Office of International Relations
Indian Institute of Technology Kharagpur
Kharagpur – 721 302

Ref: 1867/2023/OIR

Date: 12.05.2023

Subj: Request from student for approval to join the Melbourne India Partnership Academy (MIPA) Joint Doctoral Degree Programme between IIT Kharagpur and University of Melbourne

Anita Gautam (21ID91R02), Ph.D student from Ranbir and Chitra Gupta School of Infrastructure Design & Management (RCGSIDM) had put forward an application in November, 2022 to join the MIPA Joint Doctoral Degree Programme.

While she had submitted the hard-copy application to Dean OR & AA on 10th Nov, 2022 (Flag -1), her application did not reach the Office of International Relations and consequently, the application could not be placed for final selection for the programme. However, the academic section issued issued an NoC based on the approval of DeanFoEA on 17.11.2022.

Since the regular process for selection has not been followed, the student was adviced by AdeanIR & R to re-submit the application with necessary details for recommendation.

The student has now re-submitted a written request, to allow her to join the MIPA Program along with all necessary documents. Her application includes the following documents:

1. Cover letter giving all details of the intended application. Along with student's details. This is to be signed by Faculty Mentor and Head/Concerned Dean.
2. Filled up Prerequisite Form
3. NoC from Faculty Mentor and Head/Concerned Dean
4. Letter to Faculty mentor Requesting permission to join the JDP, giving details of your intended research and activities. This letter will have to be signed by the applicant
5. Letter of Support from Faculty Mentor, routed through HoD/Concerned Dean
6. Letter of Support/or email and acceptance of Host Mentor expressing willingness to mentor the student
7. Student transcripts (downloaded from ERP and hard copy prints)
8. Letter from Fac. Mentor at IITKGP stating that all medium of instruction and examination is conducted in English. Therefore the English language requirement may be waived.
9. Filled up DSC recommendation form
10. Completion of Registration Seminar for specific cases.
11. Individual Graduate Record Agreement

The IITKGP JDP Evaluation Committee is requested to review this application and provide comments regarding approval or otherwise.

Sincerely,

12/05/2023.

Koushiki Mukherjee

(IR Executive)

Associate Dean IR& R

The student is eligible for admission to the JDP programme. The DSC members have no objections to her joining the programme.

15/5/23

Dean FoS

15.05.2023

Dean BTBS

15.05.2023

Dean FoEA

16/5/23

DeanOR &AA

16/5/23

Date: April 27, 2023

To,
Associate Dean (International Relations and Ranking)
Indian Institute of Technology, Kharagpur

RE: Joint Doctoral Program (MIPA)

Dear Sir,

I, Anita Gautam (21ID91R02), a Ph.D. student in the Ranbir and Chitra Gupta School of Infrastructure Design & Management (RCGSIDM) at IIT Kharagpur, intend to apply for the Joint Doctoral Program – at the University of Melbourne and Indian Institute of Technology Kharagpur that provides an opportunity for active research collaboration. It will provide me with an exclusive opportunity to work in both institutions on research jointly developed by both home and host supervisors and mentored by a joint advisory committee consisting of academics from the University of Melbourne and IIT Kharagpur during my candidature hence earning a dual degree accredited both in India and Australia.

Dr. Jagannath Aryal from the University of Melbourne encouraged me to apply for MIPA. Therefore, I am willing to undertake research at UoM as part of the requirements under the proposed host supervisor, if offered a place as a MIPA student.

Technical Details of the proposed joint research have been enclosed as a research proposal. This research will be helpful to examine the Spatio-temporal pattern of urbanization in India and its effects on the environment.

My current CGPA is 8.8 for all five subjects at IIT Kharagpur during the doctoral coursework, that satisfies the criteria of a minimum GPA of 8.5 for the Joint Dual Doctoral program. Earlier, my under graduation (B.Tech degree) was in Electronics & Communication, and Post Graduate (M.Tech) degree in Remote Sensing from Banasthali Vidyapith, Rajasthan being awarded a Gold Medal.

Therefore, I declare that I would abide by all relevant rules of IIT Kharagpur, the University of Melbourne, and the Joint Dual Degree Program.

