HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)
CHENNAI

## DEPARTMENT OF CIVIL ENGINEERING

## MINORS OFFERED UNDER B.TECH. CIVIL ENGINEERING

## MINORS: GEOGRAPHICAL INFORMATION SYSTEM

| S.No | Course Code | Name of the Course | Total Learning Hours | Credit |
|---|---|---|---|---|
| 1 | CEM4276 | Fundamentals of Geographical Information System | 45 | 3 |
| 2 | CEM4361 | Geographical Information System Applications | 45 | 3 |
| 3 | CEM4376 | Remote Sensing | 45 | 3 |
| Total credits | | | | 9 |

## CURRICULUM

| B. TECH MINORS IN GEOGRAPHICAL INFORMATION SYSTEM | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SEM** | **COURSE CATEGORY** | **COURSE CODE** | **NAME OF THE COURSE** | **L** | **T** | **P** | **C** | **S** | **TCH** |
| IV | Minors | CEM4276 | Fundamentals of Geographical Information System | 2 | 1 | 0 | 3 | 0 | 3 |
| V | Minors | CEM4361 | Geographical Information System Applications | 2 | 1 | 0 | 3 | 0 | 3 |
| VI | Minors | CEM4376 | Remote Sensing | 2 | 1 | 0 | 3 | 0 | 3 |
| **TOTAL** | | | | **6** | **3** | **0** | **9** | **0** | **9** |

**L-Lecture T-Tutorial P-Practical C-Credit S-Self-study TCH-Total contact hours**

# MINORS

<table>
<tr><td>COURSE TITLE</td><td colspan="3">FUNDAMENTALS OF GEOGRAPHICAL INFORMATION SYSTEM</td><td>CREDITS</td><td>3</td></tr>
<tr><td>COURSE CODE</td><td>CEM4276</td><td>COURSE CATEGORY</td><td>MINORS</td><td>L-T-P-S</td><td>2-1-0-0</td></tr>
<tr><td>Version</td><td>1.0</td><td>Approval Details</td><td>33 ACM, 05.02.2022</td><td>LEARNING LEVEL</td><td>BTL-3</td></tr>
<tr><td colspan="6">ASSESSMENT SCHEME</td></tr>
<tr><td>First Periodical Assessment</td><td>Second Periodical Assessment</td><td>Seminar/ Assignments/ Project</td><td>Surprise Test / Quiz</td><td>Attendance</td><td>ESE</td></tr>
<tr><td>15%</td><td>15%</td><td>10%</td><td>5%</td><td>5%</td><td>50%</td></tr>
<tr><td colspan="6">Map with multiple courses for 45 Hours per course. End Semester Examination should be conducted per course.</td></tr>
<tr><td>Course Description</td><td colspan="5">Explore the world of spatial analysis and cartography with geographic information systems (GIS). In-depth with common data types (such as raster and vector data), structures, quality and storage</td></tr>
<tr><td>Course Objective</td><td colspan="5">The course should enable the students to<br><br>1. Expose the students with concepts of cartography as major components of input and output related to cartography.<br>2. Provide exposure to data models and data structures in GIS and to introduce various Raster and Vector Analysis capabilities.<br>3. Expose the concept of quality and design of cartographic outputs in open GIS environment</td></tr>
<tr><td>Course Outcome</td><td colspan="5">Upon completion of this course, the students will be able to<br><br>1. Understand the Characteristics and Components of Maps and GIS<br>2. Perform input of Spatial and Non-spatial data into GIS<br>3. Analyse Spatial Relationship between Elements using GIS tools<br>4. Evaluate Network and Surface Data for Decision Making<br>5. Present the Spatial Information and Access the Quality against Standards</td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
</table>

**CO, PO AND PSO MAPPING**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | - | - | - | 3 | - | - | - | - | 2 | - | - | 1 | - | - |
| CO2 | 2 | - | - | - | 3 | - | - | - | 2 | - | 2 | - | 2 | - | - |
| CO3 | 2 | - | - | - | 3 | - | - | - | - | - | - | - | 3 | - | - |
| CO4 | 2 | - | - | - | 3 | 2 | 2 | - | 3 | 3 | - | 2 | 3 | - | - |
| CO5 | - | 3 | 3 | 3 | - | - | - | 2 | - | - | 2 | - | 1 | 3 | 2 |

