessories for ranging and chaining - Methods of ranging - well-conditioned triangles - Chain traversing - Compass - Basic principles - Types - Bearing - System and conversions - Sources of errors and local attraction - Magnetic declination - Dip - compass traversing - Plane table and its accessories - Merits and demerits - Methods: Radiation - Intersection - Resection - Traversing.

**PRACTICALS:**

- Mapping and computing the area and perimeter of a polygon by chain survey with cross-staff and without cross-staff.
- Computation of included angle after adjustments of local attraction (closed / open traverse).
- Planimetric mapping of an area using plane table surveying (radiation and intersection methods).

**UNIT II LEVELLING** **9L, 12P**

Level line - Horizontal line - Datum - Benchmarks - Levels and staves - Temporary and permanent adjustments - Methods of levelling - Fly levelling - Check levelling - Procedure in levelling - Booking - Reduction - Curvature and refraction - Reciprocal levelling - Precise levelling - Contouring - Methods of interpolating contours - Characteristics and uses of contours - Areas enclosed by straight lines - Irregular figures - Volumes - Earthwork calculations.

**PRACTICALS:**

- Determination of elevation of given points by fly levelling using a dumpy level.
- Transfer of benchmark by check levelling using tilting level.
- Contour mapping using grid levelling and determining the cut and fill volume

**UNIT III THEODOLITE SURVEYING** **9L, 12P**

Theodolite - Types - Horizontal and vertical angle measurements - Temporary and permanent adjustments - Trigonometric levelling - Heights and distances - Single plane method - Double plane method - Geodetic observation - Tacheometric surveying - Stadia tacheometry - Subtense method - Tangential tacheometry.

**PRACTICALS:**

- Measurement of horizontal angle and its accuracy by repetition method.
- Measurement of horizontal angles and their weights by the reiteration method.
- Mapping of topographic features by stadia tacheometry surveying.
- Determination of length and reduced level of points on sloping terrain using tacheometric surveying.

**UNIT IV CONTROL SURVEYING AND ADJUSTMENT** **9L, 12P**

Horizontal and vertical control - Methods - Triangulation - Baseline - Instruments and accessories - Corrections - Satellite station - Traversing - Coordinate computation - Gale‘s table - Omitted measurement - Trilateration - Concepts of measurements and errors - The weight of an observation - Law of weight - Adjustment methods - Angles, lengths and levelling network - simple problems.

**PRACTICALS:**

- Establishment of horizontal control points by traverse surveying.

**UNIT V MISCELLANY SURVEYING** **9L, 12P**

Route surveying - Reconnaissance - Route surveys for highways, railways and waterways - Simple curves - Compound and reverse curves - Setting out Methods - Transition curves - Functions and requirements - Setting out of simple curves - Vertical curves - Sight distances - Hydrographic

surveying - Tides - MSL - Sounding methods - Three-point problem - Strength of fix - Sextants and station pointer - Astronomical Surveying - Astronomical term - Different celestial coordinate system - Determination of azimuth by altitude and hour angle methods.

**PRACTICALS:**

- Estimation of sunrise / sunset using sun observations and understanding of the nautical almanac.
- Computation of true bearing of reference line by extra meridian observation and hour angle method.

**TOTAL: 45L + 60P = 105 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Gain a solid understanding of the fundamental principles and concepts of surveying, includingmeasurements, coordinate systems, accuracy, error analysis, and surveying instruments.

**CO2:** Plan and conduct field surveys effectively.

**CO3:** Conduct topographic surveys to accurately measure and map the features, contours, and elevations of a given area of land using appropriate surveying techniques and equipment.

**CO4:** Analyze survey data using appropriate mathematical and statistical techniques, interpret the results, and generate accurate reports, drawings, and maps based on the collected data.

**CO5:** Understand how surveying principles and techniques are applied in engineering projects.

**TEXT BOOKS:**


1. B. C. Punmia, Ashok K. Jain and Arun K Jain, “Surveying Vol. I & II”, Lakshmi Publications Pvt Ltd, New Delhi, 17th edition, 2022. ISBN-10: 9788170088530.
2. S. K. Duggal, “Surveying Volume - 1 & 2”, McGraw-Hill, 5th edition, 2019.
3. T. P. Kanetkar and S. V. Kulkarni, “Surveying and Levelling, Part 1 & 2”, Pune Vidyarthi Griha Prakashan, Pune, 2010, 24th edition. ISBN-10: 8185825114, ISBN-13: 978-8185825113.


**REFERENCES:**


1. Subramanian R, “Surveying and Levelling”, Oxford University Press, 2nd edition, 2012, ISBN-10: 0198085427, ISBN-13 : 978-0198085423.
2. James M Anderson and Edward M Mikhail, “Surveying, Theory and Practice”, 7th edition, McGraw Hill 2001, ISBN-10: 0070159149, ISBN-13: 978-0070159143.
3. Bannister and S. Raymond, “Surveying”, 7th edition, Longman 2004, ISBN-10: 0582302498, ISBN-13: 978-0582302495.
4. S K Roy, “Fundamentals of Surveying”, 2nd edition, Prentice Hall of India 2004, ISBN-10: 9788120341982, ISBN-13: 978-8120341982.
5. K R Arora, “Surveying Vol I & II”, Standard Book House, 2019, ISBN-13: 9788189401238.
6. Venkatramaiah C, “Textbook of Surveying”, Universities Press, 2nd edition, 2011, ISBN-10: 9788173717406, ISBN-13: 978-8173717406.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 4 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| AVG. | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |

- 1 : low, 2 : medium, 3 : high.

**GI23303** **REMOTE SENSING** **L T P C**
**2 0 2 3**

**UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 6L+4P**

Definition - Components – Electromagnetic spectrum – Particle theory – Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchhoff‘s law - Radiation quantities.

**PRACTICALS:**
1. Preparation of base map from Survey of India Toposheets. (4)

**UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 6L+4P**

Atmospheric Scattering, absorption - Atmospheric windows - Energy balance equation - Specular and diffuse reflectors - Spectral signature - Typical spectral reflectance curves for vegetation, soil and water.

**PRACTICALS:**
1. Spectral measurements using Spectroradiometer for vegetation soil, water. (4)

**UNIT III ORBITS AND PLATFORMS 6L+4P**

Motions of planets and satellites - Kepler‘s laws, Escape velocity and Orbit maneuvers - Lagrange Orbit – Ground based, Airborne and Space borne platforms - Sun synchronous and Geosynchronous satellites.

**PRACTICALS:**
1. Introduction to various satellite data products and image interpretation keys. (4)

**UNIT IV SENSORS AND DATA 6L+10P**

Active and Passive – Along and across track scanners: Optical and Thermal – Sensor Calibration - Microwave sensors - High Resolution Sensors - LIDAR, UAV - Orbital and sensor characteristics of live Indian earth observation satellites; image acquisition – storage and retrieval – resolution concept.

**PRACTICALS:**
1. Preparation of landuse / landcover map using Satellite Data / Aerial Photograph. (6)
2. Study of image properties, True colour and FCC creation, Reading image statistics. (4)

**UNIT V DATA PRODUCTS AND INTERPRETATION 6L+8P**

Photographic and digital products - Types, levels - Selection and procurement of data - Visual interpretation: elements and keys - Digital Interpretation: - Sources of Image degradation – preprocessing – Geometry and Radiometry.

**PRACTICALS:**
1. Ground control and Geometric rectification and registration (2)
2. Band combination selection for feature extraction(vegetation, water and other land covers), Histogram stretch for contrast enhancement. (4)
3. Introduction to Image ratio and filters (2)

**TOTAL: 60 PERIODS (30 (THEORY) + 30(PRACTICAL))**

**COURSE OUTCOMES:**
- On completion of the course, the student is expected to

**CO1:** Understand the concepts and laws related to remote sensing.
**CO2:** Understand the interaction of electromagnetic radiation with atmosphere and Earth material.
**CO3:** Acquire knowledge about satellite orbits and different types of satellites.
**CO4:** Understand the different types of remote sensors.
**CO5:** Gain knowledge about the concepts of interpretation of satellite imagery.

**TEXTBOOKS:**


1. Thomas M Lillesand, Ralph W Kiefer and Jonathan W Chipman, "Remote Sensing
2. and Image interpretation", John Wiley and Sons, Inc., New York, 2015.
3. George Joseph and Jeganathan C, "Fundamentals of Remote Sensing", 3rd Edition Universities Press (India) Private limited, Hyderabad, 2018.
4. Basudeb Bhatta, "Remote Sensing and GIS", 3rd Edition, Oxford University Press India, 2021.


**REFERENCES:**


1. Stanley A Morain, Amelia M Budge, Michael S Renslow, "Manual of Remote Sensing", Vol. I, 4th edition, American Society for Photogrammetry and Remote Sensing, Virginia, USA, 2019.
2. Verbyla ,David, "Satellite Remote Sensing of Natural Resources", CRCPress, 2022 1st edition.
3. Paul Curran P J, "Principles of Remote Sensing", Longman, RLBS, 1996.
4. Charles Elachi and Jacob VanZyl, "Introduction to Physics and Techniques of Remote Sensing", 2021 3rd edition, Wiley Publication.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 2 | - | - | - | - | - | 1 | 1 | 1 | 2 | 2 | 2 |
| 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | 1 | 1 | 1 | 3 | 3 | 3 |
| 3 | 3 | 2 | 2 | - | 2 | - | - | - | - | 1 | 1 | 1 | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**GI23304 PRINCIPLES OF PHOTOGRAMMETRY**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**UNIT I INTRODUCTION 6L,**

History - Definition, applications - Types of photographs, classification - Photographic overlaps - Camera: Metric vs. non-metric, digital aerial cameras - Multiple frame and line cameras - Linear array scanner - Flight planning - Crab & drift - Computation of flight plan - Photogrammetry project planning.

**PRACTICALS:**

**UNIT II GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS 6L, 6P**

Photo coordinate measurement - Vertical photographs - Geometry, scale, coordinate system, relief displacement - Stereoscopes - Stereoscopic parallax - Parallax equations - Geometry, scale, coordinate system - Relief displacement - Photo Interpretation.

**PRACTICALS:**

- Testing stereo vision with a stereogram card
- Mirror stereoscope - Baseline and Photo Interpretation

**UNIT III STEREOPLOTTERS & ORIENTATION 6L, 6P**

Projection system, viewing, measuring and tracing system stereo plotters - Classification: Analog, semi analytical, analytical and digital systems - Interior orientation - Relative orientation - Absolute orientation - Collinearity condition and coplanarity condition - Orientation: Two-dimensional coordinate transformations - Three-dimensional conformal coordinate transformation.

**PRACTICALS:**

- Scale of vertical photographs and height of a point.
- Mirror stereoscope -Orientation of aerial photographs

**UNIT IV AEROTRIANGULATION, TERRAIN MODELING, ORTHOPHOTO 6L, 9P**

Neat model - Strip and blocks of photographs - Aerotriangulation: Strip adjustment, independent model triangulation, bundle block Adjustment and GPS aerotriangulation (INS and GNSS integration) - Feature collection - DTM generation and contour mapping - Ortho rectification - Mono plotting - Stereo plotting.

**PRACTICALS:**

- Generation and editing of DTM and Contour.
- Ortho photogeneration and Mosaic.

**UNIT V DIGITAL PHOTOGRAMMETRY 6L, 9P**

Photogrammetric scanner - Digital photogrammetry workStation - Work station basic system function - Storage system - Stereoscopic viewing and measuring system - Image properties - Image matching: Template matching, feature based matching - DEM and DSM - Satellite photogrammetry principles.

**PRACTICALS:**

- Bundle Block adjustment and Aerial Triangulation using digital photogrammetry
- Preparation of Planimetric map.

**TOTAL: 30L + 30P = 60 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand and appreciate the importance of photography as means of mapping, functional and physical elements of photography.

**CO2:** Understand the need of the photogrammetric mapping and the relevance of accuracy standards and means to achieve them for precise large scale maps with scientific methods.

**CO3:** Evaluate the standards of map based on the state of the art tool and techniques and assess the production standards for photogrammetric map making.

**CO4:** Acquire knowledge on the current development, issues methods and solutions in map making and evaluate methods of production.

**CO5:** Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of mapping technology.

**TEXT BOOKS:**


1. Paul R Wolf., Bon A. De Witt, "Elements of Photogrammetry with Application in GIS", McGraw Hill International Book Co., 4th Edition, 2014.
2. Matt Weilberg, "GIS Approaches for Remote Sensing and Photogrammetry", Callisto Reference, 2018.
3. .J Chris Mc Glone, "Manual of Photogrammetry", American Society for Photogrammetry and Remote Sensing, 6th Edition, 2013.
4. E M Mikhail, J S Bethel, J C McGlone, "Introduction to Modern Photogrammetry", Wiley Publisher, 2001.


**REFERENCES:**


1. Gollfried Konecny, "Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems", CRC Press, 2nd edition, 2014.
2. Karl Kraus, "Photogrammetry: Geometry from Images and Laser Scans", Walter de Gruyter GmbH & Co.2nd edition, 2007.
3. Chester C Slama, Charles Theurer, Soren W. Henriksen, "Manual of Photogrammetry", American society of Photogrammetry, 1980.
4. Wilfried Linder, "Digital Photogrammetry – A practical course", 3rd edition, Springer, 2016.
5. Yves Egels, Michel Kasser, "Digital Photogrammetry", Taylor & Francis group, 2003.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| 2 | 2 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |
| 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 2 |
| 4 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**UC23U01** **UNIVERSAL HUMAN VALUES** **L T P C**
**1 0 2 2**

**COURSE OBJECTIVE:**

The objective of the course is four-fold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

**Module I: Introduction** **(3L,6P)**

Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration– Its content and process; 'Natural acceptance' and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

**Practical Session:** Include sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

**Module II: Harmony in the Human Being** **(3L,6P)**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

**Practical Session:** Include sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

**Module III: Harmony in the Family and Society** **(3L,6P)**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society-Undivided Society, Universal Order- from family to world family.

**Practical Session**: Include sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

**Module IV: Harmony in the Nature and Existence (3L,6P)**

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.

**Practical Session:** Include sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

**Module V: Implications of Harmony on Professional Ethics (3L,6P)**

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up.

**Practical Session:** Include Exercises and Case Studies will be taken up in Sessions E.g. To discuss the conduct as an engineer or scientist etc.

**TOTAL: 45 (15 Lectures + 30 Practicals) PERIODS**

**COURSE OUTCOME:**

**By the end of the course, the students will be able to:**

1. Become more aware of themselves, and their surroundings (family, society, nature);
2. Have more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.
4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

**REFERENCES:**


1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 3rd revised edition, 2023.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews.
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj - PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

**Web URLs:**

1. Class preparations: https://fdp-si.aicte-india.org/UHV-II%20Class%20Note.php
2. Lecture presentations: https://fdp-si.aicte-india.org/UHV-II_Lectures_PPTs.php
3. Practice and Tutorial Sessions: https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php

**Articulation Matrix:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | 1 | 1 | 1 | 3 | | | 3 |
| **CO2** | | | | | | 1 | 1 | 1 | 3 | | | 3 |
| **CO3** | | | | | | 3 | 3 | 2 | 3 | | 1 | 3 |
| **CO4** | | | | | | 3 | 3 | 2 | 3 | | 1 | 3 |
| **CO5** | | | | | | 3 | 3 | 3 | 3 | | 2 | 3 |

## SEMESTER IV

**GI23401** **CARTOGRAPHY AND GIS** **L T P C**
**3 0 4 5**

**UNIT I ELEMENTS OF CARTOGRAPHY 9L, 4P**

Definition of cartography - Maps - Functions - Uses and types of maps - Map scales and contents - Map projections - Shape, distance, area and direction properties - Perspective and mathematical projections - Indian maps and projections - Map coordinate System - UTM and UPS references.

**PRACTICALS:**

Tracing the features from Survey of India Toposheet.

**UNIT II MAP DESIGN AND PRODUCTION 9L, 8P**

Elements of a map - Map layout principles - Map design fundamentals - Symbols and conventional signs - Graded and ungraded symbols - Color theory - Colours and patterns in symbolization - Map lettering - Map production - Map printing - Colours and visualization - Map reproduction - Map generalization - Geometric transformations - Bilinear and affine transformations.

**PRACTICALS:**

Symbolization of features as per the Survey of India Toposheet.

**UNIT III FUNDAMENTALS OF GIS 9L**

Introduction to GIS - Definitions - History of GIS - Components of a GIS - Hardware, software, data, people, methods – Introduction to data quality - Types of data - Spatial, attribute data - Types of attributes - Scales/levels of measurements - Spatial data models - Raster data structures - Raster data compression - Vector data structures - Raster vs vector models - TIN and GRID data models.

**PRACTICALS:**

**UNIT IV DATA INPUT AND TOPOLOGY 9L, 36P**

Scanner - Raster data input - Raster data file formats - Georeferencing - Vector data input - Digitizer - Datum projection and reprojection - Coordinate transformation - Topology - Adjacency, connectivity and containment - Topological consistency - Non topological file formats - Attribute data linking - Linking external databases - GPS data integration - Raster to vector and vector to raster conversion.

**PRACTICALS:**

Data input - On screen digitization - Creation of Point, Line and Polygon layers.
Projection, reprojection and coordinate transformation of maps.
Attribute data input and measurement of Distance, Area.
Linking external databases and tabular data analysis using SQL commands.
Data conversion - Vector to raster and Raster to vector.

**UNIT V DATA QUALITY AND OUTPUT 9L, 12P**

Assessment of data quality - Basic aspects - Completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage - Metadata - GIS standards - Interoperability - OGC - Spatial data infrastructure - Data output - Map compilation - Chart / graphs.

**PRACTICALS:**

Generating graphs, charts and diagrams from tabular data.
Map joining, edge matching and layout design.

**TOTAL: 45L + 60P = 105 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Be familiar with appropriate map projection and coordinate system for production of Maps and shall be able to compile and design maps for their required purpose.

**CO2:** Be familiar with coordinate and Datum transformations

**CO3:** Understand the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression

**CO4:** Understand the concepts of spatial data quality and data standard

**CO5:** Understand the concept of spatial data inputs

**TEXT BOOKS:**


1. Arthur H Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002.
2. Kang – TsungChang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 4th edition, 2008, ISBN: 0073051152, 9780073051154.
3. Ian Heywood, Sarah Cornelius, Steve Carver, "An Introduction to Geographical Information Systems, Pearson Education, 4th edition, 2011, ISBN: 027372259X, 9780273722595.


**REFERENCES:**


1. John Campbell, "Introductory Cartography",Wm. C. Brown Publishers, 3rd Edition, 2004.
2. Chor Pang LO, Albert K W Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd edition, 2016, ISBN: 9789332581883.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 1 | 2 | 3 | - | - | - | 3 | - | - | - | 3 | 2 | 2 |
| 2 | 3 | 2 | 1 | 2 | 3 | - | - | - | 2 | - | - | - | 3 | 2 | 2 |
| 3 | 3 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 3 | 2 |
| 4 | 3 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 3 | 2 |
| 5 | 3 | 3 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 2 | 2 |
| AVg. | 3 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 2 | 2 |

1' = Low; '2' = Medium; '3' = High

**GI23402** **ELECTRONIC SURVEYING** **L T P C**
**3 0 4 5**

**UNIT I FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES 9L 6P**

Methods of measuring distance, basic principles of total station, historical development, classifications, applications and comparison with conventional surveying - Classification - Applications of electromagnetic waves, propagation properties, wave propagation at lower and higher frequencies.

**PRACTICALS:**

- Study of Total Station and its components, functions

**UNIT II DISTANCE AND ATMOSPHERIC CORRECTION 9L 6P**

Refractive index (RI) - Factors affecting RI - Computation of group RI for light and near infrared wavesat standard and ambient conditions - Computation of RI for microwaves at ambient condition - Reference refractive index - Real time application of first velocity correction - Measurement of atmospheric parameters - Mean refractive index - Second velocity correction - Total atmospheric correction - Use of temperature and pressure transducers.

**PRACTICALS:**

- Observations with Total Station – Coordinates, MLM, REM and Resection

**UNIT III ELECTRO OPTICAL AND MICROWAVE SYSTEM 9L 18P**

Electro-optical system: Measuring principle, Working principle, reflectors, Sources of Error, Infrared andLaser Total Station instruments. Microwave system: Measuring principle, working principle,Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical andMicrowave system. Care and maintenance of Total Station instruments – Traversing andTrilateration-COGO functions, offsets and stake out-land survey applications.

**PRACTICALS:**

- Setting of a Curve using Total Station – by using Coordinates and Offsets.
- Deriving Area of a Plot using Total Station – traversing and coordinate methods

**UNIT IV GPS SATELLITE SYSTEM 9L 12P**

Basic concepts of GPS - Historical perspective and development - Applications - Geoid and ellipsoid - Satellite orbital motion - Keplerian motion - Kepler‘s law - Perturbing forces - Geodetic satellite - Doppler effect - Positioning concept - GNSS, IRNSS and GAGAN - Different segments - Space, control and user segments - Satellite configuration - GPS signal structure - Orbit determination and representation - Anti spoofing and selective availability - Task of control segment - GPS receivers.

**PRACTICALS:**

- Mapping of Point, Line and Area features using Handheld GPS
- Observations with Survey Grade GPS -Static, Kinematic and Differential Positioning

**UNIT V GPS DATA PROCESSING 9L 18P**

GPS observables - Code and carrier phase observation - Linear combination and derived observables - Concept of parameter estimation - Downloading the data RINEX format - Differential data processing - Software modules - Solutions of cycle slips, ambiguities, concepts of rapid, static methods with GPS - Semi kinematic and pure kinematic methods - Satellite geometry & accuracy measures - Applications - Long baseline processing - Use of different softwares.

**PRACTICALS:**

- Processing GPS Observations – Baseline and Network Adjustment

- Processing GPS Observations with CORS/IGS Network Observations

**TOTAL: 45 L+ 60 P= 105 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Learn the fundamentals of Total station.

**CO2:** Provides knowledge about electromagnetic waves and its usage in Total station.

**CO3:** Understand the measuring and working principle of electro optical and Microwave Total station.

**CO4:** Learn the basic concepts of GPS.

**CO5:** Gains knowledge about GPS data downloading and processing.

**TEXT BOOKS:**


1. Jean M Rueger, "Electronic Distance Measurement: An Introduction", 4th edition, Springer Science and Business Media, 2012, ISBN: 3642802338, 9783642802331.
2. Satheesh Gopi, Sathikumar R, Madhu N, "Advanced Surveying: Total Station GPS and Remote Sensing", Pearson Education, Reprint, 2007. ISBN: 8131700674, 9788131700679.


**REFERENCES:**


1. Subramanian R, "Surveying and Levelling", Oxford University Press, 2nd Edition, 2012.
2. Laurila S H, "Electronic Surveying in Practice", John Wiley and Sons Inc, 1983.
3. Guocheng Xu, "GPS Theory, Algorithms and Applications", Springer - Verlag, Berlin, 3rd edition, 2016.
4. Alfred Leick, "GPS satellite surveying", John Wiley & Sons Inc, 4th Edition, 2015.
5. Seeber G, "Satellite Geodesy", Walter De Gruyter, Berlin, 2nd Edition, 2003.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 1 | 1 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 3 | 1 | 1 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 3 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**GI23403 DIGITAL IMAGE PROCESSING L T P C**
**3 0 4 5**

**UNIT I IMAGE FORMING AND PREPROCESSING 9L, 8P**

Definition - Image representation and properties- Elements of visual perception - Image formation - Image sampling and quantization - Image acquisition - image types, parameters - Histograms – Scattergrams, univariate and multi variate statistics- Geometry and radiometry- sensor and noise models - Atmospheric, radiometric and geometric corrections Interpolation methods and resampling techniques.

**PRACTICALS:**

Data download, display, histogram, scattergram and Image statistics generation.
Image upscaling, downscaling and warping – resampling.

**UNIT II GOOGLE EARTH ENGINE PROGRAMMING WITH JAVASCRIPT 9L, 12P**

Overview of Google Earth Engine- Key features and capabilities- Introduction to JavaScript- Basic syntax and structure- Basic JavaScript for GEE- Control Structures- Conditional statements- Loops- Functions- GEE Data Structures and JavaScript- Advanced JavaScript for GEE- Creating and manipulating arrays-Creating and manipulating objects- Higher-order functions- Image and ImageCollection- Feature and FeatureCollection: Creating, manipulating and Filtering.

**PRACTICALS:**

Creating GEE environment for Image Processing.

**UNIT III IMAGE ENHANCEMENT 9L, 20P**

Point, local and regional operation – frequency and spatial domain-Contrast, spatial feature and multi-image manipulation techniques – Level slicing, contrast stretching, spatial filtering, edge detections - Fourier transform - FFT, DFT - Band ratio - Principal component analysis (PCA) - Scale - Space transform - Multi-image fusion- Visualizing Data in GEE- Map functions- Image transformations- Resampling, reprojecting, and clipping images- Compositing and mosaicking- Creating composites and mosaics.

**PRACTICALS:**

Enhancements – contrast stretching, level slicing and equalization.
Filters- low pass, high pass, and cannys.
Statistical, Directional and Frequency Filters.
Band ratioing and normalization - NDVI, NDBI & NDWI.
RGB TO HIS Transformation.

**UNIT IV SUPERVISED CLASSIFICATION 9L, 12P**

Clustering with GEE- Band math- NDVI and other indices- Pattern recognition concepts – Baye's approach – hard classifiers- Spectral signature and training sets - Separability test – training set statistics and refining- Supervised classification - Minimum distance to mean, parallelepiped, MLC – ground truthing - Accuracy metrics: error matrix, Kappa statistics, ERGAS, RMSE, ROC.

**PRACTICALS:**

Supervised Classification – NN and MLC.
Accuracy assessment – Error Matrix and kappa coefficient, ROC
Change detection & time series analysis

**UNIT V UNSUPERVISED CLASSIFICATION 9L, 8P**

Unsupervised classifiers –clustering, segmentation, similarity and distance measures, exclusive, overlapping, hierarchical and probabilistic clustering- ISODATA, K-means, fuzzy k-means, agglomerative and gaussian mixture clustering ( expectation-maximisation) – object based methods- Sub-pixel classification.

**PRACTICALS:**

Unsupervised Classification – k means/ ISODATA

.

**TOTAL: 105 PERIODS (45 (THEORY) + 60 (PRACTICAL))**

**COURSE OUTCOMES:**

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

1. Understand the principles of image formation in order to use it appropriately.
2. Develop coding using Google Earth Enginefor image processing
3. Perform various Image enhancement techniques.
4. Evaluate the information extracted for its truthfulness through validation using supervised classifiers
5. Synthesis solutions for information extraction from given image for a given application using Unsupervised classifiers

**TEXT BOOKS:**

1. John R Jensen, “Introductory Digital Image Processing: A Remote Sensing Perspective”, PrenticeHall, New Jersey, Pearson Education, 4th edition, 2016, ISBN: 013405816X, 9780134058160.
2. Robert A Schowengergt, “Techniques for Image Processing and Classification in Remote Sensing”, Academic Press, 2012, ISBN: 0323138551, 9780323138550.

**REFERENCES:**

1. Robert G Reeves, “Manual of Remote Sensing Vol. I & II”, American Society of Photogrammetry
   , Falls, Church, USA, 1983.
2. John A Richards, “Remote Sensing Digital Image Analysis - An Introduction”, Springer-Verlag, 5th Edition, 2014.
3. Rafael C Gonzalez, Richard Eugene Woods, “Digital Image Processing”, Pearson / Prentice Hall, 4th edition, 2022.
4. Annadurai, “Fundamentals of Digital Image Processing”, Pearson Education (2007).

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 1 | 1 | 1 | - | - | 2 | - | - | 2 | 3 | - | - |
| 2 | 2 | 3 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | 2 | 1 | 2 | 2 |
| 3 | 3 | 2 | 2 | 3 | 2 | 1 | - | - | | - | - | 2 | 2 | 1 | 2 |
| 4 | 3 | 3 | 2 | 3 | 3 | - | - | - | 2 | - | - | 3 | 2 | 2 | 2 |
| 5 | 2 | - | 2 | 2 | 3 | 1 | - | - | 1 | - | - | 2 | 2 | 2 | 2 |
| AVg. | 3 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | 2 | 2 | 1 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23404** **GEODESY** **L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION** **9**

Definition - Importance and history of geodesy - Classification - Geoid, ellipsoid, and Earth's figure - Geodetic datums and their relationship to the Earth's shape - Distance measurement techniques - Angle measurements and orientation - Height determination methods – Selenodesy, Planetary Geodesy.

**UNIT II GEOMETRIC GEODESY** **9**

Definition - Coordinate systems and geodetic datums - Geometry of the Earth - Geodetic geocentric, Reduced latitudes - Radius of curvature - Transformation between different coordinate systems - Characteristics of geodetic datums, datum transformations and datum shifts, geometric geodetic measurements, horizontal angle and azimuth measurements. Geodetic control networks and mapping.

**UNIT III GEODETIC ASTRONOMY** **9**

Definition - Spherical trigonometry and its applications in geodesy - Celestial sphere - Celestial coordinate systems - Equatorial, ecliptic, and galactic coordinate systems - Transformation between celestial and terrestrial coordinate systems field astronomy and its applications - Time determination - Conversion among time systems - Geodetic applications of astronomical observations geodesy in navigation and positioning systems.

**UNIT IV PHYSICAL GEODESY** **9**

Definition, history and importance of physical geodesy - Geopotential theory - Earth's gravity field - Gravity anomaly and its interpretation - Determination of gravity anomalies using terrestrial and satellite measurements - Methods for geoid determination - Geoid modeling and its applications in geodesy - Satellite missions: GRACE, Jason - Geodesy in geophysics, geodynamics, and plate tectonics.

**UNIT V INTERFEROMETRIC GEODESY** **9**

Overview - Basics of interferometry - Interferometric base line- Interferometry types: InSAR, SBAS, PSInSAR- Geodetic Measurements - Introduction to VLBI elements and Techniques- Applications of Interferometric Geodesy.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand and apply the fundamental principles of geodesy to solve geodetic problems in various disciplines.

**CO2:** Apply geometric geodesy concepts to solve practical problems related to coordinate conversions and geodetic measurements.

**CO3:** Analyze and interpret astronomical observations using celestial coordinate systems and time systems for geodetic applications.

**CO4:** Utilize physical geodesy knowledge, such as geopotential theory and anomalies to analyze Earth's gravity field and determine geoid heights.

**CO5:** Apply these concepts of Geodesy in surveying, mapping, navigation, and environmental studies.

**TEXT BOOKS:**

1. Wolfgang Torge, “Geodesy”, Walter De Gruyter Inc., Berlin, 2nd edition 2015, ISBN: 3110170728, 9783110170726.
2. Guy Bomford, “Geodesy”, Nabu Press, 2015, ISBN: 1172029091.

**REFERENCES:**

1. Petr Vanicek and Edward J Krakiwsky, “Geodesy: The concepts”, North Holland Publications Co., Amsterdam, 2nd edition, 2014.
2. Thomas H. Meyer and Wolfgang Torge, “Physical Geodesy", De Gruyter, 2nd edition , 2018, ISBN: 978-3110468359.
3. David J. Getling, “Geodesy for Geomatics and GIS Professionals”, CRC Press, 2018, ISBN: 978-1138393325.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 1 | 1 | 1 | 2 | - | - | - | 1 | - | - | 2 | 3 | 2 | 1 |
| **2** | 3 | 3 | 2 | 3 | 1 | - | - | - | 2 | - | - | 2 | 3 | 2 | 2 |
| **3** | 3 | 3 | 2 | 2 | 2 | - | - | - | 2 | - | - | 2 | 3 | 3 | 3 |
| **4** | 3 | 2 | 3 | 3 | 3 | - | - | - | 2 | - | - | 2 | 3 | 3 | 2 |
| **5** | 3 | 3 | 2 | 3 | 2 | - | - | - | 2 | - | - | 2 | 3 | 3 | 2 |
| **AVg.** | **3** | **3** | **2** | **3** | **2** | **-** | **-** | **-** | **2** | **-** | **-** | **2** | **3** | **3** | **2** |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23405 HYPERSPECTRAL AND THERMAL REMOTE SENSING L T P C**
**2 0 2 3**

**UNIT I HYPERSPECTRAL REMOTE SENSING 6L, 3P**

Diffraction principles - Field spectrum - BDRF and spectral reflectance & imaging spectrometry – Sensors: Characteristics and applications - Virtual dimensionality - Viewing – Image cube, Spectral movie - Hughe's phenomenon - Calibration and normalization – Red Edge

**PRACTICALS:**

1. Hyperspectral Image Display and Basic Analysis (Downloading, Displaying, and Analyzing Hyperspectral Imagery)

**UNIT II TOOLS FOR PROCESSING HYPERSPECTRAL DATA 3L, 3P**

ERDAS, ENVI, Prediktera, EUFAR, Spectral Analysis Manager (SPAM), Integrated Software for Imaging Spectrometers (ISIS), Spectral Image Processing System (SIPS), SPECtrum Processing Routines (SPECPR), Optical Real-time Adaptive Spectral Identification System (ORASIS), Imaging Spectrometer Data Analysis System (ISDAS), Python, MATLAB, Quantum Computing.