Your Sincerely,

Anita Gautam
28/04/2023

Anita Gautam
Roll Number – 21ID91R02

Through

Prof. Bharath H. Aithal
Thesis Advisor (IIT Kharagpur)

Through,

for HM

Chairperson (RCGSIDM)

अध्यक्ष / Chair Person
प्रो. दिलीप कुमार बैद्य / Prof. Dilip Kumar Baidya
संरचना एवं प्रबंधन विद्यालय
Ranbir & Chitra Gupta School of
Infrastructure Design & Management
भा.प्रौ.सं. खड़गपुर / IIT Kharagpur

P.S.: List of documents attached:

a) Cover letter to Associate Dean - International Relations and Ranking
b) Application for Registration
c) Research Proposal
d) Statement of Purpose
e) Transcript(s): Doctoral Training, Post Graduate Degree, Undergraduate, XII, X
f) Degree Certificates
g) Request Letter for NOC from Associate Dean - International Relations and Ranking through Supervisor and Chairperson
h) Request to Joint Doctoral Program with Partner University through Supervisor
i) Letter of Recommendation – Both Supervisors
j) Copies of Doctoral Transcripts
k) Letter of Request for English Language Requirement
l) Certificate of English from academic
m) DSc approval form of Registration
n) Completion of the Registration form – IIT KGP
o) Graduate Researcher Agreement

November 10, 2022

Dean (Outreach and Alumni Affairs)
Indian Institute of Technology, Kharagpur

Subject: Request to join the MIPA Dual Doctoral Program

I am Anita Gautam (21ID91R02), a Ph.D. student enrolled in the Ranbir and Chitra Gupta School of Infrastructure Design & Management (RCGSIDM) at IIT Kharagpur, intend to apply for Joint Doctoral Program - University of Melbourne and IIT KGP that provides an opportunity for active research collaboration. It will provide me with an exclusive opportunity to work in both institutions on research jointly developed by both home and host supervisors and mentored by a joint advisory committee consisting of academics from the University of Melbourne and IIT Kharagpur during my candidature hence earning a dual degree accredited both in India and Australia.

Dr. Jagannath Aryal from the University of Melbourne has been taking the time to discuss the joint research proposal via videoconferencing and encouraged me to apply for MIPA. Therefore, I am willing to undertake research at UoM under the proposed host supervisors, if offered a place as a MIPA student.

Technical Details of proposed joint research have been enclosed as a research proposal. This research will be helpful to examine the Spatio-temporal pattern of urbanization in India and its effects on environment.

My current CGPA is 8.8 for all five subjects at IIT Kharagpur during the doctoral coursework which satisfies the criteria of a minimum GPA of 8.5 for the Joint Dual Doctoral program. Earlier, my under graduation (B.Tech degree) was in in Electronics & Communication and Post Graduate (M.Tech) degree in Remote sensing from the Banasthali Vidyapith, Rajasthan with being awarded a Gold Medal.

I, therefore, state that I am eligible for applying for the program and, if admitted, will abide by all relevant rules of IIT Kharagpur, the University of Melbourne, and the Joint Dual Degree Program.

Your Sincerely,

Anita Gautam
Roll Number – 21ID91R02

Anita Gautam.
12/11/2022.

Through,

Prof. Bharath H Aithal
Thesis Advisor (IIT Kharagpur)

Through,

Chairperson (RCGSIDM) 15/11/22

प्रो. दिलीप कुमार बैद्य / Prof Dilip Kumar Baidya
अध्यक्ष / Chair Person
[illegible]
Ranbir & Chitra Gupta School of
Infrastructure Design & Management
भा.प्रौ.सं. खड़गपुर / IIT Kharagpur

भारतीय प्रौद्योगिकी संस्थान खड़गपुर
शैक्षणिक (स्ना. अध्य. एवं शोध) अनुभाग
Indian Institute of Technology Kharagpur
Academic (PGS&R) Section

No. IIT/Acad(PGS&R)/F.II/2/21ID91R02
Date: 23.11.2022

The undersigned is to convey that on the recommendation of the Head of the School, the Dean (FoE&A) has permitted Ms. Anita Gautam (Roll No. 21ID91R02), a Research Student in Ranbir and Chitra Gupta School of Infrastructure Design and Management (RCGSIDM) to apply for Melbourne India Postgraduate Academy (MIPA) Dual Doctoral Degree Programme for which she will be visiting the University of Melbourne, Australia during the period from **December 01, 2022** under following conditions.

