**ANNA UNIVERSITY, CHENNAI**
**NON AUTONOMOUS AFFILIATED COLLEGES**
**REGULATIONS – 2021**

# B.E. GEOINFORMATICS ENGINEERING

**CHOICE BASED CREDIT SYSTEM**

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To prepare the students for successful careers in Geospatial Industries and Information Technology that meet the needs of India and other Countries.
II. To develop the professional ability among the students to collect various Geospatial relates from various platform, data, analysis and synthesis that create user oriented real world applications.
III. To provide an opportunity for students to work as part of teams on multidisciplinary projects.
IV. To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering and multidisciplinary problems and to prepare them for graduate studies.
V. To promote students awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.

## PROGRAM OUTCOMES (POs)

**Engineering Graduates will be able to:**

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**PROGRAMME SPECIFIC OUTCOMES (PSOs)**

**Graduates of B.E. Geoinformatics students will be able to**

**PSO1** Knowledge of Geoinformatics discipline
Demonstrate in-depth knowledge of Geoinformatics engineering discipline with an ability to evaluate, analyze and synthesize existing and new knowledge.

**PSO2** Critical analysis of Geoinformatics Engineering problems and innovations
Critically analyze complex Geoinformatics problems and apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical policy context.

**PSO3** Conceptualization and evaluation of engineering solutions to Geoinformatics engineering issues
Conceptualize and solve Geoinformatics engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety and socio cultural factors

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**B.E. GEOINFORMATICS ENGINEERING**
**REGULATIONS – 2021**
**CHOICE BASED CREDIT SYSTEM**
**CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV**
**SEMESTER I**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | IP3151 | Induction Programme | - | - | - | - | - | 0 |
| **THEORY** | | | | | | | | |
| 2. | HS3151 | Professional English - I | HSMC | 3 | 0 | 0 | 3 | 3 |
| 3. | MA3151 | Matrices and Calculus | BSC | 3 | 1 | 0 | 4 | 4 |
| 4. | PH3151 | Engineering Physics | BSC | 3 | 0 | 0 | 3 | 3 |
| 5. | CY3151 | Engineering Chemistry | BSC | 3 | 0 | 0 | 3 | 3 |
| 6. | GE3151 | Problem Solving and Python Programming | ESC | 3 | 0 | 0 | 3 | 3 |
| 7. | GE3152 | அறிவியல் தமிழ் / Scientific Thoughts in Tamil | HSMC | 1 | 0 | 0 | 1 | 1 |
| **PRACTICALS** | | | | | | | | |
| 8. | GE3171 | Problem Solving and Python Programming Laboratory | ESC | 0 | 0 | 4 | 4 | 2 |
| 9. | BS3171 | Physics and Chemistry Laboratory | BSC | 0 | 0 | 4 | 4 | 2 |
| 10. | GE3172 | English Laboratory[$] | EEC | 0 | 0 | 2 | 2 | 1 |
| | | | **TOTAL** | **16** | **1** | **10** | **27** | **22** |

[$] **Skill Based Course**



**SEMESTER II**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | HS3251 | Professional English - II | HSMC | 2 | 0 | 0 | 2 | 2 |
| 2. | MA3251 | Statistics and Numerical Methods | BSC | 3 | 1 | 0 | 4 | 4 |
| 3. | PH3203 | Physics for Geoinformatics Engineering | BSC | 3 | 0 | 0 | 3 | 3 |
| 4. | BE3252 | Basic Electrical, Electronics and Instrumentation Engineering | ESC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3201 | Geoinformatics Systems | PCC | 3 | 0 | 0 | 3 | 3 |
| 6. | GE3251 | Engineering Graphics | ESC | 2 | 0 | 4 | 6 | 4 |
| 7. | | NCC Credit Course Level 1[#] | - | 2 | 0 | 0 | 2 | 2[#] |
| 8. | GE3252 | தமிழர் மரபு / Heritage of Tamils | HSMC | 1 | 0 | 0 | 1 | 1 |
| **PRACTICALS** | | | | | | | | |
| 9. | GE3271 | Engineering Practices Laboratory | ESC | 0 | 0 | 4 | 4 | 2 |
| 10. | BE3272 | Basic Electrical, Electronics and Instrumentation Engineering Laboratory | ESC | 0 | 0 | 4 | 4 | 2 |
| 11. | GE3272 | Communication Laboratory / Foreign Language [$] | EEC | 0 | 0 | 4 | 4 | 2 |
| | | | **TOTAL** | **17** | **1** | **16** | **34** | **26** |

[#] NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA
[$] Skill Based Course

## SEMESTER III

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | MA3302 | Transforms and Statistics | BSC | 3 | 1 | 0 | 4 | 4 |
| 2. | GI3301 | Spatial Database Management system | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI3302 | Surveying | PCC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI3303 | Remote Sensing | PCC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3304 | Geodesy | PCC | 3 | 0 | 0 | 3 | 3 |
| 6. | GI3391 | Photogrammetry | PCC | 3 | 0 | 0 | 3 | 3 |
| **PRACTICALS** | | | | | | | | |
| 8. | GI3311 | Surveying Laboratory I | PCC | 0 | 0 | 4 | 4 | 2 |
| 9. | GI3312 | Remote Sensing and Photogrammetry Laboratory | PCC | 0 | 0 | 2 | 2 | 1 |
| 10. | GE3361 | Professional Development [$] | EEC | 0 | 0 | 2 | 2 | 1 |
| | | | **TOTAL** | **18** | **1** | **8** | **27** | **23** |

[$] Skill Based Course

## SEMESTER IV

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | GI3401 | Sensors and Data products | PCC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3402 | Digital Image Processing | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI3403 | Microwave Remote Sensing | PCC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI3491 | Cartography and GIS | PCC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3492 | Total Station and GPS Surveying | PCC | 3 | 0 | 0 | 3 | 3 |
| 6. | GE3451 | Environmental Sciences and sustainability | BSC | 2 | 0 | 0 | 2 | 2 |
| 7. | | NCC Credit course level 2[#] | | 3 | 0 | 0 | 3 | 3[#] |
| **PRACTICALS** | | | | | | | | |
| 8. | GI3411 | Total Station and GPS Surveying Laboratory | PCC | 0 | 0 | 4 | 4 | 2 |
| 9. | GI3412 | Cartography and GIS Laboratory | PCC | 0 | 0 | 2 | 2 | 1 |
| 10. | GI3413 | Digital Image Processing Laboratory | PCC | 0 | 0 | 4 | 4 | 2 |
| | | | **TOTAL** | **17** | **0** | **10** | **27** | **22** |

[#] NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

**SEMESTER V**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | GI3501 | Spatial Analysis and Applications | PCC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3502 | Mapping toolboxes for Geomatics | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | | Professional Elective I | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | | Professional Elective II | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | | Professional Elective III | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | | Professional Elective IV | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | | Mandatory course-I[&] | MC | 3 | 0 | 0 | 3 | 0 |
| **PRACTICALS** | | | | | | | | |
| 9. | GI3511 | Mapping toolboxes Laboratory | PCC | 0 | 0 | 2 | 2 | 1 |
| | | | **TOTAL** | **21** | **0** | **6** | **27** | **19** |

