

## COURSES OF STUDIES

### M. TECH. IN GEOSPATIAL TECHNOLOGY, DEPT. OF EARTH SCIENCES

#### First year- 1st Semester

Course No.	Subjects	Credit hours
GT. 411	Basic Principles of Geospatial Technology, Survey, Thematic Mapping and Cartography	4CH
GT. 412	Earth features and phenomena, Earth Resources and Resource Management	4CH
GT. 413	Principles of Aerial Remote Sensing and Photogrammetry	4CH
GT. 414	Satellite, Microwave and thermal infrared Remote Sensing	4CH
GT. 415	Practical on Survey and Cartography, Report on Lab./ Field Visits	2CH
GT. 416	Practical on Aerial Photographs, satellite images, Term paper	2CH
GT-417	<b>Add on Non Credit Course (Optional)</b> <b>1. Communicative Skill in English</b> <b>2. Leadership and Personality Development</b>	

#### First year- 2nd Semester

Course No.	Subjects	Credit hours
GT. 421	Statistical data analysis and Spatial statistics	4CH
GT. 422	Computer Programming and Database Management	4CH
GT. 423	Digital Image Processing, Correction and Interpretation	4CH
GT. 424	Digital Elevation Modelling and Global Positioning System	4CH
GT. 425	Practical on Statistical data analysis, Computer Programming, and Digital image processing	2CH
GT. 426	Report on Field Visits / Seminar	2CH

#### Second year- 3rd Semester

Course No.	Subjects	Credit hours
GT. 511	Elective (any one of the following)	4 CH
Elective	<ul style="list-style-type: none"> <li>a. Application of Geographic Information Systems in Geology, Geotechnical Engineering and Engineering Geology</li> <li>b. Application of Geographic Information Systems in Geography, Human settlement, Land use studies and Archeology</li> <li>c. Application of Geographic Information Systems in Environmental studies and Natural Resource Management</li> <li>d. Application of Geographic Information Systems in surface and subsurface water resources, Oceanic studies, Fishery and Meteorology</li> <li>e. Application of Geographic Information Systems in Ecology, Agriculture and Forestry</li> </ul>	
GT. 512	(Training in a reputed institute on Digital Image Processing./GIS or GPS) Report on field Training	12 CH
GT. 513	Seminar (at least 4)	4 CH
GT514	<b>Add on Non Credit Course (Optional)</b> <b>1. Communicative Skill in English</b> <b>2. Leadership and Personality Development</b>	

#### Second year- 4th Semester

Course No.	Subjects	Credit hours
GT. 521	Dissertation on any topic on Remote Sensing, GIS/ GPS Global positioning system under the guidance of a faculty of the Dept./ Scientist of a RS- GIS Institute/ company.	20CH

## **DETAILED SYLLABUS FIRST SEMESTER**

### **Course- GT. 411 (4CH)**

**Objectives** This paper introduces the students with the knowledge of basics of remote sensing data and aspects of GIS. This also explains the creation of several spatial data needed for collection of GIS data sets.

**Expected outcome:** The students are equipped with the concepts of space and satellite data. While space data is a part and parcel of every geospatial subject, remote sensing has become very helpful for resolving so many geological problems.

### **Basic Principles of Geospatial Technology, Survey, Thematic Mapping and Cartography**

Introduction to Geospatial Technology; Components of Geospatial Technology and their relationship. Basic principles of Remote Sensing. Benefits of Remote Sensing over conventional method of resource survey. Electromagnetic energy and its generation; Division of EMR; Radiation principles- wave model, particle mode; Black body and Real body radiation; Contrast and illumination effect on human vision; Measurement of radiation; Energy matter interaction- Refraction, scattering, absorption, reflectance. Effects of atmosphere on EMR; EMR and their interaction with rocks, minerals, vegetation, water, soil etc.