If selected, final no objection certificate will be issued to Ms. Anita Gautam and she will be guided by the following conditions:

1. The period of **her** stay in Australia will be treated as leave **without Institute Assistantship**.
2. On expiry of leave Ms. Anita Gautam has to rejoin the Centre and submit **her** joining report through proper channel.
3. There will be no financial involvement on the part of the Institute for **her** visit abroad.
4. The Institute has no objection if **she** applies for visa for the purpose.

उप कुलसचिव (शैक्षणिक) / Deputy Registrar (Academic)

To
Ms. Anita Gautam (Roll No. 21ID91R02)
Through: Head, Ranbir and Chitra Gupta School of Infrastructure Design and Management (RCGSIDM)

Copy to:

1. Head, Ranbir and Chitra Gupta School of Infrastructure Design and Management (RCGSIDM)
2. Personal file
3. Associate Dean (IR)

To

Dean FOE&A

Re: Application for MIPA Dual Doctoral Program

This is regarding my intended interest in applying for the Dual Doctoral degree offered by IIT Kharagpur and the University of Melbourne. As per the instructions, I would need a No objection approval for the application. Therefore, I have included the letter which requires your signature of approval.

Request your kind approval for the same

Thanking You,

Yours sincerely,
Anita Gautam
Anita Gautam
16/11/2022.

Through,
Prof. Bharath H. Aithal, 16/11/22
RCGSIDM, IIT Kharagpur

To: DR (Acad.)
NOC may be issued as per Rules.
17/11/22

Sh. Sujit pl.
18/11/2022

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Application for Registration to IITKGP-University of Melbourne Joint Doctoral Program

Instructions for filling this form:

- ✓ Please treat all fields as mandatory. Incomplete application will not be considered. In case any field is not applicable then please put 'NA'.

1. APPLICANT'S DETAILS: Please provide your name and date of birth as per your passport.

Name (as in ID card)	Anita Gautam
Date of Birth	16th October 1997
Place of Birth	Agra
Nationality	Indian
Photo ID Proof	Aadhar Card

2. Dept./School/Center Details:

D/S/C	Ranbir and Chitra Gupta School of Infrastructure Design and Management (RCGSIDM)
Applicant Roll No.	21ID91R02
No. of months spent in the Ph.D Programme at IITKGP	Fifteen Months
Name of PI	Dr. Bharath H. Aithal
Email ID of PI	bharath@infra.iitkgp.ac.in
Contact Number(s) of PI	+91-3222-214944

2. APPLICANT'S CONTACT DETAILS: Please provide your current email and phone details

IITKGP Email Address	gautama076@kgpian.iitkgp.ac.in
Alternate Email Address (if any)	gautama076@gmail.com
Contact Number (with country code)	+919599802129
Alternate Contact Number	+918861551265

Please provide your current mailing address:	
Country	India
Address Line 1	Sister Nivedita Hall of Residence (SNVH)
Address Line 2	Indian Institute of Technology
Address Line 3	
Suburb/Town	Kharagpur
State	West Bengal
Postcode	721302

3. ACADEMIC QUALIFICATIONS/ EDUCATIONAL DETAILS: Start with most recent. Please include any ongoing programme

Sl no	Name of the Degree/ Exam	School/ College/ University	Year of Completion n/expected	GPA (or equivalent)	Maximum GPA scale (or equivalent)	Major/ Specialisation/ subjects	Transcripts / Grade Card
1.	Ph.D.	IIT Kharagpur	2025	3.62	4.0	Infrastructure Design	Attached
2.	M.Tech	Banasthali Vidyapith	2020	8.53 CGPA	10	Remote Sensing	Attached
3.	B.Tech	Banasthali Vidyapith	2018	7.20 CGPA	10	Electronics & Communication	Attached
4.	10+2	Rajkamal kanya Inter College, Agra	2014	8.4 CGPA	10	PCM	Attached
5.	10	Rajkamal kanya Inter College, Agra	2012	8.55 CGPA	10	All subjects	Attached

