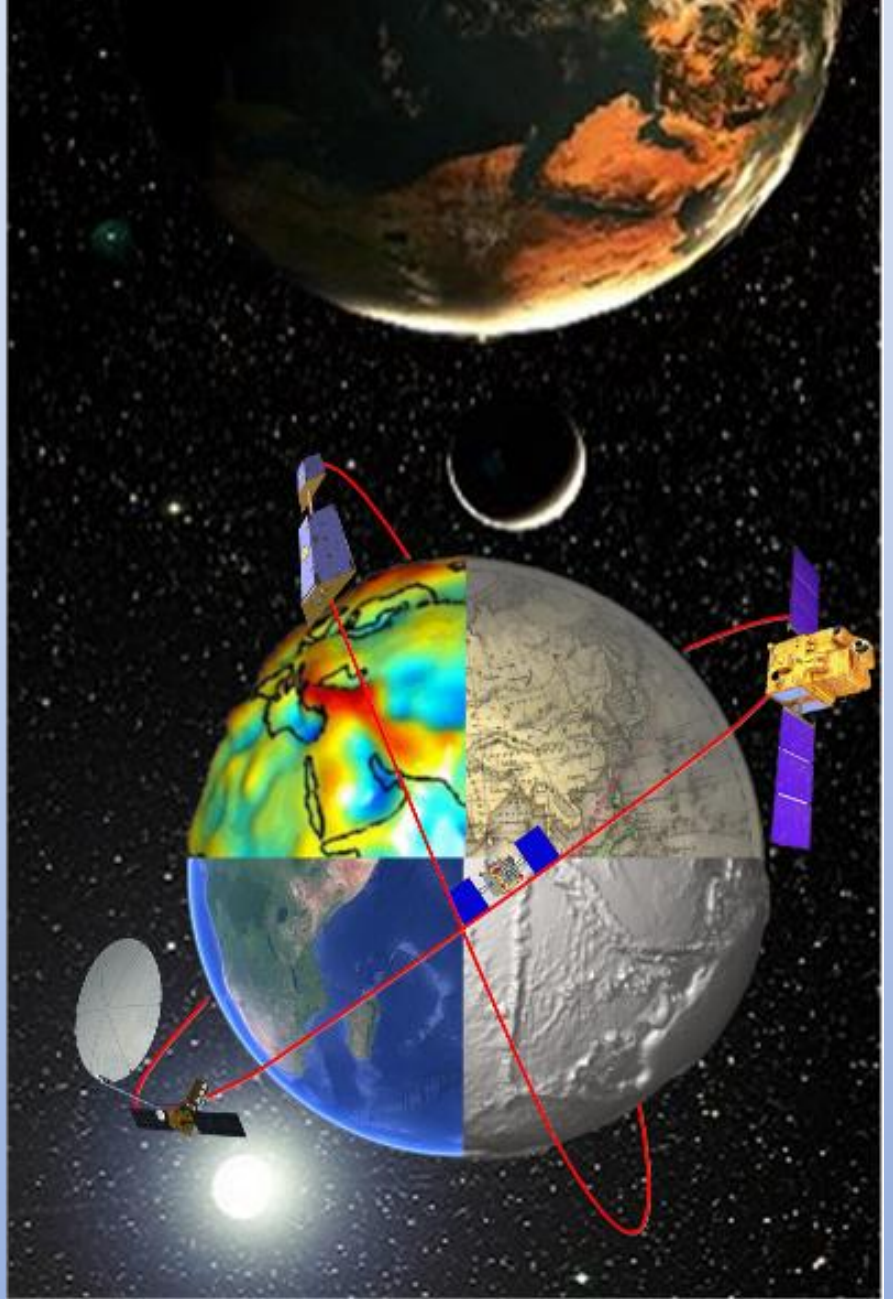


# NATIONAL CENTRE FOR GEODESY

GNZ

National  
Centre for  
Geodesy  
IIT KANPUR



# ABOUT NCG

## MISSION/VISION

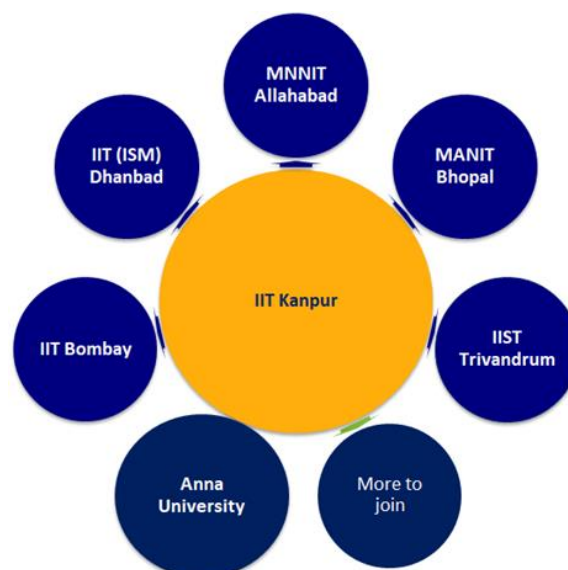
The National Centre for Geodesy (NCG) at the Indian Institute of Technology Kanpur was set up on July 1, 2019, by the Department of Science and Technology (DST), Govt. of India. The primary objective of NCG is to nucleate and strengthen the activities in the field of Geodesy education, capacity building, and academic research and development by:

1. organizing outreach activities, building capacity in Geodesy through regular short- and long-term training programs, preparing well-trained post-graduate students, developing courses and reference material, and disseminating relevant information in Geodesy.
2. conducting state-of-the-art research and development activities (academic research, sponsored/consulting) in Geodesy.
3. acting as the National Resource Centre for support (laboratory, equipment, training, library, SW, etc.) to students and researchers from various universities and institutions and advising state/central government departments on all issues related to Geodesy.

The current research areas at NCG have a broad spectrum of activities that include physical geodesy, satellite geodesy, geometric geodesy, environmental geodesy, sensor integration, and allied areas. NCG is also coordinating two major geodetic projects of national importance: (1) setting up a satellite geodetic techniques observatory named Geodesy village and (2) establishing the Indian National Geodetic Infrastructure.