Geographic data, their nature and acquisition methods. Topography. Terrestrial Survey Methods - chain and compass, plane table, prismatic compass, theodolite. Maps and their classification. Map characteristics and features; Thematic symbolization; positioning of objects on map. Properties of map projection; projection types; Extrinsic and Intrinsic problems; Map reference system- latitude, longitude and other systems. Basic principles of cartography. Cartographic communication process.

### **Books Recommended**

1. Lillesand M. Thomas and Ralph W. Kiefer, (2007) Remote Sensing and Image Interpretation, 6th revised edition, John Wiley & Sons, New York, page no. 1-768.
2. Jensen R. John (2013) Remote Sensing of the Environment, 2<sup>nd</sup> edition An Earth Resource Perspective, Pearson India Pvt. Ltd., Delhi, page no: 1-618.
3. M. Anji Reddy (2004) Geoinformatics for Environmental Management, B.S Publications, Hyderabad,
4. Sharma V.K. (1991) Remote Sensing for Land Resources Planning, Concept Publishing Company, New Delhi, page no. 1- 456
5. LO. C.P., and Albert K. W. Yeung, (2006) Concepts and Techniques of Geographic Information Systems, 2<sup>nd</sup> edition, Prentice-Hall of India, New Delhi, page no: 1-544.
6. Peter A. Burrough and Rachael A. Mc. Donnell, (2015) Principles of Geographical Information System, Oxford University Press Inc., New York, page no: 1-352.

## **Course- GT. 412 (4 CH)**

**Objectives:** : This paper introduces the students with the knowledge of various earth resources which are amenable to sensing by satellites.

**Expected outcome:** In this unit, different types of earth features and their causative geological agents have been described. The students can analyse the type of agents that has shaped a particular zone of the earth surface.

### **Earth features and phenomena, Earth Resources and Management**

Natural agents and their role in shaping the earth. Action of river, wind, glaciers; Depositional, erosional and structural land form and their characteristic features; Development of valleys and drainage system; Slope and drainage analysis; Geomorphic divisions of India; Water bodies, their shape, size, depth and water property; Soil formation and soil type.

Earth resources- renewable and no renewable (forest, water, soil, minerals etc.); Population dynamics; Consumption of natural resources; Resource evaluation methods; Environmental problems due to earth resources utilization. Resources survey and damage estimation.

#### **Books Recommended**

1. Bloom, A.L. (2004) Geomorphology - A systematic analysis of Late Cenozoic landforms. Waveland Pr Inc; 3 edition, page no:1-482.
2. Kale, V.S. and Gupta, A. (2000) Introduction to geomorphology. Orient Black Swan,page no: 1-280.
3. Thorn, C.E. (1988) Introduction to theoretical geomorphology. Kluwer Academic Publishers, page no:1-288.
4. Thornbury, W.D. (2004) Principles of geomorphology. CBS; 2 edition,page no:1-213.
5. Summerfield, M. A. (2011) Geomorphology and global tectonics. Wiley India Pvt Ltd, page no:1-388.
6. Drury, S.A. (2004) Image interpretation in geology. Routledge; 1<sup>st</sup> edition, page no:1-304.

## **Course - GT. 413 (4CH)**

### **Objectives:**

This paper explains the character, type and properties of aerial photographs, their method of acquisition and instruments of interpretation.

**Expected outcome:** The students, after the study of this paper will know about the types of aerial photographs. They shall also know about their uses.

### **Principles of Aerial Remote Sensing and Photogrammetry**

Fundamentals of aerial photography. Aerial Remote Sensing Platforms; Instruments used for aerial photography; Aerial vehicles; cameras, films and filters; Types of aerial photographs,

Characteristic features of aerial photographs - scale, overlap, sidelap. vertical exaggeration etc. Photo features - form, shape, texture, tone, drainage pattern etc., Stereoscopic perception, conditions for stereoscopic vision. Instruments for study of aerial photography- Viewing instruments,.