**1: Weakly related, 2: Moderately related and 3: Strongly related**

| **MODULE 1: CARTOGRAPHY** | **9)** |
|---|---|
| Definition of Map - Mapping Organsiation in India- Classification based on Function, Scale, Characteristics – Ellipsoid and Geoid – Co-ordinate Systems - Rectangular and Geographic Coordinates – UTM and UPS - Projection – Function - Types of Map Projections – Transformations – Function - Affine transformation - Choice of Map Projection – Evolution of cartography- Geo-Spatial, Spatial and Non-spatial data – Definition of GIS – Evolution GIS – Components of GIS. | **CO-1**<br>**BTL-2** |
| **MODULE2: GIS DATA MODELS AND DATA INPUT** | **(9)** |
| Point, Line Polygon / Area, elevation and surface –Tessellations - Attributes and Levels of Measurement - Data Sources – Ground and Remote Sensing survey – Collateral data collection – Input: Map scanning and digitization, Registration and Georeferencing – Concepts of RDBMS - Raster Data Model – Grid – Data Encoding - Data Compression – Vector Data Model – Topological properties – Arc Node Data Structure – Raster Vs. Vector Comparison – File Formats for Raster and Vector – Data conversion between Raster and vector. | **CO-2**<br>**BTL-3** |
| **MODULE 3: RASTER AND VECTOR DATA ANALYSIS** | **(9)** |
| Raster Data analysis: Local, Neighborhood and Regional Operations – Map Algebra – Vector Data Analysis: Topological Analysis, point-in-polygon, Line-in-polygon, Polygon-in-Polygon – Proximity Analysis: buffering, Thiessen Polygon – Non-topological analysis: Attribute data Analysis- concepts of SQL– ODBC | **CO-3**<br>**BTL-3** |
| **MODULE 4 : NETWORK ANALYSIS AND SURFACE ANALYSIS** | **(9)** |
| Network – Creating Network Data - Origin, Destination, Stops, Barriers – Closest Facility Analysis, Service Area Analysis, OD Cost matrix analysis, Shortest Path Analysis – Address Geocoding – Surface Analysis – DEM, DTM - Point data to Surface interpolation – DEM Representaiton – Applications. | **CO-4**<br>**BTL-3** |
| **MODULE 5: DATA OUTPUT AND WEB BASED GIS** | **(9)** |

| | |
|---|---|
| Map Compilation – Cartographic functionalities for Map Design – Symbolization – Conventional signs and symbols – Spatial Data Quality – Lineage, Positional Accuracy, Attribute Accuracy, Completeness, Logical Consistency - Meta Data – Web based GIS: Definition, Merits - Architecture – Map Server – Spatial Data Infrastructure – Spatial Data Standards – Free and Open Source – Proprietary - GIS Software . | **CO-5**<br>**BTL-3** |
| **TEXT BOOKS** | |
| 1. | Lo, C.P. and Yeung, Albert K.W. (2016) *Concepts and Techniques of Geographic Information Systems*, Pearson. |
| 2. | Ian Heywood, Sarah Cornelius, Steve Carver. (2012). *An Introduction to Geographical Information Systems,* Pearson Education, 4th Edition. |
| 3. | Kang-tsung Chang. (2018). Introduction to Geographic Information Systems: 9th Edition, ISBN 9781259929649, McGraw-Hill Education. |
| **REFERENCE BOOKS** | |
| 1. | Borden D Dent, Jeff Torguson, Thomas W. Hodler. (2008). *Cartography: Thematic Map Design.* 6th Edition, ISBN-13: 978-0072943825 McGraw-Hill Education – Europe. |
| 2. | Michael N. DeMers. (2009). *Fundamentals of geographic information systems*, Wiley. |
| 3. | Paul A. Longley, Michael F. Goodchild , David J. Maguire , David W. Rhind. (2015). *Geographic Information Science and Systems*, John Wiley & Sons Inc, , ISBN 978111867695. |
| 4. | Tor Bernhardsen. (2002) *Geographic Information Systems an Introduction*, Willey, 3rd Edition. |
| **E BOOKS** | |
| 1. | https://drive.google.com/file/d/1xEs827nZ5iUTGkkwNMru9QFQYN8RgNEo/view?usp=sharing |
| 2. | https://drive.google.com/file/d/13-EmlHYsNlWPCSALYYY8uafs50rOdk3B/view?usp=sharing |
| 3, | https://drive.google.com/file/d/1vgJ7K0t1pHm7PFa_35O4O7chA2yOi2lp/view?usp=sharing |
| 4, | https://drive.google.com/file/d/1M_GZuNm1gua333ucR3mQC6OvKy6rMq-y/view?usp=sharing |
| **MOOC https://onlinecourses.swayam2.ac.in/aic22_ge16/preview** | |
| 1. | https://www.coursera.org/learn/gis#syllabus |
| 2. | https://www.coursera.org/learn/gis-data#syllabus |