4. ACADEMIC PUBLICATIONS: YOU MAY ADD MORE ROWS IF REQUIRED

Sl. No	Title of Conference Paper/ Journal Paper/ Book Chapter/ Book	Author(s)	Publication Details (Publisher, Volume no., Pages, Year)
1.	Flood Mapping Using Sentinel-1 SAR Images and Google Earth Engine: Case Study of Odisha State, India.	Jain, S., Gautam A., Chaudhary, A., Soni, C., & Sharma, C.	Publisher- Springer, Volume no- 1424, Pages – 10 (455- 464), year - 2022

7. ADDITIONAL DETAILS OF YOUR STUDY AT IIT KHARAGPUR:

Project Details	
Proposed Title	Urban land use land cover change modelling using multi-source remote sensing data fusion
Research Topic Description (Maximum 300 words)	Attached
Statement of Purpose (Maximum 750 words)	Attached

8. Have you identified a potential mentor/supervisor at the Partner Institute?

YES ✔ **NO** _____

If you have answered YES to the Q# 8 above please provide details

University of Melbourne …	

Principal Supervisor	Dr. Jagannath Aryal
Contact information	jagannath.aryal@unimelb.edu.au, 06, 6310, Melbourne Connect -700 Swanston St, Parkville

9. Please provide names and contact of 2 referees:

1.	Dr. Bharath H. Aithal Ranbir and Chitra Gupta School of Infrastructure Design and Management, IIT Kharagpur, 721302, India Phone: +91-3222-284944 Email: bharath@infra.iitkgp.ac.in
2.	Prof. P.K Joshi School of Environmental Sciences Jawaharlal Nehru University (JNU), New Delhi. Phone: 011-26704323 Email: pkjoshi27@hotmail.com/ pkjoshi@mail.jnu.ac.in

DECLARATION

All Information shared by me is complete and correct to the best of my intention. I understand that falsifying any information may result in my application for registration to the JDP being cancelled.

Anita Gautam

.....Anita Gautam. 12/11/2022.

Student Name and signature

Urban land use land cover change modelling using multi-source remote sensing data fusion

Doctoral Research Proposal

Anita Gautam

(21ID91R01)

Ranbir and Chitra Gupta School of infrastructure design and Management

Indian Institute of Technology Kharagpur

1. Introduction

Due to the tremendous expansion in the global population and the irreversible influx of people from rural to urban regions, cities all over the world are experiencing enormous growth now. Rapid urbanization will be one of the most significant challenges to human well-being and the global environment in the future decades. The worldwide population is expected to rise by approximately 8.5 billion in 2030, 9.7 billion in 2050, and 10.9 billion in 2100 as shown in a United Nations assessment in 2019 (Chatterjee & Majumdar, 2022). Urbanization leads to the expansion of an urban region and is a multi-faceted phenomenon that involves socioeconomic development, related land use, land cover variations, population trends, and environmental responsibilities (Seto et al., 2011, Zhang et al., 2020,).

Urbanization has a variety of environmental consequences, including the fragmentation of natural regions, changes in biodiversity and ecosystems, changes in air and water quality, and depletion of natural resources. It is one of the most major and irreversible land use and land cover changes occurring at an alarming rate throughout the planet. (Sharma & Joshi, 2013). If not managed effectively, this rapid urban population growth could result in major socio-economic imbalances that are difficult to address. On the other hand, well-planned and managed urbanization boosts a country's economy and gives inhabitants increased work opportunities, education, and medicine (Pathiranage et al., 2018).

Since the 1990s, India, the world's second-most populated nation, has experienced a high level of urbanization. The development action plans for urban centers in India are mostly motivated by economic prospects (Basu & Das, 2021). According to the 1901 census, the urban population was 11.4%, but by 2011 it had expanded to 31.2%. Mumbai is expected to have a population of 25 million by the end of 2015, Hyderabad, Chennai, and Bengaluru each have a population of 10 million, Kolkata (16 million), and Delhi (16 million). By 2030, 40.8% of India's population will have moved to the city (Lahariya, 2008, Franco et al., 2017).