Measuring instruments, stereoscope, Stereometer (Parallax bar), contour finder, template, Kelsh plotter, sketch master. Scale and height measurement on single vertical aerial photographs; Height measurement based on relief displacement; Stereoscopic measurement of object height, Measurement of absolute and differential parallax; Area measurement; Measurement on Satellite images and their limitations; Softcopy photogrammetry.

### **Books Recommended**

1. J. A. E. Allum (1966) Photogeology and Regional Mapping, Elsevier, 3<sup>rd</sup> Edition, page no. 1-124
2. J. A. E. Allum (1966) Photogeology and Regional Mapping, Pergamon; 1<sup>st</sup> Edition, page no. 1-214.
3. A. J. Eardley (1941) Aerial Photographs: Their Use and Interpretation, Harper, page no. 1-154.
4. Hart C A (1948) Air Photography Applied To Surveying, Longmans Green and Co; 2nd Edition, pp. 1-215
5. Rampal, K.K. (1999): Handbook of aerial photography and interpretation. Concept Publishing Co., New Delhi. page no:1-232.

### **Course - GT. 414 (4CH)**

**Objectives:** This paper introduces the students with the skills of processing and analysis of thermal and microwave data. The students can also know the types of information they are going to get from the above datasets.

**Expected outcome:** After the study, the students will have the knowledge of processing and analysis of thermal and microwave data. The students can also know the types of information they are going to get from the above datasets.

### **Satellite Microwave and thermal infrared Remote Sensing**

Satellites and their types; Satellites launched by India for Remote Sensing data acquisition; Optical mechanical scanner; Satellite photographic system; Space shuttle photography; Return beam vidicon camera; Sensors- MSS and TM sensors, Sensors of LANDSAT, IRS, SPOT sensor system. Data transmission from sensor to ground station. Satellite RS data products and their characteristic features. Principles of Microwave remote sensing, Response of vegetation, water, urban structure to microwave; Microwave remote sensing instruments (Radiometer, Scatterometer, Altimeter, SLR, SAR), Radar image characteristics. Interpretation and application of radar images. Thermal infrared radiation properties, Thermal infrared radiation windows, Thermal radiation laws, Thermal properties of terrains, Thermal infrared multispectral scanner, Interpretation and application of Thermal infrared images.

### **Books Recommended**

1. Lillesand M. Thomas and Ralph W. Kiefer (2008) Remote Sensing and Image Interpretation, John Wiley & Sons, New York, page no:1-768.
2. Arthur H. Robinson (2002) Elements of Cartography, John Wiley & Sons, New York, page no.1-251
3. Dennis P. Curtin, Kim Foley, Kunal Sen & Cathleen Morin (1999), Information Technology - The Breaking Wave, Tata McGraw Hill Ed.page no.1-250
4. M. Anji Reddy (2004), Geoinformatics for Environmental Management, BS Publications, Hyderabad, page no
5. Sharma V.K. (1991) Remote Sensing for Land Resources Planning, Concept Publishing Company, New Delhi,pageno 1-452

### **Course - GT. 415 (2CH)**

**Objectives:** The students are allowed to carry out Chain and compass survey, plane table survey, prismatic compass survey, theodolite survey under experiences personnel.

**Expected outcome:** The students can independently apply this knowledge in future when they will be in different services.

### **Practical on Survey, cartography, Field/ Lab. Visit report**

Chain and compass survey, plane table survey, prismatic compass survey, theodolite survey.  
Cartography

Field/ Lab. Visit report

### **Course - GT. 416 (2CH)**

**Objectives:** The students are allowed to carry out measurement of distances, determination of scale and height, identification of various geomorphic features; with the help of Aerial photographs and Satellite Images for geomorphological, geological, geographical and other purposes.

**Expected outcome:** The students can independently apply this knowledge in future when they will be in different services.