**PRACTICALS:**

1. Pre-processing of Hyperspectral Data (Atmospheric Correction of Hyperspectral Imagery).

**UNIT III HYPERSPECTRAL DATA ANALYSIS 9L, 9P**

Spectral library - Response functions - MNF transformation - Library matching, spectral angle mapper, BBMLC-spectral mixture analysis - End member extraction – Linear mixture model - Spectral unmixing - MIA analysis concepts - PCF, PCA, WPCA spectral transformation - Band detection, reduction and selection principles - Data compression - Applications: Forestry, agriculture, soil and mineral- Case studies.

**PRACTICALS:**

1. Reducing High Dimensionality of Hyperspectral Imagery and Endmember Selection.
2. Thematic Information Extraction from Hyperspectral Imagery (Unsupervised classification).
3. Thematic Information Extraction from Hyperspectral Imagery (Supervised classification)

**UNIT IV THERMAL REMOTE SENSING 3L, 3P**

History - Thermal infrared radiation principles - Thermal radiation laws - Thermal properties of terrain - Data collection methods - Environmental consideration - Thermal sensors and characteristics - Thermal image characters - Image degradation sources & correction.

**PRACTICALS:**

1. Thermal Image calibration and correction.

**UNIT V THERMAL DATA ANALYSIS 9L, 12P**

Interpretation of thermal images, emissivity conservation, thermal inertia considerations, factors affecting analysis of thermal images - Application: Estimation of land surface temperature, geological studies, evapotranspiration, emissivity mapping, sea surface temperature mapping, ET distribution, urban heat island study, crop stress- Case studies.

**PRACTICALS:**

1. Thermal remote sensing imagery basic interpretation to find out the thermal hotspots.
2. Analysis of the thermal properties of the various materials.
3. Estimating thermal brightness & converting pixels to Land Surface temperature (LST).
4. Analyze the thermal data to examine the urban heat islands, soil moisture, and water body temperatures.

**TOTAL: 60 PERIODS (30 (THEORY) + 30 (LAB))**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

CO1: Understand the spectrometry principles of satellite images.
CO2: Explore the tools to visualize and analyze the hyperspectral images.
Understand the satellite thermal image for environmental parameter estimation.
CO3: Understand the hyperspectral image analysis for natural resource monitoring and management.
CO4: Understand the principles of thermal radiation and thermal image processing.
CO5: Understand the thermal image analysis for natural resource monitoring and management.

**REFERENCES:**


1. Dale A Quattarochi and Jeffrey C Luvall, “Thermal Remote Sensing in Land surface Processes”, e-book, 2005 Taylor & Fancis, ISBN 0 203 50217 5
2. John A. Richards and Xiuping Jia, “Remote sensing digital Image Analysis - An introduction” fifth edition, Springer Verlag., 2012 ISBN 978 3 642 30061 5.
3. Chein I Chang, “Hyperspectral Imaging: Techniques for Spectral Detection and Classification”, Kluwer Academic/Plenum Publishers, New York, N.Y., 2003.(ISBN: 0-30647483-2)
4. Marcus Borengasser and William C.Hungate and Russel Watkins, “Hyper spectral Remote Sensing: Principles and application” CRC,1stEdition,2008.
5. Claudia Kuenzer, Stefan Dech Editors, “Thermal Infrared Remote Sensing Sensors, Methods, Applications”, Springer,2013.
6. Qihao Weng, Series Editor, “Hyperspectral Remote Sensing Fundamentals & Practices”, Taylor & Francis, CRC Press.


**CO - PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | - | - | - | 3 | - | - | - | - | - | - | 3 | 3 | - | - |
| 2 | 2 | 2 | 3 | - | 3 | - | - | - | - | - | - | 3 | 3 | - | - |
| 3 | 3 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | 3 | 3 |
| 4 | 3 | - | - | - | 3 | - | - | - | - | - | - | 3 | 3 | - | - |
| 5 | 3 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | 3 | 3 |

• 1-low, 2-medium, 3-high

**GI23406 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C**
**2 0 0 2**

**UNIT I ENVIRONMENT AND BIODIVERSITY 6**

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

**UNIT II ENVIRONMENTAL POLLUTION 6**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

**UNIT III RENEWABLE SOURCES OF ENERGY 6**

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

**UNIT IV SUSTAINABILITY AND MANAGEMENT 6**

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocolsSustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

**UNIT V SUSTAINABILITY PRACTICES 6**

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cyclescarbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization-Socioeconomical and technological change.

**TOTAL : 30 PERIODS**

**COURSE OUTCOMES:**

**CO1** To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

**CO2** To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

**CO3** To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

**CO4** To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

**CO5** To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

**TEXTBOOKS:**


1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers , 2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Pearson; 1st edition, 2011.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, CL Engineering; International edition, 2015.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.

7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

**REFERENCES :**

**1**. Daniel J. Sherman, David R. Montgomery, " Environmental Science and Sustainability", W. W. Norton, Incorporated, 2nd edition, 2023.
2. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', B.S Publications, 2010.
3. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publications, Mumbai, 2001.
4. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
5. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 3rd edition, 2015.
6. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

**CO - PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 2 | - | - | 3 | - | 2 | - | - | - | - | 3 | 3 | 2 | - |
| **2** | 3 | 2 | 3 | - | 3 | - | - | - | - | - | - | 3 | 3 | 3 | - |
| **3** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | 3 |
| **4** | 3 | 2 | - | - | 3 | - | 2 | - | - | - | - | 3 | 3 | 2 | - |
| **5** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | 3 |
| **AVg.** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**SEMESTER 5**

**GI23501 MICROWAVE REMOTE SENSING L T P C**
**3 0 2 4**

**UNIT I FUNDAMENTALS AND ACTIVE SYSTEM 9L+6P**

Introduction - Plane waves - Phase, coherence and interference - Evolution - Radar frequency bands - SLAR - Antenna system - SLAR imaging geometry - RADAR equation - Resolution concepts: Range and azimuth resolution - Doppler beam sharpening and antenna synthesis - Synthetic aperture radar - Geometric distortions.

**PRACTICALS:**

1. Reading, displaying and header extraction of SAR images and to generate multilook images.
2. Visual image interpretation and SAR image fusion with optical data.

**UNIT II RADAR INTERACTION WITH EARTH FEATURES 9L+6P**

System parameters - Target parameters: Roughness scales and criteria, dielectric constant and penetration depth - Surface backscattering - Physical surface backscattering models: Clapp, facet, bragg resonance models and hard targets - Volume backscattering - RADAR image signatures and interpretation.

**PRACTICALS:**

1. Geocoding, Speckle Filtering Techniques and Backscatter extraction
2. Executing empirical simulations to retrieve vegetation biomass and soil moisture.

**UNIT III IMAGING AND NON IMAGING 9L+8P**

SAR interferometry - Basics - Differential SAR interferometry - Applications polarimetry - Introduction - Polarization ellipse - Polarization types - Synthesis and signatures - Polarimetric parameters - Information extraction - Polarimetric image interpretation and applications - Altimetry - Principle – Frequency bands - Location system - Missions, scatterometry - Scatterometer subsystems - Wind retrieval - Missions and application.

**PRACTICALS:**

1. Interferometric processing-Base line estimation and registration.
2. Interferogram generation and phase values extraction.
3. Phase unwrapping and interferogram interpretation.
4. Scattering matrix and scattering properties retrieval.

**UNIT IV SAR APPLICATIONS 9L+6P**

Airborne, space borne - Different platforms and sensors - History- ENVISAT, ASAR, ALOS / PALSAR - RADARSAT, RISAT ,GRACE and Sentinel 3 missions - SAR data products and selection procedure - Applications in agriculture - Forestry - Geology - Hydrology - Snow cover mapping - Snow depth estimation - Landuse/landcover mapping - Ocean related studies.

**PRACTICALS:**

1. Polarimetric Classification
2. Altimetry processing - To import and display from NetCDF format.
3. Correction methodologies and sea surface height calculation.

**UNIT V PASSIVE SYSTEM 9L+4P**

Radiometry - Thermal radiation laws - Black body radiation and grey body radiation - Emissivity, radiometers - Components - Radiometric power - Brightness temperature - Power - Temperature correspondence - Passive microwave interaction with atmospheric constituents - Emission characteristics of various earth features - Data products and applications - Passive missions - DMSP, TRMM, Aqua missions, AMSR-E, AMSU.

**PRACTICALS:**

1. Scatterometry - reading and displaying the backscatter values
2. Retrieval of wind parameters from backscatter values.

**TOTAL: 75 PERIODS (45 (THEORY) + 30 (PRACTICAL))**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the fundamentals of microwave remote sensing systems such as SLAR, RAR and SAR.
**CO2:** Learn the interaction mechanism of Radar with target features.
**CO3:** Understand the principles and applications of Imaging and Non-Imaging observation.
**CO4:** Learn about the satellite sensing system and applicability of SAR.
**CO5:** Understand the concepts of passive microwave systems and applications.

**TEXT BOOKS:**


1. 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, ISBN: 0890061920, 9780890061923.
2. John R Jensen, "Remote Sensing of the Environment: An Earth Resource Perspective", Pearson Education India, 2nd edition, 2013.
3. John A Richards, "Remote Sensing with Imaging RADAR", Springer, 2009, ISBN: 978-3-642-02020-9.


**REFERENCES:**


1. Prashant Srivastava, Dillep Gupta, Tanvir Islam, Dawei Han, Rajendra Prasad, "RADAR Remote Sensing Application and Challenges", Elsevier, 2022.
2. Pranab Kumar Karmakar, "Microwave Propagation and Remote Sensing Atmospheric Influences with Models and Applications", Taylor & Francis, CRC Press, 2020.
3. Alessandro Ferretti, "Satellite InSAR data: Reservoir Monitoring from Space", EAGE Publications, 2014.
4. John R Schott, "Fundamentals of Polarimetric Remote Sensing", SPIE press, 2010.
5. Iain H Woodhouse, "Introduction to Microwave Remote Sensing" Taylor & Francis, 2006.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | - | 3 | 2 | 3 | 2 | 2 |
| 2 | - | 3 | - | 3 | - | 2 | 3 | - | - | 3 | - | - | 3 | 3 | 3 |
| 3 | 3 | 2 | 3 | 2 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| 4 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 3 | - | 3 | 3 | 2 | 3 | 3 | 3 | - | 2 | - | 2 | 3 | 2 | 2 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**GI23502 LASER SCANNING FOR TERRAIN MAPPING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**UNIT I SPACE BORNE RADAR AND LIDAR ALTIMETER 9L**

Principle and properties of LASER- Production of LASER - Components of LASER - LiDAR - Types of LiDAR: Ellipsoidal and geoidal height, range finder, differential absorption LiDAR (DIAL) and Doppler LiDAR - Platforms: Terrestrial, airborne and space borne LiDAR - Space borne radar altimeter for mapping sea surface topography - DIAL: CALIPSO: Aerosol concentration mapping - Space borne LiDAR missions - Moon topography: Chandrayan - LLRI, polar ice sheet topography - GLAS - ICESAT - Merits of ALS in comparison to levelling, echo sounding, GPS leveling, photogrammetry and interferometry.

**UNIT II AIRBORNE LASER SCANNERS 9L**

Airborne topographic laser scanner - Pulse laser and continuous wave laser - Measurement principles of laser scanners: Time-of-flght measurement: Peak detection, threshold or leading edge detection, phase measurement techniques - First return and last return - Typical parameters of a Airborne Laser Scanner (ALS) - Specifications of commercial ALS - Components of ALS - GPS, IMU, LASER scanner assembly, imaging device, hardware and software - Onboard system integration - GPS - IMU (Position and Orientation System (POS)) - Various scanning mechanisms: Oscillating mirror, rotating polygon, nutating mirror, fibre optic - LIDAR data file formats: LAS file format and other proprietary file formats.

**UNIT III DATA ACQUISITION, PRE AND POST PROCESSING 9L, 14P**

Laser classification - Class I to class IV laser - Eye safety - LiDAR mapping principles - Synchronization of GPS, IMU and ALS data - Reflectivity of terrain objects - Flight planning - Determination of various data acquisition parameters - Swath width, point density, Number of strips, area covered, point spacing - Data processing - Determination of optimal flight trajectory - Quality assurance and quality control measures LiDAR data characterization - Geo location of Laser foot prints: Various co-ordinate transformations - Ground point filtering - Digital Surface Model and Digital Elevation Model - Point cloud registration - Processing software: Open source and COTS Software.

**PRACTICALS:**

1. Import, structure and visualization of 3D cloud points in LAS and other formats.
2. Lidar data preprocessing using GIS and LAS tools.
3. Conversion of point clouds to images, point-based rendering and others.
4. Profile analysis of 3D cloud points.
5. Filtering of point clouds: Morphological Filtering.
6. DSM to DEM conversion.

**UNIT IV TERRESTRIAL LASER SCANNERS 9L, 8P**

Terrestrial Laser Scanners (TLS) - Working principle - Static TLS - Dynamic TLS - Commercial TLS specifications - Mobile mapping Lasers: Vehicle mounted TLS, Backpack wearable Laser scanners - Asset management studies - Highways and railway asset management - Indoor mapping: Laser scanning of interior of buildings/monuments - Immersive applications - BIM model - Applications in tunnel surveying, forest inventory, open cast mine surveying.

**PRACTICALS:**

1. Mapping of interior and exterior of monument/Structure.
2. Feature extraction from 3D cloud point.
3. Detrending Terrain

**UNIT V MOBILE MAPPING AND LIDAR APPLICATIONS 9L, 8P**

Introduction - Mobile mapping observation modes: Stop and on the fly mode - Mobile mapping system design: Imaging and referencing - Indoor applications - Communication and control, processing flow - Validation of mobile mapping systems - Application examples: Railroad-track based systems, road-based systems - Engineering applications: Reconstruction of industrial sites - Structural monitoring and change detection: Change detection - Corridor mapping: Power line monitoring - Cultural heritage applications: Accurate site recording and reconstruction - 3D city models - Forestry application: Canopy height model and biomass determination.

**PRACTICALS:**

1. Canopy Height Model
2. Asset Management - Feature Extraction
3. Power Line Extraction

**TOTAL: 45L + 30P = 75 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the components of laser and various platforms of laser scanning.
**CO2:** Summarize the components of Airborne Laser Scanner and ranging principles.
**CO3:** Analyse the flight planning parameters and pre and post processing of 3D point Cloud.
**CO4:** Understand the working principle of Terrestrial Laser Scanner and its applications.
**CO5:** Understand the concept of Mobile Mapping and its applications.

**TEXT BOOKS:**


1. Jie Shan and Charles K Toth, "Topographic Laser Ranging and Scanning - Principles and Processing", CRC Press, Taylor & Francis Group, 2nd Edition, 2017, https://doi.org/10.1201/9781315154381, E Book ISBN: 9781315154381.
2. George Vosselman and Hans-Gerd Maas, "Airborne and Terrestrial Laser Scanning", Whittles Publishing, Dunbeath, Caithness KW6 6EY ,Scotland, UK 2010, ISBN: 978-184995-013-8.
3. Pinliang Dong, Qi Chen, "LiDAR Remote Sensing and Applications", CRC Press, 1st Edition, 2017, https://doi.org/10.4324/9781351233354, EBOOK ISBN: 9781351233354.


**REFERENCES:**


1. George Vosselman and Hans-Gerd Maas, "Airborne and Terrestrial Laser Scanning", Whittles Publishing, 2010.
2. Matti Maltamo, Erik Næsset, JariVauhkonen, "Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies", Springer, Dordrecht , Reprint Edition,2016, ISBN 978- 94-017-8662-1.
3. Michael Renslow, "Manual of Airborne Topographic LiDAR", The American Society for Photogrammetry and Remote Sensing, 2013.
4. Wujanz D, "Terrestrial laser scanning for geodetic deformation monitoring", Technische Universitaet Berlin (Germany), 2016.
5. Renslow M, "Manual of Airborne Topographic Lidar", 2013. https://www.asprs.org/pressreleases/order-the-asprs-airborne-topographic-lidar-manual.html
6. LAStools Tutorials - https://rapidlasso.com/category/tutorials/
7. Keranen K and R Kolvoord, "Making Spatial Decisions Using GIS and Lidar: A Workbook", 2015. http://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=291


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 1 | 1 | 2 | - | 3 | 3 | 1 | - | - | 2 | 3 | 2 | 1 |
| 2 | 3 | 2 | 2 | 2 | 1 | - | - | - | 2 | - | - | 2 | 3 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 2 | - | 3 | 2 | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 2 | - | - | 2 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 2 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | - | - | 2 | 3 | 3 | 2 |

1' = Low; '2' = Medium; '3' = High

**GI23503 SPATIAL ANALYTICS L T P C**
**2 0 4 4**

**UNIT I RASTER ANALYSIS 6L+12P**

Raster data exploration: Query analysis - Local operations: Map algebra, reclassification, logical and arithmetic overlay operations - Neighborhood operations: Aggregation, filtering - Extended neighborhood operations - Zonal operations - Statistical analysis - Cost - Distance analysis - Least cost path.

**PRACTICALS:**

1. Univariate and multivariate statistics and query analysis
2. Map algebra: image ratio, index, arithmetic and logical overlay.
3. Focal and zonal operations
4. Neibourhood
5. Cost surface
6. RGB to IHS

**UNIT II VECTOR ANALYSIS 6L+12P**

Non-Topological analysis: Attribute database query, Structured Query Language, coordinate transformation, summary statistics, calculation of area, perimeter and distance - Topological Analysis: Reclassification, aggregation, overlay analysis: Point-in-Polygon, Line-in-Polygon, Polygon-on-Polygon: Clip, erase, identity, union, intersection - Proximity analysis: Buffering.

**PRACTICALS:**

1. Point, line and polygon data
2. Statistics generation and reclassification.
3. Overlay and Cost weighted overlay.
4. Proximity–Buffer analysis
5. Point and line statistics

**UNIT III NETWORK ANALYSIS 6L+12P**

Network - Introduction - Network data model - Elements of network - Building a network database - Geocoding - Address matching - Shortest path in a network - Time and distance based shortest path analysis - Driving directions - Closest facility analysis - Catchment/Service area analysis - Location - Allocation analysis.

**PRACTICALS:**

1. Network data creation
2. Distance calculation
3. Shortest distance, shortest time analysis
4. Geocoding.
5. Short route analysis.
6. Service area

**UNIT IV SURFACE AND GEOSTATISTICAL ANALYSIS 6L+12P**

Surface data - Sources of X, Y, Z data - DEM, TIN - Terrain analysis - Slope, aspect, viewshed, watershed analysis:: Watershed boundary, Flow direction, flow accumulation, drainage network, spatial interpolation: IDW, Spline, Kriging, Variogram. 3D analysis – intervisibility and line of sight analysis, 3D topology – buffer, difference, near and union, 3D interpolation – point, line and polygon, volume, area and cut and fill calculations, Volumetric 3D Mesh, vertical profiles across linear features, 3D Simulations and predictions. Integrating BIM and GIS

**PRACTICALS:**

1. Interpolation techniques
2. Geostatistics
3. DEM creation

4. View shed analysis and Watershed Delineation
5. Viewshed analysis 6. Change detection

**UNIT V CUSTOMISATION, WEBGIS, MOBILE MAPPING 6L+12P**

Customization of GIS: Need, uses, scripting languages - Embedded scripts - Use of Python script - WebGIS: WebGIS architecture, advantages of WebGIS, web applications - Location Based Services: Emergency and business solutions - Big data analytics.

**PRACTICALS:**

1. Scripting/embedded scripts.
2. Batch Processing and Web GIS demo.
3. Web application interface

**TOTAL: 30 L + 60 P = 90 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Aware of different tools available in GIS for Raster and Vector data analysis.
**CO2:** Understand GIS functionalities to analyse network and surface dataset.
**CO3:** Know the possibilities of customization of GIS.
**CO4:** Understand the architecture of Web GIS and its applications.
**CO5:** Aware of concepts of recent techniques like mobile mapping and LBS.

**TEXT BOOKS:**


1. Holly Moore, “MATLAB for Engineers”, Pearson Publications, 6th Edition, 2022.
2. Stephen J Chapman, “MATLAB Programming for Engineers”, Thomson learning, 4th Edition, 2008.


**REFERENCES:**


1. Fausett L V, “Applied Numerical Analysis Using MATLAB”, Pearson Education, 2nd edition, 2007.
2. Amos Gilat, “MATLAB: An Introduction with Applications”, Wiley, 2nd edition, 2020.
3. Hahn B and Valentine D, “Essential Matlab for Engineers and Scientists”, Academic Press, 8th edition, 2020.
4. Rudra Pratap, “Getting Started with MATLAB 7: A Quick Introduction for Scientists and Engineers”, OUP USA, 2016.
5. Huei-Huang Lee, “Programming and Engineering Computing with MATLAB 2022”, SDC Publications, 2022.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | - | 3 | - | 3 | 3 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 2 | - | 3 | - | 3 | - | - | - | - | - | 1 | - | - | 2 | 2 | 2 |
| 3 | 2 | - | - | - | 2 | - | - | - | - | - | - | 2 | 2 | 1 | 3 |
| 4 | 2 | - | 2 | - | | - | - | - | - | - | - | - | 3 | 2 | 1 |
| 5 | 1 | - | - | - | 2 | - | - | - | - | 2 | - | 3 | 2 | 1 | 1 |
| AVg. | 2 | 3 | 2 | 3 | 2 | - | - | - | - | 1 | - | 2 | 2 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23504 | AI / ML FOR GEOINFORMATICS | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**UNIT I INTRODUCTION 9**

Foundation of AI and history of AI intelligent agents: Agents and environments, the concept of rationality, the nature of environments, structure of agents, problem-solving agents, problem formulation - AI problems - Introduction to Machine learning – Methods and applications.

**UNIT II CONCEPTS AND METHODS 9**

Inferential statistics - Hypothesis testing – Spectral Analysis -Fundamental concepts: Learning algorithms, training data, model evaluation, and performance metrics- Introduction to key techniques- Training Data Sets and Accuracy Measures

**UNIT III LEARNING BASED CLASSIFIERS 9**

Linear regression - Classification algorithms: Logistic regression, decision trees, support vector machines, and k-nearest neighbors - Model evaluation: Cross-validation, confusion matrix, precision, recall, F1-score, and ROC curves- Clustering techniques- Association rule learning Association rule learning- Dimensionality reduction.

**UNIT IV ADVANCED METHODS AND APPLICATIONS 9**

Ensemble methods: Bagging, boosting, and random forests- Neural networks: Basics of neural networks, feedforward networks, and backpropagation-Deep Learning: Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs).

**UNIT V APPLICATIONS 9**

Natural Language Processing (NLP): Text classification, sentiment analysis, and language translation- Computer vision: Image recognition, object detection, and image segmentation.- Case studies

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

On completion of the course, the student is expected to be able to

**CO1:** To understand the foundation and history of AI

**CO2:** To apply the concept of Artificial Intelligence and Machine Learning

**CO3:** To understand about learning-based classifiers.

**CO4:** To explore advanced Methods and applications in AI

**CO5:** To apply AI/ML techniques to real-world problems

**TEXTBOOKS:**


1. S. Russell and P. Norvig., “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2010.
2. T V Geetha, S Sendhilkumar., “Machine Learning Concepts, Techniques, and Applications”, CRC Press, 2023. ISBN 9781032268286.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press; Illustrated Edition, 2012.
4. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition,O’Reilly, 2019.


**REFERENCES:**


1. Bratko., Prolog., “Programming for Artificial Intelligence”, Fourth edition, Addison Wesley Educational Publishers Inc., 2011.
2. M. Tim Jones., “Artificial Intelligence: A Systems Approach (Computer Science)”, Jones and

Bartlett Publishers, Inc., First Edition, 2008.
3. Ragav Venkatesan., Baoxin Li., “Convolutional Neural Networks in Visual Computing”, CRC Press, 2017.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | - | - | 2 | 1 | - | - | - | - | - | 3 | 3 | 2 | - |
| 2 | 3 | 3 | - | - | 3 | 1 | - | - | 2 | - | 2 | 3 | 3 | 2 | - |
| 3 | 3 | 3 | 2 | 2 | 3 | | - | - | - | - | - | 3 | 3 | 3 | 2 |
| 4 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | 2 | - | 3 | 3 | 3 | 2 |
| 5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | 2 | 2 | 3 | 3 | 3 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**UC23E01 ENGINEERING ENTREPRENEURSHIP DEVELOPMENT**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
2. Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
3. Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
4. Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
5. Prepare and present an investible pitch deck of their practice venture to attract stakeholders

**MODULE – I: ENTREPRENEURIAL MINDSET** **4L,8P**

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economies – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

**MODULE – II: OPPORTUNITIES** **4L,8P**

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society – Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

**MODULE – III: PROTOTYPING & ITERATION** **4L,8P**

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.

Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

**MODULE – IV: BUSINESS MODELS & PITCHING** **4L,8P**

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest Assumptions in Business Model Design – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

**MODULE – V: ENTREPRENEURIAL ECOSYSTEM** **4L,8P**

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

Upon the successful completion of the course, students will be able to:

CO1: Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types

CO2: Comprehend the process of opportunity identification through design thinking, identify market potential and customers

CO3: Generate and develop creative ideas through ideation techniques

CO4: Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP

CO5: Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

**REFERENCES:**


1 Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition

2. Bill Aulet (2024). Disciplined Entrepreneurship: 24 Steps to a Successful Startup. John Wiley & Sons.

3. Bill Aulet (2017). Disciplined Entrepreneurship Workbook. John Wiley & Sons.

4. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business

5. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch

6. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons

7. Marc Gruber & Sharon Tal (2019). Where to Play: 3 Steps for Discovering Your Most Valuable Market Opportunities. Pearson.

## SEMESTER 6

**GI23601 GEOSPATIAL ANALYSIS WITH PYTHON PROGRAMMING**

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 4 | 3 |

**UNIT I INTRODUCTION TO GEOSPATIAL DATA ANALYSIS 3L**

Overview - Geospatial data formats - Conceptual framework - CRS - Geospatial data portals and APIs- standards - Geospatial data analysis: Potentials and problems- Introduction to Spatial statistics.

**UNIT II PyQGIS FOR GEOSPATIAL ANALYSIS 3L + 24P**

QGIS fundamentals - Installation - Scripting in the python console - IDE - Python plugins - Loading data - Authentication GUIs - Accessing the table of contents - Map canvas - Processing algorithms - Processing history - Graphical modeler - Custom python algorithm - Python on QGIS launch - Geospatial analysis library - Server API basics - QGIS server and python.

**Practicals**

1) Loading Layers, Map Rendering and Printing
   Loading vector and raster data - Attribute reading - Symbology - Labelling- Simple rendering - Rendering layers with different CRS - Output using print layout.
2) Expressions, Filtering and Calculating Values
   Parsing expressions - Evaluating expressions - Handling expression errors.
3) Interactive Maps with Map Canvas and communicating with the User Embedding map canvas - Rubber bands and vertex markers - Using map tools with canvas Add items to map canvas contextual menus- Showing messages - Showing progress - Logging.
4) Developing Python Plugins
   IDE - Writing and debugging - Release.

**UNIT III PYTHON FOR POINT PATTERN ANALYSIS 3L + 16P**

Introduction to PySAL - Shapely - Geopandas - GDAL/OGR - Point pattern - Creating point patterns: lists, numpy arrays, shapefiles - Attributes of PySAL point patterns - Intensity estimates - Point processing: Random patterns, clustered patterns, regular patterns - Centrography and visualization: Central tendency, dispersion and orientation.

**Practicals**

**5)** Geospatial Analysis: Vector Operations - I & II
Buffer - Setback - Multiple buffers - Dissolve - Append - Merge - Select - Query- Network Analysis.

**UNIT IV PYTHON FOR NETWORK AND SURFACE ANALYSIS 3L+12P**

TIGER - OpenStreetMap - OSM to NDS tools - Location-allocation - Vehicle routing - Destination cost matrix - Network analysis library- Graph analysis: Finding shortest paths, areas of availability - PyQGIS network analysis plugins- online routing mapper, travel - Time plugin, pgRoutingLayer - Standalone geospatial applications.

**Practicals**

**6)** Geospatial Analysis: Raster Operations
Surface generation - Surface Analysis

**UNIT V PYTHON FOR REMOTE SENSING 3L+8P**

GEE console and GEE map - Anaconda distribution - Libraries - Managing modules and virtual environments from the built-in Anaconda console - Working interactively in IPython and Jupyter - Working with Optical, SAR and LIDAR Data - TIN - Image Display- Histogram - Image enhancement - Filtering - Clustering and Classification.

**Practicals**

7) QGIS Server and Python
   Server API basics - Standalone or embedding - Server plugins

8) Geospatial Analysis: GEE

Image importing- Preprocessing - Classification

**TOTAL: 75 PERIODS (15 (THEORY) + 60 (PRACTICAL))**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the fundamentals of geospatial data analysis.
**CO2:** Understand advanced Python techniques in a geospatial context.
**CO3:** Attain knowledge of the use of Python in point analysis.
**CO4:** Attain knowledge of the use of Python in network and surface analysis.
**CO5:** Explore the use of Python in processing remotely sensed various satellite imagery.

**TEXT BOOKS:**


1. Joel Lawhead, "Learning Geospatial Analysis with Python Understand GIS Fundamentals and Perform Remote Sensing Data Analysis Using Python 3.7", 3rd Edition, 2019. ISBN:9781789957938, 1789957931.
2. Abdishakur Hassan, Jayakrishnan Vijayaraghavan, "Geospatial Data Science Quick Start Guide", 2019. ISBN: 9781789809336, 1789809339.
3. Allen.D. Silas Toms, Paul Crickard, Eric van Rees, "Mastering Geospatial Analysis with Python", 2018. ISBN: 9781788293815, 1788293819.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 1 | 2 | 3 | - | - | - | 1 | - | - | 3 | 3 | 2 | 1 |
| 2 | 3 | 1 | 3 | 2 | 3 | - | - | - | 1 | - | - | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 2 | 3 | - | - | - | 2 | - | - | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**GI23602 SPATIAL DATA ADJUSTMENT L T P C**
**3 0 0 3**

**UNIT I MEASUREMENT AND ERROR 9**

Definition and significance of spatial data adjustment - Concepts of measurement and Error - Sources of errors in spatial data, types of errors, and their characteristics. - Elementary concepts in probability - Reliability of measurement - significant figures - Error Propagation - linearization – Univariate and Multivariate distribution - Error ellipse - Weights of an observation - Stochastic model and Functional model.

**UNIT II LEAST SQUARES ADJUSTMENT 9**

Introduction - simple adjustment methods - Least squares method - Examples of least squares Problems – Techniques of least squares - Concept of weight - Relation between weights and standard Errors - Statistics of weighted observations - least squares adjustment of indirect Observations – least square adjustment of observations only – Simple problems.

**UNIT III ERROR PROPAGATION AND UNCERTAINTY ANALYSIS 9**

Random events and probability - Random variables - continuous probability distributions – normal distribution - Expectation - measures of precision and accuracy - covariance and correlation - covariance, cofactor, and weight matrices - Introduction to sampling - Derivation of the propagation laws – Examples - Stepwise propagation – Estimate of mean and variance.

**UNIT IV PRE-ANALYSIS OF SURVEY MEASUREMENTS 9**

Pre-analysis procedure - Horizontal angle measurement, Distance measurement, and elevation difference – Survey tolerances – GPS network pre-adjustment data analysis - Database creation using GIS - Modelling - Map layout.

**UNIT V GEODETIC COMPUTATIONS 9**

Rectangular, Polar, and Spherical Coordinates - First and Second geodetic problem - methods of point determinations: intersection, resection, arc section, and with over determinations – Two-Dimensional and Three-Dimensional Transformation adjustments - Application of least squares in processing GPS data - Least squares adjustment of GPS Networks.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Analyzing the data for outliers, blunders, or systematic errors and employing statistical or mathematical techniques to rectify them.

**CO2:** Assess the quality of spatial data, identify potential issues, and implement adjustments to ensure data integrity, completeness, and fitness for specific purposes.

**CO3:** Involves simultaneously adjusting the observations to estimate the most probable values for the unknown.

**CO4:** Provide a general framework for understanding the purposes of spatial data adjustment processes.

**CO5:** Compatibility and interoperability among different datasets facilitate data sharing and integration across different systems or platforms.

**TEXT BOOKS:**

1. Mikhail E M and Gracie G, “Analysis and adjustment of Survey measurements”, Van Nostrand Reinhold Company, New York, 2007, ISBN-10 : 0442253699, 9780442253691.
2. Charles D Ghilani, “Adjustment Computations: Spatial Data Analysis”, 6th edition, 2017, ISBN-10: 9781119385981.

**REFERENCES:**


1. P J G Teunissen, “Adjustment Theory an introduction”, VSSD, 1st edition 2000-2006, ISBN: 9789040719745.
2. U S Coast and Geodetic Survey, “Geodesy: Application of the Theory of Least Squares to the Adjustment of Triangulation (Classic Reprint)”, 2022, ISBN-10: 0656187565.
3. Brinker Russell C Minnick Roy, “The Surveying HandBook Volume-II”, Springer, 2nd edition,1997, ISBN: 9788123905341.
4. Dr. B C Punmia, Er. Ashok Kr. Jain, Dr. Arun Kumar Jain, “Surveying Vol-III”, 16th edition, 2023, ISBN: 9788170088257.
5. Subramanian R, “Surveying and Levelling”, Oxford University Press, 2nd edition, 2012, ISBN-10: 0198085427, ISBN-13 : 978-0198085423.
6. James M Anderson and Edward M Mikhail, “Surveying, Theory and Practice”, McGraw Hill, 7th edition, 2001, ISBN-10: 0070159149, ISBN-13: 978-0070159143.
7. Bannister and S Raymond, “Surveying”, Longman, 7th edition, 2004, ISBN-10: 0582302498, ISBN-13: 978-0582302495.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 4 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

## SEMESTER 7

**GI23701 WEB AND CLOUD BASED GIS L T P C**
**2 0 2 3**

**UNIT I INTRODUCTION TO MARKUP LANGUAGES AND WEBGIS 6T, 6L**

Introduction - HTML, XML, MHTML - HTML elements – CSS elements - Internet and GIS - Web GIS architecture and components - OGC standards: Web services WMS, WFS, WCS, WPS - Open server standards - protocols: HTTP, FTP, SMTP - Frontend & backend programming - Basic file formats (vector, raster) - JSON, GeoJSON - Real time applications.