One issue that has significantly influenced urbanization is that of Land cover change. Changes in city land cover characteristics cause suburban areas' development (Rana & Sarkar, 2021). Rapid urbanization and land use land cover transformations will continue to occur across space and time, although it is also vital to safeguard land resources by using crucial strategies and spatial information (Das & Angadi, 2021). Monitoring the current and future urban LULC variability is extremely significant because planners can design sustainable land and environmental development policies (Yin et al., 2011). Data from a variety of satellite missions including Landsat, Cartosat, Sentinel, and many more, are utilized to detect the unplanned growth of urban areas. With high or moderate-resolution optical sensors, it is difficult to create multi-temporal LULC maps of regions with frequent weather conditions and shadows cast by high buildings (Venkatachalaperumal et al., 2016; Kalura et al., 2021). To address these challenges, synthetic

aperture radar-based microwave remote sensing can play important role in the mapping of urban growth. (Kalura et al., 2021; Parida and Mandal, 2020). Data collected using a microwave sensor makes use of the texture and structure of items as well as their dielectric properties, while data received using an optical sensor makes use of the structural, biological, and chemical qualities of objects (Pereira et al., 2018). Researchers have discovered that the combination of optical and radar imaging has been demonstrated to be useful in identifying building density (Dell'Acqua & Gamba, 2003), differentiating between formal & informal settlements, and accurately detecting towns and cities.

1.1 Need and Motivation

Urbanization is still facing some difficulties in developing nations, such as urban growth at the edges of cities, an increase in population, migration, and changes in natural ecosystems (Campbell and Corvalan, 2007). The government and planning agencies are often not able to comprehend the growth of urban areas, making it necessary to recognize patterns of urban growth to put mitigation actions in place. It has been observed in Indian cities that urban management systems have been extremely influenced by economic reform and rapid industrialization with many urban policy measures including JNNURM (2005), AMRUT (2015), PMAY (2015), Smart city mission (2015), and other proposals for urban development, that have had a substantial effect on spatial changes in the metropolitan areas and have contributed to polarized growth within cities (Shaw & Das, 2018). Decisions made will be made easier with timely and reliable information about the changing land cover of growing cities. Policymakers, managers of resources, and scientists are concerned about this. Furthermore, the information provided can be used by the United Nations to develop Sustainable Development Goals (SDGs) that are specifically aimed at developing countries. It is the goal of SDG Goal 11 to make cities safer, more resilient, and sustainable, to achieve this, a comprehensive understanding of growth rates and expansion patterns is required (Shrestha et al., 2021).

Researchers have consistently used different sensor data to identify, connect, quantify, validate, and predict the negative consequences of urban growth on the environment. As a result, they have been able to provide real-time solutions to the challenges that rising megacities face. In this context, by combining data from multiple sensor sources, modeling of land-use change can be used to examine the spatiotemporal patterns of urbanization in India and its effects on nearby environments.

2. Literature Review

This section provides a brief explanation of the literature review on urbanization, land use and land cover, and the fusion of optical and microwave data used in urban studies in India and around the world.

2.1 Urbanization

Urbanization refers to the development of an urban area in response to a broad range of economic, political forces, and social as well as to the geographic location of the community. It also stimulates

the development of recreational areas, residential areas, infrastructure, and other public facilities for agriculture in the vicinity of the city (Yousafzai et al., 2022). Around half of the world's population currently lives in cities (Grimm et al., 2008). As the population of cities grows, urbanization affects the periphery in particular, which extends further into towns and rural areas (Heider et al., 2018).

According to numerous studies, there is a strong correlation between the urbanization and economic outcomes of a region, which determines the economy and basic needs of a city. However, if urbanization exceeds the maximum capacity of an area without being planned for basic amenities and natural balance, this can have detrimental effects on both people and the environment (Chen et al., 2014; Dociu, 2012).

When urbanization occurs unplanned, it leads to uncontrolled growth of urban areas, resulting in a decline in landscapes including water bodies, deserted areas, and vegetation that are uninhabited (Aithal et al., 2017). Rapid industrialization and urban land expansion (Huang & Zhang, 2022) are projected to have detrimental effects on land use land cover, leading to expansion of the city limits and the formation of huge urban centers (Vinayak et al., 2022).