### **Practical on Aerial photographs and Satellite Images**

Measurement of distances; Determination of scale and height; Identification of various geomorphic features; Mosaic and planimetric map preparation; Contouring; Study of Aerial photographs and Satellite Images for geomorphological, geological, geographical and other purposes. Ground trusting.

30 marks

Practical Record, Viva and Term paper

20 marks

## SECOND SEMESTER

### Course - GT. 421 (4 CH)

#### Statistical data analysis and Spatial statistics

**Objectives::** In these units, the students will study various techniques of statistical methods which will be useful in geological problems.

**Expected outcome:** The students will have the knowledge to apply the statistical methods in solving several problems related to digital image processing.

#### Unit - I

Basic statistics, Characteristic of statistical data, Limitation of statistics, Primary and secondary data, Organisation of data, Measurements- Arithmetic mean, Median, Mode, Mean deviation, standard deviation.

#### Unit - II

Correlation, Methods of measuring correlation, Regression, Multivariate analysis. Topology.

#### Books Recommended

1. S. C. Gupta (2016) Fundamentals of Statistics, Himalaya Publishing House Pvt. Ltd. 7th Edition, page no:1-234.
2. S C Gupta and V K Kapoor (2014) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, .page no. 1-458
3. J. Medhi (2007) Statistical Methods - An Introductory, New Age International, 2<sup>nd</sup> Edition, page no:1-450.
4. S. P. Gupta (2014) Statistical Methods, Sultan Chand & Sons, 44th Edition, page no:1-1436.

### Course - GT. 422 (4CH)

**Objectives:** The students are taught about the computer skills in dealing with the programming required for carrying out digital image processing.

**Expected outcome:** After the study, the students will get the scope to go through the knowledge of computer methods and softwares that will be useful in carrying out research activities.

#### Computer Programming and Database Management

##### Unit - I

Image processing system characteristics; CPU, Arithmetic, coprocessor, RAM, Operating system and compiler. Storage devices, input and output devices, Scan, display and processing unit.

##### Unit - II

Interactive graphics. Data representation in computers, Programming, Computer language (C++), Visual basic.

### **Books Recommended**

1. Pradeep Sinha and Priti Sinha (2003) Computer Fundamentals, Bpb Publications, 6<sup>th</sup> Edition, page no 1-258
2. Anita Goel (2013) Computer Fundamentals, First edition ,PEARSON Publisher, page no:1-720.
3. E. Balagurusamy (2009) Fundamentals of Computers, Mcgraw Higher Ed, 1<sup>st</sup> Edition
4. Rajaraman V., (2014) Fundamentals of Computers, Prentice Hall India Learning Private Limited; 6th Revised edition edition, page no:1-448 .
5. Dennis P. Curtin, Kim Foley, Kunal Sen & Cathleen Morin, (1999) Information Technology - The Breaking Wave, Tata McGraw Hill Ed., page no.1-450

### **Course - GT. 423 (4CH)**

#### **Objectives**

: In these units, the students will study various techniques of image processing methods for extraction of various information which will be useful in geological problems. They are also getting a scope to go through the knowledge of computer methods that will be useful in carrying out research activities.

**Expected outcome:** After the study, the students shall be in a position to process digital data in various techniques to get multitude information.

### **Digital Image Processing, Correction and Interpretation**

#### **Unit - I**

Digital data; Digital image data storage; Mass storage. Display resolution, Colour resolution software; Statistical data extraction. Univariate and multivariate statistics computed from remotely sensed data; Histograms and its significance to digital image processing, image display system, Black and white image display, Video image display. Transforming video displays to hard copy displays. Image enhancement techniques. Data input, verification, correction and storage, data quality and errors,

#### **Unit - II**

Digital Image, Radiometric and Geometric errors in digital images and their correction, image analysis and pattern recognition, Image enhancement, reduction and magnification, contrast enhancement. Rationing, spatial filtering, Edge enhancement. Band rationing, Special transformations; Thematic information extraction. Classification scheme, training site selection, supervised classification, Map accuracy assessment.