| COURSE TITLE | GEOGRAPHICAL INFORMATION SYSTEM APPLICATION | | | CREDITS | 3 |
|---|---|---|---|---|---|
| COURSE CODE | CEM4361 | COURSE CATEGORY | MINORS | L-T-P-S | 2-1-0-0 |
| Version | 1.0 | Approval Details | 33 ACM, 05.02.2022 | LEARNING LEVEL | BTL-3 |

**ASSESSMENT SCHEME**

| First Periodical Assessment | Second Periodical Assessment | Seminar/ Assignment / Project | Surprise Test / Quiz | Attendance | ESE |
|---|---|---|---|---|---|
| 15% | 15% | 10% | 5% | 5% | 50% |

Map with multiple courses for 45 Hours per course. End Semester Examination should be conducted per course.

| | |
|---|---|
| **Course Description** | Geographic Information System (GIS) Imagery Analysis Spatial Analysis satellite imagery GIS Applications. Focuses on the basic building blocks of GIS data, so that you know what types of GIS files exist, and the implications of choosing one type over another. How to take non-GIS data, such as a list of addresses, and convert it into "mappable" data using geocoding. |
| **Course Objective** | The course should enable the students to<br>1. To provide exposure to applications of GIS in various application domains through case studies |
| **Course Outcome** | Upon completion of this course, the students will be able to<br>1. Apply Geomatics Technology for Management of Natural Resources.<br>2. Evaluate use of Geomatics Technology for Disaster Management and Facility Management.<br>3. Understand the use of Geomatics in Location Based Services.<br>4. Assess the Applications of Land Information in Tax and other domains.<br>5. Apply Geomatics for solving Social and Business issues. |

**Prerequisites: Nil**

**CO, PO AND PSO MAPPING**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 3 | 2 | 2 | - | 3 | - | - | - | 2 | 2 | - | - | 3 |
| CO2 | 1 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 3 | 3 | 1 | - | 3 |
| CO3 | 1 | 2 | 2 | 1 | 3 | 2 | - | - | - | - | 2 | 2 | 1 | 2 | - |
| CO4 | 2 | 1 | 2 | 1 | 3 | 3 | - | - | - | - | 2 | 2 | 1 | 1 | - |
| CO5 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | - | - | - | 3 | 2 | - | 2 | - |

**1: Weakly related, 2: Moderately related and 3: Strongly related**

| | |
|---|---|
| **MODULE 1: NATURAL RESOURCE MANAGEMENT APPLICATIONS** | **(9)** |
| Forestry: Resource inventory, Forest fire growth modeling – Land: Land use planning, watershed management studies – Water – Identification of ground water recharge – Resource information system – Wetlands Management, Wildlife habitat analysis – Satellites data availability – Case Studies | **CO-1** **BTL-2** |
| **MODULE 2 DISASTER MANAGEMENT & FACILITY MANAGEMENT APPLICATIONS** | **(9)** |
| Disaster management: use of GIS in Risk assessment, mitigation, preparedness, Response and recovery phases of Disaster management – Utilities – Water utility applications – Electric utility Application – Telecommunication: Tower spotting, route optimization for meter reading for utilities - Other utilities – Transportation network – Crowd sourcing methods and Algorithms | **CO-2** **BTL-2** |
| **MODULE 3: LOCATION BASED SERVICES APPLICATION** | **(9)** |
| Vehicle Tracking: Automatic vehicle location (AVL), Components of AVL: Invehicle Equipment, Various communication channels, Web server, Client – Vehicle tracking alarms used in Vehicle tracking, Fleet management – Vehicle navigation – Emergency call: Address geocoding, Distress call application. | **CO-3** **BTL-3** |
| **MODULE 4: LAND INFORMATION SYSTEM & WEB GIS APPLICATIONS** | **(9)** |
| Land information system (LIS) – Tax mapping – Mobile mapping - Other LIS applications – Web GIS: Architecture of Web GIS, Map server, Web GIS applications – Bhuvan – NUIS - EPRIS | **CO-4** **BTL-3** |
| **MODULE 5: DEMOGRAPHIC APPLICATIONS** | **(9)** |
| Business applications: Sitting Retail Store, Customer Loyalty studies, Market penetration studies – Health application: Disaster Surveillance, Health information system – Crime Mapping: Mapping Crime data, Hot Spot Analysis – 3D GIS. | **CO-5** **BTL-3** |
| **TEXT BOOKS** | |