2.2 Land use/Land cover (LULC)

In past few centuries, the growth of human population and consequent sustainable growth have altered the land cover of the earth. Land cover can be described as the biophysical properties of the earth's surface such as water, forest, soil, vegetation, buildings and other physical features of the earth (Zurqani et al., 2022), that can be directly visualized from the space-based sensors (Lillesand et al., 2015). In terms of land use, this refers to the way in which land is utilized by human and their surroundings, usually with a focus on its function as a natural resource for environmental purposes (Regasa et al., 2021).

In response to rapid urbanization, natural grounds, marshes and farm areas are turned into building constructions (Yu et al., 2011), which indicates the importance of monitoring land use land cover changes for local and regional city planning studies (Mundhe et al., 2014). It has taken several centuries for these LULC changes to occur because of the pressures of the increased migration, expanding population and the socio-economic activities (Nimish et al., 2018).

As previous studies revealed that urban areas contain a wide variety of land cover types, pattern of urban features, shape, making them a very complex landscape. Obtaining accurate, current information about urban land cover is a difficult undertaking, but on that is vital to urban planning, policymaking and environment protection. In recent years, remote sensing technology has enabled land use land cover change to obtain richer data (Ban et al., 2014). By combining optical and radar data, we are able to obtain additional ground object information, thereby enhancing the land use land cover (Wu et al., 2022).

2.3 Fusion of microwave and optical data

Image fusion strategy analyzes the data from multiple sensors to obtain a more accurate detection and identification results which is not possible with a single sensor. It is also used for improving

various image processing steps such as geo-registration, detecting classes and objects, sharpening, segmenting and detecting image changes (Singh & Tiwari, 2021; Vohra & Tiwari, 2018). Sensors that are passive provide information on the emissive and reflective qualities of the surface objects, while sensors that are active provide information about the dielectric properties of objects, smoothness and texture (Jellouli et al., 2021). Imagery captured with optical cameras is often affected by nighttime illumination and adverse weather conditions. As opposed to SAR images, which are insensitive to spectral response, it is more difficult to process the information and interpret the outputs. Moreover, the interpretability of SAR images is further undermined by speckle noise (Singh & Tiwari, 2021). Data integration from these two sources will be beneficial to improvingthe classification of land cover in the future. Table 3 gives a summary of various studies related to the classification of land use and cover for rapid urbanisation using the fusion of microwave and optical data.

Table 3. Literature reviews highlight different adopted methods and their respective outcomes.

Author	Inferences
T. Zhang & Huang, 2018	An analysis of urban impervious surface mapping in rapidly urbanized areas indicated that there is a tendency to decrease, indicating that the approach to urban development has been adjusted and provides insight into the patterns of development of urban areas during their urbanization process
Feng et al., 2019	With the modified two-branch network, hyperspectral data and LiDAR data can be combined effectively, showing increased the accuracy over traditional methods for urban land-use mapping.
Iannelli & Gamba, 2019	An innovative procedure for the joint use of S1 and S2 data for the mapping of urban extents. This method combines the strengths of both sensors and produces consistently good results without knowing which data source should be used directly.
Wang, Yan & Su, 2020	An analysis of urban growth patterns in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) of China from 1980 to 2018 shows that the urban area has grown from 2607.4 km2 to 8243.5 km2 between 1980 and 2018.
Li et al., 2020, Ling et al., 2021	A study was conducted on urban mapping using SAR data and a robust extractor was developed to work with multi-scale building areas. It was found that the extractor performed well for multi-scale building areas with higher overall accuracy.
Li et al., 2020	A new automated method for identifying urban constructed areas has revealed finer and more accurate extraction of urban built-up that other traditional methods and is also useful for future urban planning and program development.
Zhai et. al., 2021	For the annual growth rate analysis, we developed two spatial heterogeneity layers, built three CA models (AGR-CA, AGRHST-CA,