[&] **Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)**

**SEMESTER VI**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | GI3601 | Geospatial analysis with R programming | PCC | 2 | 0 | 2 | 4 | 3 |
| 2. | GI3691 | Airborne and Terrestrial Laser Mapping | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | | Open elective-I* | OEC | 3 | 0 | 0 | 3 | 3 |
| 4. | | Professional Elective V | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | | Professional Elective VI | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | | Professional Elective VII | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | | Mandatory course-II[&] | MC | 3 | 0 | 0 | 3 | 0 |
| | | NCC Credit course level 3[#] | - | 3 | 0 | 0 | 3 | 3[#] |
| **PRACTICALS** | | | | | | | | |
| 8. | GI3611 | Spatial Analysis and Applications Laboratory | PCC | 0 | 0 | 4 | 4 | 2 |
| 9. | GI3612 | Survey Camp (2 Weeks) | EEC | - | - | - | - | 1 |
| | | | **TOTAL** | **20** | **0** | **6** | **26** | **21** |



***Open Elective – I shall be chosen from the emerging technologies**

[&] **Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC-II)**

[#] **NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

**SEMESTER VII/VIII***

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | GI3701 | Spatial data adjustment | PCC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3702 | Web GIS | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | GE3791 | Human Values and Ethics | HSMC | 2 | 0 | 0 | 2 | 2 |
| 4. | GE3752 | Total Quality Management | HSMC | 3 | 0 | 0 | 3 | 3 |
| 5. | | Open Elective II** | OEC | 3 | 0 | 0 | 3 | 3 |
| 6. | | Open Elective III*** | OEC | 3 | 0 | 0 | 3 | 3 |
| 7. | | Open Elective IV*** | OEC | 3 | 0 | 0 | 3 | 3 |
| **PRACTICALS** | | | | | | | | |
| 8. | GI3711 | Customization laboratory | PCC | 0 | 0 | 2 | 2 | 1 |
| | | | **TOTAL** | **20** | **0** | **2** | **22** | **21** |

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VII**

****Open Elective – II shall be chosen from the emerging technologies**

*****Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes**

**SEMESTER VIII/VII***

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **PRACTICALS** | | | | | | | | |
| 1. | GI3811 | Project Work/Internship | EEC | 0 | 0 | 20 | 20 | 10 |
| | | | **TOTAL** | **0** | **0** | **20** | **20** | **10** |



***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII**

**TOTAL NO. OF CREDITS: 164**

**MANDATORY COURSES I**

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | MX3081 | Introduction to Women and Gender Studies | MC | 3 | 0 | 0 | 3 | 0 |
| 2. | MX3082 | Elements of Literature | MC | 3 | 0 | 0 | 3 | 0 |
| 3. | MX3083 | Film Appreciation | MC | 3 | 0 | 0 | 3 | 0 |
| 4. | MX3084 | Disaster Management | MC | 3 | 0 | 0 | 3 | 0 |

**MANDATORY COURSES II**

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | MX3085 | Well Being with Traditional Practices (Yoga, Ayurveda and Siddha) | MC | 3 | 0 | 0 | 3 | 0 |
| 2. | MX3086 | History of Science and Technology in India | MC | 3 | 0 | 0 | 3 | 0 |
| 3. | MX3087 | Political and Economic Thought for a Humane Society | MC | 3 | 0 | 0 | 3 | 0 |
| 4. | MX3088 | State, Nation Building and Politics in India | MC | 3 | 0 | 0 | 3 | 0 |
| 5. | MX3089 | Industrial Safety | MC | 3 | 0 | 0 | 3 | 0 |

## PROFESSIONAL ELECTIVE COURSES: VERTICALS

| VERTICAL I (Surveying & Mapping) | VERTICALII (Geospatial Data Analytics) | VERTICAL III (Image Processing and Analysis) | VERTICAL IV (Geo Spatial Applications) | VERTICAL V (Geodesy) |
|---|---|---|---|---|
| Terrestrial and Close Range Photogrammetry | GIS Customization and Scripting | Soft Computing Techniques | Environmental Geoinformatics | Advanced Geodesy |
| GPS Surveying | Open Source GIS | Thermal, Hyperspectral and Planetary Remote Sensing | Geomatics for Urban Infrastructure | Satellite Geodesy |
| Terrestrial and Bathymetric Laser Scanning | Location Based GIS | Polarimetry and Interferometry | Geomatics for Hydrology and Water Resources | Physical Geodesy |
| Unmanned Aerial Vehicle (UAV) for Large Scale MAPPING | Enterprise GIS | AI / DL for image Processing | Satellite Meteorology | Geodetic Interferometry |
| Sub surface Survey Methods | GIS based Utility and Asset Management | Pattern Recognition (Satellite, Aerial, UAV) | Geomatics for Disaster and Risk Mitigation | Environmental Geodesy |
| Cadastral Surveying | Geo Computing | Raster Data Modelling | Geomatics for Agriculture and Forestry | Geodetic Control Survey and Adjustment |
| Advanced Surveying Techniques | Geo Spatial Modeling & Simulation | SDG and Geomatics | Geomatics for ocean and Coastal Applications | Geodetic Astronomy |



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

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialization. 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, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree 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 (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.

## PROFESSIONAL ELECTIVE COURSES : VERTICALS

### VERTICAL I: SURVEYING & MAPPING

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | GI3001 | Terrestrial and Close Range Photogrammetry | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3002 | GPS Surveying | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI3003 | Terrestrial and Bathymetric Laser Scanning | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI3004 | Unmanned Aerial Vehicle (UAV) for Large Scale Mapping | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3005 | Sub Surface Survey Methods | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | GI3006 | Cadastral Surveying | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | GI3007 | Advanced surveying Techniques (Mining, Hydrology, Route, Astronomy) | PEC | 3 | 0 | 0 | 3 | 3 |

### VERTICAL II: GEOSPATIAL DATA ANALYTICS

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | GI3008 | GIS Customization and Scripting | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3009 | Open Source GIS | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI3010 | Location Based GIS | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI3011 | Enterprise GIS (API, rest soap SOA, SAS, OGC, Web services) | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3012 | GIS based Utility and Asset Management | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | GI3013 | Geo Computing | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | GI3014 | Geo Spatial Modeling and Simulation | PEC | 3 | 0 | 0 | 3 | 3 |

**VERTICAL III: IMAGE PROCESSING AND ANALYSIS**

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | GI3015 | Soft Computing Techniques | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3016 | Thermal Hyperspectral & Planetary Remote Sensing | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI3017 | Polarimetry and Interferometry | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI3018 | AI / DL for image Processing | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3019 | Pattern Recognition (Satellite, Aerial, UAV) | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | GI3020 | Raster Data Modelling | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | GI3021 | SDG and Geomatics | PEC | 3 | 0 | 0 | 3 | 3 |

**VERTICAL IV: GEO SPATIAL APPLICATIONS**

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | GI3022 | Environmental Geoinformatics | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3023 | Geomatics for Urban Infrastructure | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI3024 | Geomatics for Hydrology and Water Resources | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI3025 | Satellite Meteorology | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3026 | Geomatics for Disaster and Risk Mitigation | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | GI3027 | Geomatics for Agriculture and Forest | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | GI3028 | Geomatics for Ocean and Coastal Applications | PEC | 3 | 0 | 0 | 3 | 3 |