## REGIONAL CENTRES FOR GEODESY (RCG)

It is also proposed to set up several Regional Centers for Geodesy (RCGs) at a few other national institutions who will be working in tandem with NCG to spread Geodesy education and R&D and contribute towards the growth of geodetic infrastructure in India. Initial handholding in terms of training of trainers, students, researchers, and faculty members in Geodesy will be provided by the NCG.



# ACADEMIC PROGRAMS

The Department of Civil Engineering (CE) offers admission to BTech program in CE through JEE advanced. At the PG level, various programs such as DIIT, MTech/MS (by research), and PhD are available. NCG supports various PG programs provided in a broad area of geodesy under the aegis of the **Geoinformatics specialization** of the Department of Civil engineering. Details of these PG programs are summarized below.

## 1. Diploma of Institute (DIIT)

DIIT is a one-year program primarily aimed at working professionals in Government departments/ institutions, industry, faculty members in academia involved in teaching and R&D in Geospatial Technology. The interested working professionals should provide a letter from the parent institution that they have been serving in the institution for at least one year and will be granted leave to attend the program.

Additionally, other eligible candidates are also encouraged to apply for this program.

The DIIT program is offered in three broad areas namely, **Geodesy**, **Navigational and Mapping**, and **Remote Sensing and GIS**.

### Eligibility for DIIT

Bachelor's degree in Civil / Mining / Electrical / Computer Science / Electronics Engineering / Information Technology / Geoinformatics/Geomatics.

Or

Master of Science in Earth Science and related areas or Geography / Physics/ Mathematics/ Environmental Sciences. Candidates with MSc degree must have Mathematics as one of the subjects at BSc level.