**PRACTICALS:**

1. Basics of scripting WebGIS using open layers
   a. File Handling (reading/writing)
   b. GUI based application development

2. Display raster and vector data using the Web services like WMS, WFS, WCS, WPS

**UNIT II JAVASCRIPT AND PHP 6T, 6L**

Introduction to Javascript- Data types and variables - Operators, expressions, and statements - Functions - Event handling - Controlling windows & frames and documents - Form handling and validations - Introduction to PHP - Programming basics- Functions - Reading Data in web pages - Embedding PHP within HTML - Establishing connectivity with database - PostgreSQL.

**PRACTICALS:**

1. Spatial data handling in Postgre SQL
   a. Reading of shapefile (point, line and poly) from QGIS
   b. Reading of shapefile (point, line and poly) from table
2. Displaying of PostGIS data, and changing layer symbology
3. Attribute handling, spatial query builder, and making simple query in Postgre SQL.
4. Simple Geo processing (buffer and overlay) in Postgre SQL and display results.

**UNIT III MAPSERVER AND GEOSERVER 6T, 6L**

Introduction - Web administration - OSGeo - Mapserver - Introduction to the Mapfile - Static and dynamic maps - Mapscript- Geo server - Loading and working with data - Shapefile - PostGIS file - Other web format data - Security.

**PRACTICALS:**

1. Displaying of PostGIS data, and changing layer symbology using PHP Mapscript.
2. Embedding openlayers, spatial query builder, and making simple query using PHP Mapscript.
3. Displaying of PostGIS data, and changing layer symbology using Javascript and Geoserver.
4. Making query using Geoserver and Javascript.

**UNIT IV CLOUD MAPPING 6T, 6L**

Introduction to GISC - Cloud and server security - GIS cloud computing deployment models - GIS-C system architecture - Data moving to cloud - Cloud SQL - Cloud-based databases and web editing - Built-in geospatial data analytics tools - Vector tiles - OpenStreetMap - Customized data upload - Thematic mapping - Aggregation tools - Visualization - SaaS solutions - Spatial analysis tools and SaaS - Data sharing protocols.

**PRACTICALS:**

1. Working with GEE
   a. Creating Mosaics
   b. Importing, Clipping, and Exporting

2. Computations on Image Collections in GEE
    a. Cloud Masking
    b. Preparation of time series charts

**UNIT V CLOUD MAPPING PLATFORMS AND APPLICATIONS 6T, 6L**

CARTO - Map editor - Map box - Mango map - GIS cloud - Amazon EC2 - Microsoft Planetary Computer (MPC) - ArcGIS Online - GEE with QGIS - Virtual Machines - Parallel processing - Data sharing and mapping, asset management and environmental streamlining, UPlan, IPLAN, and WATS' Mi community remarks, disaster mitigation and management, multi-agency collaboration and partnerships - Geospatial cloud partners.

**PRACTICALS:**

1. Change detection in GEE
    a. Classification
    b. Accuracy assessment
    c. Exporting results

**TOTAL: 30L + 30P = 60 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the concepts of HTML, CSS, and Web GIS.
**CO2:** Understand the concepts of Javascript and PHP.
**CO3:** Understand the concept of Mapserver and Geoserver.
**CO4:** Understand the fundamentals of cloud mapping.
**CO5:** Understand the various cloud web mapping platforms and their application areas.

**REFERENCES:**


1. Harvey M Deitel, Deitel & Associates, Inc., Abbey Deitel, Deitel & Associates, Inc., “Internet and World Wide Web: How to Program”, Pearson Publication, 5th edition, 2021, ISBN:9780137618279.
2. Thomas Powell, ”HTML & CSS: The Complete Reference”, McGraw Hill, 5th edition, 2010, ISBN-13:978-0071496292.
3. Thomas Powell, Fritz Schneider, “JavaScript The Complete Reference”, TATA McGraw Hill, 3rd edition, 2013, ISBN-13:9781259064685.
4. Steven Holzner, ”PHP: The Complete Reference”, TATA McGraw Hill, 1st edition, 2008, ISBN:9780070223622.
5. Stefano Iacovella, Brian Youngblood, “GeoServer Beginner’s Guide”, Packt Publishing, 2013, ISBN-13:978-1849516686, 2nd revised edition (2017).


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 3 | - | 3 | - | - | - | 2 | - | - | 3 | 3 | 3 | 3 |
| 2 | 3 | 2 | 3 | - | 3 | - | - | - | 2 | - | - | 3 | 2 | 2 | 2 |
| 3 | 3 | 2 | 3 | - | 3 | - | - | - | 2 | - | - | 3 | 2 | 3 | 2 |
| 4 | 3 | 2 | 3 | - | 3 | - | - | - | 2 | - | - | 3 | 2 | 3 | 2 |
| 5 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | - | - | 3 | 2 | 3 | 3 |
| AVg. | 3 | 2 | 3 | - | 3 | - | - | - | 2 | - | - | 3 | 2 | 3 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23702 NATURAL RESOURCE MANAGEMENT WITH GEOMATICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**UNIT I GEOMATICS APPLICATIONS IN AGRICULTURE AND FORESTRY 9**

Crop monitoring and condition assessment - mapping of saline alkaline soils – Crop acreage mapping- Crop yield estimation - optimum land use planning for sustainable agriculture - forest type and density mapping - biomass assessment - timber volume estimation - forest fire mapping and damage assessment - species mapping – Agricultural non-point source pollution studies..

**UNIT II GEOMATICS APPLICATIONS IN HYDROLOGY AND WATER RESOURCE MANAGEMENT 9**

Delineation and codification of watershed - Hydrological Modelling – runoff modelling - Water quality mapping and monitoring – Correlation model for pollution detection- Snow melt runoff - glacier runoff modelling- Flood Risk Zoning - Flood damage assessment - mathematical modelling of groundwater system- interfacing GIS with ground water model- modelling of reservoir siltation- Erosion Estimation using Remote sensing -prioritization of watersheds – watershed modelling for sustainable development.

**UNIT III GEOMATICS APPLICATIONS IN URBAN AND TRANSPORTATION STUDIES 9**

Transportation database and network flows – Vehicle routing and shortest path – location allocation model – Traffic modeling – Route planning – Accident Analysis – Highway maintenance – Transport safety management – Construction and asset management of transport structures – Land-use change and Urban Heat Island Studies - Land suitability analysis/site selection–Urban Object Analysis - Urban climate – Air quality assessment

**UNIT IV GEOMATICS APPLICATIONS IN OCEAN AND COASTAL STUDIES 9**

Biotic and Abiotic resources – Exclusive Economic Zone –Coastal Ecosystem –Potential Fishing Zone mapping - Coastal water quality: HAB and Marine litter monitoring, prediction and risk assessment, Coral bleach, pollution dispersion modelling, Oil spill/slick detection– Wetland mapping- Coastal protection structures –Coastal Regulation Zone mapping–Sea Level Rise Monitoring –Sea water intrusion - Tsunami damage assessment and early warning system.

**UNIT V GEOMATICS APPLICATIONS IN METEOROLOGY 9**

Weather forecasting: Tools and methods – Crop stress and Crop insurance – Forest health: Canopy atmosphere interaction, microclimate and Wild Fires–Site suitability for wind farms - Urban floods, air quality and UHI–Low pressure system detection and monitoring –Cyclone Warning Systemand damage assessment – Storm surge modelling –Ozone depletion and Global warming – Climate policies and actions– Visibility prediction and aviation routing.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- ·On completion of the course, the student is expected to

**CO1:** Understanding of geomatics principles and applicability in agricultural and forestry settings.

**CO2:** Understand the increased awareness of the limitations and challenges associated with implementing geomatics applications in environmental and water resource studies.

**CO3:** Increased ability to use geomatics concepts for site analysis, land use zoning, street network design, and transit planning, resulting in more efficient and sustainable urban environments.

**CO4:** Enhanced knowledge of using geomatics tools such as GIS and remote sensing for studying coastal processes, marine spatial planning, and conservation efforts.

**CO5:** Ability to apply geomatics principles to real-world satellite meteorology case studies, showcasing skills in weather analysis, forecasting, and improving data accuracy

**TEXT BOOKS:**


1. Seelye Martin,"An Introduction to Ocean Remote Sensing", Cambridge University Press, 2nd Edition, June 2014.
2. J.P. Singhal, " Disaster Management", Laxmi Publications, ISBN-10:9380386427, ISBN-13:978-9380386423, 2019.
3. Stojce Dimov Ilcev," Global Satellite Meteorological Observation (GSMO) Applications ", Volume 2 ,Springer, 2018.
4. K.Ramamohan Reddy, B.Venkateswara Rao, C.Sarala, "Hydrology and Watershed Management with a Focal Theme on Ecosystem Resilience—Rural and Urban Water Requirements", 2014.
5. Susan L. Ustin, "Manual of Remote Sensing :Remote Sensing for Natural Resource Management and Environmental Monitoring", John Wiley & Sons Inc, 2004.


**REFERENCES:**


1. Poonam Sharma, "Geospatial Technology and Smart Cities: ICT, Geoscience Modeling, GIS and Remote Sensing", Springer Nature, Switzerland AG, 2021.
2. Karsten Mangor, Nils K. Drønen, Kasper H. Kærgaard, Sten E. Kristensen, "Shoreline Management Guidelines", Publisher: Horsholm, DHI Water & Environment, Denmark, Fourth edition, 2017.
3. Mahesh Gaur, C.B. Pandey & R.K. Goyal, "Remote Sensing in Natural Resources Monitoring and Management". Scientific Publishers, 2016.
4. Su-YinTan,"Meteorological Satellite Systems", International Space University, Springer, 2014.
5. Tim Davie, Fundamentals of Hydrology 3rd Edition, Routledge. 2019.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 | | 2 | 3 | 3 | 3 | 3 | 3 | | 3 | | 3 | 3 | 3 | 3 | 3 |
| 4 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

| GI23703 | GEOGRAPHIC INFORMATION SYSTEM FOR CLIMATE AND DISASTER RISK ASSESSMENT | L T P C 3 0 0 3 |
|---|---|---|

**UNIT I OVERVIEW OF CLIMATE CHANGE AND DISASTER MANAGEMENT 9**

Climate Change - Hazards and Disasters - Overview of international agreements - Climate model - GCM – Regional Models - Sectoral models – CMIP - Performance Indicators for Evaluating GCMs - Policy Frameworks and Instruments for Climate Change Mitigation and adaptations - Policy Frameworks for Disaster Management - Disaster Risk Reduction for SDG Achievement – IPCC and Sendai Framework for Disaster Risk Reduction.

**UNIT II FLOOD, DROUGHT AND COASTAL RISK ASSESSMENT 9**

Changes in precipitation patterns and hydrological cycles- Flood and Drought Risk assessment - Remote Sensing Applications in Agricultural Drought Monitoring and Forecasting - Satellite sensors and imagery for Water Resources –Spectral Indices (NDWI, MNDWI) – Hydrological parameter estimation using RS & GIS; Digital Elevation Model (DEM), hydro-processing, drainage network and pattern, watershed delineation - Application of hydrologic models in present and future resources assessment - GIS application in hydrological models – Coastal Hazards – Coastal erosion and Inundation mapping- Storm Surge Hazard Mapping, Vulnerability Analysis- Landslide Hazard Mapping

**UNIT III AGRICULTURE RISK AND FOREST HABITAT SUITABILITY ASSESSMENT 9**

Interaction between climate systems and agricultural/forest ecosystem - Role of forests in the global carbon cycle - Carbon Dynamics and Forest Management - Application of remote sensing in precision agriculture and forest management - Satellite sensors and imagery for Forest and Agriculture –Spectral Indices (NDBI, NDVI, SAVI, SMI) – Mapping: Cropping Pattern Change Analysis - Layer classification - Modeling and decision support systems - Adaptation and mitigation strategies in agriculture and forest - Carbon credits and markets

**UNIT IV GIS FOR DISASTER PLANNING AND PREPAREDNESS 9**

Geoinformatics models in managing forest fires, floods, landslides, cyclone and earthquake mapping - Essential Disaster Management Map Layers- Common GIS Tasks for Disaster Planning and Preparation Activities- Evacuation Route Planning- Evacuation Zone Planning -Scenario Modeling to Answer What-If Questions - Public Outreach and Citizen Participation- Disaster Response GIS Products- Future of GIS for Disaster Management

**UNIT V CASE STUDIES 9**

Feature Extraction using Google Earth - Geo-referencing Raster Map Images – Field Survey using GPS- Land Use Mapping using ArcGIS- Extraction of Exposure Data from Land Use Map using ArcGIS- Computation of Area Exposed to Hazard using ArcGIS- Generation of Vulnerability Maps using ArcGIS- Generation of Risk Maps and Damage to Properties

**REFERENCES**


1. Brian Tomaszewki (2021) Geographic Information Systems (GIS) for Disaster Management, Routledge, Taylor and Francis
2. Nair, Sreeja S. (2012). Geoinformatics Applications in Disaster Management, Trainer's Module. National Institute of Disaster Management, New Delhi – 110 002.

3. Geographic information system for climate and disaster risk assessment- Training Manual, Climate Change Commission, Manila (2016)
4. Remote Sensing of the Environment - An Earth Resource Perspective. Jensen, J.R., .Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2001
5. Remote Sensing and Image Interpretation, T.M. Lillesand and R.W. Kiefer, John Wiley & Sons, 2000

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** To understand the causes and progress of climate change.
**CO2:** To understand the present scenario and its effect on changing climate.
**CO3:** To apply the knowledge gained in terms of climate dynamics to prepare and mitigate extreme climate.
**CO4:** To analyze the probable causes and plan for the preparedness for future climate anomalies.
**CO5:** To develop a climate resilience resource planning mode using geospatial tools and data.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | | | | | | 2 | 3 | | | 1 | | 3 | | 2 | |
| 2 | 2 | 3 | | 2 | 3 | 2 | | | | | | | | 2 | |
| 3 | 3 | 2 | 3 | 2 | 3 | | | 2 | | | 1 | | 2 | | |
| 4 | | | | 2 | | | 2 | 1 | | | 2 | 2 | | | 3 |
| 5 | 2 | 3 | 3 | | 2 | | | 2 | | | | | 3 | | 3 |
| AVg. | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | | 1 | 2 | 3 | 3 | 2 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High3

**GI23704 SURVEY AND MAPPING PROJECT WITH STANDARDS**

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 3 |

**UNIT I** **3**

Foundation of Geospatial Standards- ISO TC 211 Geospatial / Geomatics Standards- Open Geospatial Consortium- American Society of Remote Sensing & Photogrammetry (ASPRS) Standards- IHO Standards.

**UNIT II** **3**

Spatial Data Quality Standards ISO 19157-1:2023; ISO Metadata Standards ISO19115

**UNIT III** **3**

Open Geospatial Standards – Interoperability- Standards- Web services

**UNIT IV** **3**

ASPRS Positional Accuracy Standards for Digital Geospatial Data – 2024

**UNIT V** **3**

Practicum - Application of Standards in real life- Present Geospatial Case Studies on application

**PROJECT REQUIREMENT** **30**

Students will conduct a mini project utilizing geospatial standards and submit a comprehensive report detailing their findings and methodologies.

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the national and international geospatial standards.
**CO2:** Know about the data quality and metadata standards.
**CO3:** Understand the open geospatial standards.
**CO4:** Understand the positional accuracy standards.
**CO5:** Apply the concepts of Geomatics engineering concepts and standards for suggesting a robust/efficient solution to the Identified Challenge/Problem.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 2 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 5 | 3 | 3 | 3 | 2 | 3 | - | - | 3 | 3 | 3 | - | - | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 2 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

## SEMESTER 8

**GI23801 PROJECT WORK/ INTERNSHIP CUM PROJECT WORK**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 16 | 8 |

**STRATEGY:**

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the evaluation committee constituted by the Head of the Department.

The student can choose to work in the Institute/Department or alternatively can do the Project Work / Long Term Internship in the Industry/Company/Institute of Eminence.

**TOTAL: 240 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Identify Engineering challenges/problems which require the use of Geomatics domain.
**CO2:** Do the review of literature and identify the gaps/weakness in existing solutions to the identified challenge/problem.
**CO3:** Identify appropriate techniques to analyze complex engineering problems.
**CO4:** Apply the concepts of Geomatics Engineering for suggesting a robust/efficient solution to the Identified Challenge/Problem.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | - | 3 | - | - | - | - | 3 | 2 | - | - | 3 | 3 | - |
| 2 | 3 | 3 | - | 3 | - | - | - | - | 3 | 2 | - | - | 3 | 3 | 2 |
| 3 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | - | 3 | 3 | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | - | 3 | - | - | - | 3 | - | 3 | 3 | 3 | 3 | 3 |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| AVg. | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

## PROFESSIONAL ELECTIVE COURSES (PEC)

## VERTICAL I: SURVEYING AND MAPPING

**GI23001 TERRESTRIAL AND SATELLITE PHOTOGRAMMETRY L T P C**
**3 0 0 3**

**UNIT I FUNDAMENTALS OF TERRESTRIAL AND CLOSE-RANGE PHOTOGRAMMETRY 9**

Terrestrial cameras - Metric and non-metric cameras - Photo theodolites - Stereometric cameras - Photogrammetric process, systems, products - Aspects - Image forming model - Coordinate systems - Transformations - Adjustment techniques - Geometric elements - Horizontal and vertical angles from terrestrial photographs - Camera azimuth.

**UNIT II IMAGING SYSTEMS 9**

Imaging concepts - Geometric fundamentals - Imaging systems - Targeting and illumination - Image preprocessing - Geometric image transformation - Digital processing of single images - Image matching and 3D object reconstruction.

**UNIT III ANALYTICAL METHODS 9**

Orientation methods - Bundle triangulation - Object reconstruction - Line photogrammetry - Multimedia photogrammetry - Panoramic photogrammetry - Analytical self-calibration - Statistics - Matrix equations for analytical self - Calibration - Initial approximations for least square adjustments - Solution approach for self-calibration adjustment - Control for terrestrial photogrammetry - Analytical determination of horizontal position of a point from photographic measurement - Graphical method.

**UNIT IV PHOTOGRAMMETRIC MEASURING SYSTEM 9**

Comparators - Single camera systems - Stereoscopic processing systems - Multi image measuring systems - Systems of surface measurement - Project planning - Camera calibration dynamic photogrammetry - Close range aerial imagery.

**UNIT V APPLICATION OF TERRESTRIAL AND CLOSE RANGE PHOTOGRAMMETRY 9**

Architecture and cultural heritage - Engineering surveying and civil engineering - Industrial applications - Forensic application - Medicine - Criminology - Structural studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Describe fundamental concepts in terrestrial and close-range photogrammetry.
**CO2:** Describe the imaging systems.
**CO3:** Use analytical methods in parameter estimation.
**CO4:** Use photogrammetric concepts in measurement.
**CO5:** Application of terrestrial and close-range photogrammetry in the problem domain.

**TEXTBOOKS:**


1. Paul. R Wolf., Bon A.DeWitt, Benjamin E. Wilkinson, “Elements of Photogrammetry with Application in GIS”, McGrawHill International Book Co., 4th Edition, 2014.
2. Luhmann, Thomas, Robson, Stuart, Kyle, Stephen and Boehm, Jan. “Close-Range Photogrammetry and 3D Imaging”, Berlin, Boston: De Gruyter, 2020. https://doi.org/10.1515/9783110607253.
3. Thomas Luhmann, Stuart Robson, Stephen Kyle, Ian Harley, “Close range photogrammetry Principles, techniques and applications”, Whittles Publishing, 2011. ISBN 978-184995-057-2 Print edition 978-1870325-50-9.
4. Alex Alvarez, Reg Downing , “Image Based Modeling : Advanced 3D Modeling from Panoramas”, 2005.
5. Wilfried Linder, “Digital Photogrammetry, A Practical Course” 4th edition, 2016.
6. Atkinson, “Development in Close Range Photogrammetry - I”, Development series, 1988.

**REFERENCES:**


1. Gollfried Konecny, “Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems”, CRC Press, 2nd Edition, 2014. ISBN: 9781420068566.
2. Karl Kraus, “Photogrammetry: Geometry from Images and Laser Scans”, Walter de Gruyter GmbH & Co. 2nd Edition, 2007.
3. 3.E.M.Mikhail, J.S.Bethel, J.C.McGlone, “Introduction to Modern Photogrammetry”, Wiley Publisher, 2001.
4. E.M.Mikhail, J.S.Bethel, J.C.McGlone, “Introduction to Modern Photogrammetry”, Wiley Publisher, 2012. ISBN: 978-8126539987.
5. Karara, H.M., “Non topographic Photogrammetry”, 2nd Edition American Society for Photogrammetry and Remote Sensing, 1989.
6. American Society of Photogrammetry and Remote Sensing, 4th Edition, 2013.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - | - |
| 2 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - | - |
| 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | - | - |
| 4 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | 3 | - | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 3 | - | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23002 | GNSS SURVEYING | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**UNIT I INTRODUCTION TO GNSS 9**

Overview - History and evolution - GNSS satellite orbits and constellations - Working Principle - Components - Types, features, and specifications of GNSS receivers - Positioning and Navigation with GNSS - Reference Systems - Coordinate Systems - Time Systems - Orbit Determination - Ephemerides.

**UNIT II GNSS SIGNAL AND OBSERVABLES 9**

Signal Structure - Propagation Effects - Receiver Design: Types, Components, Processors - GNSS Observables: Code, Phase, Doppler and Biases - Data Combinations - Atmospheric Effects - Relativistic effects - Antenna Phase Center offset - Multipath - Data Transfer and File Formats - RINEX, NMEA.

**UNIT III GNSS POSITIONING AND DATA PROCESSING 9**

Point Positioning - Differential Positioning - Relative Positioning: Static, Kinematic, Pseudo Kinematic - Phase differences - Data Processing: Cycle slip Detection and Repair - Ambiguity Resolution - Adjustment and Filtering - Network Adjustment - Dilution of Precision - Coordinate Transformations - Height Transformations – SBAS and GBAS.

**UNIT IV GLOBAL GNSS SYSTEMS 9**

History - Segments - Configuration - Services - Signal Structure - New Developments of GPS, GLONASS, COMPASS and GALILEO systems - Comparison - Differential Systems: Space based, ground based - Augmentation Systems: Space based, Ground based - Regional GNSS Systems: QZSS - Applications.

**UNIT V IRNSS GNSS SYSTEM 9**

Introduction - Comparison – Architecture – constellation - satellite design and characteristics - Ground control segment - Signal Characteristics L5, S, and C bands - Data Collection: IRNSS receiver types and specifications - Data Processing and Analysis - Differential correction techniques - Error analysis and quality control - Data Processing - Applications of IRNSS - Challenges and Limitations.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the history, principles and components of GNSS systems.
**CO2:** Analyze GNSS data to derive accurate positioning information.
**CO3:** Apply data processing techniques for surveying and mapping applications.
**CO4:** Demonstrate a comprehensive understanding of various GNSS and Augmentation Systems.
**CO5:** Understand the architecture, data processing and applications of IRNSS GNSS System.

**TEXT BOOKS:**

1. Bernhard Hofmann-Wellenhof , Herbert Lichtenegger , Elmar Wasle, “GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo and more”, Springer Vienna, 978-3-211-73012-6, https://doi.org/10.1007/978-3-211-73017-1.

**REFERENCES:**


1. Elliott D. Kaplan, Christopher Hegarty, “Understanding GPS/GNSS: Principles and Applications”, Artech House; 3rd Edition (2017) ISBN-13: 978-1630810580.
2. Scott Madry, “Global Navigation Satellite Systems and Their Applications”, Springer New York, NY ISBN: 978-1-4939-2608-4, https://doi.org/10.1007/978-1-4939-2608-4.
3. Peter Teunissen and Oliver Montenbruck, “Handbook Of Global Navigation Satellite Systems” by Springer International Publishing, 2017, 978-3-3194-2926-7.
4. Basudeb Bhatta, “Global Navigation Satellite Systems New Technologies and Applications”, 2nd Edition CRC Press 2021, ISBN 9780367474089.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - | 2 |
| 2 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 1 | - | 2 |
| 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 | - | 2 | 2 | 2 |
| 4 | 2 | 1 | 1 | - | - | - | 1 | - | - | - | 1 | 2 | 1 | 2 | 1 |
| 5 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | - | - | - | 1 | 2 | 2 | 2 | 1 |
| AVg. | 2 | 2 | 2 | 2 | 2 | 3 | 1 | - | - | - | 1 | 2 | 2 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23003 | TERRESTRIAL AND BATHYMETRIC LASER SCANNING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I TERRESTRIAL LASER SCANNING 9**

Terrestrial Laser Scanner (TLS) - Measurement Techniques: Pulse and Phase based - Components of TLS - Scanning Mechanism in TLS - Scanning Geometry - Working Principle of TLS - Factors affecting 3D Point Cloud Quality - Commercially available Terrestrial Laser Scanners: Salient Features - Selection of Scanners - Static TLS - Dynamic TLS - Vehicle Mounted and Backpack Wearable Mobile Mapping Laser Scanner.

**UNIT II TLS – PROJECT PLANNING AND DATA ACQUISITION 9**

TLS Project Planning - Eye Safety - Reconnaissance: Visibility - Number of Instrument Stations and positioning to ensure full coverage - Control Point Requirements - Indoor Mapping: Number of Instrument Stations and its position - Data Acquisition Procedures - Georeferencing - Processing Software - Data Quality, Modelling.

**UNIT III TLS APPLICATIONS 9**

Overview of TLS Applications - Topographic Mapping - Asset Management Studies - Tunnel Deformation and Maintenance Studies - Mine: Volume Calculation Studies - Accident/Crime Scene Investigation - Cultural Heritage Preservation Studies - Digital 3D City Model development studies.

**UNIT IV BATHYMETRIC LASER SCANNING 9**

Bathymetric Laser Scanners (BLS) - Types of Laser used in BLS - Working Principle of BLS Waveform Analysis - Secchi Depth - Factors affecting Depth of Penetration of BLS - Project Planning: Flying Height, Scanning Speed, Swath Width, and Point Spacing - Data Acquisition - Processing Software.

**UNIT V BLS APPLICATIONS 9**

Overview of BLS Applications - Preparation of Nautical Charts - Maintenance Dredging in Ports and Harbors - Submerged archaeological sites in shallow water - Shallow Water Bathymetry studies - Coastal Engineering Applications.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the working principle of Terrestrial Laser Scanner.
**CO2:** Summarize the Project Planning and Data Acquisition Procedures.
**CO3:** Understands the applications of TLS in various domains/industry.
**CO4:** Understands the working principle of BLS.
**CO5:** Understands the applications of BLS in various domains/industry.

**TEXT BOOKS:**


1. Yuriy Reshetyuk “Terrestrial laser scanning: Error sources, self-calibration and direct georeferencing”,VDM Verlag (July 9, 2009) Berlin Heidelberg - 2011, ISBN-13: 978-3639175509.
2. George Vosselman, Hans – Gerd Mass, “Airborne and Terrestial Laser Scanning”, Whittles Publishing, 2010. ISBN: 978-1904445-87-6.
3. “Airborne Laser Hydrography – II”, Blue Book II, William Philpot, editor,2019, Available from:https://ecommons.cornell.edu/handle/1813/66666.
4. Jie Shan and Charles K. Toth, “Topographic Laser Ranging and Scanning – Principles and Processing”, 2nd Edition, CRC Press, Taylor and Francis Group, 2018.
5. Pinliang Dong, Qi Chen, “LiDAR Remote Sensing and Applications”, 1st Edition, CRC Press

2018.

**REFERENCES:**


1. Bahadır Ergün (2011), Prof. Chau-Chang Wang (Ed.). “Terrestrial Laser Scanning Data Integration in Surveying Engineering, Laser Scanning, Theory and Applications”,ISBN: 978-953-307-205-0,InTech,DOI:10.5772/14728. Available from:http://www.intechopen.com /books/laser-scanning-theory-and-applications/terrestrial-laser-scanning-data-integration-in-surveying- engineering.
2. Zhilin Li, Qing Zhu, Chris Gold, “Digital terrain modeling: principles and methodology”, CRC Press, 2005.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | - | - | 3 | - | 3 | - | - | - | - | - | 4 | - | - |
| 2 | 3 | 3 | 3 | 3 | - | 3 | 3 | - | - | - | 2 | 3 | 4 | 3 | - |
| 3 | 3 | 4 | 3 | 3 | 3 | - | 3 | - | - | - | - | 3 | 4 | 3 | 3 |
| 4 | 3 | 3 | 3 | - | - | 3 | 3 | - | - | - | - | - | 4 | 3 | - |
| 5 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 3 | 4 | - | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 3 | 4 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23004 | UNMANNED AERIAL SYSTEM (UAS) FOR LARGE SCALE MAPPING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION** **9**

Unmanned Aircraft Systems, History, Classification - Advantages - Aerodynamics and Airframe Configurations - Characteristics of Aircraft Types - Design Standards and Regulatory Aspects - Introduction to Design and Selection of the System for applications - Category of UAVs - Fixed wing - VTOL - Quadcopters – Nano, Mini, Micro – Small, Medium, Large – Launching and Landing methods -Hand - Catapult - Water surface - VTOL - civilian and military category classes.

**UNIT II UAS HARDWARE AND CONTROL SYSTEMS** **9**

Components: Wings - Propellers - Sensors - Pitot tubes - Autopilot or manual operating system - IMU - UAS IP datalink - UAV tracking (antenna) - Mimo tracking antenna - Ground control systems - UAV gimbal - Propeller and accessories - Ground detecting sensors - Wing types and systems - Source of energy- Endurance – Range - Controls - PIO feedback - Modems - Memory system - Simulation - Ground test - Analysis – Troubleshooting, Anti-drone systems.

**UNIT III PAYLOADS FOR UAS** **9**

Sensors: Payloads Dispensable Payloads - Non-Dispensable Payloads - Active Payloads - Passive Payloads –- Special sensors for UAV systems - Payloads: RGB, MSS, LiDAR, Microwave, Thermal, Hyperspectral, Magnetometer – Commercially available sensors: Specifications - Selection criteria of Payloads for various applications.

**UNIT IV OPERATIONAL AND DATA PROCESSING SOFTWARE** **9**

Flight planning - Features of mission planning - Intuitive workflow - Polygon of AOI - Automatic 3D flight planning - Photogrammetry based flight simulation - Oblique and Ortho image coverage - Waypoints - Directional take-off - Real-time flight status – Preprocessing of data - Work flow of UAS photogrammetry - Camera model - Purpose of GCP - Point cloud and mesh – ray cloud DSM - Ortho– mosaic, DTM and other products – Commercial and Open source software.

**UNIT V APPLICATIONS** **9**

Topographic mapping - Volume estimation from point cloud - Surveillance - Wildlife Monitoring – Disaster Management - Resource Applications: Forestry, Agriculture, Water, Archeology, Energy, Land, Glacier - Urban planning – Healthcare – Case studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understanding the different types of UAS and their characteristics.
**CO2:** Synthesize the function of various components.
**CO3:** Know various payload available for mapping.
**CO4:** Plan and process UAS based mapping missions.
**CO5:** Plan and process UAS based mapping missions.

**TEXT BOOKS:**


1. Vahram Dilbaryan “Investigations about the use of UAV photogrammetry and Laser Scanning: Investigation about UAV Photogrammetry and Laser Scan for control of construction works by comparison with CAD model”, AV Akademikerverlag Publisher, 2017, ISBN: 978- 3639871098.
2. Lauren Newman , “Drones (21st Century Skills Innovation Library: Emerging Tech)”, Cherry Lake Publishing, 2017.
3. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010. ISBN: 978-0-470-05819-0.
4. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, 4th Edition, John Wiley

& Sons, Ltd, 2012. ISBN: 9781119978664.

**REFERENCES:**

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001.
2. Kirnon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007.
3. Robert Nelson, “FLIGHT STABILITY AND AUTOMATIC CONTROL”, 2nd Edition, McGraw Hill Education, 2017, ISBN: 978-0070661103.
4. https://www.pix4d.com/education-course-material**.**

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 1 | 1 | 1 | 3 | 2 | - | - | - | - | 2 | - | 2 | 1 | 1 |
| **2** | 3 | 1 | 2 | 2 | 3 | 1 | - | - | - | - | 2 | - | 2 | 1 | 2 |
| **3** | 3 | 1 | 2 | 2 | 3 | 2 | - | - | - | - | 2 | - | 3 | 2 | 2 |
| **4** | 3 | 2 | 3 | 2 | 3 | 1 | - | - | - | - | 2 | - | 3 | 3 | 3 |
| **5** | 3 | 2 | 2 | 2 | 2 | 3 | - | - | - | - | 2 | - | 3 | 3 | 3 |
| **AVg.** | 3 | 1 | 2 | 2 | 3 | 2 | - | - | - | - | 2 | - | 3 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23005 UNDERGROUND AND HYDROGRAPHIC SURVEYING L T P C**
**3 0 0 3**

**UNIT I UNDERGROUND SURVEYING 9**

Introduction: Purpose, methods, advantages - Underground traversing and its constraints, Correlation of underground and surface surveys by different methods: traversing through shafts, assumed bearing, Weiss quadrilateral, Weiss triangle methods - Estimation of errors.