**VERTICAL V:GEODESY**

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | GI3029 | Advanced Geodesy | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | GI3030 | Satellite Geodesy | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | GI3031 | Physical Geodesy | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | GI3032 | Geodetic Interferometry | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | GI3033 | Environmental Geodesy | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | GI3034 | Geodetic Control Survey and Adjustment | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | GI3035 | Geodetic Astronomy | PEC | 3 | 0 | 0 | 3 | 3 |

## OPEN ELECTIVES

**(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories)**

### OPEN ELECTIVE I AND II
### (EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | OCS351 | Artificial Intelligence and Machine Learning Fundamentals | OEC | 2 | 0 | 2 | 4 | 3 |
| 2. | OCS352 | IoT Concepts and Applications | OEC | 2 | 0 | 2 | 4 | 3 |
| 3. | OCS353 | Data Science Fundamentals | OEC | 2 | 0 | 2 | 4 | 3 |
| 4. | OCS354 | Augmented and Virtual Reality | OEC | 2 | 0 | 2 | 4 | 3 |

### OPEN ELECTIVES – III

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | OHS351 | English for Competitive Examinations | OEC | 3 | 0 | 0 | 3 | 3 |
| 2. | OMG352 | NGOs and Sustainable Development | OEC | 3 | 0 | 0 | 3 | 3 |
| 3. | OMG353 | Democracy and Good Governance | OEC | 3 | 0 | 0 | 3 | 3 |
| 4. | OME353 | Renewable Energy Technologies | OEC | 3 | 0 | 0 | 3 | 3 |
| 5. | OME354 | Applied Design Thinking | OEC | 2 | 0 | 2 | 4 | 3 |
| 6. | OMF351 | Reverse Engineering | OEC | 3 | 0 | 0 | 3 | 3 |
| 7. | OMF353 | Sustainable Manufacturing | OEC | 3 | 0 | 0 | 3 | 3 |
| 8. | OAU351 | Electric and Hybrid Vehicle | OEC | 3 | 0 | 0 | 3 | 3 |
| 9. | OAS352 | Space Engineering | OEC | 3 | 0 | 0 | 3 | 3 |
| 10. | OIM351 | Industrial Management | OEC | 3 | 0 | 0 | 3 | 3 |
| 11. | OIE354 | Quality Engineering | OEC | 3 | 0 | 0 | 3 | 3 |
| 12. | OSF351 | Fire Safety Engineering | OEC | 3 | 0 | 0 | 3 | 3 |
| 13. | OML351 | Introduction to non-destructive testing | OEC | 3 | 0 | 0 | 3 | 3 |
| 14. | OMR351 | Mechatronics | OEC | 3 | 0 | 0 | 3 | 3 |
| 15. | ORA351 | Foundation of Robotics | OEC | 3 | 0 | 0 | 3 | 3 |
| 16. | OAE352 | Fundamentals of Aeronautical engineering | OEC | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 17. | OCE353 | Lean Concepts, Tools And Practices | OEC | 3 | 0 | 0 | 3 | 3 |
| 18. | OAI351 | Urban Agriculture | OEC | 3 | 0 | 0 | 3 | 3 |
| 19. | OEN351 | Drinking Water Supply and Treatment | OEC | 3 | 0 | 0 | 3 | 3 |
| 20. | OEE352 | Electric Vehicle technology | OEC | 3 | 0 | 0 | 3 | 3 |
| 21. | OEI353 | Introduction to PLC Programming | OEC | 3 | 0 | 0 | 3 | 3 |
| 22. | OCH351 | Nano Technology | OEC | 3 | 0 | 0 | 3 | 3 |
| 23. | OCH352 | Functional Materials | OEC | 3 | 0 | 0 | 3 | 3 |
| 24. | OBT352 | Biomedical Instrumentation | OEC | 3 | 0 | 0 | 3 | 3 |
| 25. | OFD352 | Traditional Indian Foods | OEC | 3 | 0 | 0 | 3 | 3 |
| 26. | OFD353 | Introduction to food processing | OEC | 3 | 0 | 0 | 3 | 3 |
| 27. | OPY352 | IPR for Pharma Industry | OEC | 3 | 0 | 0 | 3 | 3 |
| 28. | OTT351 | Basics of Textile Finishing | OEC | 3 | 0 | 0 | 3 | 3 |
| 29. | OTT352 | Industrial Engineering for Garment Industry | OEC | 3 | 0 | 0 | 3 | 3 |
| 30. | OTT353 | Basics of Textile Manufacture | OEC | 3 | 0 | 0 | 3 | 3 |
| 31. | OPE351 | Introduction to Petroleum Refining and Petrochemicals | OEC | 3 | 0 | 0 | 3 | 3 |
| 32. | OPE352 | Energy Conservation and Management | OEC | 3 | 0 | 0 | 3 | 3 |
| 33. | OPT351 | Basics of Plastics Processing | OEC | 3 | 0 | 0 | 3 | 3 |
| 34. | OEC351 | Signals and Systems | OEC | 3 | 0 | 0 | 3 | 3 |
| 35. | OEC352 | Fundamentals of Electronic Devices and Circuits | OEC | 3 | 0 | 0 | 3 | 3 |
| 36. | OBM351 | Foundation Skills in integrated product Development | OEC | 3 | 0 | 0 | 3 | 3 |
| 37. | OBM352 | Assistive Technology | OEC | 3 | 0 | 0 | 3 | 3 |
| 38. | OMA352 | Operations Research | OEC | 3 | 0 | 0 | 3 | 3 |
| 39. | OMA353 | Algebra and Number Theory | OEC | 3 | 0 | 0 | 3 | 3 |
| 40. | OMA354 | Linear Algebra | OEC | 3 | 0 | 0 | 3 | 3 |