- **GATE requirement is waived off for all DIIT candidates.**

### Credits and Duration

DIIT candidates need to complete a minimum of 72 credits using a suitable combination of credits earned through course work and project work as given below:

❖ Maximum total credits	72
• by course work (minimum)	36
• by project work (minimum)	18
❖ Minimum Duration	2 Sem
❖ Maximum Duration	3 Sem

## Course structure for DIIT

Specialization	Semester I Courses
<b>Geodesy</b>	<ul style="list-style-type: none"> <li>• Reference Frames, Coordinate Systems and Map Projections</li> <li>• Geodetic Astronomy and Introduction to Satellite Geodesy</li> <li>• Adjustment Computation for Geoinformatics-I</li> </ul>
<b>Navigation and Mapping</b>	<ul style="list-style-type: none"> <li>• Reference Frames, Coordinate Systems and Map Projections</li> <li>• Adjustment Computation for Geoinformatics-I</li> </ul>
<b>Remote Sensing and GIS</b>	<ul style="list-style-type: none"> <li>• Remote Sensing</li> <li>• Adjustment Computation for Geoinformatics-I</li> </ul>
	<b>Semester-II Courses</b>
<b>Geodesy</b>	<ul style="list-style-type: none"> <li>• Introduction to Global Navigation Satellite Systems (GNSS)</li> <li>• Global Navigation Satellite Systems (GNSS) for Surveying and Mapping</li> </ul>
<b>Navigation and Mapping</b>	<ul style="list-style-type: none"> <li>• Introduction to Global Navigation Satellite Systems (GNSS)</li> <li>• Introduction to Inertial and Multi-Sensor Navigation</li> </ul>
<b>Remote Sensing and GIS</b>	<ul style="list-style-type: none"> <li>• Geographical Information Systems</li> </ul>
<b>Elective courses</b>	<ul style="list-style-type: none"> <li>• Adjustment Computation for Geoinformatics-II</li> <li>• Photogrammetry and LiDAR</li> <li>• Machine Processing of Remotely Sensed Data</li> <li>• Geographical Information System (GIS)</li> <li>• Environmental Geodesy</li> <li>• Signal processing on sphere</li> <li>• Physical Geodesy</li> <li>• Geoinformatics</li> <li>• Instrumentation, Laboratory and Field Practices in Geoinformatics</li> </ul>

### Other relevant information

- Admission to DIIT program is offered once in a year for the Academic year from July to June. The application and selection procedure are completed in April-May, every year.
- This program is of 2 semesters duration and the project work can be taken up during summer (May-June).
- The minimum CPI requirement for continuing in the programme for graduation is 6.5.

## 2. MTech and MS by Research (MS (R))

- MTech/MS (R) are normally two years program (four semesters) and are open to candidates with a valid GATE score.
- Application and selection process for these programs is normally initiated in April-May.
- Details are available at the websites of the Institute and the Civil Engineering department.
  - [www.iitk.ac.in](http://www.iitk.ac.in)
  - [www.iitk.ac.in/ce](http://www.iitk.ac.in/ce)
  - [gi-iitk.github.io](https://github.com/gi-iitk)
  - [www.iitk.ac.in/ncg](http://www.iitk.ac.in/ncg)
- The minimum CPI requirement for continuing in the programme or for graduation for MTech/MS(R) is 6.5.

### Eligibility for MTech/MS (R)

Bachelor's degree in Civil / Mining / Electrical / Computer Science / Electronics Engineering / Information Technology / Geoinformatics/Geomatics.

Or

Master of Science in Earth Science and related areas or Geography / Physics/ Mathematics/ Environmental Sciences. Candidates with MSC degree must have mathematics as one of the subjects at BSc level.