**UNIT II ALIGNMENT AND STOPE SURVEYING 9**

Alignment / Gradient control of vertical and inclined shafts, sinking and raising shafts - Gradient control in development openings - Holing surveys - Fixing center lines for shafts - Measuring subsidence - Determining the true and apparent dip and strike from bore hole data - Determining the deviation in the borehole drilling- Stope surveying - Purpose and advantages - Classification of stope surveying - Methods and instruments used - Documentation of underground structures, mining maps.

**UNIT III HYDROGRAPHIC SURVEYING 9**

Introduction - Shore line survey - Soundings - Datum - Instruments used - Horizontal and vertical controls - Methods of locating soundings - Plotting of soundings - Coast lining - Planning and data processing the tides - Prediction of tides - Tide gauges - Mean sea level as datum - River surveys - Measurement of current and discharge - Bathymetric measurements.

**UNIT IV GROUND PENETRATING RADAR SURVEY 9**

Electromagnetic principles of GPR - Electrical and magnetic properties of rocks - Soil and fluids - Types of GPR - Measurement configuration - Bands and polarizations - Manual and vehicle mounted GPR - Salient technical features of commercially available GPR - Ground penetrating radar surveys: Reflection survey - Multi source - Multi receiver - Data processing: Dewow - Time - Gain - Deconvolution - Migration - Topographic correction - Signal optimization, modulation, processing and filtration - Modeling and analysis - Processing software (commercially available & RGPR)- Other geophysical surveys for subsurface investigation.

**UNIT V APPLICATIONS 9**

Applications in ground water resources: Depth to water from the land surface - Archaeological science: Identification and mapping buried structures - Mapping of underground utilities like power cables - Pipelines and other buried utilities - Containment mapping. - Imaging shallow stratigraphy: Delineation of soil profiles to shallow depth - Geological mapping: Depth to bedrock, karst features, groundwater contact.

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**

On completion of the course the student is expected to be able to

**CO1:** Plan the underground and hydrographic survey for a given project also capable of extending consultancy service for real time Hydrographic and Mining operations.

**CO2:** Apply the knowledge of different methods of survey to investigate real underground and hydrographic condition

**CO3:** Apply the knowledge of survey to measure stope and traverse underground

**CO4:** Plan the underground and hydrographic investigation program for a given project and also capable of extending consultancy service for real time underground mapping and Foundation Engineering problems

**CO5:** Apply the knowledge of different methods of exploration to select appropriate methods of boring for investigating real field conditions.

**REFERENCES:**

1. George Wood Logan, “Elements of Hydrographic Surveying”, Legare Street Press, 2022, ISBN -13: 978-1015494541
2. Ghatak, S., “Mine Surveying and Levelling – Vol I, II & III“, Coal Field Publishers, Asansol, 2005.
3. Harry M. Jol, “GROUND PENETRATING RADAR: Theory and Applications”, 1st edition, Elsevier Science, 2008, ISBN: 9780444533487.
4. Raffaele Persico, “Introduction to ground penetrating radar: Inverse Scattering and Data Processing”, Y John Wiley & Sons, Inc., Hoboken, New Jersey, 2014.
5. Annan A. P, “GPR Methods for Hydrogeological Studies: in Hydrogeophysics”, edited by Y. Rubin and S. S. Hubbard, Springer, The Netherlands,2005, pp. 185-213.
6. Annan A. P, “Ground Penetrating RADAR: Near Surface Geophysics”, Dwain K. Butler, Society of Exploration Geophysicists, 2005, ISBN: 9781560801306
7. Dr. B. C. Punmia , Er. Ashok Kr. Jain , Dr. Arun Kumar Jain, “SURVEYING VOL. II”, 16th Edition, Laxmi Publications, 2019, ISBN: 9788170088837.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 3 | 2 | 2 | - | - | - | - | - | 2 | 3 | 1 | 2 |
| 2 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 | 3 | 2 | 3 |
| 3 | 3 | 2 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 2 | 2 | 3 |
| 4 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | 2 | 2 | 3 | 2 |
| 5 | 3 | 2 | 3 | 2 | 3 | 3 | - | - | - | - | - | 2 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 3 | 2 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23006 | CADASTRAL SURVEYING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I CADASTRE- INTRODUCTION 9**

History of cadastral survey - Types of survey - Tax - Real Property - Legal cadastre - Graphical and Numerical Cadastre, Legal Characteristics of Records - Torrens System.

**UNIT II METHODS OF SURVEYING 9**

Cadastral Survey Methods - Survey of villages - Instruments used for cadastral survey - Orthogonal, Polar survey methods - Boundary survey - Rectangulation - Town survey - Calculation of area - GPS and Total Station in Cadastral survey.

**UNIT III MAINTENANCE AND MEASUREMENT 9**

Cadastral survey maintenance - FMS: Manual and digital - Resurveys - Measurement of sub - Division – Measurement of obstructed lines - Survey of urban areas - Control requirement for Urban survey use of Satellite Imagery in boundary fixing - Maintenance of accounts.

**UNIT IV LAND INFORMATION SYSTEM 9**

land records in India - Digital conversions of records - NLRMP - DILRMP - Smart cities - Current systems - International and nationals - Digital solutions for land records - Examples - Indian initiatives - Tamil nilam.

**UNIT V MODERN TECHNOLOGY 9**

Current developments - UAV - UAS - Tools and techniques - Laser terrain mapping - Documentation - Data maintenance - Data bases - Block chain technology - Web technology.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the principles of the Cadastral system, records and taxation.
**CO2:** Apply various methods used for surveying, mapping and maintenance of cadastral records.
**CO3:** Know the procedure of maintenance and documentation of land records and the current national developments in this regard.
**CO4:** Update with modern surveying technology and geospatial solutions for creation, maintenance and documentation of land records.
**CO5:** Frame the methodology to create and maintain digital cadastre, LIS, etc.

**TEXT BOOKS:**


1. Peter F.Dale, John D. McLaughlin, “Land Information Management: An Introduction with Special Reference to Cadastral Problems in Third World Countries”, Clarendon Press,1988.
2. George M.Cole &Donald A Wilson, “Land Tenure, Boundary Surveys, and Cadastral Systems”, CRC Press, 2016.
3. “Multipurpose Land Information Systems The Guidebook by The FederalGeodetic Control Committee”, US,1989.


**REFERENCES:**


1. “The (TAMIL NADU) survey and boundaries act - 1923”, Tamil Nadu Act No.VIII.
2. Pertti ONKALO, “Cadastral Survey Methodologies and Techniques in Developing Countries”, 2006.
3. “NLRMP - Guidelines, Technical Manuals and MIS”, 2009.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| 2 | 1 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |
| 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| 4 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 |
| 5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| AVg. | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

## VERTICAL II: GEOSPATIAL DATA ANALYTICS

| GI23007 | GIS CUSTOMIZATION AND SCRIPTING | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |

**UNIT I INTRODUCTION 6+6**

Need for customization in GIS - Introduction to customization environments and platforms - Introducing Python - Introducing model builder - Programming basics - Objects, classes, methods, functions, attributes and variables - Introduction to data types and arguments.

**UNIT II PROGRAMMING IN GIS 6+6**

Objects in GIS - Maps, tables, layers, symbols and features - Programming with objects - Concept of lists, loops, decision structures, strings, inheritance, polymorphism, encapsulation, and abstraction.

**UNIT III GIS DATA ACCESS AND MANIPULATION 6+6**

Reading attribute data - Accessing data fields - Reading through records - Retrieving records using attribute and spatial queries - Working with cursors - Working with raster data - Events and triggers - Reading and parsing text files - Writing geometries - Working with map documents.

**UNIT IV TESTING AND TROUBLESHOOTING 6+6**

Testing concepts - Unit testing, integration testing, recursive testing and performance testing - Troubleshooting and identifying problems - Diagnosis - Using the spyder debugger, printing messages from the geoprocessor - Code standardization and optimization technique.

**UNIT V GIS DEVELOPMENT FRAMEWORKS 6+6**

Introduction to desktop development frameworks (Python, .net, Java) - Web development frameworks (JS, Angular, React, Leaflets) - Mobile development frameworks (Android, IOS, Xamarin) - Database customization frameworks (PL/SQL, Post GIS/Postgres).

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course, the student is expected to

**CO1:** Employ different programming languages commonly used in GIS customization and describe how to use these technologies to expand upon existing GIS software functionality.
**CO2:** Perform object-oriented programming tasks using various programming languages, such as Python.
**CO3:** Analyze procedures and interactions for workflows within GIS.
**CO4:** Program small-scale GIS-based models in Python, integrated within a GIS software.
**CO5:** Recognize and employ general software engineering concepts and good programming methods and practices.

**TEXTBOOKS:**

**1.** Paul Berry, “Head First Python”, 2nd Edition, 2016.

**REFERENCES:**

**1.** Paul A. Zandbergen, “Python Scripting for ArcGIS Pro”, 2020.
**2.** Joel Lawhead, “Learning Geospatial Analysis with Python: Understand GIS Fundamentals and Perform Remote Sensing Data Analysis using Python 3.7”, 3rd Edition, 2019.
**3.** Chaowei Yang, “Introduction to GIS Programming and Fundamentals with Python and ArcGIS”, 1st Edition, 2018.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 2 | 3 | 2 | 3 | - | - | 1 | 2 | 1 | 1 | 3 | 2 | 2 | 2 |
| 2 | 3 | 3 | 3 | 2 | 3 | - | - | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |
| 3 | 2 | 2 | 2 | 3 | 3 | - | - | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |
| 4 | 2 | 3 | 3 | 2 | 3 | - | - | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |
| 5 | 2 | 2 | 1 | 1 | 2 | - | - | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 1 |
| AVg. | 2 | 2 | 3 | 2 | 3 | - | - | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23008 LOCATION BASED GEOSPATIAL SERVICES L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**

Introduction - Evolution of location based services (LBS)- Components- Spatial location: Coordinate systems, Datums, Map projections- Spatial database and GIS- LBS Standards- Interoperability- Application areas of location based services - Application taxonomy - LBS privacy - LBS markets and customer segments.

**UNIT II PLATFORM AND ARCHITECTURE 9**

Fundamentals of Positioning- Accuracy and Precision- Indoor and Outdoor platform and communication channel: Integrated and standalone, Network and Terminal-based positioning, GNSS, Cellular networks, WiFi, WLAN, Bluetooth, RFID - Data capture and collection - LBS middleware standards (Open GML,KML) - Mobile platform technologies for LBS- LCS Network Architecture.

.

**UNIT III DATA AND VISUALIZATION TOOLS 9**

LBS Data - Crowdsourcing and open street maps , google earth, google maps, bing maps - Content distribution formats - GeoJSON, GeoRSS, KML - Generating KML's dynamically - Location determination: Indoor GPS, network based positioning techniques, short range positioning, hybrid positioning.

**UNIT IV LBS APPLICATIONS 9**

Vehicle Tracking: Tracking concepts, components of vehicle tracking, online and offline tracking - Alarms used in vehicle tracking, fleet management - Vehicle navigation: Navigation concepts for road, waterways and airways - Components of vehicle navigation, file formats used for navigation - Distress call management.

**UNIT V COMMUNICATION & BUSINESS IN LBS 9**

Location Intelligence- Web GIS- Communication in LBS: Mobile Mapping System- Maps - Issues - Multi model and context aware modes - Emerging sectors - Emerging products - Standard digitization - Legal and social issues.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the evolution and application of Location Based Services.
**CO2:** The concepts of Location Based Services and architecture.
**CO3:** Summarize the tools available for data and visualization of LBS .
**CO4:** Identify the various feasible LBS applications.
**CO5:** Identify the various feasible LBS applications.

**TEXT BOOKS:**


1. Allan Brimicombe, Chao Li, "Location-Based Services and Geo-Information Engineering", August 2009, ISBN: 978-0-470-85737-3.
2. Jochen Schiller & Agnes Voisard, " Location - Based Services", Morgan Kaufmann Publishers, 2004.
3. Richard Ferraro & Murat Aktihanoglu, "Location-Aware Applications", Manning Publications Company, 2011.
4. Syed A. Ahson& Mohammad Ilyas, "Location-Based Services Handbook: Applications, Technologies, and Security", CRC Press, 2010.

**REFERENCES:**

**1.** Next Generation Location Based Services for Mobile - Sidney Shek CSC , http://assets1.csc.com/lef/downloads/CSC_Grant_2010_Next_Generation_Location_Based_Services_for Mobile_Devices.pdf

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 2 | 1 | 1 | 3 | 1 | - | - | - | - | - | - | 3 | 2 | 1 |
| **2** | 3 | 2 | 2 | 1 | 3 | 1 | - | - | - | - | - | - | 3 | 2 | 2 |
| **3** | 3 | 2 | 2 | 2 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | 3 |
| **4** | 2 | 2 | 1 | 2 | 1 | 2 | - | - | - | - | - | - | 2 | 3 | 3 |
| **5** | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 2 |
| **AVg.** | 3 | 2 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | 3 | | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23009** **SPACE SYNTAX** **L T P C**
**3 0 0 3**

**UNIT I PUBLIC SPACE AND HUMAN BEHAVIOR 9**

Types of space - Foucault's theory - Heterotopic sites - New urbanism, Spatial order, evolution of urban design - Space and human response - Theories of human behavior, the ambient environment - Temperature, sound, smell, illumination, shapers of space, location based visualization, maps and drawing.

**UNIT II GEOMATICS PLANNING TOOLS 9**

Visualization - 2D and 3D representation of space - High resolution data - Satellites, UAVs, ; Urban land cover classification, decision tree, support vector machines and other machine learning methods; Built up area estimation and urban typology - Population data, trip data, traffic data and network data - Pedestrian and traffic count analysis - Layout analysis - Creating urban land cover / typology map.

**UNIT III GIS NETWORK ANALYSIS 9**

Network data model - Topology considerations - Network database - Geocoding - Address matching - Time and distance based route analysis - Density maps - Service area analysis - OD matrix - Vehicle routing - Location allocation problems - Creating transportation network for an area.

**UNIT IV SPACE SYNTAX METHOD 9**

Space and society - Functions of cities - Theory of spatial combinatorics and natural movement - Centrality concept - Extrinsic spatial properties; Space syntax metrics: Convex space, isovist fields, and the axial line - Urban grid, justified graph, depth and total depth analysis: Connectivity, axial integration, global and local radii, syntactic step analysis, recent concepts.

**UNIT V APPLICATIONS 9**

Sustainable city debate - SDG and space syntax - Accessibility analysis of public facilities - Street network, urban planning, archeology, economy; Hand on qualifying the location suitability of a public utility.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understanding the importance of planning of public spaces based on its effect on the human behavior for a justifiable decision on locating and designing public space in an urban area.

**CO2:** Develop knowledge on geospatial tools and technique for characterizing urban space based on its geometric pattern with remote sensing data.

**CO3:** Familiarization with the space concepts of urban spaces and topology based geospatial tools for organizing, analyzing and qualifying the urban spaces for and efficient refurbishment.

**CO4:** Understanding the space syntax concepts, theories and the metrics to characterize urban space based on their stake on human behavior so as to use them as inputs for planning.

**CO5:** Apply the knowledge in the concepts of space syntax and the tools to have a hands on experience with the available data sets about a city and to apply on other suitable applications.

**REFERENCES:**

1. B. F. Skinner, "Science and human behavior", Pearson Education, Inc, Library of Congress Catalog Card Number: 53-7045 , 2014.

2. MGH Bell, Y.Lida, “Transportation network analysis”, John Willey and sons, ISBN: 0-471- 96493-X.
3. Yosef Sheffi, “Urban Transportation Networks: Equilibrium analysis with Mathematical Programming Methods”, Prentice Hall, ISBN: 0-13-939729-9.
4. Akkelies van Nes , Claudia Yamu (2021), “Introduction to Space syntax in urban studies”, Springer Link, 2021.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | 3 | 2 | 3 |
| 3 | 2 | 1 | 1 | 1 | 3 | 1 | - | - | - | - | - | - | 3 | 2 | 2 |
| 4 | 2 | 1 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | 3 | 2 | 2 |
| 5 | 2 | 2 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 3 | 3 | 3 |
| AVg. | 2 | 1 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | 3 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23010 GIS BASED UTILITY AND ASSET MANAGEMENT L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**

History of AM/FM Systems - Moving from CAD to GIS - Introducing key components of Utility GIS - Unique utility GIS requirements - Introduction to various products available in the market towards utility GIS.

**UNIT II DATA MODELS 9**

Spatial Data model for GIS- Industry Centric GIS data model- Data models for Electrical utility- Telecom data model – Energy data model – Water and Wastewater data model - Multi utility data model.

**UNIT III DATA COLLECTION METHODOLOGIES 9**

Identify various data to be collected (Primary, Secondary and Tertiary data sources) - Introduction to mobile mapping data collection - Drone based survey - Door - To -Door survey (for consumer index) etc. - Introduction to quality control framework - Implementation of data governance within an organization.

**UNIT IV BUSINESS PROCESS IMPLEMENTATION 9**

Identifying business process - Integration with external systems (ERP, EAM, SCADA etc.) - Introduction to typical electric utility business process - Introduction to typical telco utility business process - Introduction to typical gas utility business process - Introduction to typical water utility business process.

**UNIT V MODERN SYSTEM FOR SMART UTILITIES 9**

Introduction to smart grid initiatives for electric utility - Fiber planning and 5G rollout for telcos , vegetation management using LiDAR/drone imagery via AI/ML systems - Advanced asset identification and management using AI/ML - Building of organizational dashboards using big data and analytics software.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Gain a comprehensive understanding of Utility GIS systems, their history.

**CO2:** Develop proficiency in utilizing data models designed to effectively manage utility data.

**CO3:** Acquire practical skills in various data collection methodologies for utility GIS applications.

**CO4:** Apply knowledge of utility business processes useful to optimize utility GIS systems in an organization.

**CO5:** Gain insights into modern technologies and systems for smart utilities.

**TEXT BOOKS:**


1. Pat Hohl, Keith Mann, “Delivering Water and Power: GIS for Utilities”, 2021, ISBN-13: 978-1589486751, 2021.
2. Bill Meehan, “GIS for Enhanced Electric Utility Performance”, Artech House Power Engineering, 2013, ISBN-13: 978-1608075591.
3. Bill Meehan, “Modeling Electric Distribution with GIS”, 2013, ISBN-13: 978-1589482418.
4. Bill Meehan, “Empowering Electric and Gas Utilities with GIS”, 2007, ISBN-13: 978-1589480254.

**REFERENCES:**


1. https://www.ge.com/digital/applications/smallworld-gis-geospatial-asset-management
2. https://www.esri.com/en-us/arcgis/products/arcgis-utility-network/overview
3. https://www.hexagonsafetyinfrastructure.com/products/utilities-and-communications- products/advanced-utility-gis/intergraph-gtechnology


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 2 | 2 | - | 1 |
| **2** | 2 | 2 | 2 | 2 | - | 1 | - | - | - | - | - | - | 3 | - | 1 |
| **3** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | 2 | 3 | 3 | 2 |
| **4** | 2 | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | 2 | 3 | 2 | 2 |
| **5** | 3 | 3 | 2 | 2 | 3 | 1 | - | - | - | - | - | 2 | 3 | 3 | 2 |
| **AVg.** | 2 | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | 2 | 3 | 3 | 2 |

1' = Low; '2' = Medium; '3' = High

**GI23011 GEOSPATIAL MODELLING AND SIMULATION L T P C**
**3 0 0 3**

**UNIT I CONCEPTS OF MATHEMATICAL MODELS 9**

Concepts - Types of models – Merits and Demerits - Examples - Modelling assumptions - Choice of equation - Phenomena and model geometry - Choice of variables and parameters - Data and knowledge acquisition - Model building - Calibration and validation - Results, visualization and inference - Development of model – Challenges.

**UNIT II ATMOSPHERIC MODELING 9**

Study on Atmosphere - Greenhouse effect - Aerosol - Natural and manmade - Ozone depletion - Acid rain - Classification of atmosphere - Modelling of atmosphere - Governing equations weather and climate modelling - Numerical weather prediction model - Global and regional climate models - Air quality model - Gaussian dispersion model.

**UNIT III HYDROLOGICAL MODELLING 9**

Hydrological cycle - Definition - Various components - Rainfall - Runoff model - Groundwater model - Different types; Lumped and distributed- Areal extent of the model - Boundary conditions - Compilation of geological & hydrological information - Model stresses - Model size & discretization - Finite difference & finite element - Interfacing GIS with groundwater model - Modelling the effect of climate change on water resources.

**UNIT IV BIOLOGICAL / ECOLOGICAL SYSTEM MODELLING 9**

Environmental modelling - Needs- Physical process - Integrating forest growth model with GIS - Ecological modelling, GIS & expert system - Regional fish species richness model - Introduction to quantitative methods - Landscape ecology.

**UNIT V SIMULATION MODEL FOR FOREST MANAGEMENT 9**

Types of fires - Empirical approaches to modelling wildland fire - Simulating forest fire regimes - Simulation of broadscale fire - Natural forest landscape disturbance - Forest fire - Timber harvesting - Forest management using decision support system - Developing forest management strategies based on fire regimes.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Gain knowledge on concepts for building mathematical models.
**CO2:** Apply mathematical models in hydrology, Atmosphere; Biological / ecological domains.
**CO3:** Develop mathematical models for modelling hydrological phenomena.
**CO4:** Apply Modelling techniques for ecological systems.
**CO5:** Develop simulations for sufficient management of forests.

**REFERENCES:**


1. George F. Pinder, “Groundwater modelling using GIS”, John Wiley & Sons, New York, 2002.
2. Michale N. Demers, “GIS modelling in Raster”, John Wiley & Sons, inc, 2002.
3. Keith C. Clarke, Bradley O.Parks. Michale P.Crane, “GIS & Environmental modelling”, Prentice Hall, Inc. New Jersey, 2002.
4. Meyer, Walter J., “Concepts of Mathematical Modeling “, 2004, ISBN 10: 0070417474 / ISBN 13: 9780070417472.
5. Edward A. Bender, “An Introduction to Mathematical Modeling”, Dover Publication 2003, ISBN 10: 048641180X / 0-486- 41180-X, ISBN 13: 9780486411804.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 2 | 2 | 2 | 3 | 1 | - | - | - | - | - | - | 2 | 1 | 2 |
| **2** | 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 3 | 3 | 3 |
| **3** | 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 3 | 3 | 3 |
| **4** | 2 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 3 | 3 | 3 |
| **5** | 2 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 3 | 3 | 3 |
| **AVg.** | 2 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 3 | | |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23012 SUSTAINABLE DEVELOPMENT GOALS AND GEOMATICS LT P C**
**3 0 0 3**

**UNIT I SDG EVOLUTION 9**

UNDP - Rio Earth summit 1992 - Agenda 21 - Millennium summit - MDGs - World summit on sustainable development - R + 20, rio - Open working group - Post - 2015 Development agenda - 2030 agenda - 2015 agreements and international policy shaping - SDG formulation

**UNIT II 17 SDGs 9**

SDGs - 17 goals - Targets and indicators global sustainable development report 2019 and 2023 - yearly SDG reports ( 2016 to 2022) - Capacity development - International scenario - Geospatial capacity in India - Niti Ayog - Cooperative federalism, sub groups and task force - key initiatives - Verticals - Reports - Model agreements - SDG scope in Tamil Nadu - TNAPCC 2

**UNIT III SDG - WORLD EXPERIENCE 9**

UNDP - Integrated solutions - SDG acceleration tool kits - Global initiative - Covid -19 experience; UN - GGIM - Genesis - Objectives - IAEG-SDGS - Regional committees - Working groups - Build the bridge phases - Collaboration, corroboration and collation.

**UNIT IV GEOMATIC TOOLS FOR GIS 9**

Geospatial technology - Earth observation - Historical and current sensors and technology -Open and costed data products - Geo portals - Application areas - SDG focus indicators - National datasets - Data portals - GIS - Data assimilation - Modeling capabilities - Statistical dis-aggregation

**UNIT V SDG - GEOSPATIAL ROAD MAP 9**

Data availability - Focus indicators - Geospatial Indian story maps - Geo-viable SDG indicators - Water availability - Primary productivity - Building index - Land capability maps - Health indices - Land temperature maps - Watershed characteristics - Climate products from satellites - Assessment of SDG matrix

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Appreciate the importance of sustainable development and the understand history of worlds unified effort to achieve through SDG s and the participation of the partner countries including India to achieve the same.

**CO2:** Understand the relevance of SDG s , the role of the geospatial technology as central idea to realize the SDG s and the status of this technology worldwide.

**CO3:** Acquire the knowledge about the standard geospatial focus indicators to achieve SDGs and evaluate the methodology to formulate them.

**CO4:** Acquire knowledge on the current development, issues, methods and solutions in application of geospatial technology in comprehending the SDGs for a better world future.

**CO5:** Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation efforts and capacity building of geospatial technology to achieve SDGs.

**TEXT BOOKS:**


1. "The sustainable Development Goals" by United Nations: Department of Public Information, 2018, ISBN - 978-9211013696.
2. Dilip Kumar., R.B. SinghRanjeet Kaur., "Spatial Information Technology for sustainable Development Goals (sustainable Development Goals series)", ISBN-13, 978-3319580388, Springer, 1st edition, 2019.
3. Rajabifard., Abbas (Editor)., "Sustainable Development Goals Connectivity Dilemma", ISBN9780429290626, Taylor & Francis, 2022 Open access http:// library.oapen.org/ handle/20.500.12657/24929.
4. SDGs Geospatial roadmap-UN GGIM, https://ggim.un.org/meetings/GGIMcommittee/ 11thSession/documents/The_Geospatial_SDGs_Roadmap_WGGI_IAEG_SDGs_20210804.pdf

**REFERENCES:**


1. UNDP, INEGI, “The SGD s Geospatial Roadmap”, 2019 – OPEN ACCESS.
2. UNDP, UNHABITAT, GLOBAL TASK FORCE, “Road map for localizing the SDG: implementation and monitoring at sub national level”.
3. WWW.NITIAYOG.IN
4. UNDP, “global consultation draft: strategies pathways”, 2020.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 |
| 2 | 3 | 1 | 1 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| 4 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| 5 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

## VERTICAL III - IMAGE PROCESSING AND ANALYSIS

**GI23013 SOFT COMPUTING TECHNIQUES L T P C**
**2 1 0 3**

**UNIT I SOFT COMPUTING AND ARTIFICIAL NEURAL NETWORKS 9**

Soft computing: Introduction - Soft computing vs. Hard computing - Soft computing techniques - Applications of soft computing - ANN: Structure and function of a single neuron: Biological neuron, artificial neuron, definition of ANN, taxonomy of neural net, difference between ANN and human brain, characteristics and applications of ANN, single layer network, perceptron training algorithm, linear separability, widrow & hebbian learning rule/delta rule, ADALINE, MADALINE and BPN.

**UNIT II FUZZY SYSTEMS 9**

Fuzzy Logic: Fuzzy set theory, fuzzy set versus crisp set, crisp and fuzzy relations - Introduction and features of membership functions, fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making.

**UNIT III NEURO FUZZY MODELING 9**

Adaptive neuro - Fuzzy inference systems - Architecture - Hybrid learning algorithm - Learning methods that cross-fertilize ANFIS and RBFN - Coactive neuro fuzzy modeling - Framework neuron functions for adaptive networks - Neuro fuzzy spectrum.

**UNIT IV GENETIC ALGORITHM 9**

Genetic algorithm: Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, bitwise operator, generational cycle, convergence of GA, applications & advances in GA, differences & similarities between GA & other traditional method.

**UNIT V APPLICATIONS OF SOFT COMPUTING IN GEOMATICS 9**

Image registration - Object recognition - Automated feature extraction - Navigation - Integration of soft computing and GIS for flood forecasting and monitoring, landslide susceptibility, highway alignment, smart city planning, agriculture, solid waste disposal.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the concept of soft computing techniques and Artificial Neural Networks.

**CO2:** Gain knowledge about polarimetric processing concepts.

**CO3:** Understand the merits of hybrid computing techniques.

**CO4:** Solve problems using Genetic algorithms.

**CO5:** Use soft computing methods on multidisciplinary problems.

**TEXT BOOKS:**


1. Freeman J.A. and Skapura B.M., “Neural Networks, Algorithms Applications and Programming Techniques”, Pearson, 2002.
2. Jang J.S.R., Sun C.T and Mizutani E., “Neuro Fuzzy and Soft computing” , Prentice hall New Jersey, Pearson, 2015.

**REFERENCES:**


1. JacekZurada.M., “Introduction to Artificial Neural Systems”, Jaico Publishing House, 1992.
2. Timothy J.Ross., “Fuzzy Logic Engineering Applications”, 4th Edition, McGraw Hill, NewYork, 2016.
3. Laurene Fauseett., “Fundamentals of Neural Networks”, Prentice Hall India, New Delhi, 1994.
4. George J.Klir and Bo Yuan., “Fuzzy Sets and Fuzzy Logic”, Prentice Hall Inc, New Jersey, 1995.
5. Nih.J. Ndssen., “Artificial Intelligence”, Harcourt Asia Ltd., Singapore, 1998.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 2 | - | 3 | 2 | - | - | 2 | - | - | 2 | 2 | 3 | 2 |
| 2 | 2 | 2 | 2 | - | 3 | 2 | - | - | 2 | 2 | - | 2 | 3 | 3 | 3 |
| 3 | 2 | 2 | 2 | - | 3 | 2 | - | - | 3 | 2 | - | 3 | 3 | 2 | 2 |
| 4 | 3 | 3 | 2 | 2 | 2 | 3 | | - | 2 | - | - | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 2 | 2 | 2 | 3 | - | - | 2 | - | - | 2 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 2 | 1 | 3 | 2 | - | - | 2 | 1 | - | 2 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23014 POLARIMETRY AND INTERFEROMETRY L T P C**

**3 0 0 3**

**UNIT I BASICS OF SAR POLARIMETRY 9**

Introduction - Electromagnetic waves, pane waves, coherence, polarization ellipse - Polarization types: Circular, elliptical and linear polarization - Amplitude and phase difference - Polarimetric channels: Single, dual, compact, alternative and quadrature polarized waves - Polarimetric representation: Stokes vector and degree of polarization, scattering matrix - Covariance, coherence, stokes and muller matrix - Polarimetry parameters: Total power, co-pol correlation coefficient, co-pol phase difference, degree of polarization and coefficient of variation - Merits and limitations of SAR polarimetry techniques for practical applications.

**UNIT II PROCESSING OF SAR POLARIMETRY DATA 9**

Polarization synthesis - Polarization Signature: Single, double ,multi-bounce scatterers and bragg scatterer - Coherent polarimetric decomposition methods: Pauli, krogager, cameron decompositions and touzi criterion - Incoherent polarimetric decomposition methods: Freeman, huynen-barnes, eigen vector - Eigen value decomposition - Polarimetric classifications: Unsupervised and supervised classifications, scope of machine and deep learning methods - Overview of data formats and software - Prospective technology and processing trends.

**UNIT III BASICS OF SAR INTERFEROMETRY 9**

Basics principle - Interference pattern: Point source, constructive and destructive interference - Interferogram - Interference fringe: Intensity and visibility of fringes - Localization of fringes - Complex SAR image - Interferometric data structure/Single Look Complex data - Classes of SAR interferometry - Single pass/across track, repeat pass/along track and differential SAR interferometry - INSAR viewing geometry - Sensitivities and errors**.**

**UNIT IV PROCESSING OF SAR DATA FOR INTERFEROMETRY 9**

Terrain altitude measurement using INSAR: Baseline estimation, interferogram generation, orbital flattening, phase unwrapping: Branch cuts, fringe detection and absolute phase determination, phase to height conversion, geocoding of DEM - Differential INSAR: - Multipass geometry - Multi-interferogram techniques: PSINSAR , SBAS and SqueeSAR - 2D-displacement estimation - Precision assessment and validation: Atmospheric contribution, phase noise sources: Look angle and temporal decorrelation effect, volume scattering effect, data availability, software availability, limitations and future trends.

**UNIT V MISSIONS AND APPLICATIONS 9**

Missions: TerraSAR X, ERS 1and2, ENVISAT, RADARSAT, ALOS, RISAT, Sentinel 1 and GRACE satellite - Polarimetric Applications: Soil tillage, crop productivity - Snow mapping - Sea - Ice structure and type - Forest type mapping - Soil moisture mapping - Soil salinity estimation - Flood/Wetland mapping - Marine winds - Oil slick detection - Ship detection. Interferometric applications vegetation height estimation - Tectonic deformations: Pre, co-and post-seismic deformations - Ground subsidence: Oil and ground water extraction, Mine subsidence - Landslide detection - Reclaimed land monitoring - Glacier monitoring: Regular ice stream movement and tidal flexing of glaciers - Volcanic inflation and deflation.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the basic concepts of Polarimetry and Interferometry.
**CO2:** Acquaint with the concepts of uncertainty and its impacts on artificial intelligence.
**CO3:** Acquire the knowledge about the fundamentals of SAR Interferometry.
**CO4:** Learn about the grammetric concepts of Interferometric techniques.
**CO5:** Familiarize about the applicability of SAR Polarimetry and Interferometry.