**OPEN ELECTIVES – IV**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | OHS352 | Project Report Writing | OEC | 3 | 0 | 0 | 3 | 3 |
| 2. | OMA355 | Advanced Numerical Methods | OEC | 3 | 0 | 0 | 3 | 3 |
| 3. | OMA356 | Random Processes | OEC | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4. | OMA357 | Queuing and Reliability Modelling | OEC | 3 | 0 | 0 | 3 | 3 |
| 5. | OMG354 | Production and Operations Management for Entrepreneurs | OEC | 3 | 0 | 0 | 3 | 3 |
| 6. | OMG355 | Multivariate Data Analysis | OEC | 3 | 0 | 0 | 3 | 3 |
| 7. | OME352 | Additive Manufacturing | OEC | 3 | 0 | 0 | 3 | 3 |
| 8. | OME353 | New Product Development | OEC | 3 | 0 | 0 | 3 | 3 |
| 9. | OME355 | Industrial Design & Rapid Prototyping Techniques | OEC | 2 | 0 | 2 | 4 | 3 |
| 10. | OMF352 | Micro and Precision Engineering | OEC | 3 | 0 | 0 | 3 | 3 |
| 11. | OMF354 | Cost Management of Engineering Projects | OEC | 3 | 0 | 0 | 3 | 3 |
| 12. | OAU352 | Batteries and Management system | OEC | 3 | 0 | 0 | 3 | 3 |
| 13. | OAU353 | Sensors and Actuators | OEC | 3 | 0 | 0 | 3 | 3 |
| 14. | OAS353 | Space Vehicles | OEC | 3 | 0 | 0 | 3 | 3 |
| 15. | OIM352 | Management Science | OEC | 3 | 0 | 0 | 3 | 3 |
| 16. | OIM353 | Production Planning and Control | OEC | 3 | 0 | 0 | 3 | 3 |
| 17. | OIE353 | Operations Management | OEC | 3 | 0 | 0 | 3 | 3 |
| 18. | OSF352 | Industrial Hygiene | OEC | 3 | 0 | 0 | 3 | 3 |
| 19. | OSF353 | Chemical Process Safety | OEC | 3 | 0 | 0 | 3 | 3 |
| 20. | OML352 | Electrical, Electronic and Magnetic materials | OEC | 3 | 0 | 0 | 3 | 3 |
| 21. | OML353 | Nanomaterials and applications | OEC | 3 | 0 | 0 | 3 | 3 |
| 22. | OMR352 | Hydraulics and Pneumatics | OEC | 3 | 0 | 0 | 3 | 3 |
| 23. | OMR353 | Sensors | OEC | 3 | 0 | 0 | 3 | 3 |
| 24. | ORA352 | Foundation of Automation | OEC | 3 | 0 | 0 | 3 | 3 |
| 25. | ORA353 | Concepts in Mobile Robotics | OEC | 3 | 0 | 0 | 3 | 3 |
| 26. | OMV351 | Marine Propulsion | OEC | 3 | 0 | 0 | 3 | 3 |
| 27. | OMV352 | Marine Merchant Vehicles | OEC | 3 | 0 | 0 | 3 | 3 |
| 28. | OMV353 | Elements of Marine Engineering | OEC | 3 | 0 | 0 | 3 | 3 |
| 29. | OAE353 | Drone Technologies | OEC | 3 | 0 | 0 | 3 | 3 |
| 30. | OCE354 | Basics of Integrated Water Resources Management | OEC | 3 | 0 | 0 | 3 | 3 |
| 31. | OAI352 | Agriculture Entrepreneurship Development | OEC | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 32. | OEN352 | Biodiversity Conservation | OEC | 3 | 0 | 0 | 3 | 3 |
| 33. | OEE353 | Introduction to control systems | OEC | 3 | 0 | 0 | 3 | 3 |
| 34. | OEI354 | Introduction to Industrial Automation Systems | OEC | 3 | 0 | 0 | 3 | 3 |
| 35. | OCH353 | Energy Technology | OEC | 3 | 0 | 0 | 3 | 3 |
| 36. | OCH354 | Surface Science | OEC | 3 | 0 | 0 | 3 | 3 |
| 37. | OBT353 | Environment and Agriculture | OEC | 3 | 0 | 0 | 3 | 3 |
| 38. | OFD354 | Fundamentals of Food Engineering | OEC | 3 | 0 | 0 | 3 | 3 |
| 39. | OFD355 | Food safety and Quality Regulations | OEC | 3 | 0 | 0 | 3 | 3 |
| 40. | OPY353 | Nutraceuticals | OEC | 3 | 0 | 0 | 3 | 3 |
| 41. | OTT354 | Basics of Dyeing and Printing | OEC | 3 | 0 | 0 | 3 | 3 |
| 42. | OTT355 | Fibre Science | OEC | 3 | 0 | 0 | 3 | 3 |
| 43. | OTT356 | Garment Manufacturing Technology | OEC | 3 | 0 | 0 | 3 | 3 |
| 44. | OPE353 | Industrial safety | OEC | 3 | 0 | 0 | 3 | 3 |
| 45. | OPE354 | Unit Operations in Petro Chemical Industries | OEC | 3 | 0 | 0 | 3 | 3 |
| 46. | OPT352 | Plastic Materials for Engineers | OEC | 3 | 0 | 0 | 3 | 3 |
| 47. | OPT353 | Properties and Testing of Plastics | OEC | 3 | 0 | 0 | 3 | 3 |
| 48. | OEC353 | VLSI Design | OEC | 3 | 0 | 0 | 3 | 3 |
| 49. | OEC354 | Industrial IoT and Industry 4.0 | OEC | 2 | 0 | 2 | 4 | 3 |
| 50. | OBM353 | Wearable devices | OEC | 3 | 0 | 0 | 3 | 3 |
| 51. | OBM354 | Medical Informatics | OEC | 3 | 0 | 0 | 3 | 3 |

**SUMMARY**

| S.No. | SUBJECT AREA | CREDITS AS PER SEMESTER | | | | | | | | CREDITS TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII/VIII | VIII/VII | |
| **1.** | **HSMC** | 4 | 3 | | | | | 5 | | **12** |
| **2.** | **BSC** | 12 | 7 | 4 | 2 | | | | | **25** |
| **3.** | **ESC** | 5 | 11 | | | | | | | **16** |
| **4.** | **PCC** | | 3 | 18 | 20 | 7 | 8 | 7 | | **63** |
| **5.** | **PEC** | | | | | 12 | 9 | | | **21** |
| **6.** | **OEC** | | | | | | 3 | 9 | | **12** |
| **7.** | **EEC** | 1 | 2 | 1 | | | 1 | | 10 | **15** |
| | **Total** | **22** | **26** | **23** | **22** | **19** | **21** | **21** | **10** | **164** |
| **8.** | Mandatory Course (Non Credit) | | | | | ✓ | ✓ | | | |

**ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

**VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other programmes)**

| VERTICAL I | VERTICAL II | VERTICAL III | VERTICAL IV | VERTICAL V |
|---|---|---|---|---|
| **Fintech and Block Chain** | **Entrepreneurship** | **Public Administration** | **Business Data Analytics** | **Environment and Sustainability** |
| Financial Management | Foundations of Entrepreneurship | Principles of Public Administration | Statistics for Management | Sustainable infrastructure Development |
| Fundamentals of Investment | Team Building and Leadership Management for Business | Constitution of India | Datamining for Business Intelligence | Sustainable Agriculture and Environmental Management |
| Banking, Financial Services and Insurance | Creativity and Innovation in Entrepreneurship | Public Personnel Administration | Human Resource Analytics | Sustainable Bio Materials |
| Introduction to Blockchain and its Applications | Principles of Marketing Management for Business | Administrative Theories | Marketing and Social Media Web Analytics | Materials for Energy Sustainability |
| Fintech Personal Finance and Payments | Human Resource Management for Entrepreneurship | Indian Administrative System | Operation and Supply Chain Analytics | Green Technology |
| Introduction to Fintech | Financing New Business Ventures | Public Policy Administration | Financial Analytics | Environmental Quality Monitoring and Analysis |
| - | - | - | - | Integrated Energy Planning for Sustainable Development |
| - | - | - | - | Energy Efficiency for Sustainable Development |

**(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)**

**VERTICAL 1: FINTECH AND BLOCK CHAIN**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | CMG331 | Financial Management | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | CMG332 | Fundamentals of Investment | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | CMG333 | Banking, Financial Services and Insurance | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | CMG334 | Introduction to Blockchain and its Applications | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | CMG335 | Fintech Personal Finance and Payments | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | CMG336 | Introduction to Fintech | PEC | 3 | 0 | 0 | 3 | 3 |

**VERTICAL 2: ENTREPRENEURSHIP**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | CMG337 | Foundations of Entrepreneurship | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | CMG338 | Team Building and Leadership Management for Business | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | CMG339 | Creativity and Innovation in Entrepreneurship | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | CMG340 | Principles of Marketing Management for Business | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | CMG341 | Human Resource Management for Entrepreneurship | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | CMG342 | Financing New Business Ventures | PEC | 3 | 0 | 0 | 3 | 3 |