| | |
|---|---|
| 1. | Ana Claudia Teodoro. (2018).*GIS – An Overview of Applications*, Bentham Science Publishers. |
| 2. | Paul Longley, Michael F. Goodchild, David J.Maguire, David W.Rhind. (2015). *Geographic Information Systems and Science*, John Wiley and Sons. |
| 3. | Uzair M.Shamsi. (2002).*GIS Tools for Water, Wastewater, and Storm water Systems*, ASCE Press. |
| **REFERENCE BOOKS** | |
| 1. | Alan L, MD Melnick. (2002). *Introduction to Geographic Information Systems for Public Health*, Aspen Publishers, first edition. |
| 2. | Amin Hammad, Hassan Karimi. (2004).*Telegeoinformatics: Location-based Computing and Services*, CRC Press. |
| 3. | Allan Brimicombe. (2010). *GIS Environmental Modeling and Engineering*, Taylor & Francis. |
| 4. | Van Dijk, M.G. Bos. (2001).*GIS and Remote Sensing Techniques in Land-And-Water- Management*, Kluwer Academic Publisher. |
| **E BOOKS** | |
| 1. | https://drive.google.com/file/d/1XWh4Yuf0jsv7ilAq7qbA8Pj3SshIEaAC/view?usp=sharing |
| 2. | https://drive.google.com/file/d/1JGzCqRjE1tm0G-x_jJNOq6dq2Wrwm19i/view?usp=sharing |
| 3. | https://drive.google.com/file/d/1caJh_6SCSbEDF3doAQyLYRTq0CnxWt0Q/view?usp=sharing |
| 4. | https://drive.google.com/file/d/1kI6vKreApbrEnTj2Bc1FbHqJHxzg_08r/view?usp=sharing |
| **MOOC- COURSERA** | |
| 1. | https://onlinecourses.swayam2.ac.in/aic22_ge16/preview |
| 2. | https://www.coursera.org/learn/gis-data-acquisition-map-design |

| COURSE TITLE | REMOTE SENSING | | | CREDITS | 3 |
|---|---|---|---|---|---|
| COURSE CODE | CEM4376 | COURSE CATEGORY | MINORS | L-T-P-S | 2-1-0-0 |
| Version | 1.0 | Approval Details | 33 ACM, 05.02.2022 | LEARNING LEVEL | BTL-3 |

**ASSESSMENT SCHEME**

| First Periodical Assessment | Second Periodical Assessment | Seminar/ Assignments/ Project | Surprise Test / Quiz | Attendance | ESE |
|---|---|---|---|---|---|
| 15% | 15% | 10% | 5% | 5% | 50% |

Map with multiple courses for 45 Hours per course. CIA calculated from Coursera platform. End Semester Examination should be conducted per course.

| | |
|---|---|
| **Course Description** | This course will introduce the students to the state-of-the-art concepts and practices of remote sensing and GIS. It starts with the fundamentals of remote sensing and GIS and subsequently advanced methods will be covered. This course is designed to give comprehensive understanding on the application of remote sensing and GIS in solving the research problems. Upon completion, the participants should be able to use remote sensing (Satellite images and Field data) and GIS in their future research work. |
| **Course Objective** | The course should enable the students to<br>1. To familiarize about the basic principles of remote sensing<br>2. To acquire knowledge about the motion of remote sensing satellites in the space<br>3. To expose the various types of sensors used for remote sensing<br>4. To gain knowledge about the generation of satellite data products |
| **Course Outcome** | Upon completion of this course, the students will be able to<br>1. Understand the concepts and laws related to remote sensing Process images using complex algorithms to manipulate data.<br>2. Acquire knowledge about various remote sensing platforms Use digital elevation models and creating slope and distance analysis products.<br>3. Understand the characteristics of different types of remote sensors.<br>4. Gain knowledge about reception, product generation, storage and ordering of satellite data.<br>5. Understand the concept of different image processing techniques and interpretation of satellite data. |