- A valid GATE score is required for admission to the MTech/MS (R) program in the case of regular candidates. These admissions may be made directly based on the GATE scores of the candidates and performance in the qualifying examination, and in addition, some of the candidates may also be called for written tests and/or interviews. The requirement of GATE score is waived for the candidates who are BTech graduates from IITs with a minimum overall CPI of 6.5 and a minimum CPI of 8.0 in the last two years in BTech.
- A candidate working in an R & D establishment which is equipped with the necessary research and library facilities may be considered for admission only to the MTech/MS (R). Such a candidate must be sponsored by his/her employer and must have been in employment with the sponsoring organization for at least 2 years at the time of admission. The sponsored candidates seeking admission to the MTech/MS (R) programme who have not qualified GATE will be called for interview and may in addition be asked to take a written test.
- The Institute also offers part-time postgraduate

programmes leading to the MTech/MS by Research degrees for professionally employed personnel such as working engineers, scientists and teachers who can, while employed, attend regular classes as per schedule of the Institute.

### Credits and Duration

#### MTech

❖ Maximum total credits	144
• by course work (minimum), in CE	72
• by research (minimum), in CE	72

#### MS (R)

❖ Maximum total credits	144
• by course work (minimum), in CE	36
• by research (minimum), in CE	72
❖ Minimum Duration	4 Sem
❖ Maximum Duration	4 Years

### Course structure for MTech

Semester I	Courses
<b>Compulsory</b>	<ul style="list-style-type: none"> <li>• Mathematics</li> <li>• Reference Frames, Coordinate Systems and Map Projections</li> <li>• Geodetic Astronomy and Introduction to Satellite Geodesy</li> <li>• Adjustment Computation for Geoinformatics-I</li> </ul>
<b>Electives</b>	<ul style="list-style-type: none"> <li>• Remote sensing</li> <li>• Physical Geodesy</li> </ul>
<b>Semester-II</b>	
<b>Compulsory</b>	<ul style="list-style-type: none"> <li>• Introduction to Global Navigation Satellite Systems (GNSS)</li> <li>• Global Navigation Satellite Systems (GNSS) for Surveying and Mapping</li> </ul> OR <ul style="list-style-type: none"> <li>• Introduction to Inertial and Multi-Sensor Navigation</li> <li>• Instrumentation, Laboratory and Field Practices in Geoinformatics</li> </ul>
<b>Electives</b>	<ul style="list-style-type: none"> <li>• Photogrammetry and LiDAR</li> <li>• Machine Processing of Remotely Sensed Data</li> <li>• Environmental Geodesy</li> <li>• Signal processing on sphere</li> <li>• Physical Geodesy</li> <li>• Geographical Information Systems Geoinformatics</li> </ul>

### Course structure for MS (R)

For MS (R) program also, the candidate is advised to choose a suitable combination of courses as listed for the MTech program such that while satisfying the credit requirements through coursework, he/she is ready to take up a thesis research work with strong theoretical foundations of the subject.

### 3. Doctor of Philosophy (PhD)

- The admissions to the PhD program are generally offered in both regular semesters.
- Application and selection process for these programs is normally initiated in April-May for the first semester and in November-December for the second semester. Details are available at the websites of the Institute and the Civil Engineering department.
- The minimum CPI requirement for continuing in the programme or for graduation is 7.0

#### Eligibility for PhD

MTech/ME in Civil, Computer Science, Electrical, Electronics, Mining engineering, Information Technology, Geoinformatics/Geomatics.

OR

MTech/MSc in Geology, Geophysics, Geography, Physics, Mathematics, Environmental Sciences. Candidates with MSc degree must have Mathematics as one of the subjects at BSc level.

The applicant must have a master's degree in engineering with marks/CPI not below the specified minimum.

Those applicants may also be considered who have a bachelor's degree in engineering or science (4-year program) with a minimum of 75 percent marks/7.5 CPI

OR

a master's degree in science or an allied area while satisfying each of the following criteria:

- a) A minimum of 65 percent marks/6.5 CPI in the master's degree,
- b) First division in bachelor's degree, and
- c) JRF/95 percentile or higher in GATE.

A valid GATE score is required for the candidates with bachelor's degree in engineering.