**VERTICAL 3: PUBLIC ADMINISTRATION**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | CMG343 | Principles of Public Administration | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | CMG344 | Constitution of India | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | CMG345 | Public Personnel Administration | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | CMG346 | Administrative Theories | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | CMG347 | Indian Administrative System | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | CMG348 | Public Policy Administration | PEC | 3 | 0 | 0 | 3 | 3 |

**VERTICAL 4: BUSINESS DATA ANALYTICS**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | CMG349 | Statistics for Management | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | CMG350 | Datamining for Business Intelligence | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | CMG351 | Human Resource Analytics | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | CMG352 | Marketing and Social Media Web Analytics | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | CMG353 | Operation and Supply Chain Analytics | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | CMG354 | Financial Analytics | PEC | 3 | 0 | 0 | 3 | 3 |



**VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | CES331 | Sustainable infrastructure Development | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | CES332 | Sustainable Agriculture and Environmental Management | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | CES333 | Sustainable Bio Materials | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | CES334 | Materials for Energy Sustainability | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | CES335 | Green Technology | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | CES336 | Environmental Quality Monitoring and Analysis | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | CES337 | Integrated Energy Planning for Sustainable Development | PEC | 3 | 0 | 0 | 3 | 3 |
| 8. | CES338 | Energy Efficiency for Sustainable Development | PEC | 3 | 0 | 0 | 3 | 3 |

**MA3302 TRANSFORMS AND STATISTICS L T P C**
**3 1 0 4**

**UNIT I FOURIER SERIES 9 + 3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Root mean square value - Parseval's identity – Harmonic Analysis.

**UNIT II FOURIER TRANSFORM 9 + 3**

Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

**UNIT III RANDOM VARIABLES 9 + 3**

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

**UNIT IV 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 V ESTIMATION THEORY 9 + 3**

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means, variations and ratio of two variances.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Apply Fourier series techniques used in wide variety of situations in which the functions used are not periodic and to solve boundary value problems.

**CO 2** Apply the Fourier transform techniques to solve boundary value problems.

**CO 3** To understand and apply the concept of Probability and random variables in Statistics which is central to many geometric applications.

**CO 4** To apply the basic concepts of two dimensional random variables.

**CO 5** To understand the knowledge of applying the concept of estimation theory which plays an important role in real life problems.



**TEXTBOOKS:**

1. Grewal. B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
2. John E. Freund's "Mathematical Statistics with Applications", 8th Edition, Pearson Education, New Delhi, 2017.
3. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.

**REFERENCES:**

1. James. G., "Advanced Modern Engineering Mathematics ", 4th Edition, Pearson Education, New Delhi, 2016.
2. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, New Delhi, 2014.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 8th Edition, 2012.
4. Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 5th Edition, 2014.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

**GI3301 SPATIAL DATABASE MANAGEMENT SYSTEM L T P C**
**3 0 0 3**

**OBJECTIVES:**

- Introduce the students to the concepts of DBMS, Spatial Database Management System (SDBMS), Spatial Database design, basic application program development and user interfaces.

**UNIT I INTRODUCTION 9**

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.

**UNIT II SPATIAL CONCEPTS AND DATA MODELS 9**

Field based model – 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).

**UNIT III QUERY LANGUAGE 9**

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.

**UNIT IV SPATIAL STORAGE AND INDEXING 9**

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.



**UNIT V SPATIAL DATABASE SYSTEMS AND APPLICATION DESIGN AND DEVELOPMENTS 9**

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.

**TOTAL:45 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. Shashi Shekhar, Sanjay Chawla,"Spatial Databases a Tour" Prentice Hall, 1st edition, 2003.
2. Philippe Rigaux, Michel Scholl, Agnès Voisard "Spatial Databases" Morgan Kaufmann,2001

**REFERENCES:**

1. Abraham Silberschatz, Henry F. Korthand S. Sudharshan,"Database System Concepts", 7th edition, McGraw Hill, 2020.
2. Ravi Kothuri, Albert Godfrind, Euro Beinat "Pro Oracle Spatial for Oracle Database 11g", Apress, 2019.
3. Regina, Leo Hsu "Post GIS in Action", Oreilly&AssociatesInc., third edition (2021).
4. Vijay Gandhi; James Kang; Shashi Shekhar, "Spatial Databases." Minnesota univ minneapolis dept of electrical and computer engineering, 2007
5. Albert K. W. Yeung & G. Brent Hall ," Spatial Data and Spatial Database Systems", 2007

**GI3302** **SURVEYING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the rudiments of surveying and its principles to Geoinformatics Engineers.
- To learn the various methods of surveying to solve the real-world problems.
- To introduce the concepts of control surveying
- To introduce the basics of cadastral Surveying

**UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING 9**

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 - Radiation – Intersection – Resection – Plane table traversing.

**UNIT II LEVELLING 9**

Level line – Horizontal line – Datum – Benchmarks – Levels and Staves - Temporary and Permanent adjustments – Methods of leveling – Fly leveling – Check leveling – Procedure in leveling – Booking – Reduction – Curvature and refraction – Reciprocal leveling – Precise leveling – Contouring – Methods of interpolating Contours – Characteristics and uses of Contours – Areas enclosed by straight lines – Irregular figures – Volumes – Earth work calculations.

**UNIT III THEODOLITE SURVEYING 9**

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.



**UNIT IV CONTROL SURVEYING AND ADJUSTMENT 9**

Horizontal and Vertical control – Methods – Triangulation – Base line – Instruments and accessories – Corrections – Satellite station – Traversing – Coordinate computation – Gale‘s table – Omitted measurement – Trilateration – Concepts of measurements and errors – weight of an observation – law of weight – adjustment methods – angles, lengths and levelling network – simple problems

**UNIT V CADASTRAL SURVEYING 9**

History of cadastral survey – Land Records - FMB Sketch -Tax – Real Property- Legal Cadastral – Graphical and Numerical Cadastre - Legal Characteristics of Records - Torrens System. Cadastral map reproduction – Map projection for cadastral maps - Automated Cadastral map – Land Information System.

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Understand the rudiments of various surveying and its principles.
**CO 2** Gain knowledge in computation of levels of terrain and ground features
**CO 3** Understand the concepts of Theodolite Surveying for complex surveying operations
**CO 4** Understand the procedure for establishing horizontal and vertical control
**CO 5** Gain knowledge on cadastral survey

**TEXTBOOKS:**

1. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 &2, Pune Vidyarthi Griha Prakashan, Pune, 2010, 24th edition.
2. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016.

**REFERENCES:**

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001.
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4. S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India 2004.
5. K. R. Arora, Surveying Vol I & II, Standard Book house, 2019
6. C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.

**GI3303 REMOTE SENSING 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 RADIATION 9**

Definition — components of RS — History of Remote Sensing — Merits and demerits of Data Collation 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 — Spectral reflectance&emittance— 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, Air borne 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.

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Understand the concepts and laws related to remote sensing
**CO 2** Understand the interaction of electromagnetic radiation with atmosphere and Earth material
**CO 3** Acquire knowledge about satellite orbits and different types of satellites.
**CO 4** Understand the different types of remote sensors.
**CO 5** Gain knowledge about the concepts of interpretation of satellite imagery.