### **Books Recommended**

1. Bloom, A.L. (2004) Geomorphology - A systematic analysis of Late Cenozoic landforms. Waveland Pr Inc; 3<sup>rd</sup> edition, page no:1-482.
2. Kale, V.S. and Gupta, A. (2000) Introduction to geomorphology. Orient BlackSwan, page no.: 1-280

3. Thorn, C.E. (1988) Introduction to theoretical geomorphology. Kluwer Academic Publishers, page no:1-288.
4. Thornbury, W.D. (2004) Principles of geomorphology. CBS; 2 edition,page no:1-213.
5. Drury, S.A. (2004) Image interpretation in geology. Routledge; 1 edition,page no:1-304.
6. Lillesand, T.M. and Kieffer, R.W. (2008) Remote sensing and image interpretation, 6th Revised edition John Wiley, page no:1-768.

### **Course - GT. 424 (4CH)**

#### **Objectives**

In these units, the students will study various parts of a GPS and their working techniques. It will also introduce the facts of usefulness of GPS for mapping, surveying and spatial data collection.

**Expected outcome:** After the study, the students can apply the knowledge of DEM to derive a variety of information such as area calculation, contour mapping etc. In addition, they shall have the practical ability to handle the GPS instrument.

#### **Digital elevation Modelling and Global positioning System**

##### **Unit - I**

Basics of Digital Elevation Model; Terrain visualization. Methods of representing DEM; Image methods, Point models; Data sources and sampling methods for DEMs; Data registration and geo-coding; Volume estimation in cut and fill problems; Contour maps; Line of sight maps; Shaded relief maps; Automated landform delineation from DEMs.

##### **Unit - II**

Global positioning system (GPS)- basic concepts; Characteristic of GPS Satellite; GPS signals, GPS receivers; Observation principles, Types of GPS positioning, Measures of accuracy, Determination of orthographic

#### **Books Recommended**

1. Satheesh Gopi, (2005) Global Positioning System Principles and Applications. Tata McGraw-Hill Publishing Company Limited, New Delhi, page no: 1-337.
2. Ahmed el Rabbany, (2006) Engineer's Guide to GPS (Mobile Communications Library) (English) 1<sup>st</sup> Edition, Artech House Publishers, page no: 1-224
3. Ian Heywood, Sarah Cornelivs and Steve Carver, (2010) An Introduction to Geographical Information System, Pearson Education Pvt .Ltd., New Delhi,. Page no. 1-254
4. LO. C.P., and Albert K. W. Yeung, (2006) Concepts and Techniques of Geographic Information Systems, 2 edition, Prentice-Hall of India, New Delhi, page no: 1-544.
5. Peter A. Burrough and Rachael A. Mc. Donnell, (2015) Principles of Geographical Information System, Oxford University Press Inc., New York, page no: 1-352.



6. Misra, R. P. and Ramesh, A, (2002) Fundamentals of Cartography, Concept Publishing Company, New Delhi. Page no.1 - 320

**Course - GT. 425 (2CH)**

**Objectives:** The students are allowed to carry out programming techniques and statistical methods which will be useful for digital image processing.

**Expected outcome:** The students can independently apply this knowledge in future when they will be in different services.

Practicals on statistical data analysis, Computer programming

Practical Record and Viva

Seminar

**Course - GT. 426 (2CH)**

**Objectives:** The students are allowed to carry out field visits along with teachers wherein they come to know the image interpretation elements and the keys required to identify the features in remote sensing data.

**Expected outcome:** The students can independently apply this knowledge in future when they will be in different services.

Report on Field Visits

Seminar

## **THIRD SEMESTER**

**Any one of the following:**

**Course - GT. 511. A (4CH)**

**Objectives:** The students are allowed to choose any one of the application areas of remote sensing and GIS related to their core area so that their core areas will be strengthened with the skill of geospatial technology.