#### Credits and Duration

❖ Maximum Total Credits	216
○ by course work (minimum)	72
○ by research (minimum)	72
❖ Minimum Duration	6 Sem
❖ Maximum Duration	7 Years

#### Financial support

For MTech/MS (R) programs, selected candidates are offered Institute fellowship (from MHRD). To avail the financial assistance, the selected candidates with a bachelor's degree in engineering or science (4-year program) must have a minimum of 75 percent

marks/7.5 CPI with a valid GATE/UGC/CSIR score, except for graduate from IITs with a minimum CPI of 8.0.

Additionally, financial support from the NCG provides fellowship to 3 MTech and 3 MS (R) and 12 DIIT candidates with monthly stipend of 12,000/- INR.

For selected PhD students, the corresponding Institute fellowship (from MHRD) is Rs. 25,000/- for the first two years and thereafter it is raised to Rs. 28,000/- respectively.

For details on academic requirements and procedures related to PG programs, please visit:

<https://www.iitk.ac.in/doaa/data/pgmanual-02Sep2015.pdf>.

For fees of different programs, please visit:

<https://www.iitk.ac.in/dosa/index.php/component/content/article/50-home/24-home-page?highlight=WyJmZWVzI10=>

### 4. Internship

NCG offers internships (short and long term) to bright UG and PG students (with Engineering or Science background) who are interested to work in geodesy and allied areas. Interested students can apply by writing to NCG. Alternatively, they can also apply by filling up the internship form available at NCG website.

Shortlisted candidates will be intimated for an interview. Selected candidates will be required to provide necessary academic and personal documents from their parent institution including a no objection certificate. They will be provided stipend as per the prevailing norms of Center for Continuing Education (CCE). However, the hostel, mess and other charges have to borne by the student. Only after the approval by the competent authority, hostel accommodation may be provided in the one of the student hostels, if available.

#### Eligibility for internship

Through CCE, NCG offers internship positions to eligible candidates/students who are interested to work in geodesy and allied areas. The internship is open to candidates who are undergoing or have completed the following programs:

Bachelor's degree in Civil / Mining / Electrical / Computer Science / Electronics Engineering / Information Technology / Geoinformatics/Geomatics.

Or

Master of Science in Earth Science and related areas or Geography / Physics/ Mathematics/ Environmental Sciences. Candidates with MSc degree must have Mathematics as one of the subjects at BSc level.

Internship forms are available at [iitk.ac.in/ncg](http://iitk.ac.in/ncg)  
Duration of Internship: 8 weeks to 24 weeks.

# OUTREACH AND RESEARCH ACTIVITIES

## Short-term courses

NCG offers a variety of courses in geodesy and allied areas. Details of upcoming courses are regularly updated on the NCG website. Following is a list of recent courses:

- Geodesy for Survey of India (2021-2022)
- Winter School on Physical Geodesy and its Applications (2021)
- Geodesy for Senior level Survey of India (2021)
- Introduction to GNSS and its Applications (2021)
- The Present and Future of Satellite Gravimetry (2020)
- Introduction to VLBI Technique for Geodetic Applications in India (2020)
- Geospatial Technologies for Smart Cities and Urban Mobility (2020)
- Autumn School on Physical Geodesy and Its Applications (2019)

## Indicative research areas

- Determination of precise gravimetric geoid using satellite, airborne, and terrestrial gravimetry  
Estimation of essential climate variables
- Earth rotation and polar motion studies  
Study of time variable and static gravity field
- Simulation studies for future satellite gravity field missions  
Characterizing catchments with terrestrial gravimetry  
Geoid model development
- Establishment of horizontal, vertical, gravity, and tidal datum  
Crustal deformation and plate tectonic studies
- Cartography, map generalization
- Satellite Altimeter for marine geoid determination and sea level variation studies  
Geodetic techniques for earth surface deformation monitoring using InSAR and GNSS  
Map projection and coordinate transformation
- Positioning algorithms for GNSS, IRNSS satellite systems  
Realization of ITRF and ICRF using VLBI techniques  
development of low cost GNSS receivers
- Navigation in indoor and GNSS denied environments  
Multi sensor fusion for navigation and mapping  
Airborne/Terrestrial/Mobile LiDAR processing
- Deep Learning for LiDAR point cloud classification  
Land Consolidation and Cadastral mapping
- Application of high-resolution LiDAR data in solar energy, water harvesting, 3 D city modelling, flood modelling, forest inventory
- Space Geodetic Techniques (VLBI, SLR, GNSS)