**TEXTBOOKS:**

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

**REFERENCES:**

1. Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.
3. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition.

**GI3304 GEODESY L T P C**
**3 0 0 3**



**OBJECTIVES:**

- To understand the geometry of the earth, Gravity, and its relationship with nature.

**UNIT I FUNDAMENTALS 9**

Definitions - Classifications, Problem of Geodesy and purpose of Geodesy Historical development and Organization of Geodesy. Reference Surfaces and their relationship. Applications, Engineering, Lunar, Planetary and interferometric Synthetic aperture radar Geodesy – Local and International Spheroid.

**UNIT II GEOMETRIC GEODESY 9**

Geometry of ellipsoid, fundamental mathematical relationship of ellipsoid, Geodetic, Geocentric and Reduced latitudes and their relationship. Ellipsoidal Co-ordinates in terms of Reduced, Geodetic and geocentric latitude. Radius of curvature in the meridian & prime vertical and their relationship. Mean Radius of curvature in any azimuth, Length of the meridian arcs and arcs of parallel and Area of trapezium on the ellipsoid. Curves on the ellipsoid, properties of Geodesic.

**UNIT III CO-ORDINATE SYSTEMS 9**

Natural or Astronomical Co-ordinate System, Geodetic or Geographical co-ordinate System, Rectangular or Cartesian Co-ordinate System and relationship between them. Curvilinear Co-ordinate System. Deflection of Vertical, Spherical excess. Astro-Geodetic method of determining the reference Spheroid.

**UNIT IV PHYSICAL GEODESY 9**

Basics - INGN -the significance of gravity measurements, Gravity field of earth, Concept of equipotential, Geo potential and Sphero potential Surface - Normal gravity and its computations, Methods of measuring Absolute and Relative gravity- Gravimeters - Reduction of gravity measurements, terrain and Isostasy corrections. Gravity networks. Gravity anomaly and Gravity disturbance - Fundamental equation of Physical Geodesy. Gravimetric determination of Geoid and Deflection of Vertical - Gravimetric satellite.

**UNIT V GEODETIC ASTRONOMY 9**

Celestial Sphere – Astronomical triangle – celestial coordinates systems and its relationship with Cartesian Co-ordinates and Transformation between them - Special star positions, Major 44 constellations - time systems (sidereal, Universal, atomic and standard) rising and setting of Stars with respect to Declination, hour angle and Azimuth, Culmination, Prime Vertical Crossing and Elongation.

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Learn about the fundamentals of Geodesy
**CO 2** Understand the concepts of geoid, ellipsoid and their interrelationship
**CO 3** Know about the various types of coordinate systems and relationship between them
**CO 4** Learn about the methods for measurement of gravity and gravity network
**CO 5** Understand the concepts of geodetic astronomy

**TEXTBOOKS:**

1. Wolfgang Torge, Geodesy, Walter De Gruyter Inc., Berlin, 2015 2nd edition.
2. Guy Bomford‖Geodesy‖ Nabu Press, 2015, ISBN 1172029091.

**REFERENCES:**

1. PetrVanicek and Edward J. Krakiwsky, Geodesy: The concepts, North-Holland Publications Co., Amsterdam, 2014 2nd edition.
2. Tom Herring, Geodesy Elsevier,2009, ISBN: 0444534601
3. Schwarze, V.S. Geodesy: The challenge of the 3rd millennium, Springer verlag, and 2003.
4. James R.Smith, Introduction to Geodesy, John wiley & Sons Inc. 1997

**GI3391 PHOTOGRAMMETRY L T P C**
**3 0 0 3**



**OBJECTIVES:**

- To introduce basics and concepts of optics, aerial photography acquisition and mapping from aerial photographs.

**UNIT I PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY 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

**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.

**TEXTBOOKS:**

1. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4th Edition, 2014.
2. 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. Manual of Photogrammetry – American society of Photogrammetry & amp; R. S by Albert. D, 1980.
4. Digital Photogrammetry – A practical course by Wilfried Linder, 3rd edition, Springer, 2009.
5. Digital Photogrammetry by – Y. Egels& amp; Michel Kasser, Taylor & amp; Francis group, 2003.



**GI3311 SURVEYING LABORATORY I** **L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To familiarize with the various surveying instruments and methods.

**EXCERCISES:**

**1.** Chain traversing
**2.** Compass traversing
**3.** Centre line marking of a building
**4.** Planimetric Mapping of an Area using Plane Table Surveying (Radiation, Intersection)
**5.** Map updation using Plane Table Surveying through Resection (Graphical Method)
**6.** Plane table surveying – Two point problem
**7.** Fly and Check Levelling using dumpy level / tilting level
**8.** Determination of horizontal and vertical angles using theodolite
**9.** Determination of tacheometric constants using horizontal and inclined line of sight
**10.** Single plane method using theodolite
**11.** Double plane method using theodolite

**12.** Determination of RL of a point on sloping terrain using tacheometric surveying
**13.** Preparation of Planimetric Map using stadia tacheometry

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Gain knowledge on the usage of basic surveying instruments like chain/tape, compass, plane table and leveling instruments
**CO 2** Use levelling instrument for surveying operations
**CO 3** Use theodolite for various surveying operations
**CO 4** Carry out the necessary surveys for social infrastructures
**CO 5** Prepare the planimetric maps

**REFERENCES:**

1. T. P. Kanetkar and S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th Reprint, 2010.
2. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 17th Edition, 2016.
3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001
4. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004 a. David Clark, Plane and Geodetic Surveying for Engineers, Volume I, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
5. David Clark and James Clendinning, Plane and Geodetic Surveying for Engineers, Volume II, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
6. S. K. Roy, Fundamentals of Surveying, Second Edition, Prentice 'Hall of India 2004
7. K. R. Arora, Surveying Vol. I & II, Standard Book house, 2019.



**GI3312 REMOTE SENSING AND PHOTOGRAMMETRY LABORATORY L T P C**
**0 0 2 1**

**OBJECTIVES:**

- To facilitate the students with hands on experience on visual interpretation of satellite data products and conventional and digital interpretation of aerial photographs.

**REMOTE SENSING EXERCISES**

1. Preparation of Base Map from Survey of India Topo sheets
2. Introduction to various satellite data products and image interpretation keys
3. Preparation of Land use/land cover map using Satellite Data / Aerial Photograph.
4. Spectral measurements using spectroradiometer and processing for
   a. Water & Soil
   b. Vegetation
   c. Various surfaces and land cover

**PHOTOGRAMMETRY EXERCISES**

1. Testing stereovision with Stereogram card
2. Mirror stereoscope- base line, orientation of aerial photographs and Photo Interpretation
3. To find the height of point using Parallax bar
4. Scale of vertical photographs
5. Aerial Triangulation using digital photogrammetry
6. Bundle Block adjustment
7. Generation and editing of DTM and Contour
8. Orthophoto generation and Mosaic
9. Preparation of Planimetric map

**TOTAL: 30 PERIODS**

**The following instruments and software are required**

| Sl. No. | Instrument | Numbers |
|---|---|---|
| 1. | Light Table | 10 |
| 2. | Computer | 10 |
| 3. | Spectroradiometer | 1 |
| 4. | Pocket Mirror Stereoscope | 10 |
| 5. | Mirror Stereoscope | 10 |
| 6. | Parallax bar | 10 |
| 7. | Digital Photogrammetry Software (Free software also available) (licenses) | 5 |
| 8. | Anaglyphic Glass | 20 |
| 9. | CAD software (Free software also available) (licenses) | 5 |

**COURSE OUTCOMES:**

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

**CO 1** Identify different features from satellite images
**CO 2** Interpret images to prepare thematic maps
**CO 3** Determine geometrical elements of aerial photograph
**CO 4** Analyze the aerial Photograph
**CO 5** To generate Digital Elevation Model and Ortho photo from Stereo models

**TEXTBOOKS:**

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4th Edition, 2014.