**Expected outcome:** The students can independently apply this knowledge in future when they will be in different services.

### **Application of Geographic Information Systems in Geology, Geotechnical Engineering and Engineering Geology**

#### **Unit 1**

Introduction to Geographic information system. History of GIS; Components of GIS, Advantages of GIS, Data models, Layers and coverages, Database structure of GIS; Raster and Vector data for geographical entities. Data encoding. Data manipulation, Data analysis and spatial modelling, Data quality, Errors and natural variation, interpretation; Data output; Selection of a GIS, Integrated Multidisciplinary Geoinvestigations, Advantages and limitations of combining multidata.

#### **Unit 2**

Basic principles of geology, Concept of non-renewable natural resources, Various land forms developed in different rock types, Preparation of lithotectonic maps and their integration with existing geological maps; Plotting of field data on computer generated lithotectonic maps; Thematic map generation; Slope map construction; Integration of Toposheet with satellite images, Digital elevation map preparation and their Integration with geological maps, linear features and Lineament mapping and their analysis, reservoir site selection, water holding capacity assessment, flood zone mapping. Application of GIS in site selection for dams, bridges, tunnels and detection of landslide prone areas, earthquake and tsunami studies.

**Course - GT. 511. B (4CH)**

### **Application of Geographic Information Systems in Geography, Human settlement, Land use studies and Archeology**

#### **Unit 1**

Introduction to Geographic information system. History of GIS; Components of GIS, Advantages of GIS, Data models, Layers and coverages, Database structure of GIS; Raster and Vector data for geographical entities. Data encoding. Data manipulation, Data analysis and spatial modelling, Data quality, Errors and natural variation, interpretation; Data output; Selection of a GIS, Integrated Multidisciplinary Geoinvestigations, Advantages and limitations of combining multidata.

#### **Unit 2**

Basic principles of geography, Concept of natural resources, Classification of land and soil; Land potentiality study, Preparation of land use- landcover maps and their integration with existing geographical maps; wetland and wasteland mapping using RS & GIS, Study of topography/

geomorphology using remote sensing data products, contouring; Cadastral mapping. Generation of Digital elevation models and contouring; Application of GIS in urban planning, road communication, traffic control. Supervised and unsupervised classification of digital maps for soil erosion mapping, study of agriculture, crop yield prediction, hazard zone mapping.

### **Course - GT. 511. C (4CH)**

#### **Application of Geographic Information Systems in Environmental studies and Natural Resource Management**

##### **Unit 1**

Introduction to Geographic information system. History of GIS; Components of GIS, Advantages of GIS, Data models, Layers and coverages, Database structure of GIS; Raster and Vector data for geographical entities. Data encoding. Data manipulation, Data analysis and spatial modelling, Data quality, Errors and natural variation, interpretation; Data output; Selection of a GIS, Integrated Multidisciplinary Geoinvestigations, Advantages and limitations of combining multidata.

##### **Unit 2**

Basic principles of ecology and ecosystem, natural resources and their assessment, Human consumption of natural resources and its impact on environment, Concept of development, Industrialization and its impact, Concept of Natural and anthropogenic hazards, Application of RS & GIS for Classification of land and soil, water bodies, forests; Preparation of land use- landcover maps and their integration with existing geographical maps; wetland and wasteland mapping using RS & GIS, Generation of Digital elevation models related to environmental studies, flood zone mapping, draught area detection; Application of GIS in site selection for industries, towns, mining, water resource projects. Supervised and unsupervised classification of digital maps for soil erosion mapping, study of agriculture, crop yield prediction, hazard zone mapping. Application of RS and GIS in Environmental Impact Assessment studies (baseline data generation, DEM generation).