**TEXT BOOKS:**


1. Yoshio Yamaguchi., "Polarimetric SAR Imaging Theory and Applications", CRC Press, 2023.
2. Michele Crosetto., Lorenzo Solari., "Satellite Interferometry Data Interpretation and Exploitation", Elsevier, 2023.
3. John R.Schott., "Fundamentals of Polarimetric Remote Sensing", SPIE press, 2010.
4. P.Hariharan., "Basics of SAR Interferometry", Elsevier, 2007.


**REFERENCES:**


1. AlessandroFerretti., "Satellite InSAR data: Reservoir monitoring from Space", EAGE Publications, 2014.
2. Alessandro Ferretti., Andrea Monti-Guarnieri., Claudio Prati., Fabio Rocca., "INSAR principles: Guidelines for SAR Interferometry processing and interpretation", ESA Publications,2007.
3. Woodhouse Iain. H., "Introduction to Microwave Remote Sensing", Taylor & Francis, 1st edition, 2006.
4. V. B. H. (Gini) Ketelaar., "Satellite Radar Interferometry- Subsidence Monitoring Techniques", Springer, 2009.
5. Jong-sen Lee., Eric Pottier., "Polarimetric Radar Imaging :From Basics to Applications", Taylor & Francis Inc,2009.
6 Ramon F. Hanssen., "Radar Interferometry: Data Interpretation and Error Analysis: 2 (Remote Sensing and Digital Image Processing)", Springer, 2001.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | - | - | - | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 | 3 | 2 | 2 | - | - | - | 2 | - | 3 | - | 2 | 3 | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**GI23015 PATTERN RECOGNITION L T P C**
**3 0 0 3**

**UNIT I PATTERN CLASSIFIER 9**

Overview of pattern recognition, Types of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayes theorem - Bayesian belief network, naive bayesian classifier, non-parametric density estimation, histograms, kernels, window estimators.

**UNIT II CLUSTERING 9**

Unsupervised learning - Clustering concept - Hierarchical clustering procedures - Partitional clustering - Clustering of large data sets - EM algorithm - Grid based clustering - Density based clustering.

**UNIT III FEATURE EXTRACTION AND SELECTION 9**

Boundary detectors and descriptors – Template and feature matching – Texture measures- Entropy minimization – GLCM - Karhunen loeve transformation - Feature selection: Filter, Wrapper and Embedded method - Binary feature selection - K-NN.

**UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINES 9**

State machines - Hidden markov models: Maximum likelihood for the HMM, the forward and backward algorithm, sum-product algorithm for the HMM, scaling factors, the viterbi algorithm, extensions of the hidden markov model - Support vector machines: Maximum margin classifiers, relevance vector machines.

**UNIT V FUZZY AND ANN METHODS 9**

Fuzzy classification: Fuzzy set theory, Fuzzy and crisp classification, fuzzy clustering, fuzzy pattern recognition - Introduction to neural networks: Elementary neural network for pattern recognition, hebb net, perceptron, ADALINE, back propagation.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Perform various types of pattern recognition and its applications.
**CO2:** Carry out unsupervised classification suitable for pattern classification.
**CO3:** Perform feature selection algorithms and methods of implementing them in applications.
**CO4:** Carry out Hidden Markov Models and Support Vector Machines for classification.
**CO5:** Apply various advanced classification methods.

**TEXT BOOKS:**

1. Andrew Webb., “Statistical Pattern Recognition”, Arnold publishers, London, Second edition, 2002.

**REFERENCES:**

1. C. M. Bishop., “Pattern Recognition and Machine Learning”, Springer, Second Edition, 2011.
2. R. O. Duda., P. E. Hart., D. G. Stork., “Pattern Classification”, John Wiley, 2001.
3. Narasimha Murthy., V. Susheela Devi., “Pattern Recognition”, Springer 2011.
4. Menahem FriedmanAbraham Kandel., “Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific publishing Co. Ltd, 2020.
5. Robert J. Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., 1992.
6. S. Theodoridis., K. Koutroumbas., “Pattern Recognition”, Fourth Edition, Academic Press, 2009.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 2 | 2 |
| 2 | 3 | 3 | 3 | - | 3 | - | - | - | - | 2 | - | 2 | 3 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |
| 4 | 3 | 3 | 3 | 2 | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |
| 5 | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 2 | 3 | - | - | - | 2 | 2 | - | 2 | 3 | 3 | 2 |

1' = Low; '2' = Medium; '3' = High

**GI23016** **RASTER DATA MODELLING** **L T P C**
**3 0 0 3**

**UNIT I POINT BASED FUNCTION 9**

Image Properties – Reading and writing – Display: Zoom, Pan – Histogram: Brightness, Contrast – Univariate and multivariate statistics –- Pyramids - Enhancements: Linear, Non-linear, scale space transformation- Arithmetic, Boolean and overlay operations.

**UNIT II NEIGHBORHOOD AND PROXIMITY ANALYSIS 9**

8-, 4-D- Neighborhood, adjancy, connectivity, distance, path - Texture: Types, criteria, statistical metrics, region growing, Buffers (point, line, area) – Co-occurrence matrix, cellular propagation and weighted propogation – Medial axis transformation.

**UNIT III AREA DESCRIPTORS/ BOUNDARIES 9**

Regions, zonal operators: Single layer and multi-layer operations, Statistical and geometric computation – Area, Shape numbers, Perimeter, Aspect ratio, Boundaries – ROI, subset creation - Point in polygon - Line in polygon - Overlay analysis.

**UNIT IV MULTILAYER MODELING 9**

Image ratio - Indices – Image Normalization: Mean, Standard deviation based - Image fusion- Similarity measures: Maximum likelihood classification: Feature vectors, Training statistics, supervised and unsupervised- MCDM: AHP, Delphi evidence based Methods.

**UNIT V STATISTICAL METRICS 9**

Mean - Mode - Standard deviation - Correlation - Regression – Variance, covariance, Co-occurrence - kappa statistics – ROC, AOC - Random, stratified and systematic sample selection – Data quality metrics.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course, the student is expected to

**CO1:** Acquaint with the raster data structure and its relevance in from pint based, neighborhood based and region based geospatial data analysis.

**CO2:** Understand the various raster based data modeling applied on the earth observation data for resource management.

**CO3:** Evaluate theprocedures of spatial data handling using raster data model for solving resource management problems.

**CO4:** Acquire knowledge on the current development, issues methods and solutions in raster data analysis using earth observation data.

**CO5:** Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of geospatial data modeling.

**TEXT BOOKS:**


1. “Land Information Management: An Introduction with Special Reference to Cadastral Problems in Third World Countries”, by Peter F.Dale, John D. McLaughlin,1988.
2. “Land Tenure, Boundary Surveys, and Cadastral Systems” by George M.Cole &Donald A Wilson,2016.
3. “Multipurpose Land Information Systems The Guidebook” by The FederalGeodetic Control Committee, US,1989.


**REFERENCES:**


1. The (TAMIL NADU) survey and boundaries act, 1923, Tamil Nadu Act No.VIII.
2. “Cadastral Survey Methodologies and Techniques in Developing Countries”, Pertti ONKALO, 2006.
3. NLRMP - Guidelines, Technical Manuals and MIS,2009.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| 2 | 1 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |
| 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| 4 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 |
| 5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| AVg. | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23017 AGRICULTURE AND FOREST MANAGEMENT USING GEOMATICS L T P C**
**3 0 0 3**

**UNIT I CROP INVENTORY AND REMOTE SENSING 9**

Introduction - Leaf optical properties - Identification of crops and crop inventorying - crop acreage estimation - Vegetation indices - Yield estimation - Crop production forecasting through digital analysis - Microwave and hyper spectral sensing for crop inventory - Crop monitoring and condition assessment
- Case studies.

**UNIT II REMOTE SENSING FOR SOIL 9**

Introduction - Soil survey, types of soil surveys - Soil genesis and soil classification - Soil taxonomy - Soil reflectance properties - Soil mapping using remote sensing - Problem soils - Saline, alkali soil characteristics - Mapping of saline alkaline soils-soil erosion and sedimentation - Assessment of soil erosion - Estimation of reservoir capacity.

**UNIT III LAND EVALUATION AND MANAGEMENT 9**

Introduction - Land use/Land cover definition - Land use/ Land cover classification - Concepts and approaches of land evaluation - Change dynamics - Land capability assessments - Decision support system for land use planning - Optimum land use planning for sustainable agriculture.

**UNIT IV DAMAGE ASSESSMENT 9**

Introduction - Damage by pests and diseases - Crop loss assessment by floods - Flood hazard zone mapping- Remote sensing capabilities and contributions for drought management - Land degradation due to waterlogging and salinity - Cropstress - Reflectance properties of stressed crops - Identification of crop stress - Agricultural insurance in India - CCIS, ECIS, FIIS and NAIS.

**UNIT V FOREST MANAGEMENT 9**

Introduction - forest taxonomy - Inventory of forests-forest type and density mapping - Biomass assessment - Timber volume estimation - Factors for forest degradation - Mapping degraded forests deforestation and afforestation - Forest fire mapping and damage assessment - species mapping - sustainable development of forests.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Characterize the crops using Remote Sensing tools.
**CO2:** The concepts of soil mapping through remote sensing.
**CO3:** The evaluation of land capability for better land use planning.
**CO4:** Acquire Knowledge in damage assessment using remote sensing.
**CO5:** Understand the forest management using remote sensing.

**TEXT BOOKS:**


1. “Applications of Remote Sensing in Agriculture”, Elsevier Science, 2013.
2. Mutlu Ozdogan, Yang Yang., “Remote Sensing of Agricultural crops & Vegetation”, Excelic press, 2020.
3. Steve E. Franklin., “Remote Sensing for Sustainable Forest Management”, CRC Press, 2001.
4. Srinivas,M.G., “Remote Sensing Applications”, Narosa Publishing House, 2001.
5. Andrew Rencz., “Manual of Remote Sensing. Vol.3. Edn.3. Remote Sensing for the Earth Sciences, American Society for photogrammetry and Remote Sensing”, John Wiley& Sons, 1999.

**REFERENCES:**


1. Jensen,J.R., “Remote Sensing of the Environment -An Earth Resource Perspective”. Pearson Education India; 2nd edition , 2013.
2. Mahesh Gaur, C.B. Pandey & R.K. Goyal., “Remote Sensing in Natural Resources Monitoring and Management”, Scientific Publishers, 2016.
3. Agarwal,C.S. and P.K.Garg, “Remote Sensing in Natural Resources Monitoring and Management”, WheelerPublishing, 2000.
4. Narayan,L.R.A., “Remote Sensing and its Applications”, Universities Press (India) Ltd., , 2001.
5. A.K.Singh &U.K. Chopra., “Geoinformatics Applications in Agriculture”, New India Publishing Company, 2007.
6. Peter James Eredics., “Mapping Forestry”, ESRI Press, 2010.
7. Nicholas Baghdadi, Clement Mallet, Mehrez Zribi., “QGIS & applications in Agriculture and forest”, John wiley &Sons, 2018.
8. Ravi Shankar Dwivedi., “Remote Sensing of Soils”, Springer, 017.
9. G.P.Obi Reddy, S.K.Singh., “Geospatial Technologies in Land Resource Mapping, Monitoring and Management”, Springer International Publishing, 2018.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | - | 1 | 1 | - | 3 | 3 | 2 | 1 |
| 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | - | 1 | 1 | - | 2 | 3 | 2 | 3 |
| 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | - | 2 | 3 | 2 | 1 |
| 4 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | - | 3 | 3 | 2 | 3 |
| 5 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | - | 2 | 1 | - | 2 | 3 | 2 | 2 |
| AVg. | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | - | 2 | 3 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23018 SPATIAL STATISTICS L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**

Introduction - Datatypes - Visualization - Spatial correlation review of non-spatial statistics - Spatial data - Overview of different types of spatial data - Exploratory spatial data analysis - Grid based Statistics - Metrics point sets - Distance statistics - Data clusters - Spatial autocorrelation - Spatial data visualization and exploration - Introduction to statistical tools needed for spatial analysis.

**UNIT II STATISTICAL PARAMETERS AND MODELS 9**

Mean and covariance functions - Stationary, isotropic - Matern covariance - Smoothness properties Positive definiteness - Random fields - Parametric models for the spatial correlations - Gaussian processes - Definition - Properties - Representations such as spectral and convolution - Geostatistical modeling: Approaches and models - Exploratory data analysis techniques in geostatistics - Sampling design, sample size and their implications for geostatistical analysis.

**UNIT III ESTIMATION AND PREDICTION 9**

Variograms and covariance functions - Fitting variogram functions - Variogram models, interpreting, statistical tests, variance decompositions - Maximum likelihood - Bayesian methods - Kriging Spatial Regression - Spatial smoothing - Data visualization - Spatial continuity analysis and modeling - Assessment of uncertainty models.

**UNIT IV AREAL AND POINT PROCESS METHODS 9**

Areal data: Neighborhoods, testing for spatial association - Global and local tests of association - Autoregressive models (CAR and SAR) inference - Estimation/inference; Grids and image analysis - Auto logistic models - Mapping using GIS; Point process data - Types of spatial patterns, spatial randomness - Spatial clustering and testing for clustering - Models and methods.

**UNIT V SPATIAL STATISTICAL MODELS 9**

Spatial autocorrelation - Spatial autoregressive models - Spatio temporal data, Spatio-temporal modelling - Markov models, non-separable models - Multivariate data - Bayesian methods for spatial data - Spatial regression and bayesian kriging - Software for geostatistical modeling - Geostatistical case studies for various applications.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Distinguish different types of spatial data (geostatistical, areal, point process) and understand how spatial autocorrelation plays a role in statistical modeling.
**CO2:** Apply the knowledge of investigating spatial autocorrelation in real time data.
**CO3:** Derive properties (covariance, smoothness, stationarity) of models for spatial data.
**CO4:** Apply the knowledge of spatial models and Bayesian statistics to handle Spatio temporal and Multivariate data.
**CO5:** Choose the appropriate spatial methods to use for different types of data using statistical software and tools.

**TEXT BOOKS:**

1. N. A. C. Cressie, “Statistics for Spatial Data”, John Wiley & Sons, 1993 ISBN:9780471002550.
2. Richard Webster, Margaret A. Oliver, “Geostatistics for Environmental Scientists”, John Wiley & Sons, 2007, ISBN:9780470028582.

**REFERENCES:**

1. Gaetan,C.and Guyon,X , “Spatial Statistics and Modeling”, Springer, 2010.
2. Gelfand, A.E., Diggle,P., Guttorp, P. and Fuentes,M., “Handbook of Spatial Statistics”, CRC Press, 2010.
3. Ricardo A. Olea., “Geostatistics for Engineers and Earth Scientists”, Springer, 1999.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 2 | 3 | 2 | 2 | - | - | - | - | - | 2 | 3 | 1 | 2 |
| 2 | 3 | 3 | 3 | 3 | 4 | 2 | - | - | - | - | - | 2 | 3 | 2 | 3 |
| 3 | 3 | 2 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 2 | 2 | 3 |
| 4 | 3 | 3 | 2 | 3 | 4 | 2 | - | - | - | - | - | 2 | 2 | 3 | 2 |
| 5 | 3 | 3 | 3 | 2 | 4 | 3 | - | - | - | - | - | 2 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 2 | - | - | | - | - | 2 | 3 | 2 | 3 |

1' = Low; '2' = Medium; '3' = High

## VERTICAL IV: GEOSPATIAL APPLICATIONS

**GI23C02 ENVIRONMENTAL GEOINFORMATICS L T P C**
**3 0 0 3**

**UNIT I WATER AND THE ENVIRONMENT 9**

Sources and demands of water - Characteristics of water - Point and non-point sources of water pollution - Spectral responses of clear and contaminated water - Chlorophyll - Remote Sensing of Water quality assessment - Classification of water quality for various purposes, Sampling procedure, quality analysis, Database creation and quality modeling using GIS. Database Creation and designing water supply network, sewerage network using GIS. Runoff estimation - Flood prediction modeling - Aquifer vulnerability modeling.

**UNIT II SOIL CONSERVATION AND MANAGEMENT 9**

Formation of Soils - Classification - Landforms - Soil erosion - Factors influencing soil erosion, soil contamination - Distribution and accumulation of contaminants such as toxic metals, synthetic chemicals in soil – Mining pollution - Methods of conservation - Afforestation - EMR responses with contaminated soil - Modeling soil characteristics using satellite data - Soil degradation assessment using Remote Sensing and GIS - Land reclamation.

**UNIT III SOLID WASTE MANAGEMENT 9**

Definition - Sources - elements of integrated waste management and roles of stakeholders - Seven elements and seven step approach to integrated solid waste management planning, identification of storage and collection location - Analysis of collection route - Site selection: Transfer station, Disposal site - Waste allocation - leachate model - Case studies.

**UNIT IV AIR POLLUTION 9**

Structure and composition of atmosphere – Sources and classification of air pollutants, Air Quality Standards - Chemical and Physical Components - Sampling - Mapping of atmospheric pollution - Air pollution due to industrial activity - Plume behaviors - Dispersion model: Gaussian Plume model - Introduction to commonly used software-based models such as ADMS, AERMOD, CALINE, CALPUFF, DEGADIS, HYROAD, INDUSTRIAL SOURCE COMPLEX, SCREEN, HYSPLIT, INDEX etc. - Remote Sensing to monitor atmosphere constituents - Case Studies.

**UNIT V SENSORS AND DATA FOR ENVIRONMENTAL MONITORING 9**

Sensors for environmental monitoring - sensors - LIDAR- LASER Remote Sensing - EMR - absorption spectrometers - Selection of ground truth sites-sea truth observation - Radar techniques for sensing ocean surface - Thermal measurements - Application of remote sensing for oil slicks mapping - Chlorophyll detection - Fisheries resources - Coastal marine studies - Determination of temperature and sea state.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the possible applications of remote sensing and GIS in water quality analysis and network design.

**CO2:** Understand the possible applications of remote sensing and for soil conservation.

**CO3:** Understand the possible applications of remote sensing and for solid waste management.

**CO4:** Understand the possible applications of remote sensing and for air pollution mapping and modeling.

**CO5:** Understand the possible applications of remote sensing and for climate change perspectives.

**TEXT BOOKS:**

1. Susan L. Ustin., “Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring”, John Wiley& Sons Inc, 2004.
2. Eric Charles Barrett., Leonard Frank Curtis, “ Introduction to Environmental Remote Sensing, Chapman and Hall”, 2nd edition, 1982.

3. Andrew N. Rencz., " Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring", John Wiley & Sons Inc, 3rd Edition, 2004.
4. Baretl, E.C. and Culis I.F., "Introduction to Environmental Remote Sensing", 2nd edition, Chapman and Hall, New York, 2013.

**REFERENCES:**

1. Jr. Lintz, Joseph, David S. Simonett., " Remote sensing of environment Addision Wesley", 1976.
2. Martin Paegelow and María Teresa Camacho Olmedo., "Modelling Environmental Dynamics: Advances in Geomatic Solutions", Springer, 2008.
3. Jonathan Li and Xiaojun Yang., "Monitoring and Modeling of Global Changes: A Geomatics Perspective", Springer Remote Sensing/Photogrammetry, 2015.
4. Robert Scally., "GIS for Environmental Management", ESRI Press, 2006.
5. Andrew Skidmore., "Environmental Modelling with GIS and Remote Sensing", CRC Press, 2017.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| 5 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |

1' = Low; '2' = Medium; '3' = High

**GI23019 TRANSPORTATION GEOMATICS L T P C**
**3 0 0 3**

**UNIT I ENGINEERING SURVEYS AND GEOMETRIC DESIGN 9**

Classification of roads and railways - Alignment surveys and investigations using conventional and remote sensing techniques (preliminary, reconnaissance and final location surveys) - Types of Highway pavements - Design principles of highway geometric elements.

**UNIT II URBAN TRANSPORTATION SYSTEMS AND PLANNING 9**

Urban transportation: policy alternatives - Transportation and the environment - Urban transport planning processes - Socio-demographic data and travel surveys - Transportation modelling - Traffic congestion - Plan evaluation and implementation - Planning and financing - Critiques of transportation modelling and forecasting.

**UNIT III REMOTE SENSING APPLICATIONS IN TRANSPORTATION 9**

Traffic analysis - Accident analysis - Site suitability analysis for transport infrastructure – Population distribution studies - Improving rural road network - Regional road network connectivity - Vehicle tracking - Incident identification and management.

**UNIT IV GIS IN TRANSPORTATION ANALYSIS 9**

Transportation analysis in GIS: Network flows - Shortest path algorithms: Distance and Cost-based - Transportation databases: creation and maintenance - Facility location: Catchment area analysis - Vehicle routing – Route alignment studies: Raster analysis - Highway maintenance - Case studies.

**UNIT V INTEGRATED TRANSPORT MODELS 9**

Land use transport interaction models - Transport environment interaction models - Intelligent Transportation Systems (ITS) - Development - Architecture - Integration with GIS, GPS, IOT – Traffic volume estimation and monitoring - Case studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1**:Understand various highway geometric elements and surveys carried out for highway alignment.

**CO2**:Understand the factors involved in urban transportation planning.

**CO3**:Apply remote sensing techniques for transportation problems.

**CO4**:Apply GIS for transportation analysis.

**CO5:**Gain knowledge on latest developments in transportation planning.

**TEXT BOOKS:**

1. Harvey J. Miller., Shih-Lung Shah, “Geographic Information Systems for Transportation – Principles and Applications”, Oxford University Press, 2001.
2. John Stillwell, Graham Clarke., “Applied GIS and Spatial Analysis”, John Wiley & Sons Ltd, 2004.

**REFERENCES:**

1. Papacostas, C.S, Prevedouros, P.D., “Transportation Engineering and Planning, Prentice- Hall India”, 2015.
2. L.R.Kadiyali., “Transportation Engineering”, Khanna Book publishing Co (P) Ltd, 2021.
3. Jotin Khisty C and B.Kent Lall, “Transportation Engineering-An Introduction”, Prentice Hall of India Private Limited, 2009.

4. Igor Ivan, Itzhak Benenson, Bin Jiang, Jiri Horak and James Haworth., “Geoinformatics for Intelligent Transportation System”, Springer International Publishing AG, 2015.
5. Barry Boots, Atsuyuki Okabe and Richard Thomas., “Modelling Geographical Systems – Statistical and computational applications”, Kluwer Academic Publishers, 2014.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | | 3 | 2 | | |
| 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | |
| 3 | 3 | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | |
| 4 | 3 | 3 | 3 | - | 2 | | 3 | - | - | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23C03 GEOMATICS FOR HYDROLOGY AND WATER RESOURCES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**UNIT I HYDROLOGIC COMPONENTS 9**

Hydrologic cycle - Estimation of various components - Clouds: Types of Clouds - rainfall: Types of Rainfall - runoff - evaporation - transpiration - Evapo-transpiration -Interception - Depression storage - Spectral properties of water.

**UNIT II SURFACE WATER MODELLING 9**

Drainage basin - Delineation and codification of watershed - Morphometric analysis - Hydrological Modelling - Rainfall - runoff modelling - USDA-SCS-CN Method - Urban Hydrology - LiDAR Mapping for Urban area - Impact of Climate change on Hydrological modeling – Water quality mapping and monitoring - Correlation model for pollution detection.

**UNIT III RISK AND DAMAGE ASSESSMENT 9**

Mapping of snow-covered area - Snow melt runoff - Glacier runoff modelling - Flood forecasting - Flood Risk Zoning - Flood damage assessment - Flood Modelling - Early warning system for Flood mitigation - drought- Types - Assessment of droughts and mitigation – Desertification - Water harvesting methods, Assessments of intervention measures.

**UNIT IV GROUNDWATER MODELLING 9**

Origin - Classification and properties of aquifer - Ground water potential identification - Surface indicators - Aquifer parameters - Hydrologic budgeting - Different types of Ground water models - Mathematical modelling of groundwater system - Sea water intrusion - Interfacing GIS with groundwater model - Artificial recharge.

**UNIT V IRRIGATION AND WATERSHED MANAGEMENT 9**

Crop water requirements - Crop Stress: Biophysical Indicators – Irrigation performance assessment - Reservoir Sedimentation Studies - Capacity curve generation - modelling of reservoir siltation – Impact of climate and land use change on drainage basin - Erosion Estimation using Remote sensing - Prioritization of watersheds - watershed modelling for sustainable development.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the challenges faced by the scientific community in the management of water in the past as well as present situations in the face of ever-changing climate and socioeconomic conditions.

**CO2:** Develop knowledge on the previously used scientific methods and environment development with particular reference to the environment status and scope of geospatial technology to address the WRM issues.

**CO3:** Comprehend the current research trends and the remote sensing data sources, products and tools that are of value along with their limitations so as to find solutions to the issue of various phenomena and domain of WRM.

**CO4:** Analyze the complicated and multi-source and layered problems of water resources management with state of the art, tools and techniques for sustained livelihood.

**CO5:** Apply the knowledge in the conceptualization of extraction and implementation of the Geospatial based solutions sets and to interpret them with tools from ancillary sources for dependable policy making.

**TEXT BOOKS:**


1. Gert A. Schultz, Edwin T. Engman, "Remote Sensing in Hydrology and Water Management", Springer, 2011.
2. S. K. Gupta, "Modern Hydrology and Sustainable Water Development", John Wiley & Sons, 2010.
3. K. Ramamohan Reddy, B. Venkateswara Rao, C. Sarala, "Hydrology and Watershed Management with a Focal Theme on Ecosystem Resilience - Rural and Urban Water Requirements", 2014.


**REFERENCES:**


1. Schultz, G. A. and Engman, E. T., "Remote Sensing in Hydrology and Water Management", Springer, 2000.
2. David Keith Todd , "Groundwater Hydrology", John Wiley & Sons, New York, 2nd Edition, 2005.
3. H. M. Raghunath , "Hydrology- principles, Analysis, Design", New Age International, 2000.
4. L. Asawa, "Irrigation and Water Resources Engineering", New Age International, 2008.
5. Andrew Skidmore, "Environmental Modelling with GIS and Remote Sensing", 2017.
6. Dorota Swiatek, Stefan Ignar, "Modelling of Hydrological Processes in the Narew Catchment", Springer Science & Business Media, 2011.
7. Tim Davie, "Fundamentals Of Hydrology", 3rd edition, 2019.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | - | - | - | 3 | - | - | - | - | - | - | - | 3 | | |
| 2 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | | |
| 3 | 3 | 3 | - | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | |
| 4 | 3 | 3 | 3 | | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**GI23020** **SATELLITE METEOROLOGY** **L T P C**
**3 0 0 3**

**UNIT I ATMOSPHERIC CHARCTERISTICS 9**

Meteorology: Definition and types - Origin and Composition of atmosphere - Structure of Standard atmosphere - Distribution of Temperature, Pressure and Density - Distribution of winds: Global wind circulation pattern, Local and Monsoon winds - Aerosols - Conventional measurement of Temperature, Humidity, Wind, pressure and precipitation - Modern meteorological instruments – Surface and Upper air observation network - Doppler weather radar.

**UNIT II WEATHER AND CLIMATE SYSTEM 9**

Cloud types and formation processes - Precipitation development - Bergeron and Findeison mechanism - Air masses and fronts: Warm, Cold, Stationary and Occluded fronts - Weather charts and symbols - Tropical Cyclones: Influencing factors, Formation, Structure, Life cycle, movement and climatology - Life cycle - Thunderstorms - ElNino -Southern Oscillation - Climatic scales and classification - genetic and empirical approaches.

**UNIT III METEOROLOGICAL SATELLITES AND SENSING SYSTEM 9**

Polar and Geostationary orbits - Payloads: imaging and non-imaging - Evolution of polar and geostationary satellites: TIROS, NIMBUS, GOES, Meteosat and Metop series - Indian meteorological missions - Current operational satellites: INSAT-3D and INSAT-3DR - Imaging channels: visible,IR, water vapour and shortwave IR - Meteorological image properties - Visual image interpretation.

**UNIT IV ATMOSPHERIC SOUNDING 9**

Atmopsheric absorption and emission - absorption bands of CO2, water vapour and ozone - Vertical sounding - Radiosonde - Radiative Transfer Modelling- transmittance and weighting function - IR and Microwave sounders - vertical profile retrieval for temperature - aerosol retrieval - Ozone sounding:in-situ measurement, satellite techniques - BUV, occultation, Limb scattering and emission.

**UNIT V APPLICATIONS 9**

Weather forecasting: Tools and methods - Low pressure system monitoring - DVORAK Cyclone intensity estimation - Cyclone Warning System - Flood and storm surge warning system - Global warming and sea level change - Agrometeorology - Urban meteorology - aviation meteorology - WildFires and Volcanic Ash.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** To gain knowledge about the characteristics of earth atmosphere, meteorological parameters and its conventional observation.

**CO2:** To understand the various weather and climate processes and phenomena.

**CO3:** To familiarize about the characteristics and applications of past and current operational meteorological platforms and sensors.

**CO4:** To acquire knowledge about the principle of atmospheric sounding and vertical profile retrieval methods.

**CO5:** To analyze and investigate the critical weather and climatic issues and to develop the solutions.

**TEXT BOOKS:**

1. Chandrasekar.A., “Basics of atmospheric science”, PHI Learning Pvt Ltd, 2010.
2. Stojce Dimov Ilcev., “ Global Satellite Meteorological Observation (GSMO) Applications”,

Springer, 2018
3. S.R.Kalsi., “Use of Satellite Image in Tropical Cyclone Intensity Analysis and Forecasting”, India Meteorological Department, New Delhi, Meteorological Monograph, Cyclone warning Division No.1/2002.
4. Kidder and VonderHarr., “Satellite Meteorology: An introduction”, Academic Press, 1995.
5. Cracknell., “The Advanced Very High Resolution Radiometer (AVHRR)”, Taylor and Francis Int. Ltd., 1997.

**REFERENCES:**

1. Asnani, G.C., “Tropical Meteorology”, Vol.I and II, 3rd Edition, 2016.
2. Doviak and Zrnic., “Doppler Radar and Weather Observations”, Dover Publications Inc, 2006.
3. Su-Yin Tan., “Meteorological Satellite Systems”, International Space University, Springer, 2014.
4. Kelkar R.R., “Satellite Meteorology”, B S Publications, 2007.
5. P.J. Robinson., “Contemporary Climatology”, Ann Henderson-Sellers, 2nd edition, 1999.
6. Adarsh Deepak., “Remote Sensing of Atmospheres and Oceans”, Academic Press , 2012.
7. Adarsh Deepak., “Inversion methods in Atmospheric Remote Sensing”, Academic Press Inc, 2012.
8. Kelkar R.R., “Satellite Meteorology”, B S Publications, 2007.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | - | 2 | - | 2 | - | 2 | 3 | 3 | 2 | 3 | 2 | - | - | 3 |
| 2 | 3 | - | 2 | 2 | - | 3 | 3 | - | - | 3 | - | - | 2 | 3 | 3 |
| 3 | - | 2 | - | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 2 | 2 | - | 2 | 3 | 3 | 3 |
| 5 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23C04 GEOMATICS FOR DISASTER AND RISK MITIGATION L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**

Disaster: Definition and Classification – Hydrological, meterological, geological and man-made disasters, characteristics crisis and consequences –Multi hazard disaster risk management – National database for emergency management, relief and rescue operations –Role of earth observation in DRR – International collaboration, satellite communications –Best practices in DRR, etc – Role of Government administration, International disaster assistance.

**UNIT II HYDROLOGICAL DISASTERS 9**

Hydrological Data Acquisition and Analysis: Rainfall data collection and analysis, Streamflow and river gauge data, Digital elevation models and terrain analysis – Hydrological modeling techniques – Flood hazard mapping and risk assessment– Floodplain delineation and modeling – Real-time flood monitoring, mitigation and early warning systems – Case studies.

**UNIT III METEOROLOGICAL DISASTERS 9**

Meteorological Data Acquisition and Analysis: Weather station data collection and analysis, Radar data processing and interpretation, Satellite-based meteorological data products, Numerical weather prediction models and data assimilation techniques - Cyclone forecasting, lightening, storm surge modeling, - Analysis & detection - Spatial Modeling and Simulation- Multi-hazard and risk assessment and mitigation in meteorology.

**UNIT IV GEOLOGICAL DISASTERS 9**

Landslide and earthquake inventory and susceptibility mapping : Data collection, compilation and methods - Statistical and geospatial models - Terrain stability analysis using geospatial data - Landslide and earthquake susceptibility and hazard maps - Early warning systems - Case studies - Geospatial Modeling for Geological Disaster Analysis - Geospatial Techniques for Geological Mitigation and Management.

**UNIT V DROUGHTS AND FOREST FIRES 9**

Drought indices and indicators for geospatial analysis–Remote sensing data for drought severity and extent mapping – Integration of meteorological and hydrological data for drought monitoring – Geospatial data for forest fire risk assessment – Vegetation mapping and fuel load estimation – Fire behavior modeling and fire danger mapping – Risk Assessment , mitigation and Mapping – Early Warning Systems– Case studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Gain knowledge on various types of disasters and infrastructural facilities available for managing
disasters.

**CO2:** Plan long term disaster mitigation measures.

**CO3**: Evaluate the safety of the various social structures.

**CO4:** Use remote sensing data products for disaster management.

**CO5:** Apply GIS concepts in disaster management.

**TEXT BOOKS:**

1. Brian Tomaszewski, "Geographic Information Systems in Disaster Management", Routledge Taylor & Francis Group, 2021.
2. Sisi Zlatanova, Alfred Stein, and Elfriede M. Fendel, "Geoinformatics for Disaster Management" Springer, 2005.