**Prerequisites: Nil**

| CO, PO AND PSO MAPPING | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
| **CO1** | **2** | **-** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **2** | **-** | **-** | **1** | **1** | **-** |
| **CO2** | **2** | **-** | **-** | **-** | **3** | **-** | **-** | **-** | **2** | **-** | **2** | **-** | **1** | **0** | **-** |
| **CO3** | **2** | **-** | **-** | **-** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **1** | **0** | **-** |
| **CO4** | **2** | **-** | **-** | **-** | **3** | **2** | **2** | **-** | **3** | **3** | **-** | **2** | **2** | **1** | **-** |
| **CO5** | **-** | **3** | **3** | **3** | **-** | **-** | **-** | **2** | **-** | **-** | **2** | **-** | **2** | **1** | **-** |

**1: Weakly related, 2: Moderately related and 3: Strongly related**

| **MODULE 1: PHYSICS OF REMOTE SENSING** | **(9)** |
|---|---|
| Remote Sensing - Definition - Components - Electro Magnetic Spectrum – Basic wave theory – Particle theory – Stefan Boltzman law - Wiens-Displacement Law - Radiometric quantities - Effects of Atmosphere- Scattering – Different types – Absorption-Atmospheric window- Energy interaction with surface features – Spectral reflectance of vegetation, soil and water –atmospheric influence on spectral response patterns- multi concept in Remote sensing. | **CO-1 BTL-2** |
| **MODULE2: PLATFORMS** | **(9)** |
| Orbit elements – Types of orbits – Motions of planets and satellites – Launch of space vehicle – Orbit perturbations and maneuvers – escape velocity - Types and characteristics of different remote sensing platforms – sun synchronous and geo synchronous satellites. | **CO-2 BTL-3** |
| **MODULE 3: OPTICAL SENSORS** | **(9)** |
| Classification of remote sensors – selection of sensor parameters - resolution concept - Spectral, Radiometric and temporal resolution – Quality of images in optical systems – imaging mode – photographic camera – opto-mechanical scanners – pushbroom and whiskbroom cameras – Panchromatic, multi spectral , hyperspectral scanners – geometric characteristics of scannerimagery - Earth resource satellites operating with optical sensors- Landsat, SPOT, IRS, WorldView. | **CO-3 BTL-3** |
| **MODULE 4: DATA RECEPTION AND DATA PRODUCTS** | **(9)** |
| Ground segment organization – Data product generation – sources of errors in received data – referencing scheme – data product output medium – Digital products – Super structure, Fast,GeoTIFF, Hierarchical and HDF formats – Indian and International Satellite Data Products – ordering of data | **CO-4 BTL-3** |
| **MODULE 5: DATA ANALYSIS** | **(9)** |
| Data products and their characteristics – Elements of visual interpretation – interpretation keys – Digital image processing – Preprocessing – Image rectification – Image enhancement techniques– Image classification – | **CO-5 BTL-3** |

| | |
|---|---|
| Supervised and unsupervised classification algorithms for multispectral and hyperspectral images – Accuracy assessment. | |
| **TEXT BOOKS** | |
| 1. | Lillesand T.M., and Kiefer, R.W. (2015). *Remote Sensing and Image interpretation*, VI edition of John Wiley & Sons. |
| 2. | John R. Jensen.(2015). *Introductory Digital Image Processing: A Remote Sensing Perspective*, Pearson 4th Edition. |
| 3. | John A.Richards, Springer – Verlag. (2013). *Remote Sensing Digital Image Analysis* 5th edition,. |
| **REFERENCE BOOKS** | |
| 1. | Paul J Curran (1996). Principles of Remote Sensing, Oxford: Blackwell. |
| 2. | Charles Elachi and Jakob J. van Zyl. (2006). *Introduction to the Physics and Techniques of Remote Sensing*, Wiley Series in Remote Sensing and Image Processing, 2nd edition. |
| 3. | George Joseph. (2018). *Fundamentals of Remote Sensing*, Third Edition, Universities Press (India) Pvt Ltd, Hyderabad,. |
| 4. | Basudeb Bhatta. (2011).*Remote Sensing and GIS*, Oxford University Press,. |
| **E BOOKS** | |
| 1. | https://drive.google.com/file/d/1UqNWPNoOT5LKio4Mn25axeksl5zaB6Nc/view?usp=sharing |
| 2. | https://drive.google.com/file/d/1Ru0aTDEKaCoAWOt5AToaBUWqcJAQfZqc/view?usp=sharing |
| 3. | https://drive.google.com/file/d/1KOCxv6Y0YTwlsV9E5huASNDt7zxPBPmR/view?usp=sharing |
| **SWAYAM/NPTEL** | |
| 1. | https://onlinecourses.nptel.ac.in/noc21_ce61/preview |