### **Course - GT. 511. D (4CH)**

#### **Application of Geographic Information Systems in Surface and subsurface water resources, Oceanic studies and Fishery**

##### **Unit 1**

Introduction to Geographic information system. History of GIS; Components of GIS, Advantages of GIS, Data models, Layers and coverages, Database structure of GIS; Raster and Vector data for geographical entities. Data encoding. Data manipulation, Data analysis and spatial modelling, Data quality, Errors and natural variation, interpretation; Data output; Selection of a GIS, Integrated Multidisciplinary Geoinvestigations, Advantages and limitations of combining multidata.

##### **Unit 2**

Importance of surface and subsurface water resources; Human use and misuse of water resources and its impact on environment; vertical zonation of ground water; water quality parameters; Basic principles of water flow and their measurement; various sources of water pollution. Concept of watershed and their management; Depth zonation of oceans, marine

processes and resources; Sources of marine pollution and their detection using RS data products; RS & GIS methods of Turbidity, temperature, phytoplankton studies; RS & GIS methods of subsurface water resources assessment, RS & GIS methods used in Fishery. RS and GIS applications in Water flow modeling, Reservoir routing etc. and DEM generation.

### **Course - GT. 511. E (4CH)**

### **Application of Geographic Information Systems in Ecology, Agriculture, Forestry and Meteorology**

#### **Unit 1**

Introduction to Geographic information system. History of GIS; Components of GIS, Advantages of GIS, Data models, Layers and coverages, Database structure of GIS; Raster and Vector data for geographical entities. Data encoding. Data manipulation, Data analysis and spatial modelling, Data quality, Errors and natural variation, interpretation; Data output; Selection of a GIS, Integrated Multidisciplinary Geoinvestigations, Advantages and limitations of combining multidata.

#### **Unit 2**

Basic principles of ecology and ecosystem, Renewable resources and their assessment, Human consumption of forest and natural resources and its impact on environment, Concept of Natural and anthropogenic hazards like flood, cyclone, draught, forest fire etc, Application of RS & GIS for Classification of soil, forests; Preparation of land use- landcover maps, flood zone mapping, draught area detection; Application of GIS in soil conservation, afforestation, damage estimation due to urbanization, mining, water resource projects, road and rail links. Application of RS & GIS in meteorology. Supervised and unsupervised classification of digital maps for soil erosion mapping, study of agriculture, crop yield prediction, hazard zone mapping.

#### **Books Recommended for course GT. 511 A - E:**

1. Bloom, A.L. (2004) Geomorphology - A systematic analysis of Late Cenozoic landforms. Waveland Pr Inc; 3 edition, page no:1-482.
2. Chorley, R.J., Schumm, S.A. and Sugden, D.E. (1985) Geomorphology. Methuen.
3. Kale, V.S. and Gupta, A. (2000) Introduction to geomorphology. Orient BlackSwan, page no.: 1-280
4. Thornbury, W.D. (2004) Principles of geomorphology. CBS; 2 edition, page no:1-213.
5. Drury, S.A. (2004) Image interpretation in geology. Routledge; 1 edition, page no:1-304.
6. Lillesand, T.M. and Kieffer, R.W. (2008) Remote sensing and image interpretation, 6th Revised edition John Wiley, page no:1-768.

**Course - GT.E. 512 (12CH)**

**Objectives:** The students are allowed to carry out training in a reputed institute wherein all project related works are going on.

**Expected outcome:** The students can independently apply this knowledge in carrying out their dissertation work.

**Training**

Training in a reputed institute on Digital Image Processing,/GIS or GPS. Report on field Training (50 days)

**Course - GT.E. 513**

**Seminar (4CH)**

Seminar (at least 4)

**FOURTH SEMESTER**

**Course - GT.C. 521 (20 CH)**

**Dissertation**

**Objectives:** The whole semester is devoted for carrying out project work independently under the supervision of experienced persons from inside and outside the University.

**Expected outcome :** The students are allowed to carry out dissertation on any topic on Remote Sensing, GIS/ GPS Global positioning system under the guidance of a faculty of the Dept./ Scientist of a RS- GIS Institute/ company so that hand-on training can be achieved.