**REFERENCES:**

1. F.G.Bell., “Geological Hazards: Their assessment, avoidance and mitigation”, SPON, 2007.
2. “Mitigating Natural Disasters, Phenomena, Effects and Options, A Manual for policy makers and planners”, United Nations, 1991.
3. Gupta, Anil.K, Sreeja S, Nair, Bemmerlein-Lux, Florian, Chatterji, Sandhya., “Disaster Management and Risk reduction: Role of Environmental Knowledge", Narosa Publishing House, 2013.
4. Kapur Anu, “Vulnerable India: A Geographical study of Disasters”, IIAS and sage Publishers, 2010.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 2 | - | - | - | 3 | 3 | 3 | 3 | 2 | - | 3 | - | | 2 |
| 2 | - | 3 | - | - | - | 3 | 3 | 3 | 3 | 2 | 3 | 3 | - | | 2 |
| 3 | 3 | 3 | - | 3 | - | 3 | 3 | 3 | 3 | - | - | - | - | | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | 3 | | 3 |
| 5 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | - | 3 | 3 | 3 | 3 | | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23C05 GEOMATICS FOR OCEAN AND COASTAL APPLICATIONS L T P C**
**3 0 0 3**

**UNIT I FUNDAMENTAL OCEANOGRAPHY AND COASTAL PROCESSES 9**

Origin and formation of large water bodies - Ocean basins - Oceanic Zones - Ocean Circulations: Global thermohaline, wind driven circulations and currents - Regional Upwelling and eddy development - Waves: structure, characteristics and wave generated currents - Current meters - Tides - Coastal erosional and accretional landforms.

**UNIT II SEA WATER CHARACTERISTICS AND MEASUREMENT 9**

Heat, Light and sound transmission characteristics - Seawater chemistry - Ocean Biology - Marine food web - Sea water sampling and measurement - NISKIN water sampler and DSRT - CTD profiler CTD rosette - Bathythermograph - XBT - Sediment samplers: Dredge,GRAB and deep sea coring devices.

**UNIT III COASTAL HYDRODYNAMICS AND SENSING SYSTEMS 9**

Sea water intrusion - Pollution dispersion - Coastal protection structures - Platforms and sensing systems - Payloads - Past and current operational satellites: NOAA, SeaSTAR, Adeos, ERS, Topex/Poseidon, QikSCAT and sentinel 3 - Indian missions: Oceansat1 and 2, SARAL and SCATSAT.

**UNIT IV REMOTE SENSING RETRIEVAL AND MAPPING 9**

Ocean color remote sensing - Bio-optical algorithm and SeaDAS processing - Sea surface temperature estimation - Sea surface topography mapping: RADAR altimetry and data processing - Sea level Anomaly - Scatterometry:Sea surface wind retrieval and mapping - Bathymetry - Bathymetric LiDAR.

**UNIT V COASTAL MANAGEMENT APPLICATIONS 9**

Coastal zone management: Critical issues, LU/LC and wetland mapping - Coastal Regulation Zones - Potential Fishing Zone Mapping - Shoreline Change Analysis - Sea Level Rise Monitoring - Cyclone tracking and damage assessment - Tsunami early warning system and damage assessment - Use of SAR images - Ship detection - Oil spill studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1**: Understand the basic concepts of Ocean and Coastal processes.
**CO2:** Gain knowledge on physical, chemical and biological characteristics of sea water.
**CO3:** Familiarize about coastal hydro dynamism and operational sensing systems.
**CO4:** Acquire knowledge on retrieval through remote sensing methods.
**CO5:** Analyze the applicability of retrievals for solving critical issues and develop strategic management plan.

**TEXT BOOKS:**


1. Ian.S.Robinson., “Discovering the Ocean from Space: The unique applications of satellite oceanoghraphy”, Springer &Praxis Publishing, 2010.
2. Seelye Martin., “An Introduction to Ocean Remote Sensing”, Cambridge University Press, 2nd edition, 2014.
3. Ian.S.Robinson., “Measuring the Oceans from Space-The principles and methods of satellite Oceanoghraphy”, Springer &Praxis Publishing, 2004.


**REFERENCES:**


**1.** Robert Stewart., “Introduction to Physical Oceanography”, University Press of Florida, 2009**.**

2. Motoyoshi Okeda and Frederic W.Dobson., “Oceanographic applications of Remote Sensing”, CRC Press, 1995
3. Vasilis D. Valavanis., “Geographical Information System in oceanography & Fisheries”, Taylor & Francis London &NewYork, 1st edition 2007.
4. David Halpem., “Satellites, Oceanography and Society”, Elsevier Science, 2012.
5. Alasdair J.Edward, “Remote Sensing Handbook for Tropical Coastal Management”, UNESCO publishing, 2000.
6. Karsten Mangor, Nils K. Drønen, Kasper H. Kærgaard, Sten E. Kristensen., “Shoreline Management Guidelines”, Publisher: Horsholm, DHI Water & Environment, Denmark, 4th edition, 2017
7. L.S.Robinson. “Satellite Oceanography: An introduction for Oceanographers and Remote-Sensing Scientists”, John Wiley and Praxis Publishing, 1995.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 3 | 3 | 3 | - | - | 3 | - | - | - | - | - | - | 3 | 3 |
| **2** | 3 | 2 | 2 | 3 | 2 | - | - | 3 | 3 | 3 | 2 | 2 | - | - | 2 |
| **3** | 2 | | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **4** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | - |
| **5** | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | 3 | 3 | 3 | 3 | 3 |
| **AVg.** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

## VERTICAL V: GEODESY

**GI23021 ADVANCED GEODESY L T P C**
**3 0 0 3**

**UNIT I GEODETIC NETWORK DESIGN 9**

Definition and significance of geodetic control networks - Types of geodetic networks - Components of a geodetic network: stations, observations, constraints - Factors influencing network design: accuracy requirements, terrain, accessibility - Determining optimal control point configurations - Evaluating network reliability and precision.

**UNIT II GEODETIC NETWORK ANALYSIS 9**

Geodetic network adjustment techniques - Determining the coordinates and heights of unknown points based on measured angles, distances, and other observations - Adjustment models and observation weighting - Solution methods for network adjustment - Software tools for network adjustment - Simulation methods for network design evaluation.

**UNIT III GEODETIC HEIGHT 9**

Geopotential number - Height systems: orthometric, ellipsoidal, normal, and dynamic height and their correction - Ellipsoidal height and its determination with a single and reciprocal observation of vertical angle - Geoid determination methods - Geopotential models and their role in geoid modelling - Geoid height determination techniques - Geodetic levelling networks and benchmarks - National and international height reference systems - Applications of geodetic height measurement.

**UNIT IV GEODETIC GEOPHYSICS 9**

Integration of geodetic observations with geophysical models to study Earth's dynamic processes - Monitoring tectonic plate movements - Crustal deformation - Sea level variations - Geophysical phenomena like earthquakes and volcanic activity - Theory of least squares and variance - Covariance matrices, to detect and analyze small-scale deformations.

**UNIT V GEODETIC APPLICATIONS AND GEOSPATIAL ANALYSIS 9**

Geodesy for geodynamics, geohazards, geospatial infrastructure, navigation, and mapping - Analysis and processing of geodetic imagery, point clouds, and digital elevation models for geospatial applications - Geospatial analysis techniques, geodatabase management, and integration with Geographic Information Systems.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Create an optimal and reliable network of geodetic control points that enables accurate positioning and measurements on the Earth's surface.

**CO2:** Gain proficiency in working with different geodetic reference systems, including their definitions, transformations, and compatibility.

**CO3:** Understand the principles, methods, and applications of geodetic height measurement.

**CO4:** Investigate various phenomena related to the Earth's shape, gravity field, tectonic movements, and other geophysical processes.

**CO5:** Utilize geodetic data and geospatial techniques to solve real-world problems.

**TEXT BOOKS:**


1. Weikko A. Heiskanen and Helmet Moritz.,"Physical Geodesy", W.H.Freeman and Company, 1967.
2. Michele Caputo., "The gravity field of the Earth", International Geophysics Series- Vol-10, Academic Press, 1967.


**REFERENCES:**


1. Petr Vanicek and Edward J. Krakiwsky., "Geodesy: The concepts", North-Holland Publications Co., 1991.
2. James R.Smith., "Introduction to Geodesy", John wiley & Sons Inc, 1997
3. Tom Herring., "Geodesy", Elsevier, 2009, ISBN: 0444534601.
4. Schwarze, V.S., "Geodesy: The challenge of the 3rd millennium", Springer verlag, 2002
5. Charles D. Ghilani., "Adjustment Computations: Spatial Data Analysis", 6th Edition, 2017., ISBN-10: 9781119385981.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 2 |
| 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 3 |
| 4 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |
| 5 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |

**1-** low, 2 - medium, 3 - high,

**GI23022 SATELLITE GEODESY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION** **9**

Introduction - Classification - Concepts - Historical Development - Reference Coordinate Systems – Time - Keplerian laws of satellite motion- Perturbed Satellite Motion - Orbit Determination - Satellite Orbits and Constellations - Applications.

**UNIT II SATELLITE GEODETIC TECHNIQUES** **9**

Observables and Basic Concepts - Determination of Directions - Ranges and Range Differences (Doppler method) - Interferometric Measurements - Satellites Used in Geodesy - Navigation Payload - PRARE - Planned Satellites and Missions - Electronic Ranging SECOR - Electronic observation techniques - Doppler Effect - Positioning concept - Development of TRANSIT satellites.

**UNIT III LASER RANGING AND VLBI** **9**

Introduction - Satellites with Laser Reflectors - Laser Ranging Systems - Components - Corrections, Data Processing and Accuracy - Applications of Satellite Laser Ranging - Lunar Laser Ranging - Space borne Laser.

**UNIT IV SATELLITE ALTIMETRY AND GRAVIMETRY** **9**

Principle - satellites and missions - Measurements - Data Processing and Accuracy - Corrections - determination of mean sea surface - Applications: Geoid and gravity field determination, Geophysical interpretation, Oceanography and Glaciology - Gravity Field Missions - Concept - Satellite-to-satellite tracking (SST) - High-low mode, CHAMP, Low-low mode, GRACE - Satellite gravity gradiometry - Concept - GOCE mission.

**UNIT V GNSS SYSTEM** **9**

Introduction - Components - Signal Structure - observables - code and carrier phase observation - Ambiguity resolution - Multi path and other observational errors - Cycle slip detection - Positioning: Static - Rapid static and pseudo kinematic; kinematic positioning -. Real time network (VRS) services - Geodetic control surveys- Applications of GNSS.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Explain the fundamental concepts and principles of satellite geodesy, including satellite orbits, orbital perturbations, and geodetic reference systems.

**CO2:** Demonstrate a comprehensive understanding of principles used to determine directions and ranges with geodetic satellites.

**CO3:** Perform geodetic measurements using satellite laser ranging (SLR).

**CO4:** Utilize satellite geodesy techniques for precise positioning, gravity field determination, and deformation monitoring.

**CO5:** Use GNSS based observation for establishment of control networks and utilize it in various applications.

**TEXT BOOKS:**

1. Seeber G., “Satellite Geodesy”, Walter De Gruyter, Berlin, 2nd edition, 2008.

**REFERENCES:**

1. Alfred Leick., “GPS satellite surveying, Dover Earth Science”, John Wiley & Sons Inc., 4th Edition, 2015.
2. Guocheng Xu., “GPS Theory, Algorithms and Applications”, Springer – Verlag, 2004.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| **2** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **3** | 3 | 2 | 2 | 1 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **4** | 3 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | 3 | 2 |
| **5** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 | 2 |
| **AVg.** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23023** **PHYSICAL GEODESY** **L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**

Need to study gravity- historical review- research areas – applications - Potential theory: some vector calculus - attraction and potential - potential of a solid body- Laplace equation – exterior potential field - Poisson equation – interior potential field- spherical harmonics- boundary value problems - Measurement techniques in physical geodesy.

**UNIT II GRAVITY FIELD OF THE EARTH 9**

Gravitation- gravity- attraction of point mass- attraction of a point mass- rigid body- gravity and shape of the Earth- level surfaces and plumb lines- natural coordinates- Normal gravity: Superposition principle- ellipsoid as an approximation of the Earth- the level ellipsoid- series expansion of the normal gravity field - Earth's gravity field and its modelling Gravity anomalies and geoid determination.

**UNIT III GRAVIMETRY 9**

Functional of the gravity field - terrestrial gravimetry – absolute and relative- airborne gravimetry - spaceborne gravimetry – gradiometry - torsion balance - gravity networks. Gravity field modelling: The linear model of physical geodesy- disturbing potential and gravity- anomalous potential and gravity - gravity anomalies and their interpretation - gravity reductions- Geoid modelling: The Stokes integral- Koch's formula- Vening - Meinesz formula- Molodensky's approach- practical aspects.

**UNIT IV GRAVITY FIELD AND HEIGHT SYSTEMS 9**

Statistics of the gravity field: The power spectrum - Kaula's rule of thumb - covariance functions - Height systems: Height measurements - physical and geometric heights and their relationship - height systems around the world- Geoid as a vertical reference frame.

**UNIT V TEMPORAL VARIATIONS OF THE GRAVITY FIELD 9**

Geophysical effects on gravity - loading theory – tides - hydrological loading - atmospheric loading - ocean loading - ice-mass loading - glacial isostatic adjustment - Earth's rotation and polar motion - Geodetic observations of rotation and polar motion.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the fundamental principles and concepts underlying physical geodesy.
**CO2:** Familiarize various geodetic measurement techniques used in physical geodesy.
**CO3:** Develop skills to analyze and interpret geodetic data, including gravity measurements.
**CO4:** A**c**quire knowledge of earth's gravity field parameters computations.
**CO5:** Understand the factors affecting the gravity field and their influence.

**TEXT BOOKS:**


1. Bernhard Hofmann-Wellenhof, Helmut Moritz, and Wolfgang Freeden, "Physical Geodesy", 2019.
2. Hofmann-Wellenhof- B and Moritz- H, "Physical Geodesy". Springer Vienna. Doi: 10.1007/978-3-211-33545-1, 2006.
3. Thomas H. Meyer, "Introduction to Geometrical and Physical Geodesy: Foundations of Geomatics", ESRI press. 2010.
4. Wolfgang Torge and Jürgen Müller, "Geodesy",De Gruyter, 2012.
5. Martin Vermeer, "Physical Geodesy"Aalto University Publication Series, 2020.

**REFERENCES:**


**1.** Torge- W. “Geodesy”. 3rd edition. Walter de Gruyter. Berlin, 2012.

**2.** Vanícek- P and Krakiwsky- E. “Geodesy: The Concepts”. 2nd edition. Elsevier Science. 2015.

**3.** Zhiping Lu, Yunying Qu, Shubo Qiao, ”Geodesy: Introduction to Geodetic Datum and Geodetic Systems”, Springer Berlin, Heidelberg, 2014.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 2 |
| 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 3 | 3 | 3 | 2 |
| 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 3 |
| 4 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |
| 5 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23024 | GEODETIC INTERFEROMETRY | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**UNIT I INTRODUCTION 9**

History - Overview - Basics of interferometry - Interferometric base line - Differential interferometry - Phase unwrapping - Correlation.

**UNIT II GEODETIC INTERFEROMETRY TECHNIQUES 9**

ScanSAR interferometry - Solutions for baseline and source position vectors - Phase Referencing - Position - Frequency - Precession and Nutation - Measurement of Polar Motion and UTI.

**UNIT III GEODETIC MEASUREMENTS 9**

Geodetic Measurements - Proper Motion and Parallax Measurements - Solar Gravitational Deflection - Imaging Astronomical Masers - Least-Mean-Squares Analysis - Second-order effects in phase referencing.

**UNIT IV VLBI IN GEODETIC INTERFEROMETRY 9**

Introduction - VLBI elements - Techniques - Space segment - Propagation media - Ground segment - Interferometer and interferometric principle - Carrier of interferometer baseline- Determination of observables - Precision and analysis of group delays.

**UNIT V DATA ANALYSIS 9**

Automated geodetic VLBI - Antenna and receiving systems - Data acquisition systems - Monitoring and control systems - Observations - Data reduction and analysis.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Apprehend the fundamentals of interferometry.
**CO2:** Identify various interferometric techniques.
**CO3:** Understand different geodetic measurements for Geodetic observations.
**CO4:** Comprehend the components and working principle of VLBI.
**CO5:** Summarize the methods for VLBI data analysis and reduction.

**REFERENCES:**


1. Alef.W Felli, M., and Spencer, R.E., Eds., Kluwer, Dordrecht., (1989), “Introduction to Phase-Reference Mapping in Very Long Baseline Interferometry: Techniques and Applications”, pp. 261–274.
2. Backer, D.C., and Sramek, R.A., 1999, “Proper Motion of the Compact, Nonthermal Radio Source in the Galactic Center, Sagittarius A”, Astrophys. J., 524, 805–815.
3. Bailer-Jones, C.A.L., 2015, “Estimating Distances from Parallaxes”, Publ. Astron. Soc. Pacific, 127, 994– 1009.
4. Bartel, N., Bietenholz, M.F., Lebach, D.E., Ransom, R.R., Ratner, M.I., and Shapiro, I.I., 2015, “VLBI for Gravity Probe B: The Guide Star”, IM Pegasi, Class. Quantum Grav., 32, 224021 (21pp).
5. Bartel, N., Ratner, M.I., Shapiro, I.I., Cappallo, R.J., Rogers, A.E.E., and Whitney, A.R., 1985, “Pulsar Astrometry via VLBI”, Astron. J., 90, 318–325.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **1** | 3 | 3 | 1 | 1 | 2 | - | 1 | - | | - | - | 2 | 2 | 1 | 1 |
| **2** | 3 | 2 | 2 | 2 | 1 | - | | - | 2 | - | - | 2 | 3 | 2 | 2 |
| **3** | 3 | 3 | 2 | 2 | 3 | - | 1 | - | | - | - | 2 | 3 | 2 | 2 |
| **4** | 3 | 3 | 2 | 2 | 3 | - | | - | 2 | - | - | 2 | 2 | 2 | 2 |
| **5** | 3 | 3 | 1 | 2 | 2 | - | 1 | - | | - | - | 2 | 3 | 2 | 3 |
| **AVg.** | 3 | 3 | 2 | 2 | 2 | - | 1 | - | 2 | - | - | 2 | 3 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23025 | GEODETIC CONTROL SURVEY AND ADJUSTMENT | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**UNIT I HORIZONTAL CONTROL SURVEYING 9**

Definition - Uses and establishment of horizontal control - Methods: Triangulation, traversing and trilateration - Classification and accuracy - Instruments: Theodolite, total Station and GNSS - Pre-analysis procedure - Survey tolerances - Selection of survey instrument - Horizontal control point selection and distribution - Field procedure for triangulation, traversing and trilateration: Horizontal angle measurements methods - Baseline measurement - Elimination of blunder and systematic errors - Computation of weight of observation for length and angle.

**UNIT II ADJUSTMENT OF HORIZONTAL CONTROL 9**

Introduction - Simple adjustment methods - Error propagation and linearization - Least squares adjustment method for triangulation, traversing and trilateration - Least squares adjustment of indirect Observations - Least squares adjustment of observations only - Geodetic network design principles - Network adjustment and analysis for horizontal control - Adjustment software and tools.

**UNIT III VERTICAL CONTROL SURVEYING 9**

Definition - Uses and establishment of vertical control - Methods: Spirit levelling, Reciprocal levelling, trigonometric levelling, GNSS Surveying and precise Levelling - Classification and accuracy - Instruments: Dumpy level, tilting level, auto level, digital level, total Station and GNSS - Field procedures for measurement and data collection - Elimination of blunder and systematic errors - Computation of weight of observation - Geoid modeling.

**UNIT IV ADJUSTMENT OF VERTICAL CONTROL 9**

Introduction - Simple adjustment methods - Error propagation and linearization - Least squares adjustment method for level net and trigonometrical leveling - Least squares adjustment of indirect observations - Least squares adjustment of observations only - Geoid modeling and its applications - Network adjustment and analysis for vertical control - Network densification techniques - Adjustment software and tools.

**UNIT V COORDINATE COMPUTATION 9**

Plane and spherical coordinate system - Computation of plane coordinate for horizontal control point of triangulation, traversing and trilateration stations - Computation of spherical coordinate for horizontal control point of triangulation, traversing and trilateration stations - Computation of bearing and length from plane coordinates - Computation of forward azimuth, backward azimuth, and length from spherical - Coordinates - Report writing and documentation standards - Presentation and visualization of survey results

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the concepts and principles of geodetic control surveying
**CO2:** Apply appropriate surveying methods and techniques for establishing geodetic control points
**CO3:** Analyze and interpret geodetic control survey data.
**CO4:** Perform adjustments of survey measurements using various adjustment techniques.
**CO5:** Utilize geodetic software tools for data processing and adjustment

**TEXT BOOKS:**

1. Mikhail, E.M. and Gracie G., “Analysis and adjustment of Survey measurements”, Van Nostrand Reinhold, New York, 2007., ISBN-10 : 0442253699.

2. Charles D. Ghilani., “Adjustment Computations: Spatial Data Analysis” 6th Edition, 2017, ISBN-10: 9781119385981.

**REFERENCES:**

1. Subramanian. R., “Surveying and Levelling”, Oxford University Press, Second Edition, 2012. ISBN-10: 0198085427, ISBN-13 : 978-0198085423
2. James M., Anderson and Edward Mikhail., “Surveying, Theory and Practice”, Seventh Edition, McGraw Hill 2001. ISBN-10: 0070159149, ISBN-13: 978-0070159143
3. Bannister and S. Raymond., “Surveying”, Seventh Edition, Longman 2004. ISBN-10: 0582302498, ISBN-13: 978-0582302495
4. S. K. Roy., “Fundamentals of Surveying”, Second Edition, Prentice, Hall of India 2004. ISBN-10: 9788120341982, ISBN-13: 978-8120341982
5. K. R. Arora., “Surveying Vol I & II”, Standard Book House, 2019. ISBN-13: 9788189401238
6. C. Venkatramaiah, “Textbook of Surveying”, Universities Press, Second Edition, 2011. ISBN-10: 9788173717406, ISBN-13: 978-8173717406

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 3 | 3 |
| 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 3 |
| 4 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| 5 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| GI23026 | GEODETIC ASTRONOMY | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**UNIT I INTRODUCTION 9**

Definition and application of geodetic astronomy - Spherical trigonometry - Spherical excess- Celestial sphere - Definition of terms in astronomy - Solution of astronomical triangle celestial coordinate systems

**UNIT II CELESTIAL COORDINATE SYSTEM 9**

Celestial coordinate system: Horizon system - Hour angle system - Right ascension system - Ecliptic system and their inter-transformations - Derivation and problems: Variation in celestial coordinates: precession - Nutation and polar motion - Reduction of star position

**UNIT III TIME SYSTEMS 9**

Sidereal time - Universal time - Relation between sidereal time and universal time - Irregularities of rotational time systems - Proper motion time systems: solar - Sidereal - Ephemerides - Atomic - Time dissemination - The astronomical basis of time keeping and time recording - Rotational time systems: UT0- UT1- UT2 and UTC- Polar motion CIO - Earth rotation - Leap second

**UNIT IV DETERMINATION OF POSITION AND ASTRONOMIC AZIMUTH 9**

Determination of astronomic azimuth - Latitude and longitude - Azimuth by star hour angle and star altitudes - Latitude by meridian zenith distance and polaris at any hour angle - Longitude by meridian transit distance

**UNIT V STAR CATALOGUES AND APPLICATION OF GEODETIC ASTRONOMY 9**

Historical and types of star catalogues - Ephemerides - Time span - Observer location - Target body- almanacs - Star almanacs for land surveyors - Astrometry: Precise positions - Angular proper motions and parallaxes of celestial sources - Application of Geodetic Astronomy: Case study.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Develop a comprehensive understanding of geodetic astronomy principles and techniques.
**CO2:** Gain proficiency in converting between different celestial coordinate systems using appropriate mathematical methods.
**CO3:** Understand different time systems and their relationship to astronomical observations.
**CO4:** Acquire knowledge and skills in determining astronomic azimuths, latitudes, and longitudes using star observations.
**CO5:** Apply the concepts and methods of geodetic astronomy for precise positioning and geodetic applications.

**REFERENCES:**


1. Torge, W., (2001) Geodesy, 3rd edition, Walter de Gruyter.
2. Vanícek. P and Krakiwsky. E., (1986). Geodesy: The Concepts 2nd edn, Elsevier.
3. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 2nd edition 2008.
4. Kaula, W.M. (2000). Theory of Satellite Geodesy: Applications of Satellites to Geodesy. Dover Publications.
5. Montenbruck, O. and Gill, E (2000). Satellite Orbits. Springer – Verlag, Berlin, 2003.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **2** | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 | 2 |
| **3** | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 | 2 |
| **4** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| **5** | 2 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | 2 | 3 | 2 | 1 |
| **AVg.** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 2 | 3 | | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

## VERTICAL VI: GEOINTELLIGENCE

| GI23027 | DIGITAL TWINS AND BIM | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION** **9**

Introduction to technologies - Computational tools in science and technology - From computational techniques to digital twins - Different tools in digital twins - Applications, opportunities, and challenges influencing digital twins - DT modelling and simulation - Review of various DT models (static versus dynamic) - Digital twins platform ecosystem and the business context/advantages of digital twins - Risks and challenges.

**UNIT II DESIGNING AND DEPLOYING DIGITAL TWINS** **9**

Digital twins terminologies & essentials - Working of digital twins - Digital thread - Digital shadow - Digital twins building blocks - Digital twins technology drivers & enablers - Types of digital twins, based on product, process, based on functionality, based on maturity - Characteristics of a good digital twins platform - Use of artificial intelligence (AI) in developing and deploying digital twins.

**UNIT III SIMULATION AND MODELLING** **9**

Simulation techniques with digital twins - Simulation techniques for digital twins: Agent-based modelling, systems dynamics, discrete event simulation - Modelling digital twins using augmented reality (AR), virtual reality (VR), and other strategies for complex problems - Applying digital twins to model based design - Implementing digital twins - Application of digital twins to real-life problems.

**UNIT IV INTRODUCTION TO BIM** **9**

Building components and systems (architectural, MEP, structural) - Building drawings, specifications - Building design process - Definition of BIM - History of BIM - BIM on the architecture and engineering disciplines - BIM as a part of the e-building design process - BIM vs 3D CAD - Evolution and development of BIM & object-based parametric modeling - BIM platforms.

**UNIT V BIM MODELING AND APPLICATIONS** **9**

Mass and concept modeling - Detailed modeling - Creating, importing and modifying families of objects and elements - Architecture, MEP and structural applications - Creating plans, sections, details, schedules, cover page - Circulation (stairs, pathways, etc.) - Documentation - Applications of BIM in cost estimating, energy modeling, conflicts/interference checking.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Describe the digital technologies for industrial visualization such as digital twins, extended reality, and artificial intelligence.

**CO2:** Understand the potential of digital twins in the context of design of complex systems.

**CO3:** Model the architecture, identify the functions and understand the necessary steps of data gathering and data preparation to develop a digital twins application.

**CO4:** Design basic building components and employ parametric modeling in 3D design.

**CO5:** Understand applications of BIM, such as cost estimation, architectural renderings, interference checking, and modeling of energy consumption.

**REFERENCES:**

1. Elaine Durtsche, “Digital Twin Technology: Twins Digital Technology and Industries”, 2022. ASIN : B09PM9KVTD

2. Garber, Richard, “BIM Design: Realizing the Creative Potential of Building Information Modeling”, AD Smart 02. Chichester, U.K.: Wiley, 2004.
3. Kim, Marcus, Lance Kirby, and Eddy Krygiel, “Mastering Autodesk Revit 2017 for architecture”. 1st edition INpolis, IN: John Wiley & Sons, 2016.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 4 | 3 | 4 | 2 | - | - | - | - | 1 | 4 | 3 | 4 | 2 |
| 2 | 3 | 3 | 4 | 3 | 3 | 3 | - | - | - | - | 2 | 4 | 3 | 3 | 3 |
| 3 | 3 | 3 | 4 | 3 | 3 | 2 | - | - | - | - | 3 | 3 | 2 | 4 | 3 |
| 4 | 3 | 3 | 4 | 3 | 4 | 3 | - | - | - | - | 3 | 4 | 2 | 3 | 2 |
| 5 | 3 | 3 | 4 | 2 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 4 | 3 | 3 | 2 | - | - | - | - | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23028 BIG DATA ANALYTICS FOR GEOMATICS L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**

Concept of geospatial big data - Spatial database - Sources - Satellites, UAV mounted cameras , Distributed sensors, GPS enabled devices - Volunteer Geographic Information platforms - Address linked public records - Crowdsourced geospatial data - Challenges and opportunities - Geospatial data analysis tasks - Geospatial big data storage and processing solutions - Distributed data management platforms.

**UNIT II GEOSPATIAL BIG DATA ANALYTICS 9**

Scalable geospatial data pipeline - Automated downloading - High performance computing - Processing Cross-Domain data fusion - Knowledge extraction - Geovisualization and geovisual analytics - Interactive analysis - Proactive Location intelligence, geospatial OLAP, CEP engine - Batch analysis - Analysis extension, big data statistics, data mining - Theme analysis - Geospatial big data integration and management.

**UNIT III BIG GEO-AI 9**

Big geospatial AI - Multimodal spatio-temporal datasets - Temporal dynamics of big data - Geospatial knowledge construction - Remote sensing scene understanding - Semantics - Classification and regression methods - Machine and deep learning methods - SVM, RF, GBRT, gaussian processor, CNN, RNN, feed-forward neural networks - Hybrid models - Model development and selection - Cloud-Based machine and deep learning frameworks - Automated training database generation - Automated mapping and feature extraction.

**UNIT IV CLOUD SERVICES FOR GEOSPATIAL BIG DATA 9**

Geospatial big data storage and processing solutions - Geospatial big data visualization methods and tools - GIS cloud - Application and technology model - Geodata and the cloud - Advantages of GIS hosted on a cloud - ETL processes - Geospatial big data mining - Hadoop and MapReduce frameworks - Spark and stream data processing - Cloud-based databases and web editing - Amazon EC2, Esri's cloud-based GIS SaaS, Google Earth Engine (GEE), GEE with QGIS, Microsoft Planetary Computer (MPC), Big Query, Vertex AI, Cloud SQL, Dataproc, Web editing: Opportunities and challenges - Cloud computing for geospatial big data analytics - Geospatial cloud partners.

**UNIT V CASE STUDIES 9**

3D Visualization of digital twins cities - Geospatial spectral solutions - Urban flood mapping and damage assessment - Geo-statistical modeling for landslides - Agriculture - City dynamics from crowdsources dataset - Cryosphere - Land use and land cover - Forest - Climate change.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the various data sources and database management platforms of the big geospatial data.

**CO2:** Learn and explore the scalable solutions available for processing and analyzing geospatial big data.

**CO3:** Understand the role of AI in geospatial big data analytics.

**CO4:** Attain knowledge of various state-of-the-art open-source and commercial cloud computing platforms available to handle big geospatial data.

**CO5:** Appreciate the opportunities of geospatial big data analytics by exploring case studies of various application areas to better understand the potential real-world impact of this field.

**TEXT BOOKS:**

**1.** Durbha, S.S., Sanyal, J., Yang, L., S Chaudhari, S., Bhangale, U., Bharambe, U., & Kurte, K., "Advances in Scalable and Intelligent Geospatial Analytics: Challenges and Applications (1st edition), 2023. CRC Press. https://doi.org/10.1201/9781003270928.

**REFERENCES:**

1. Yu, J., Sarwat, M. 2021., "Big Geospatial Data Processing Made Easy: A Working Guide to GeoSpark. In: Werner, M., Chiang, YY. (eds) Handbook of Big Geospatial Data", Springer, Cham. https://doi.org/10.1007/978-3-030-55462-0_2
2. Moya, D., Giarola, S., Hawkes, A. 2021, "Geospatial Big Data analytics to model the long-term sustainable transition of residential heating worldwide", IEEE International Conference on Big Data (Big Data), Orlando, FL, USA, 4035-4046. https://doi.org/10.1109/Big Data 52589.2021.9671339.
3. Sassite,F., Addou, M., Barramou, F. 2020, "A smart data approach for Spatial Big Data analytics", IEEE International conference of Moroccan Geomatics (Morgeo), Casablanca, Morocco, 1-6. https://doi.org/10.1109/Morgeo49228.2020.9121920.
4. Lenka, R. K., Barik, R. K., Gupta, N., Ali, S. M., Rath, A., Dubey, H. 2016, "Comparative analysis of Spatial Hadoop and GeoSpark for geospatial big data analytics", 2nd International Conference on Contemporary Computing and Informatics (IC3I), Greater Noida, India, 484-488. https://doi.org/10.1109/IC3I.2016.7918013.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 1 | 1 | 3 | - | - | - | 3 | - | - | 3 | 3 | 1 | 1 |
| 2 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| 4 | 3 | 1 | 1 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 2 | 1 |
| 5 | 2 | 3 | 1 | 1 | 2 | - | - | - | 3 | - | - | 3 | 3 | 3 | 1 |
| AVg. | 3 | 2 | 2 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 2 | 2 |

1' = Low; '2' = Medium; '3' = High

**GI23029 IOT APPLICATIONS IN GEOMATICS L T P C**
**3 0 0 3**

**UNIT I FUNDAMENTALS OF IoT 9**

Web of Things versus Internet of Things - Evolution of Internet of Things - Elements of an IoT system - Physical, networking, middleware, service, and application layer - Trends and implications - Enabling technologies - IoT Architectures - Simplified IoT Architecture and Core IoT Functional Stack - Functional blocks of an IoT ecosystem - IoT protocols - Interoperability - Design and development - Data analytics and supporting services - Ethics, privacy and security.