**REFERENCES:**

1. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.
2. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
3. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication
4. Gollfried Konecny, Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 2nd Edition, 2014.
5. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, WalterdeGruyter GmbH & Co.2nd Edition, 2007.



**GI3401 SENSORS AND DATA PRODUCTS L T P C 3 0 0 3**

**OBJECTIVES:**

- To familiarize the students with principle and operation of available sensing system, access protocols and its applicability.

**UNIT I OPTICAL AND IR SENSORS 9**

Land observation satellites, IRS series, LANDSAT series, SPOT series, High resolution satellites, character and applications, CARTOSAT series, IKONOS Series, QUICKBIRD series, Weather/Meteorological satellites, INSAT series – data formats

**UNIT II MICROWAVE AND THERMAL SENSORS 9**

Use of Microwave data - SeaWiFS, OCR, CZCs studies -chlorophyll production index -sea surface temperature (SST) sensors -NIMBUS, RADARSAT, CASI - MESSR, OCTS ATSR -Sensors - OCEANSAT ATSR on ERS TOPEX/Poseidon satellite data – NASA earth data, ESA, NCEL, GLOVIS, NEO, USGSEE - GOOGLE EARTH- SARAL.

**UNIT III HYPERSPECTRAL SENSORS 9**

Scanner types and characterization - specifications of various sensors Spectrographic imagers-hyperspectral sensors, Design tradeoffs. Data formats and systems, AVIRIS, CASI, NASA Terra Moderate Resolution Imaging Spectrometer (MODIS), Hyperion - VEDAS

**UNIT IV GEO PORTALS 9**

Open sources satellite imagery - USGS Earth Explorer - NASA Earth data Search - NOAA Data Access Viewer - Bhuvan Indian Geo-Platform of ISRO – Google Earth Engine - Copernicus Open Access Hub – up scaling and downscaling – sample data download and appraisal

**UNIT V APPLICATION AREAS 9**

Data download – climatic data- oceanic data – coastal data – land data – rainfall data; applications – rainfall vs NDVI, PPI- LST vs land use – wind vector and oceans current; mini project

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Gain knowledge on the current and historic satellite missions and sensors national and international importance and their relevance in the resource application

**CO 2** Gain information on the various types of primary and derived satellite data for earth resource management and their specifications

**CO 3** Acquire the knowledge about open geoportals that offer satellite data and related resource data and their applicability

**CO 4** Acquire knowledge on the methods to download satellite data or how to procure them from the authorized geoportals

**CO 5** Analyze critically and evaluate the quality, standards of satellite data and to use them for various applications.



**TEXTBOOKS:**

1. Introduction to Satellite Remote Sensing (Atmosphere, Ocean, Land and Cryosphere Applications), Bill Emery, Adriano Camps, First edition, 2017.
2. Landsat Data Continuity Mission(L1) Data format Control Book – USGS
3. Eni G.Njoku ,"Surface waves and Fluxes: Chapter-Satellite Remote Sensing of Sea Surface Temperature",1990,Volume 8,ISBN: 978-94-010-6769-0.

**REFERENCES:**

1. Fundamentals of Satellite Remote Sensing: An Environmental Approach, Emilio Chuvieco, Third Edition, 2020.
2. Hyperspectral Remote Sensing: Principles and Applications, Marcus Borengasser, First Edition, 2007.
3. Advances in Environmental Remote sensing: QihaoWeng, 1st Edition. 2017.

**GI3402 DIGITAL IMAGE PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To make the undergraduate Engineering Students understand the concepts, principles, processing of Satellite data in order to extract useful information from them.

**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 PREPROCESSING 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 classifier– Error matrix -Accuracy assessment – accuracy metrics: Kappa statistics, ERGAS, RMS.

**UNIT V ADVANCED CLASSIFIERS 9**

Texture based classification -Segmentation (Spatial, Spectral)-regions Fuzzy set classification – Object based classifiers – Deep Learning - Artificial Neural nets: Hebbian leaning - 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

**CO 1** To understand various components and characteristics of image processing systems
**CO 2** To familiarize the concepts of image geometry and radiometry corrections
**CO 3** To acquire knowledge about different types of image enhancement techniques used for satellite image processing
**CO 4** To gain knowledge about image classification and accuracy assessment of various classifiers
**CO 5** To acquaint with various advanced classification techniques available for feature extraction



**TEXTBOOKS:**

1. John,R.Jensen, Introductory Digital Image Processing, Prentice Hall, NewJersey, 2021 Fourth edition.
2. Robert,A.Schowengergt, Techniques for Image Processing and classification in Remote Sensing,1983.



**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, Fifth Edition, 2014.
3. Digital Image Processing by Rafael C. Gonzalez, Richard Eugene Woods - Pearson/Prentice Hall,Fourth edition, 2022.
4. Fundamentals of Digital Image Processing by Annadurai Pearson Education (2007)

**GI3403** **MICROWAVE REMOTE SENSING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To impart the knowledge on Microwave Remote Sensing and its applications.

**UNIT I FUNDAMENTALS AND ACTIVE SYSTEM 9**

Introduction–Radar frequency bands – SLAR - Antenna System – SLAR Imaging Geometry – RADAR equation – Resolution concepts: Range and Azimuth resolution – Synthetic Aperture Radar - Geometric Distortions – Multilook averaging and speckle correction.

**UNIT II RADAR INETERACTION WITH EARTH FEATURES 9**

System parameters - target parameters: roughness scales and criteria, dielectric constant and penetration depth – Surface backscattering models: Clapp, Facet, Bragg resonance models and Hard targets – Volume backscattering – RADAR Image signatures.

**UNIT III IMAGING AND NON IMAGING SENSING 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 Systems- missions, Scatterometry- Scatterometer types and calibration - missions

**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- Passive microwave sensing components - Blackbody radiation and Grey body radiation – Emissivity, Radiometers – Components - Brightness temperature - Antenna 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

**CO 1** Understand the fundamentals of microwave remote sensing system such as SLAR, RAR and SAR
**CO 2** Learn the interaction mechanism of Radar with target features
**CO 3** Understand the principles and applications of Imaging and Non-Imaging observation
**CO 4** Learn the about the satellite sensing system and applicability of SAR
**CO 5** Understand the concepts of passive microwave systems and applications

**TEXTBOOKS:**

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.
2. John R.Jensen,"Remote Sensing of the Environment: An Earth Resource Perspective",Pearson Education India, 2013.
3. John A.Richards,"Remote Sensing with Imaging RADAR", Springer,2009.

**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. Jhon R.Schott, Fundamentals of Polarimetric Remote Sensing , SPIE press, 2010
5. Woodhouse lain. H, "Introduction to Microwave Remote Sensing" Taylor & Francis, 2006.