# MAJOR FACILITIES

<p><b>Continuously Operating Reference Station</b> established adhering with the International GNSS Service (IGS) standards and guidelines. It consists of Trimble Alloy GNSS reference receiver. The station is first from India to be a part of the Asia-Pacific Reference Frame network. It has already been recommended to be included in the IGS stations list. This reference station tracks GPS, GLONASS, Galileo, BeiDou, QZSS, and NavIC (IRNSS) signals. The station provides continuous tracking and have data transmission facilities allowing for rapid (minimally: daily) data transmission to the data centers. The major aim of this station is to participate in the International Terrestrial Reference Frame realization.</p>	
<p><b>FARO FocusS 350/350 Plus</b> is specially designed for outdoor applications due to its small size, extra lightweight and extended scanning range. It provides scanning results even in challenging environments, narrow job-sites, dusty or humid areas, in rain or direct sunlight applications. An on-site compensation tool allows data quality optimization on-site. Integrated GPS &amp; GLONASS receiver enable easy positioning. HDR imaging and HD photo resolution ensure true-to-detail scan results with high data quality.</p>	
<p><b>V-Line 3D Terrestrial Laser Scanner RIEGL VZ-400</b> provides high-speed, non-contact data acquisition using a narrow infrared laser beam and a fast-scanning mechanism. This scanner provides scan data acquisition with 5 mm accuracy / 3 mm repeatability, a measurement range of up to 600 m, and an efficient measurement rate of up to 122,000 measurements/sec. It has a wide field of view of 100° vertical and 360° horizontal. A high-precision mount of the scanner also enables the integration of a DSLR camera. VZ-400 uses an invisible laser beam for eye safe operation in Laser Class 1.</p>	
<p><b>gPhone gravity meter</b> has a low drift so that it can be used to integrate periodic signals (like earth tides) for very long time periods (years). The gPhone gravity meter has a sophisticated data acquisition system synchronized by a rubidium clock that can be locked to GPS so that arrays of gPhones can be used to give a wider area picture of seismic or long period gravity changes due to subsurface density changes. This instrument can be monitored and controlled via the internet for remote operation.</p>	
<p><b>Trimble R10 GNSS system</b> for acquiring precise positioning. The system consists of Trimble 360 receiver that supports signals from all the existing GNSS constellations and augmentation systems. It provides improved interference protection to suppress a variety of intentional and unintentional sources of interferences and spoofing. The Trimble R10 GNSS system also includes HD-GNSS processing engine, Trimble SurePoint and xFill technologies along with Trimble CentrePoint RTX. These ensure precise positioning with full tilt compensation, RTL level precision worldwide without the need for a base station of VRS network and centimetre-level positioning during connection outages</p>	
<p><b>Automatic Weather Station (AWS) AWS810 and Met Sensor</b> enables modern, high-quality surface weather observation networks. It is a comprehensive measurement, communication, and data monitoring solution that makes modern observation networks easy to create, manage, and maintain over a long lifespan. With sensors, equipment, and analysis conveniently bundled. The AWS810 makes surface observation networks easy to create and manage.</p>	

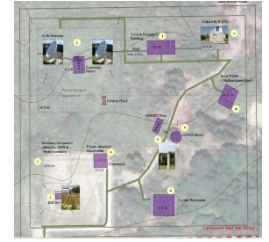
Additionally, a wide variety of electronic surveying instruments are available with NCG:

<p><b>Surveying Equipment</b></p> <ol style="list-style-type: none"> <li>1. Trimble M3/3600/S7/SX10 (Total Positioning System/Scanning TotalStation)</li> <li>2. Leica and Trimble Auto Levels/Digital levels</li> <li>3. Robotic Total Stations</li> <li>4. Auto Lock Total Stations</li> </ol>	<p><b>GNSS Receivers and Instruments</b></p> <ol style="list-style-type: none"> <li>1. Trimble Juno 3B/ TDC 600/R4/Geo 7X</li> <li>2. Geodetic Receiver and MetSensor</li> <li>3. Trimble GNSS Receiver with RTK Capability</li> </ol>
<p><b>Instruments for Imaging and Ranging</b></p> <ol style="list-style-type: none"> <li>1. 3D TLS VZ-2000i</li> <li>2. Terrestrial 3D Laser Scanner Optech</li> <li>3. Position and Orientation Systems</li> </ol>	<p><b>Gravimetry</b></p> <ol style="list-style-type: none"> <li>1. CG6 Autograve Gravimeter</li> <li>2. gPhone Mg LaCoste</li> </ol>

NCG has a large collection of Software used in geospatial technology such as ENVI, ERDAS Imagine, ArcGIS, GAMIT/GLOBK, BERNESE, Trimble Business Center, Leica Geo Office, GeoLab, SARscape, etc.

# GEODESY VILLAGE

In the process of setting up a Geodetic VLBI network in India for participation in the international campaigns, NCG has planned to establish a Geodesy village at IIT Kanpur. Geodesy village will be hosting different space geodetic infrastructure such as VLBI, GNSS, DORIS and SLR. Geodesy village will also house instruments (Gravimeters (Absolute & Relative), Automatic Weather Stations, Water Vapor Radiometers and weather, hydrological and seismic sensors).



## HUMAN RESOURCES

### **Dr. Onkar Dikshit**

PhD, University of Cambridge, UK, Professor, Dept. of Civil Engg. & Coordinator, NCG IIT Kanpur

*Research:* Remote Sensing Applications, Photogrammetry, SAR, GNSS and Digital Image Processing for Engineering Problems.

### **Maj. Gen. (Dr.) B. Nagarajan**

PhD, Ohio State University, USA, Visiting Professor, Dept. of Civil Engg. IIT Kanpur & Chairman, NGP

*Research:* Geodesy, Gravimetric Studies, Earth Rotation, Geoid Modelling, Topographical Surveying and Mapping, Satellite Altimetry.

### **Dr. Balaji Devaraju**

PhD Stuttgart University, Germany, Asst. Professor, Dept. Of Civil Engg. & Member, Coordination Committee, NCG IIT Kanpur

*Research:* Physical Geodesy, Future Satellite Gravity Missions, Geodetic Tools for Environmental Monitoring, Signal Processing on the Sphere.

### **Dr. Bharat Lohani**

PhD University of Reading, UK, Professor, Dept. of Civil Engg. IIT Kanpur

*Research:* 3D Laser Imaging, 3D Modelling, Terrestrial Laser Scanning, GIS, Applications using High Resolution LiDAR

### **Dr. Salil Goel**

PhD, University of Melbourne and IIT-Kanpur, Asst. Professor, Civil Engg. IIT Kanpur

*Research:* Unmanned Aerial Vehicles (UAVs), LiDAR, Photogrammetry, GNSS/INS Integration, Filtering and Estimation, Sensor Fusion

### **Dr. Ashutosh Tiwari**

PhD, IIT Kanpur, Research Establishment Office (REO), NCG, IIT Kanpur

*Research:* InSAR and applications, Geodetic surveying, Machine learning for remote sensing and geodesy, Surface deformation studies using multi-sensor fusion.

NCG also supports a large number of project staff, PG students (MTech/MS (R)/DIIT/PhD) and interns (both short and long term) working in geospatial technology/geodesy.

## CONTACT

<p>NCG Office PEB Building, Block B Near Flight Lab, IIT Kanpur Kanpur, 208016</p>		<p>0512-259-7723/2208/2209 ncc@iitk.ac.in <a href="https://www.iitk.ac.in/ncc/">https://www.iitk.ac.in/ncc/</a> <a href="https://www.iitk.ac.in/ce/">https://www.iitk.ac.in/ce/</a></p>
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