**UNIT II IoT FOR INTELLIGENT TRANSPORTATION 9**

GIS - T - Map view, navigational view, behavioral view - Intelligent transport system - Sensor system, monitoring system, display system - GIS and GPS integration - Web mapping - Big data cloud computing - Vehicle road coordination, intelligent parking - Intelligent transportation planning - Deep learning under 5G network - Traffic volume - STTF prediction - CASE for traffic signals control - Intelligent logistics - Intelligent supply chain system.

**UNIT III INTELLIGENT AGRICULTURE 9**

Geospatial big data - Remote sensing, GIS, GPS - RFID- Web server - IoT sensors - AI Block chain technology - Agricultural IoTs for precision agriculture - Smart monitoring - Intelligent irrigation systems - Agrochemicals applications - Disease management - Smart harvesting - Supply chain management - Smart agricultural practices - Soil erosion rate sensor - Soil health - Soil moisture - Research challenges - Future research directions for agricultural IoTs.

**UNIT IV IoT FOR ENVIRONMENT & HEALTHCARE APPLICATIONS 9**

Sustainable environmental - Weather monitoring - Endangered species protection - Smart energy management - Electricity supply chains - Air quality monitoring - Smart waste management - Fleet management - Smart water quality monitoring - IoT based intelligent building - Intelligent building architecture - Digital twin - Healthcare planning and policy - Disease mapping - IoT based in-hospital healthcare system - ZigBee mesh protocol - Integrated smart watches - Risk management system based on IoT, BIM, and GIS.

**UNIT V IoT FOR DISASTER APPLICATIONS 9**

Disaster management cycle - Mitigation - Preparedness - Response - Recovery - IoT-based early warning systems - Natural disasters - Earthquake, landslides, volcanic eruption, floods, stream erosion, cyclones, tsunami, fire - Man-made disasters - Nuclear, chemical, mine, biological disasters - BRINCO- BRCK- flood beacon - Community based flood early warning system - Tsunami early warning system - Floating sensor network - Lighting detection - ALARMS - Shake Alert - IOT based cost efficient emergency recovery - Victim localization.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Learn the fundamentals of IoT Architecture, Protocols, Interoperability, Privacy, and Security.
**CO2:** Understand the potential of IoT in developing intelligent urban transportation and logistics.
**CO3:** Explore the opportunities of the IoT in smart agriculture applications.
**CO4:** Explore the scope of IoT in sustainable environment and healthcare applications.
**CO5:** Understand the potential use of IoT in preparedness, response, recovery, and mitigation phases of disaster management for natural and man-made disasters.

**REFERENCES:**


1. Sadeghi-Niaraki, A., 2023., “Internet of Thing (IoT) review of review: Bibliometric overview since its foundation”, Future Generation Computer Systems 143, 361-377. https://doi.org/10.1016/j.future.2023.01.016.
2. Dhanaraju, M., Chenniappan, P., Ramalingam, K., Pazhanivelan, S., Kaliaperumal, R., 2022, “Smart Farming: Internet of Things (IoT) - Based Sustainable Agriculture”, Agriculture 12, 1745. https://doi.org/10.3390/agriculture12101745.
3. Sharma, K., Anand, D., Sabharwal, M., Tiwari, P.K., Cheikhrouhou, O., Frikha, T., 2021, “A Disaster Management Framework Using Internet of Things - Based Interconnected Devices.”, Mathematical Problems in Engineering ,2021, 1-21. https://doi.org/10.1155/2021/9916440.
4. Granell, C., Kamilaris, A., Kotsev, A., Ostermann, F.O., Trilles, S., 2020, “Internet of Things.”, In: Guo, H., Goodchild, M.F., Annoni, A. (eds), Manual of Digital Earth. Springer, Singapore. https://doi.org/10.1007/978-981-32-9915-3_11
5. Hassan, R., Qamar, F., Hasan, M.K., Aman, A.H.M.; Ahmed, A.S., 2020, “Internet of Things and Its Applications: A Comprehensive Survey.” Symmetry 12, 1674. https://doi.org/10.3390/sym12101674.
6. Manju Khari, Raghvendra Kumar, Valentina E. Balas, Vijender Kumar Solanki., 2018, “Internet of Things and Big Data Analytics for Smart Generation”,Germany: Springer International Publishing. ISBN:9783030042035, 3030042030
7. Hwaiyu Geng ,2016, “Internet of Things and Data Analytics Handbook”, Wiley, ISBN: 978-1-119-17364-9


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 1 | 2 | 1 | 3 | - | - | - | 3 | - | - | 3 | 3 | 1 | 2 |
| 2 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 2 |
| 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 2 |
| 4 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 2 |
| 5 | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 2 |
| AVg. | 3 | 3 | 3 | 2 | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23030 DECISION SUPPORT SYSTEMS FOR GEOMATICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**UNIT I STRUCTURE OF EXPERT SYSTEMS 9**

Definition - Features, needs, components - Characteristics - Players - Structure and phases of building ES - Human vs Artificial expertise, conventional programming vs expert system - types - Rule based, frame based & hybrid - Activities - Design, planning, monitoring, controlling - Expert system - examples in geomatics.

**UNIT II RULE BASED EXPERT SYSTEMS 9**

Levels and sources of knowledge - Knowledge Engineering - Process - Knowledge acquisition methods - RGA analysis - Machine learning - Validation, representation schemes, rule, semantic network, frames and logic - Inference techniques - Types of reasoning deductive, inductive, adductive, analogical and non-monotonic - Rule based expert system - Evolution - Architecture - Evolution - Architecture - Conflict resolution - Types of inference: Forward and backward chaining - Search techniques - Case studies: MYCIN, PROSPECTOR - R environment - Examples in geomatics.

**UNIT III INEXACT REASONING 9**

Bayesian theory, examples - Certainty theory: Overview, uncertain evidence, rule inferencing - Certainty factors - Fuzzy sets - Representation, hedges inference & fuzzy logic - Classification of RS data using Fuzzy logic.

**UNIT IV OPERATION RESEARCH 9**

Origin - Nature and significance - Models and modeling - Applications and scope - Linear programming - Problem formulation - Structure and assumptions - Standard form - Graphical solution - Solution by simplex method - Sensitivity analysis - Duality - Formulations of dual problem - Geoinformatics problems & solutions - Use of AHP.

**UNIT V NETWORK MODELS 9**

Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT network - Critical path scheduling - Types of inventories - The classical EOQ model - Deterministic inventory problems - Price breaks - Stochastic inventory problems - Selective inventory control techniques.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the structure of the Expert system and its difference with conventional programming.
**CO2:** Acquaint with Rule based expert system for geomatic problems.
**CO3:** Solve inexact real-world problems to get the solution.
**CO4:** Perform operation research and geomatic tools to design a Hybrid model to solve real world problems.
**CO5:** Plan, control and monitor the activities of the project properly for effective implementation.

**TEXT BOOKS:**

1. Peter Jackson, “Introduction to Expert systems”, Pearson Education, 1999.
2. Turban E, “Expert Systems and Applied Artificial Intelligence”, Macmillan, 2004.

**REFERENCES:**


1. Donald A Waterman, “A Guide to Expert Systems”, Pearson Education, 2001.
2. Durkin J, “Expert Systems Design and Development”, Prentice Hall, 1994.
3. Dan W Patterson, “Introduction to Artificial Intelligence and Expert systems”, Prentice Hall, 2009.
4. Ermine J I, “Expert Systems: Theory and Practice”, Prentice, 2004.
5. Ramez Elmasri and Shamkant Navathe, “Fundamentals of Database Systems”, Addison Wesley Company, 7th edition, 2015.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **1** | - | 1 | | - | 1 | - | - | - | - | - | 3 | 3 | 2 | - | - |
| **2** | 1 | 3 | 1 | - | 3 | 2 | - | - | - | 2 | | 3 | - | 2 | 1 |
| **3** | 2 | 3 | 2 | 2 | 2 | 2 | 1 | - | - | 3 | 2 | 2 | - | 2 | 3 |
| **4** | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 3 | 3 | 3 | 2 | 3 | 3 |
| **5** | 2 | 2 | 3 | 3 | 2 | 3 | - | - | - | 2 | 3 | 3 | - | 3 | 2 |
| **AVg.** | 2 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 3 | 3 | 3 | 2 | 3 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23031 LOCATION INTELLIGENCE AND SURVEILLANCE L T P C**
**3 0 0 3**

**UNIT I MAPS AND SPATIAL REASONING 9**

Key concepts - Underlying spatial sciences - Scientific method and spatial reasoning - Methods and issues relating to representing the physical world in digital and print maps - Cartography and graphic elements: Discussion of map design principles, symbology, and cartographic technique - Use of graphics to communicate, stylize and problem-solving.

**UNIT II GEOSPATIAL DATA COLLECTION 9**

Overview of technologies and uses of GNSS and GPS - Geospatial data collection workflows and primary data collection; accuracy and precision - Spatial data quality - Evaluating and maintaining spatial data quality - Spatial data sources for spatial analysis - New world of data, research methods.

**UNIT III LOCATION INTELLIGENCE 9**

Location Intelligence (LI): Layering location-specific data on a dashboard for unique insights. – LI model: spatial analyzes, cartographic visualizations, and mapping – Location scoring, analysis and creating of service areas– Statistics-based decision-making, and customer mapping-Managing accuracy and uncertainty in GIS.

**UNIT IV SURVEILLANCE 9**

Purpose of surveillance - Common forms of surveillance - Surveillance cameras: Specifications, process - Inside surveillance: Mobile phone tracking, GPS trackers, computers, networks, and miniaturization - Outside surveillance: Remote sensing, surveillance cameras, facial recognition, a profusion of internet - Connected devices, Geodemographics.

**UNIT V 3D MAPPING & SURVEILLANCE 9**

UAV-based surveying – Mobile mapping systems - 3D modelling - Applications - Smart 3D surveillance - Real-time change detection: LiDAR, video and thermal imaging, geofencing - Enterprise-level video surveillance solutions for various applications, public safety, mining, energy infrastructure, transportation and property tax and building violation mapping - Significance in physical security.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Explain modern geographic analysis and visualization tools can be used across a variety of disciplines.
**CO2:** Demonstrate the understanding of data representation methods by creating meaningful maps.
**CO3:** Apply modern mapping and GIS technologies to problem-solving within diverse fields of study.
**CO4:** Utilize various tools of surveillance based on their purpose and forms.
**CO5:** Apply the knowledge of remote sensing technology for 3D mapping and surveillance.

**REFERENCES:**


1. VanOort P A J (Pepijn), “Spatial Data Quality: From Description to Application”, Doctoral dissertation, Netherlands Geodetic Commission, Delft, 2005, (Selected chapters).
2. Zeiler, Michael and Jonathan Murphy, “Modeling Our World: The Esri Guide to Geodatabase Concepts”, Redlands, CA, Esri Press, 2010.
3. https://www.esri.com/arcgis-blog/products/mapping/mapping/introducing-smart-mapping/
4. https://dl.acm.org/doi/abs/10.1145/1459359.1459409
5. https://link.springer.com/article/10.1007/s12518-013-0120-x

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 4 | 2 | | 3 | 2 | - | - | - | - | - | 3 | 3 | 1 | 2 |
| **2** | 3 | 3 | 3 | | 3 | 2 | - | - | - | - | - | 2 | 3 | 2 | 3 |
| **3** | 3 | 4 | 4 | | 3 | 2 | - | - | - | - | - | 3 | 2 | 4 | 3 |
| **4** | 3 | 3 | 2 | | 3 | 2 | - | - | - | - | - | 3 | 2 | 4 | 2 |
| **5** | 3 | 4 | 4 | | 3 | 3 | - | - | - | - | - | 3 | 3 | 3 | 3 |
| **AVg.** | 3 | 4 | 3 | 3 | 3 | 2 | - | - | - | - | - | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23032 GEOMATICS FOR SMART CITIES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**UNIT I GEOSPATIAL DATA ACQUISITION 9**

Key concepts and characteristics of smart cities - Remote sensing techniques for urban mapping - Unmanned aerial vehicles (UAVs) and their role in data collection - LiDAR technology for 3D urban modeling - 3D spatial-temporal modeling - Integration of global position system (GPS), remote sensing and GIS.

**UNIT II DATA ANALYSIS AND VISUALIZATION 9**

Introduction to geospatial analysis techniques - Spatial data modeling and analysis for urban planning - Data visualization methods for smart city applications - Spatial decision support systems (SDSS) for urban planning - Spatial data analysis and mining techniques - multi-criteria decision analysis (MCDA) in smart city decision-making - Integration of geospatial data with other urban datasets.

**UNIT III INFRASTRUCTURE MANAGEMENT 9**

Geomatics for transportation planning and management - Asset management using geospatial technologies - Monitoring and maintenance of urban infrastructure - Geospatial analysis of energy consumption patterns - Renewable energy site selection using geospatial tools - Geospatial analysis of water resources in urban areas - Water supply and distribution optimization for smart cities.

**UNIT IV URBAN MOBILITY AND PUBLIC SAFETY 9**

Global navigation satellite system (GNSS) and location - Based service techniques - Geospatial analysis for transportation planning and optimization - Intelligent transportation systems (ITS) - Emergency response planning using geospatial tools - Crime mapping and analysis for urban security - Disaster management and resilience using geomatics.

**UNIT V ENVIRONMENT AND HEALTH APPLICATIONS 9**

Geospatial analysis of environmental indicators in smart cities - Green space planning and urban ecology using geomatics - Climate change adaptation and mitigation strategies - Geospatial analysis for public health planning - Disease surveillance and spatial epidemiology - Geomatics applications in healthcare accessibility.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the role of geomatics in smart city planning and management.
**CO2:** Apply geospatial data acquisition techniques in the context of smart cities.
**CO3:** Analyze and interpret geospatial data for urban planning and decision-making.
**CO4:** Evaluate the impact of geomatics technologies on smart city development.
**CO5:** Demonstrate practical skills in using geospatial tools and software for smart city applications.

**REFERENCES:**


1. Houbing Song, Ravi Srinivasan, Tamim Sookoor and Sabina Jeschke, “Smart Cities: Foundations, Principles, and Applications”, Wiley Publishers, 2017.
2. Poonam Sharma, “Geospatial Technology and Smart Cities: ICT, Geoscience Modeling, GIS and Remote Sensing”, Springer Nature, Switzerland AG, 2021.
3. Dr. P Partheeban and Dr. B Anuradha, “Applications of Geospatial Technologies for Smart City Traffic and Transportation Planning”, Veda Publications, Chennai, 2022.
4. T M Vinod Kumar, “Geographic Information System for Smart Cities”, COPAL Publishing Group, India, 2014.
5. Carrillo, Francisco Javier, et al., “Knowledge and the City: Concepts, Applications and Trends of Knowledge-based Urban Development”, Routledge, 2014.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | - | 2 | 3 | 2 | 2 |
| 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 2 | 2 | 3 | - | - | 2 | - | 2 | - | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

| OE | UNMANNED AERIAL SYSTEM (UAS) FOR LARGE SCALE MAPPING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION** **9**

Unmanned Aircraft Systems, History, Classification - Advantages - Aerodynamics and Airframe Configurations - Characteristics of Aircraft Types - Design Standards and Regulatory Aspects - Introduction to Design and Selection of the System for applications - Category of UAVs - Fixed wing - VTOL - Quadcopters – Nano, Mini, Micro – Small, Medium, Large – Launching and Landing methods -Hand - Catapult - Water surface - VTOL - civilian and military category classes.

**UNIT II UAS HARDWARE AND CONTROL SYSTEMS** **9**

Components: Wings - Propellers - Sensors - Pitot tubes - Autopilot or manual operating system - IMU - UAS IP datalink - UAV tracking (antenna) - Mimo tracking antenna - Ground control systems - UAV gimbal - Propeller and accessories - Ground detecting sensors - Wing types and systems - Source of energy- Endurance – Range - Controls - PIO feedback - Modems - Memory system - Simulation - Ground test - Analysis – Troubleshooting, Anti-drone systems.

**UNIT III PAYLOADS FOR UAS** **9**

Sensors: Payloads Dispensable Payloads - Non-Dispensable Payloads - Active Payloads - Passive Payloads –- Special sensors for UAV systems - Payloads: RGB, MSS, LiDAR, Microwave, Thermal, Hyperspectral, Magnetometer – Commercially available sensors: Specifications - Selection criteria of Payloads for various applications.

**UNIT IV OPERATIONAL AND DATA PROCESSING SOFTWARE** **9**

Flight planning - Features of mission planning - Intuitive workflow - Polygon of AOI - Automatic 3D flight planning - Photogrammetry based flight simulation - Oblique and Ortho image coverage - Waypoints - Directional take-off - Real-time flight status – Preprocessing of data - Work flow of UAS photogrammetry - Camera model - Purpose of GCP - Point cloud and mesh – ray cloud DSM - Ortho– mosaic, DTM and other products – Commercial and Open source software.

**UNIT V APPLICATIONS** **9**

Topographic mapping - Volume estimation from point cloud - Surveillance - Wildlife Monitoring – Disaster Management - Resource Applications: Forestry, Agriculture, Water, Archeology, Energy, Land, Glacier - Urban planning – Healthcare – Case studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understanding the different types of UAS and their characteristics.
**CO2:** Synthesize the function of various components.
**CO3:** Know various payload available for mapping.
**CO4:** Plan and process UAS based mapping missions.
**CO5:** Plan and process UAS based mapping missions.

**TEXT BOOKS:**


1. Vahram Dilbaryan “Investigations about the use of UAV photogrammetry and Laser Scanning: Investigation about UAV Photogrammetry and Laser Scan for control of construction works by comparison with CAD model”, AV Akademikerverlag Publisher, 2017, ISBN: 978- 3639871098.
2. Lauren Newman , “Drones (21st Century Skills Innovation Library: Emerging Tech)”, Cherry Lake Publishing, 2017.
3. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010. ISBN: 978-0-470-05819-0.
4. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, 4th Edition, John Wiley

& Sons, Ltd, 2012. ISBN: 9781119978664.

**REFERENCES:**

1. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001.
2. Kirnon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007.
3. Robert Nelson, "FLIGHT STABILITY AND AUTOMATIC CONTROL", 2nd Edition, McGraw Hill Education, 2017, ISBN: 978-0070661103.
4. https://www.pix4d.com/education-course-material**.**

**CO's, PO's MAPPING:**

| CO | PO | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **1** | 3 | 1 | 1 | 1 | 3 | 2 | - | - | - | - | 2 | - |
| **2** | 3 | 1 | 2 | 2 | 3 | 1 | - | - | - | - | 2 | - |
| **3** | 3 | 1 | 2 | 2 | 3 | 2 | - | - | - | - | 2 | - |
| **4** | 3 | 2 | 3 | 2 | 3 | 1 | - | - | - | - | 2 | - |
| **5** | 3 | 2 | 2 | 2 | 2 | 3 | - | - | - | - | 2 | - |
| **AVg.** | 3 | 1 | 2 | 2 | 3 | 2 | - | - | - | - | 2 | - |

1' = Low; '2' = Medium; '3' = High

## CLIMATE CHANGE STUDIES

**L T P C**
**3 0 0 3**

**UNIT I BASICS OF CLIMATIC CHANGE** **9**

Concepts of climatic cycles and long term changes – earth orbital variations – solar flares and outputs – magnetic and force fields – earth movements and energy release – ocean variability and periodic cycles –impacts of earthquakes and volcanoes.

**UNIT II ANTHROPOGENIC IMPACTS** **9**

Anthropogenic impacts- agriculture and impacts - industries and pollutions – urbanization – vehicles, transport and fossil fuels - chemicals, synthetics, solid wastes and gas outputs – municipal wastes.

**UNIT III CHANGE ASSESSMENT** **9**

Historical evidences – Archeological evidences – indicators of vegetation: species limits, pollens, tree rings and fossils – temperature and precipitation trends – evidences from terrain evaluation – ice and glacier changes – sea- level assessments – under water assessments – sediment analysis

**UNIT IV CLIMATE CHANGE HAZARDS** **9**

Global warming and impacts – carbon gas build up – possible land use changes – land productivity and livelihood changes – forest fires and wild life – impacts on water bodies – floods and droughts – human health impacts-Change Management: Use of renewable energy– land use adaptation - planning disaster mitigation

**UNIT V CLIMATE CHANGE MODELS** **9**

Climate change Models – RCM –GCM-Ozone depletion – greenhouse gas carbon-sequestration-IPCC and Indian scenario – SDG Mission.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the basic concepts of climate and climate change

**CO2:** Understand the natural and human impacts on climate change.
**CO3:** Understand the various methods to assess the evidence for climate change.
**CO4:** Understanding the climate change effects like Global warming, impacts on Agriculture, water body, health and their adaptations.
**CO5:** Understand the climate models to predict the climate and adaptation techniques for future

**TEXT BOOKS:**

1. William James Burroughs , "Climate change : A Multi disciplinary Approach", 2nd Edition, 2007
2. Jane Mc Adam, "Climate change and Displacement Multi disciplinary Perspectines", 2010.

**REFERENCES:**

1. Richard Somerville, "The forgiving Air: Understanding Environmental Change", 2nd revised Edition, 2008.
2. Heidi Cullen, "The weather of the future; heat waves, extreme storms, and other scenes from a climate changed planet", Reprint Edition, 2011.
3. Stephen H Schneider, "Science as a contact sport inside the battle to save earth's Climate,National Geographic",1st Edition, 2009.
4. James Hoggan, "Climate cover up; The crusade to deny global warming",1st Edition, 2009.
5. PK Joshi, TP Singh, "Geoinformatics for climate change studies", TERI Press, 2011.
6. John.L.Brooke, "Climate Change and the course of global History, A Rough Journey", Cambridge University Press, 2014.

**CO's, PO's & PSO's MAPPING:**

| CO | PO | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **1** | 2 | 1 | 1 | 3 | | 3 | - | - | | - | - | 3 |
| **2** | 1 | 1 | 2 | 3 | 3 | 2 | - | - | 2 | - | - | 3 |
| **3** | 3 | 3 | | 3 | 3 | | - | - | 3 | - | - | 3 |
| **4** | 3 | 3 | 3 | 3 | 3 | | - | - | 3 | - | - | 3 |
| **5** | 2 | 3 | 3 | 2 | 1 | | - | - | 2 | - | - | |
| **AVg.** | 2 | 3 | 3 | 3 | 3 | 3 | - | - | 2 | - | - | 3 |

1' = Low; '2' = Medium; '3' = High

## LIST OF OPEN ELECTIVES
## (TO BE OFFERED TO STUDENTS OF OTHER PROGRAMMES)

**GI23901 PHOTOGRAMMETRY L T P C**
**3 0 0 3**

**OBJECTIVE:**

To introduce basics and concepts of aerial photography, acquisition and mapping from aerial photographs using different types of stereo plotters

**UNIT I INTRODUCTION 9**

Principles - Stereoscopic depth perception – aerial photo-aerial camera -Scale – overlaps – stereoscopy – concepts – viewing and measuring system – principle of floating mark – methods of parallax measurement – vertical photographs – geometry, scale, parallax equations, planimetric mapping – Tilted photograph – Geometry, Coordinate system, Scale, Planimetric mapping

**UNIT II TRANSFORMATIONS 9**

Coordinate systems for Photogrammetry - Map projections, Datum and conversions- 2D and 3D Coordinate transformations: Affine, 7 Parameter Transformations - Collinearity and Space resection- Analytical stereomodel and relative orientation

**UNIT III MAPPING 9**

Concepts of interior, relative, absolute orientation – direct georeferencing – object, image relation collinearity and coplanarity conditions – effect of orientation elements - Elements and principles of Aerotriangulation – Independent Models-Simultaneous bundle adjustment - ortho mosaic

**UNIT IV DIGITAL PHOTORGRAMMETRY 9**

Concepts of Digital Photogrammetry- Digital cameras- CCD camera- full frame, frame transfer, interline CCD camera - Time delay integration- spectral sensitivity of CCD sensor – geometry and radiometry problem of CCD image Image Generation - Data Compression - formats – Softwares used for Digital Photogrammetric Mapping - Georeferencing - Stereo viewing-Display modes - image matching techniques - Image measurements

**UNIT V APPLICATIONS 9**

Review of space resection & intersection - Automatic tie point generation - Automatic Block triangulation, feature collection and plotting– DEM Generation - accuracy of DEMs, Orthorectification - regular & irregular data collection methods - contour generation – Applications in Hydrology, Highway (Cut and Fill Volume Calculations) - Satellite Photogrammetry principles – missions - stereo image products.

**OUTCOMES: TOTAL: 45 PERIODS**

On completion of this course, the student shall

Acquire knowledge about photogrammetry principles, methods and products generation strategies in both Analytical and digital photogrammetry system.

Understand the problem related to generation of products and solving them.

**REFERENCES:**

1 Paul R.Wolf, Elements of Photogrammetry, McGraw-Hill Science, 2001, ISBN

0070713464, 9780070713468

2 Karl Kraus, Photogrammetry, Fundamentals and standard processes, Dümmler, 2000, ISBN 9783110190076 12

3 Micheal Kasser and Yves Egels, “Digital Photogrammetry”, Taylor and Francis, 2002, ISBN

0 748409440

4 Francis h. Moffitt, Edward M. Mikhail, Photogrammetry, TBS The Book Service Ltd, 1968, ISBN 13: 9780700221370

5 Edward M. Mikhail, James S.Bethel, J.Chris McGlone, Introduction on “Modern

Photogrammetry”, John Wiley & Sons, Inc., 2001, ISBN 0-471 -30924-9

6 Wilfried Linder, “Digital Photogrammetry”-Theory and Applications, Springer-Verlag Berlin

Heidelberg New York, 2003, ISBN 3-540-00810-1

**GI23902 TOTAL STATION AND GPS SURVEYING L T P C**

**3 0 0 3**

**OBJECTIVES :**

- To understand the working of Total Station and GPS equipment and solve the surveying problems.

**UNIT I FUNDAMENTALS 9**

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Global Navigation System, Regional Navigation System and SBAS - Basic concepts of GNSS, Glonass,IRNSS Historical perspective and development - applications - Geoid and Ellipsoid- satellite orbital motion - Keplerian motion – Kepler"s Law - Perturbing forces - Geodetic satellite - Doppler effect-Different Coordinates and Time System.

**UNIT II ELECTROMAGNETIC WAVES 9**

Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI-Computation of group for light and near infrared waves at standard and ambient conditions-Computation of RI for microwaves at ambient condition - Reference refractive index- Real time application of first velocity correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction -Total atmospheric correction- Use of temperature - pressure transducers.

**UNIT III ELECTRO OPTICAL AND MICRO WAVE SYSTEM 9**

Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments– Applications of COGO functions - Traversing and Trilateration – Downloading and mapping - Recent trends.

**UNIT IV GPS SATELLITE SYSTEM 9**

GPS - Different segments - space, control and user segments - satellite configuration - GPS signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability – Task of control segment - GPS receivers- Single and Dual Frequency Receivers- Survey Grade GPS – GNSS Satellite Constellations

**UNIT V GPS DATA PROCESSING 9**

GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation – downloading the data -data processing – software modules - solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid, static methods with GPS - semi Kinematic, pure Kinematic and Real time kinematic methods –basic constellation of satellite geometry & accuracy measures - applications- Different GPS Data Processing and Mapping softwares.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

On completion of this course students shall be able to

- Understanding the concepts of Electromagnetic waves and impact of Refractive Index

- Work with Electro optical and microwave Total Station and understand error sources.
- Understand the advantages of electronic surveying over conventional surveying methods
- Understand the working principle of GNSS , it"s components, signal structure, and error sources
- Understand various GNSS surveying methods and processing techniques used in GNSS
- Observations
- Familiarise various areas of GNSS applications and new developments.

**REFERENCES:**

1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th edition, 2004
2. Satheesh Gopi, rasathishkumar, N.madhu, " Advanced Surveying, Total Station GPS and Remote Sensing " Pearson education , 2017
3. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 2007.
4. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 2007.
5. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
6. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 2007

**GI23903 COMPUTER VISION AND SATELLITE IMAGE PROCESSING** **L T P C**
**3 0 0 3**

**OBJECTIVE**:

The objective of the course is to describe about the fundamentals of computer vision and concepts of satellite data acquisition and analysis.

**UNIT I FUNDAMENTALS OF COMPUTER VISION** **9**

Image Formation and Coordinate Transformations - Camera Matrix - Motion/Stereo Pin-hole model - Human eye / cognitive aspects of colour / 3D space; Illumination; Sampling and Quantization - Coordinate transformations and camera parameters - Satellite data acquisition Whisk and push broom scanning: data products - Data formats: Image Display systems

**UNIT II IMAGE DEGRADATION AND RESTORATION** **9**

Sensor model; Sensor parameters – Spectral, Spatial, temporal and radiometric resolution; Image Representation-spatial, frequency and feature space domain - geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures- Atmospheric, Radiometric, Geometric Corrections- Image Geometry Restoration-Interpolation methods and resampling techniques.

**UNIT III IMAGE ENHANCEMENT** **9**

Histograms – types, scope, Univariate and multi variate statistics; Scattergrams; operators – point, local and regional operators; Contrast manipulation - contrast, spatial feature and multi image manipulation techniques - Fourier transform - principle component analysis - Optimal Rotation Transformation – Scale-space transform, wavelet transform. Multi-image fusion

**UNIT IV IMAGE CLASSIFICATION** **9**

Training sites - methods of collection- training accuracy – Supervised- Parallellepiped, Minimum distance to mean and Maximum Likelihood classifiers - Baye's Theorem, Unsupervised- ISODATA and Chain methods – parametric Classification - Decision tree –SVM Classifier – other Non parametric classifiers - sub pixel classification – Hyper-spectral image analysis – Accuracy assessment- test accuracy.

**UNIT V IMAGE ANALYSIS** **9**

Pattern recognition - boundary detection and representation - textural and contextual analysis decision concepts: Fuzzy sets - evidential reasoning - Expert system – Features, ArchitectureRule based expert system; Artificial Neural Network- Architecture- Types: Adaline, Madaline, SOM and BPN networks – Case studies

**TOTAL : 45 PERIODS**

**OUTCOME**:

- On completion of this course, the student shall be able to get familiarized about various fundamentals of computer vision, image enhancement and image processing techniques.

**TEXT BOOKS:**

1. David Forsyth and Jean Ponce, Computer Vision: A modern Approach, Pearson Education India; 2 edition, 2015

2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.

3. Robert Shcowebgerdt, Remote sensing models & methods for image processing, 3 rd edition, 2006.

**REFERENCES:**

1. John A.Richards, Springer – Verlag, Remate Sensing Digital Image Analysis 2013.

2. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007.

3. W.G.Rees - Physical Principles of Remote Sensing, Cambridge University Press, 2012.

**GI23904 REMOTE SENSING CONCEPTS L T P C**
**3 0 0 3**

**OBJECTIVES:**

 To introduce the concepts of remote sensing processes and its components.  To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

**UNIT I REMOTE SENSING AND ELECTROMAGNETIC SPECTRUM 9**

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – wave theory, particle theory, Stefan – Boltzmann Law and Wien's Law – visible and non visible spectrum – Radiation sources: active & passive; Radiation Quantities

**UNIT II EMR INTERACTION WITH ATMOSPHERE 9**

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere - Scattering (Rayleigh, Mie, non-selective scattering) absorption and refraction – Atmospheric effects on visible, infrared, thermal and microwave spectrum – Atmospheric windows.

**UNIT III EMR INTERACTION WITH EARTH 9**

Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectro radiometer / Spectrophotometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water body – Factors affecting spectral reflectance of vegetation, soil and water body.

**UNIT IV PLATFORMS AND SENSORS 9**

Ground based platforms –Airborne platforms – Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Resolution concepts – Scanners - Along and across track scanners – Orbital and sensor characteristics of different satellites – Airborne and Space borne TIR sensors – Calibration – S/N ratio – Passive/Active microwave sensing – Airborne and satellite borne RADAR –SAR –LIDAR , UAV – High Resolution Sensors – Sensors for Earth Resources, Ocean Monitoring, Environmental Monitoring, Rainfall Estimation – Hyper Spectral Sensors

**UNIT V DATA PRODUCTS, VISUAL AND DIGITAL IMAGE PROCESSING 9**

Photographic (film and paper) and digital products – quick look products - High Resolution data products data - ordering – interpretation – basic characteristics of image elements – interpretation keys (selective and elimination) – visual interpretation of natural resources- Digital Image Processing-Preprocessing and Image Enhancement - Image Classifiers

**TOTAL: 45 PERIODS**

**OUTCOME**:

- On completion of this course, the student shall be able to get familiarized about various fundamentals of computer vision, image enhancement and image processing techniques.

**TEXT BOOKS:**

1. David Forsyth and Jean Ponce, Computer Vision: A modern Approach, Pearson Education India; 2 edition, 2015

2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.

3. Robert Shcowebgerdt, Remote sensing models & methods for image processing, 3 rd edition, 2006.

**REFERENCES:**

1. John A.Richards, Springer – Verlag, Remate Sensing Digital Image Analysis 2013.

2. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007.
3. W.G.Rees - Physical Principles of Remote Sensing, Cambridge University Press, 2012.