**GI3491 CARTOGRAPHY AND GIS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce concepts of Cartography and GIS
- To expose the process of map making and production
- To introduce GIS data structures, data input and data presentation

**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 Co-ordinate 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

**CO 1** Be familiar with appropriate map projection and co-ordinate system for production of Maps and shall able to compile and design maps for their required purpose.
**CO 2** Be familiar with co-ordinate and Datum transformations
**CO 3** Understand the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression
**CO 4** Understand the concepts of spatial data quality and data standard
**CO 5** Understand the concept of spatial data inputs

**TEXTBOOKS:**

1. Arthur H. Robinson et al, “Elements of Cartography”, 7th Edition, Wiley, 2002.
2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.
3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.

**REFERENCES:**

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

**GI3492 TOTAL STATION AND GPS SURVEYING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the working of Total Station and GPS and solve the surveying problems.



**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 - 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 II ELECTRO-OPTICAL AND MICROWAVE 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.

COGO functions: Area, Inverse / MLM, REM, Resection, offsets and stakeout - Land survey applications.

**UNIT III 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 and IRNSS – SBAS: GAGAN and WAAS 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 IV 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 - Multi path and other observational errors – satellite geometry and accuracy measures – Continuously Operating Reference System (CORS)– long base line processing - use of different processing software's: Open Source, Scientific and Commercial.

**UNIT V SURVEYING METHODS AND APPLICATIONS** **9**

Total Station: Traversing and Trilateration measurement and adjustment –Planimetric map and Contour map and Topography Mapping.

GNSS: Concepts of rapid, static, semi-Kinematic, pure Kinematic and RTK methods. Observation by Radiation, Lee frog and Trilateration measurement and processing -Topography mapping using PPK and RTK methods

Total Station and GNSS applications

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Learn about the fundamental concept of Total station.
**CO 2** Provide knowledge about electromagnetic waves and its usage in Total station and GNSS.
**CO 3** Gain Knowledge on basic concepts of GNSS
**CO 4** Understand the measuring and working principle of electro optical and Microwave Total station and GPS
**CO 5** Gain knowledge about Total station and GNSS data processing and Mapping.

**TEXTBOOKS:**

1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition,1996.
2. SatheeshGopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. isbn: 978-81317 00679.
3. Gunter Seeber , Satellite Geodesy, Walter De Gruyter, Berlin, 2nd Edition, 2003



**REFERENCES:**

1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second 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,3rdEdition,2016.
4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.



**GE3451 ENVIRONMENTAL SCIENCE 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 protocols-Sustainable 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 Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

**TOTAL:30 PERIODS**

**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, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
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. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
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**GI3411 TOTAL STATION AND GPS SURVEYING LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To train the students to acquire skill in making precise measurements and obtaining accurate results with Total Station and GPS.

**EXCERCISES:**

1. Temporary adjustment of Total station and Angle, Distance and Coordinate measurement
2. Establishment of Horizontal control point by Traversing
3. To determine the instrument station coordinate by Resection method (Angles only and Distances only)
4. Application COGO function: Area, MLM / Inverse function, REM and offsets

5. Planimetric mapping using Total Station
6. Preparation of Contour map using Total Station
7. Setting out: by Coordinates, by Distance and angle, Points at equal length
8. Navigation and Feature collection using handheld GPS
9. GNSS Planning
10. Accuracy evaluation of baseline with different common observation times
11. Establishment of Ground Control Point using Static / Rapid Static differential GNSS survey by Lee Frog Method
12. Establishment of Ground Control Point using Static / Rapid Static differential GNSS survey by Trilateration method
13. Preparation of Planimetric map using Post Processed Kinematic (PPK) method
14. Network Adjustment of GNSS observation

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Gain the basic idea about Total station and GNSS.
**CO 2** Acquire knowledge about establishment of horizontal control point using Total station and GNSS.
**CO 3** Impart Knowledge in preparation of contour map using Total station and GNSS.
**CO 4** Understand the various coordinate geometry function in Total station and GPS
**CO 5** Gain knowledge about Total station and GNSS data processing, network adjustment and Mapping.

**REFERENCES:**

1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition,1996.
2. Satheesh Gopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. isbn: 978-81317 00679.
3. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 2003
4. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
5. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc.,1983
6. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin,3rd Edition,2016.
7. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.



**GI3412 CARTOGRAPHY AND GIS LABORATORY** **L T P C 0 0 2 1**

**OBJECTIVES:**

- Hands on experience of basics of cartography and GIS.
- Designing the map
- Development of GIS database and populating attribute data

**EXCERCISES:**

1. Simple conical,cylindrical and planar projection for the reduced earth having 2to4 cm radius – aspect and secant demo.
2. Graded symbolization and isopleth/choropleth map
3. Map compilation and Design
4. Data Input –Onscreen Digitization –Creation of Point, Line and Polygon layers
5. Projection, Reprojection and Coordinate Transformation of Maps
6. Attribute data input and Measurement of Distance, Area
7. Linking External Database and Tabular Data Analysis using SQL commands
8. Generating Graphs,Charts and Diagrams from Tabular data
9. Data Conversion –Vector to Raster and Raster to Vector
10. Map Joining, Edge Matching and Layout Design

**TOTAL:30 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Design and produce thematic maps with suitable projection, symbols and color codes
**CO 2** Compile and develop digital maps
**CO 3** Create spatial database and non-spatial databases in GIS environment
**CO 4** Analyze spatial database and generate reports, maps
**CO 5** Represent spatial data in a professional format

**REFERENCES:**

1. Arthur,H.Robinson,Elements of Cartography, Seventh Edition, John Wiley and Sons, 2002.
2. C.P.Lo Albert K.W.Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, Second Edition, 2016.

**LIST OF EQUIPMENTS**

1. i7 computer system with minimum 4GBRAM, 500GB HDD-15 Numbers for 30 students
2. Standard GIS Software-15 user licenses.

**GI3413 DIGITAL IMAGE PROCESSING LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To familiarize the undergraduate level students in the regular Image Processing Software.

**EXCERCISES:**

1. Image reading and writing
2. Pre-processing techniques: radiometric correction
3. Random and Periodic Noise removal
4. Pre-processing techniques: Ground control and rectification
5. Enhancements – histogram, filters
6. Band ratioing and normalization – NDVI, SAVI & NDWI
7. PCA
8. Image fusion
9. Classification –supervised &unsupervised
10. Sub pixel classification
11. Classification using Neural Network and Fuzzy Logic
12. Accuracy assessment – correlation, RMSE & kappa
13. Crop conditioning assessment/ inundation damage assessment/ forest fire/ change dynamic analysis



**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

**CO 1** Enhance satellite imagery through filtering, band ratioing , PCA etc
**CO 2** Georeference and project the satellite imagery
**CO 3** Classify and assess accuracy of classification.
**CO 4** Perform advanced classifier
**CO 5** Carry out mini project in any of the application

**TEXT BOOK**

1. Richards, Remote sensing digital Image Analysis –An Introduction Springer-Verlag1993.

**LIST OF EQUIPMENTS**

1. Number of i7 Computer system - 15 for 30 students (two students per system).
2. Standard Satellite image processing software - 15 user licenses.
3. Satellite data indifferent spatial resolution and corresponding Toposheets.
4. A1size Scanner and Color plotter.