**MINOR PROGRAMME ON REMOTESENSING AND GEOMATICS**
**(TO BE OFFERED TO STUDENTS OF OTHER PROGRAMME)**

| | | | | | |
|---|---|---|---|---|---|
| **GI23033** | **REMOTE SENSING** | **L** | **T** | **P** | **C** |
| | | **3** | **0** | **0** | **3** |

**UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9**

Definition - Components of remote sensing - History of remote sensing - Merits and demerits of data collection between conventional and remote sensing methods - Electromagnetic spectrum - Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchhoff's law - Radiation sources: active & passive - Radiation quantities.

**UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9**

Standard atmospheric profile - Main atmospheric regions and its characteristics - Interaction of radiation with atmosphere - Scattering, absorption and refraction - Atmospheric windows - Energy balance equation - Specular and diffuse reflectors - Spectroradiometer - Spectral signature concepts - Typical spectral reflectance curves for vegetation, soil and water – Solid surface scattering in microwave region.

**UNIT III ORBITS AND PLATFORMS 9**

Motions of planets and satellites - Newton 's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types - Orbital perturbations and maneuvers - Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms - Classification of satellites - Sun synchronous and Geosynchronous satellites - Lagrange Orbit.

**UNIT IV SENSING TECHNIQUES 9**

Classification of Remote Sensors - Resolution concept: Spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners - Optical-infrared sensors - Thermal sensors - Microwave sensors - Calibration of sensors - High Resolution Sensors - LIDAR, UAV - Orbital and sensor characteristics of live Indian earth observation satellites.

**UNIT V DATA PRODUCTS AND INTERPRETATION 9**

Photographic and digital products - Types, levels and open-source satellite data products - Selection and procurement of data - Visual interpretation: Basic elements and interpretation keys - Digital interpretation - Concepts of image rectification, image enhancement and image classification - Classification accuracy assessment.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course, the student is expected to

**CO1:** Understand the concepts and laws related to remote sensing.
**CO2:** Understand the interaction of electromagnetic radiation with atmosphere and Earth material.
**CO3:** Acquire knowledge about satellite orbits and different types of satellites.
**CO4:** Understand the different types of remote sensors.
**CO5:** Gain knowledge about the concepts of interpretation of satellite imagery.

**TEXTBOOKS:**

1. Thomas M Lillesand, Ralph W Kiefer and Jonathan W Chipman, "Remote Sensing and Image interpretation", John Wiley and Sons, Inc., New York, 2015.

2. George Joseph and Jeganathan C, “Fundamentals of Remote Sensing”, 3rd Edition Universities Press (India) Private limited, Hyderabad, 2018.
3. Basudeb Bhatta, “Remote Sensing and GIS”, 3rd Edition, Oxford University Press India, 2021.

**REFERENCES:**

1. Stanley A Morain, Amelia M Budge, Michael S Renslow, “Manual of Remote Sensing”, Vol. I, 4th edition, American Society for Photogrammetry and Remote Sensing, Virginia, USA, 2019.
2. Verbyla ,David, “Satellite Remote Sensing of Natural Resources”, CRCPress, 2022 1st edition.
3. Paul Curran P J, “Principles of Remote Sensing”, Longman, RLBS, 1996.
4. Charles Elachi and Jacob VanZyl, “Introduction to Physics and Techniques of Remote Sensing”, 2021 3rd edition, Wiley Publication.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 2 | - | - | - | - | - | 1 | 1 | 1 | 2 | 2 | 2 |
| 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | 1 | 1 | 1 | 3 | 3 | 3 |
| 3 | 3 | 2 | 2 | - | 2 | - | - | - | - | 1 | 1 | 1 | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23401** **CARTOGRAPHY AND GIS** **L T P C**
**3 0 0 3**

**UNIT I ELEMENTS OF CARTOGRAPHY 9**

Definition of cartography - Maps - Functions - Uses and types of maps - Map scales and contents - Map projections - Shape, distance, area and direction properties - Perspective and mathematical projections - Indian maps and projections - Map coordinate System - UTM and UPS references.

**UNIT II MAP DESIGN AND PRODUCTION 9**

Elements of a map - Map layout principles - Map design fundamentals - Symbols and conventional signs - Graded and ungraded symbols - Color theory - Colours and patterns in symbolization - Map lettering - Map production - Map printing - Colours and visualization - Map reproduction - Map generalization - Geometric transformations - Bilinear and affine transformations.

**UNIT III FUNDAMENTALS OF GIS 9**

Introduction to GIS - Definitions - History of GIS - Components of a GIS - Hardware, software, data, people, methods – Introduction to data quality - Types of data - Spatial, attribute data - Types of attributes - Scales/levels of measurements - Spatial data models - Raster data structures - Raster data compression - Vector data structures - Raster vs vector models - TIN and GRID data models.

**UNIT IV DATA INPUT AND TOPOLOGY 9**

Scanner - Raster data input - Raster data file formats - Georeferencing - Vector data input - Digitizer - Datum projection and reprojection - Coordinate transformation - Topology - Adjacency, connectivity and containment - Topological consistency - Non topological file formats - Attribute data linking - Linking external databases - GPS data integration - Raster to vector and vector to raster conversion.

**UNIT V DATA QUALITY AND OUTPUT 9**

Assessment of data quality - Basic aspects - Completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage - Metadata - GIS standards - Interoperability - OGC - Spatial data infrastructure - Data output - Map compilation - Chart / graphs.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Be familiar with appropriate map projection and coordinate system for production of Maps and shall be able to compile and design maps for their required purpose.

**CO2:** Be familiar with coordinate and Datum transformations

**CO3:** Understand the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression

**CO4:** Understand the concepts of spatial data quality and data standard

**CO5:** Understand the concept of spatial data inputs

**TEXT BOOKS:**


1. Arthur H Robinson et al, “Elements of Cartography”, 7th Edition, Wiley, 2002.
2. Kang – TsungChang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 4th edition, 2008, ISBN: 0073051152, 9780073051154.
3. Ian Heywood, Sarah Cornelius, Steve Carver, “An Introduction to Geographical Information Systems, Pearson Education, 4th edition, 2011, ISBN: 027372259X, 9780273722595.

**REFERENCES:**


1. John Campbell, “Introductory Cartography”,Wm. C. Brown Publishers, 3rd Edition, 2004.
2. Chor Pang LO, Albert K W Yeung, “Concepts and Techniques of Geographic Information Systems”, Pearson Education, 2nd edition, 2016, ISBN: 9789332581883.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 2 | 1 | 2 | 3 | - | - | - | 3 | - | - | - | 3 | 2 | 2 |
| **2** | 3 | 2 | 1 | 2 | 3 | - | - | - | 2 | - | - | - | 3 | 2 | 2 |
| **3** | 3 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 3 | 2 |
| **4** | 3 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 3 | 2 |
| **5** | 3 | 3 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 2 | 2 |
| **AVg.** | 3 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | - | - | 3 | 2 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23403 DIGITAL IMAGE PROCESSING L T P C**
**3 0 0 3**

**UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9**

Definition - Image representation - Steps in DIP - Components - Elements of visual perception - Image formation - Image sampling and quantization - Image acquisition, storage and retrieval - Relationships between pixels - Color image fundamentals - RGB, HSI models - Data products - Satellite data formats - Digital image processing systems - Hardware and software design consideration.

**UNIT II PRE PROCESSING 9**

Image characteristics - Histograms - Scattergrams - Initial statistics - Univariate and multivariate statistics - Initial image display - Ideal display, types, sensor models - Spatial, spectral, radiometric, temporal - IFOV, GIFOV & GSI - Geometry and radiometry - Sources of image degradation and correction procedures - Atmospheric, radiometric, geometric corrections - Image geometry restoration - Interpolation methods and resampling techniques.

**UNIT III IMAGE ENHANCEMENT 9**

Image characteristics - Point, local and regional operation - Contrast, spatial feature and multi-image manipulation techniques – Level slicing, contrast stretching, spatial filtering, edge detections - Fourier transform - FFT, DFT - Band ratio - Principal component analysis (PCA) - Scale - Space transform - Multi-image fusion.

**UNIT IV IMAGE CLASSIFICATION 9**

Pattern recognition concepts - Bayes approach - Spectral signature and training sets - Separability test - Supervised classification - Stages - Minimum distance to mean, parallelepiped, MLC - Unsupervised classifiers - ISODATA, K-means - Support vector machine - Sub-pixel classifierm - Error matrix - Accuracy assessment - Accuracy metrics: Kappa statistics, ERGAS, RMSE.

**UNIT V ADVANCED CLASSIFIERS 9**

Texture based classification - Segmentation (spatial, spectral) - Regions fuzzy set classification - Object based classifiers - Deep learning - Artificial neural nets: Hebbian learning - Adaline, madaline, BPN - Hybrid classifiers - Neuro - Fuzzy models - Expert system - Knowledge based systems.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Familiarize the basic concept of satellite image processing.
**CO2:** Perform the geometric and radiometric corrections.
**CO3:** Apply image enhancement techniques for satellite images.
**CO4:** Perform image classification and accuracy assessment
**CO5:** Apply various advanced classification techniques such as ANN, Expert system and Fuzzy logic.

**TEXT BOOKS:**


1. John R Jensen, “Introductory Digital Image Processing: A Remote Sensing Perspective”, PrenticeHall, New Jersey, Pearson Education, 4th edition, 2016, ISBN: 013405816X, 9780134058160.
2. Robert A Schowengergt, “Techniques for Image Processing and Classification in Remote Sensing”, Academic Press, 2012, ISBN: 0323138551, 9780323138550.

**REFERENCES:**


1. Robert G Reeves, “Manual of Remote Sensing Vol. I & II”, American Society of Photogrammetry
   , Falls, Church, USA, 1983.
2. John A Richards, “Remote Sensing Digital Image Analysis - An Introduction”, Springer-Verlag, 5th Edition, 2014.
3. Rafael C Gonzalez, Richard Eugene Woods, “Digital Image Processing”, Pearson / Prentice Hall, 4th edition, 2022.
4. Annadurai, “Fundamentals of Digital Image Processing”, Pearson Education (2007).


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 2 | 2 | 1 | 1 | 1 | - | - | 2 | - | - | 2 | 3 | - | - |
| 2 | 2 | 3 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | 2 | 1 | 2 | 2 |
| 3 | 3 | 2 | 2 | 3 | 2 | 1 | - | - | | - | - | 2 | 2 | 1 | 2 |
| 4 | 3 | 3 | 2 | 3 | 3 | - | - | - | 2 | - | - | 3 | 2 | 2 | 2 |
| 5 | 2 | - | 2 | 2 | 3 | 1 | - | - | 1 | - | - | 2 | 2 | 2 | 2 |
| AVg. | 3 | 2 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | 2 | 2 | 1 | 2 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23304 PRINCIPLES OF PHOTOGRAMMETRY L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**

History - Definition, applications - Types of photographs, classification - Photographic overlaps - Camera: Metric vs. non-metric, digital aerial cameras - Multiple frame and line cameras - Linear array scanner - Flight planning - Crab & drift - Computation of flight plan - Photogrammetry project planning.

**UNIT II GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS 9**

Photo coordinate measurement - Vertical photographs - Geometry, scale, coordinate system, relief displacement - Stereoscopes - Stereoscopic parallax - Parallax equations - Geometry, scale, coordinate system - Relief displacement - Photo Interpretation.

**UNIT III STEREOPLOTTERS & ORIENTATION 9**

Projection system, viewing, measuring and tracing system stereo plotters - Classification: Analog, semi analytical, analytical and digital systems - Interior orientation - Relative orientation - Absolute orientation - Collinearity condition and coplanarity condition - Orientation: Two-dimensional coordinate transformations - Three-dimensional conformal coordinate transformation.

**UNIT IV AEROTRIANGULATION, TERRAIN MODELING, ORTHOPHOTO 9**

Neat model - Strip and blocks of photographs - Aerotriangulation: Strip adjustment, independent model triangulation, bundle block Adjustment and GPS aerotriangulation (INS and GNSS integration) - Feature collection - DTM generation and contour mapping - Ortho rectification - Mono plotting - Stereo plotting.

**UNIT V DIGITAL PHOTOGRAMMETRY 9**

Photogrammetric scanner - Digital photogrammetry workStation - Work station basic system function - Storage system - Stereoscopic viewing and measuring system - Image properties - Image matching: Template matching, feature based matching - DEM and DSM - Satellite photogrammetry principles.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand and appreciate the importance of photography as means of mapping, functional and physical elements of photography.

**CO2:** Understand the need of the photogrammetric mapping and the relevance of accuracy standards and means to achieve them for precise large scale maps with scientific methods.

**CO3:** Evaluate the standards of map based on the state of the art tool and techniques and assess the production standards for photogrammetric map making.

**CO4:** Acquire knowledge on the current development, issues methods and solutions in map making and evaluate methods of production.

**CO5:** Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of mapping technology.

**TEXT BOOKS:**


1. Paul R Wolf., Bon A. De Witt, “Elements of Photogrammetry with Application in GIS”, McGraw Hill International Book Co., 4th Edition, 2014.
2. Matt Weilberg, “GIS Approaches for Remote Sensing and Photogrammetry”, Callisto Reference, 2018.
3. .J Chris Mc Glone, “Manual of Photogrammetry”, American Society for Photogrammetry and Remote Sensing, 6th Edition, 2013.

4. E M Mikhail, J S Bethel, J C McGlone, “Introduction to Modern Photogrammetry”, Wiley Publisher, 2001.

**REFERENCES:**

1. Gollfried Konecny, “Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems”, CRC Press, 2nd edition, 2014.
2. Karl Kraus, “Photogrammetry: Geometry from Images and Laser Scans”, Walter de Gruyter GmbH & Co.2nd edition, 2007.
3. Chester C Slama, Charles Theurer, Soren W. Henriksen, “Manual of Photogrammetry”, American society of Photogrammetry, 1980.
4. Wilfried Linder, “Digital Photogrammetry – A practical course”, 3rd edition, Springer, 2016.
5. Yves Egels, Michel Kasser, “Digital Photogrammetry”, Taylor & Francis group, 2003.

**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| 2 | 2 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |
| 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 2 |
| 4 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| AVg. | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23402** **ELECTRONIC SURVEYING** **L T P C**
**3 0 0 3**

**UNIT I FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES 9**

Methods of measuring distance, basic principles of total station, historical development, classifications, applications and comparison with conventional surveying - Classification - Applications of electromagnetic waves, propagation properties, wave propagation at lower and higher frequencies.

**UNIT II DISTANCE AND ATMOSPHERIC CORRECTION 9**

Refractive index (RI) - Factors affecting RI - Computation of group RI for light and near infrared wavesat standard and ambient conditions - Computation of RI for microwaves at ambient condition - Reference refractive index - Real time application of first velocity correction - Measurement of atmospheric parameters - Mean refractive index - Second velocity correction - Total atmospheric correction - Use of temperature and pressure transducers.

**UNIT III ELECTRO OPTICAL AND MICROWAVE SYSTEM 9**

Electro-optical system: Measuring principle, Working principle, reflectors, Sources of Error, Infrared andLaser Total Station instruments. Microwave system: Measuring principle, working principle,Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical andMicrowave system. Care and maintenance of Total Station instruments – Traversing andTrilateration-COGO functions, offsets and stake out-land survey applications.

**UNIT IV GPS SATELLITE SYSTEM 9**

Basic concepts of GPS - Historical perspective and development - Applications - Geoid and ellipsoid - Satellite orbital motion - Keplerian motion - Kepler‘s law - Perturbing forces - Geodetic satellite - Doppler effect - Positioning concept - GNSS, IRNSS and GAGAN - Different segments - Space, control and user segments - Satellite configuration - GPS signal structure - Orbit determination and representation - Anti spoofing and selective availability - Task of control segment - GPS receivers.

**UNIT V GPS DATA PROCESSING 9**

GPS observables - Code and carrier phase observation - Linear combination and derived observables - Concept of parameter estimation - Downloading the data RINEX format - Differential data processing - Software modules - Solutions of cycle slips, ambiguities, concepts of rapid, static methods with GPS - Semi kinematic and pure kinematic methods - Satellite geometry & accuracy measures - Applications - Long baseline processing - Use of different softwares.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Learn the fundamentals of Total station.

**CO2:** Provides knowledge about electromagnetic waves and its usage in Total station.

**CO3:** Understand the measuring and working principle of electro optical and Microwave Total station.

**CO4:** Learn the basic concepts of GPS.

**CO5:** Gains knowledge about GPS data downloading and processing.

**TEXT BOOKS:**

1. Jean M Rueger, “Electronic Distance Measurement: An Introduction”, 4th edition, Springer Science and Business Media, 2012, ISBN: 3642802338, 9783642802331.
2. Satheesh Gopi, Sathikumar R, Madhu N, “Advanced Surveying: Total Station GPS and Remote Sensing”, Pearson Education, Reprint, 2007. ISBN: 8131700674, 9788131700679.

**REFERENCES:**


1. Subramanian R, “Surveying and Levelling”, Oxford University Press, 2nd Edition, 2012.
2. Laurila S H, “Electronic Surveying in Practice”, John Wiley and Sons Inc, 1983.
3. Guocheng Xu, “GPS Theory, Algorithms and Applications”, Springer - Verlag, Berlin, 3rd edition, 2016.
4. Alfred Leick, “GPS satellite surveying”, John Wiley & Sons Inc, 4th Edition, 2015.
5. Seeber G, “Satellite Geodesy”, Walter De Gruyter, Berlin, 2nd Edition, 2003.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **1** | 3 | 1 | 1 | 1 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **4** | 3 | 1 | 1 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **5** | 3 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| **AVg.** | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23702 NATURAL RESOURCE MANAGEMENT WITH GEOMATICS L T P C**
**3 0 0 3**

**UNIT I GEOMATICS APPLICATIONS IN AGRICULTURE AND FORESTRY 9**

Crop monitoring and condition assessment - mapping of saline alkaline soils – Crop acreage mapping- Crop yield estimation - optimum land use planning for sustainable agriculture - forest type and density mapping - biomass assessment - timber volume estimation - forest fire mapping and damage assessment - species mapping – Agricultural non-point source pollution studies..

**UNIT II GEOMATICS APPLICATIONS IN HYDROLOGY AND WATER RESOURCE MANAGEMENT 9**

Delineation and codification of watershed - Hydrological Modelling – runoff modelling - Water quality mapping and monitoring – Correlation model for pollution detection- Snow melt runoff - glacier runoff modelling- Flood Risk Zoning - Flood damage assessment - mathematical modelling of groundwater system- interfacing GIS with ground water model- modelling of reservoir siltation- Erosion Estimation using Remote sensing -prioritization of watersheds – watershed modelling for sustainable development.

**UNIT III GEOMATICS APPLICATIONS IN URBAN AND TRANSPORTATION STUDIES 9**

Transportation database and network flows – Vehicle routing and shortest path – location allocation model – Traffic modeling – Route planning – Accident Analysis – Highway maintenance – Transport safety management – Construction and asset management of transport structures – Land-use change and Urban Heat Island Studies - Land suitability analysis/site selection–Urban Object Analysis - Urban climate – Air quality assessment

**UNIT IV GEOMATICS APPLICATIONS IN OCEAN AND COASTAL STUDIES 9**

Biotic and Abiotic resources – Exclusive Economic Zone –Coastal Ecosystem –Potential Fishing Zone mapping - Coastal water quality: HAB and Marine litter monitoring, prediction and risk assessment, Coral bleach, pollution dispersion modelling, Oil spill/slick detection– Wetland mapping- Coastal protection structures –Coastal Regulation Zone mapping–Sea Level Rise Monitoring –Sea water intrusion - Tsunami damage assessment and early warning system.

**UNIT V GEOMATICS APPLICATIONS IN METEOROLOGY 9**

Weather forecasting: Tools and methods – Crop stress and Crop insurance – Forest health: Canopy atmosphere interaction, microclimate and Wild Fires–Site suitability for wind farms - Urban floods, air quality and UHI–Low pressure system detection and monitoring –Cyclone Warning Systemand damage assessment – Storm surge modelling –Ozone depletion and Global warming – Climate policies and actions– Visibility prediction and aviation routing.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- ·On completion of the course, the student is expected to

**CO1:** Understanding of geomatics principles and applicability in agricultural and forestry settings.

**CO2:** Understand the increased awareness of the limitations and challenges associated with implementing geomatics applications in environmental and water resource studies.

**CO3:** Increased ability to use geomatics concepts for site analysis, land use zoning, street network design, and transit planning, resulting in more efficient and sustainable urban environments.

**CO4:** Enhanced knowledge of using geomatics tools such as GIS and remote sensing for studying coastal processes, marine spatial planning, and conservation efforts.

**CO5:** Ability to apply geomatics principles to real-world satellite meteorology case studies, showcasing skills in weather analysis, forecasting, and improving data accuracy

**TEXT BOOKS:**


1. Seelye Martin,"An Introduction to Ocean Remote Sensing", Cambridge University Press, 2nd Edition, June 2014.
2. J.P. Singhal, " Disaster Management", Laxmi Publications, ISBN-10:9380386427, ISBN-13:978-9380386423, 2019**.**
3. Stojce Dimov Ilcev," Global Satellite Meteorological Observation (GSMO) Applications ", Volume 2 ,Springer, 2018**.**
4. K.Ramamohan Reddy, B.Venkateswara Rao, C.Sarala, "Hydrology and Watershed Management with a Focal Theme on Ecosystem Resilience—Rural and Urban Water Requirements", 2014.
5. Susan L. Ustin, "Manual of Remote Sensing :Remote Sensing for Natural Resource Management and Environmental Monitoring", John Wiley & Sons Inc, 2004.


**REFERENCES:**


1. Poonam Sharma, "Geospatial Technology and Smart Cities: ICT, Geoscience Modeling, GIS and Remote Sensing", Springer Nature, Switzerland AG, 2021.
2. Karsten Mangor, Nils K. Drønen, Kasper H. Kærgaard, Sten E. Kristensen, "Shoreline Management Guidelines", Publisher: Horsholm, DHI Water & Environment, Denmark, Fourth edition, 2017.
3. Mahesh Gaur, C.B. Pandey & R.K. Goyal, "Remote Sensing in Natural Resources Monitoring and Management". Scientific Publishers, 2016.
4. Su-YinTan,"Meteorological Satellite Systems", International Space University, Springer, 2014.
5. Tim Davie, Fundamentals of Hydrology 3rd Edition, Routledge. 2019.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3 | | 2 | 3 | 3 | 3 | 3 | 3 | | 3 | | 3 | 3 | 3 | 3 | 3 |
| 4 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1' = Low; '2' = Medium; '3' = High

**GI23501 MICROWAVE REMOTE SENSING L T P C**
**3 0 0 3**

**UNIT I FUNDAMENTALS AND ACTIVE SYSTEM 9**

Introduction - Plane waves - Phase, coherence and interference - Evolution - Radar frequency bands - SLAR - Antenna system - SLAR imaging geometry - RADAR equation - Resolution concepts: Range and azimuth resolution - Doppler beam sharpening and antenna synthesis - Synthetic aperture radar - Geometric distortions.

**UNIT II RADAR INTERACTION WITH EARTH FEATURES 9**

System parameters - Target parameters: Roughness scales and criteria, dielectric constant and penetration depth - Surface backscattering - Physical surface backscattering models: Clapp, facet, bragg resonance models and hard targets - Volume backscattering - RADAR image signatures and interpretation.

**UNIT III IMAGING AND NON IMAGING 9**

SAR interferometry - Basics - Differential SAR interferometry - Applications polarimetry - Introduction - Polarization ellipse - Polarization types - Synthesis and signatures - Polarimetric parameters - Information extraction - Polarimetric image interpretation and applications - Altimetry - Principle – Frequency bands - Location system - Missions, scatterometry - Scatterometer subsystems - Wind retrieval - Missions and application.

**UNIT IV SAR APPLICATIONS 9**

Airborne, space borne - Different platforms and sensors - History- ENVISAT, ASAR, ALOS / PALSAR - RADARSAT, RISAT ,GRACE and Sentinel 3 missions - SAR data products and selection procedure - Applications in agriculture - Forestry - Geology - Hydrology - Snow cover mapping - Snow depth estimation - Landuse/landcover mapping - Ocean related studies.

**UNIT V PASSIVE SYSTEM 9**

Radiometry - Thermal radiation laws - Black body radiation and grey body radiation - Emissivity, radiometers - Components - Radiometric power - Brightness temperature - Power - Temperature correspondence - Passive microwave interaction with atmospheric constituents - Emission characteristics of various earth features - Data products and applications - Passive missions - DMSP, TRMM, Aqua missions, AMSR-E, AMSU.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course the student is expected to be able to

**CO1:** Understand the fundamentals of microwave remote sensing systems such as SLAR, RAR and SAR.

**CO2:** Learn the interaction mechanism of Radar with target features.

**CO3:** Understand the principles and applications of Imaging and Non-Imaging observation.

**CO4:** Learn about the satellite sensing system and applicability of SAR.

**CO5:** Understand the concepts of passive microwave systems and applications.

**TEXT BOOKS:**


1. 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, ISBN: 0890061920, 9780890061923.
2. John R Jensen, “Remote Sensing of the Environment: An Earth Resource Perspective”, Pearson Education India, 2nd edition, 2013.
3. John A Richards, “Remote Sensing with Imaging RADAR”, Springer, 2009, ISBN: 978-3-642-

02020-9.

**REFERENCES:**


1. Prashant Srivastava, Dillep Gupta, Tanvir Islam, Dawei Han, Rajendra Prasad, “RADAR Remote Sensing Application and Challenges”, Elsevier, 2022.
2. Pranab Kumar Karmakar, “Microwave Propagation and Remote Sensing Atmospheric Influences with Models and Applications”, Taylor & Francis, CRC Press, 2020.
3. Alessandro Ferretti, ”Satellite InSAR data: Reservoir Monitoring from Space”, EAGE Publications, 2014.
4. John R Schott, “Fundamentals of Polarimetric Remote Sensing”, SPIE press, 2010.
5. Iain H Woodhouse, “Introduction to Microwave Remote Sensing” Taylor & Francis, 2006.


**CO's-PO's & PSO's MAPPING**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | - | 3 | 2 | 3 | 2 | 2 |
| 2 | - | 3 | - | 3 | - | 2 | 3 | - | - | 3 | - | - | 3 | 3 | 3 |
| 3 | 3 | 2 | 3 | 2 | 3 | 3 | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| 4 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5 | 3 | - | 3 | 3 | 2 | 3 | 3 | 3 | - | 2 | - | 2 | 3 | 2 | 2 |
| AVg. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1’ = Low; ‘2’ = Medium; ‘3’ = High

**GI23E03 ENVIRONMENTAL ECONOMICS L T P C**
**3 0 0 3**

**UNIT I PRINCIPLES OF ECONOMICS 9**

Environment as an Asset - Interaction between economy and environment – Economic concepts of Wealth, Welfare, Scarcity, Growth, Sustainability, Costs, Benefits, Opportunity costs ,Social Costs- Trade off and marginal thinking- Marginal Costs and Marginal Benefits – Positive and Normative criteria for decision making - Equi marginal principle- Abatement cost and Efficient level of pollution - Marginal Damage Functions –Consumer Choice theory – Economic Efficiency and Markets– Supply and Demand– Consumers' surplus - Producers' surplus and net social benefit -Static and dynamic efficiency - market failures –Property Rights, Externalities, and Environmental Problem - Coase Theorem - Public Goods and Externalities - Free rider problem – Tragedy of the commons

**UNIT II ECONOMIC VALUATION OF ENVIRONMENTAL RESOURCES 9**

Types of Economic value - Environmental Benefits and Environmental Costs – Classifying economic valuation methods– Direct and indirect methods – Surrogate markets – Stated Preference and Revealed Preference methods- hedonic prices, travel cost models, contingent valuation, benefit transfer –economic valuation of ecosystem services- Assessment of Loss of Ecology - Valuation of Health impacts - Environmental accounting

**UNITIII ECONOMICS OF POLLUTION PREVENTION AND CONTROL 9**

Economics of Environmental Quality- - Cost benefit analysis and Cost effectiveness analysis– welfare foundation of cost-benefit analysis - Principles, methodology and Limitations – Discounting and intergenerational equity - Profitability of Pollution Prevention - Pay back period – Present value estimation – Internal rate of return –Economic analysis of Pollution Prevention Case studies– economically efficient pollution control programmes – Economics of Enforcement - Efficient allocation of pollution from mobile and stationery source – Total Cost Assessment- Life cycle costing-Green Accounting and Economic indicators

**UNIT IV ECONOMIC INSTRUMENTS FOR ENVIIRONMENTAL PROTECTION 9**

Economic analysis of Environmental Policy -Regulatory versus Economic Instruments – Decentralized Policies: Liability Laws, Property Rights, and Moral Suasion - Command-and- Control Strategies - Pigovian and Pollution Taxes – Internalizing externality using the Pigouvian tax approach - Emission Charges and Subsidies– Marketable permits – Emission trading -– Non Compliance fees, bonds and deposit refunds –Evaluation of Instruments – Choice of instruments for Environmental policy - macroeconomic effects of environmental regulations - - Economics of Climate Change – Climate Finance – Carbon credits.

**UNIT V NATURAL RESOURCE ECONOMICS 9**

Natural Resources and Environmental resources – Concept and Classification , Scarcity and its economic implications - Economics of depletable and non-renewable resources – Recyclable resources – Replenishable but depletable resources – Storable renewable resources – Renewable common property Resources–Optimal Use of Exhaustible Resources-Natural resources accounting - Economics of Forestry and fisheries exploitation –Trade and environment – Income Effects and Environmental Kuznets Curves – Race to the Bottom and Pollution Haven Hypothesis - Porter Hypothesis

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course, the student is expected to be able to

**CO1** explain the various terms and basic principles of environmental economics
**CO2** apply the knowledge of science and engineering fundamentals to analyse costs, benefits and value of environmental and natural resources accounting

**CO3** design of economic instruments and policies for optimal pollution, economics of exhaustible resources and renewable resources

**CO4** select appropriate economic instruments and policies for environmental management taking into account the impact of the solutions in a sustainability context

**CO5** conduct research pertinent to environmental economics and communicate effectively to different stakeholders as well as engage in independent life- long learning

**REFERENCES:**


1. Tom Tietenberg, Lynne Lewis ,Environmental Economics: The Essentials, Taylor & Francis, 2019
2. Tom Tietenberg, Lynne Lewis , Natural Resource Economics: The Essentials, Taylor & Francis, 2019
3. Barry Field and Martha Field, Environmental Economics: An Introduction, McGraw-Hill, 2021.
4. Nancy Olewiler; Barry Field, Environmental Economics , McGraw-Hill Ryerson, 2015
5. Kate Raworth, Doughnut Economics - Seven ways to think like a 21st century Economist, Random House Business Books, UK, 2017
6. Kolstad, Charles, Environmental Economics", Oxford University Press, New York, 2011
7. John Asafu Adjaye, " Environmental Economics for non-Economists – techniques and policies for Sustainable Development, World Scientific,2005


**CO-PO-PSO MAPPING: ENVIRONMENTAL ECONOMICS**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **1** | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 3 |
| **2** | 1 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 1 | 1 |
| **3** | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |
| **4** | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 3 |
| **5** | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **Avg.** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

• 1' = Low; '2' = Medium; '3' = High

**GI23E04 WASTE MANAGEMENT FOR CIRCULAR ECONOMY L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION TO WASTE CLASSIFICATION & CIRCULAR ECONOMY 10**

Sources and types of wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects — solid waste (M&H) rules — Integrated solid waste management-Public awareness; Role of NGO's- Public Private participation- Introduction to circular economy-Purpose of circular economy-Circular sustainability- Challenges for circular economy.

**UNIT II ON-SITE STORAGE AND PROCESSING 8**

On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and environmental aspects of open storage – waste segregation and storage - case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling of plastic waste –Construction and Demolishing waste.

**UNIT III COLLECTION AND TRANSFER 9**

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes - Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems - case studies on waste collection and material recovery- Circular bioeconomy- Circular Business Models to create economic and social value- Extended Producer Responsibility

**UNIT IV OFF-SITE PROCESSING 9**

Objectives of waste processing — Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation; Thermal processing options — case studies under Indian conditions.

**UNIT V DISPOSAL 9**

Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor – Dumpsite capping –Biomining – Case studies on Biomining

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

On completion of this course, the student is expected to be able to:

| | |
|---|---|
| **CO1** | Understand the nature and characteristics of municipal solid wastes and theregulatory requirements regarding municipal solid waste management |
| **CO2** | Explains the segregation of solid waste and the onsite storage methods |
| **CO3** | Explains the various transfer methods and to know the site condition for thetransfer station |
| **CO4** | Select appropriate methods for processing and disposal of solid and hazardouswastes, taking into account the impact of the solutions in a sustainability context |
| **CO5** | Knowledge about selection of appropriate disposal methods and its handling in anefficient manner |

**TEXTBOOKS**


1. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors PvtLtd, 2018
2. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management — Science and Engineering , Butterworth-Heinemann, 2016

**REFERENCES:**


1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
2. CPHEEO, “Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rd Edition, Cengage Learning, 2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
5. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014.
6. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010


**CO-PO-PSO MAPPING: WASTE MANAGEMENT FOR CIRCULAR ECONOMY**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **1** | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 3 |
| **2** | 1 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 1 |
| **3** | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **4** | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| **5** | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 |
| **Avg.** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

• 1’ = Low; ‘2’ = Medium; ‘3’ = High