	and AGRGDT-CA), and found that AGR-CA achieved the best accuracy in terms of landscape pattern.
Dey et al., 2021	Two new indices were developed to extract built-up areas from full and dual polarimetric SAR data, which showed that full classification accuracy is greater than dual polarized, due to higher polarimetric information in full data.
Feng et al., 2021	Based on the spatial autoregressive model (SAR), three cellular automata (CA) models were constructed, and the results demonstrate that neighborhood size has a significant impact on the proposed models' performance; however, the proximity between the simulated patterns and the actual patterns has a minor effect.
Huang et. al., 2021	A new model, which integrates artificial fish swarm algorithms (AFSA) and the CA method, for optimizing variables in the urban growth model shows that AFSA is optimal for solving nonlinear optimization problems since an initial parameter setting does not affect AFSA parameter optimization.
Purswani et. al., 2021	Geospatial methodologies have been used to analyze the land change pattern with pixel-by-pixel transition to predict the future. There was an insight into the spatial and quantitative results of amount and location changes with pixel-by-pixel transition.
Wang et al., 2022	Utilizing bivariate Moran's, I and GWR models, we examined the spatially varying relationships between land subsidence and urbanization in Wuhan, indicated that there was a significant and uneven distribution of land subsidence across the territory.
Kumar et al., 2022	The use of Sentinel-1 SAR data to assess the extent of urban damage and surface deformation in the Kathmandu city region revealed that the built-up areas in the south-eastern and north-western districts were severely damaged because of high population density and dense built-up areas.
Kumari et al., 2022	Study of the SAR-based spatial heterogeneity and footprint study of the Hyderabad metropolitan area, which showed that the southern parts have very high densities, while the northern parts have low densities.

Natural grounds, marshes and farm fields are changing due to urbanization, making accurate monitoring and mapping of urban growth and its effects essential for sustainable development. The management of natural resources and the monitoring of the environment both heavily rely on information about land cover. Due to the quick changes in land cover caused by a combination of human activity and natural processes, precise land cover classification is still difficult to achieve today. Information about earth features can be obtained from multi-sensors data and improved through data fusion. Several studies have shown that each method is useful, but data fusion can combine the complementary information found in various types of data, making it easier to distinguish between different land cover classes. Microwave and optical sensors used in geospatial

approaches with autonomous algorithms effectively demonstrate greater accuracy over conventional methods for mapping urban expansion. To develop algorithms and understand the pattern of urbanization, researchers can greatly benefit from geospatial modeling with the fusion of multiple sensors.

3. Broad Aim and Objectives

The main aim of the research is understanding the land-use change modelling through amalgamation of various sensor data sources and ancillary data inputs, this includes: -

- Task 1: Analysis of Multi-Sensor data extraction of temporal urban growth and its comparison.
- Task 2: Developing data fusion methods for better segmentation of multi sensors data into different land use classes.
- Task 3: Comparison of improvement with and without ancillary data sources for better pattern analysis
- Task 4: Develop land use change modelling algorithms based on Knowledge-based systems through developed fused datasets.

4. Expected outcomes

- The proposed research will examine urban dynamics using multi source dataset to establish the understanding of data as a factor of better accuracy
- Research will analyse spatio-temporal urban form through data sources and including the ancillary dataset as it has been shown in various publications that with introduction of ancillary dataset the accuracy can be improved. This research also proposes to test the different ancillary data
- The Research specifically aims to publish research outcome in the leading scientific journal(s) modelling of future growth, specific required immediate policy interventions apart from communicating to the decision makers (through conference publications and workshops).
- Recommendations towards sustainable planning, that are the need of the hour would help to shape the smart cities in India with sustainable development policies, through meetings with stakeholders of these urban regions majorly through scientific publications, academic network and regions specific players of development including the government organizations.

5. Timeline of Research

ACTIVITY	STATUS	ACTIVITY DURATION (In months)																								
		1st Year (Aug 21 – July 22)				2nd Year (Aug 22 – July 23)				3rd Year (Aug 23– July 24)				4th Year (Aug 24– July 25)												
		3	6	9	12	15	18	21	24	27	30	33	36	40	44	48	52									
Course Work	Completed																									
Background Study	Ongoing																									
Problem Understanding	Ongoing																									
Literature Review	Ongoing																									
Detailed Research Method Registration	Ongoing																									
Imagery Selection	Yet to Begin																									
Task 1	Yet to Begin																									
Training Models	Yet to Begin																									
Task 2 -UOM	Yet to Begin																									
Task 3 -UOM	Yet to Begin																									
Task 4	Yet to Begin																									
Thesis/Research Papers	Yet to Begin																									

Journal Research paper 1

Conference paper 1

Research paper 2

Conference paper 2

Research paper 3

6. Biblography

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Statement of Purpose

My name is Anita Gautam, a doctoral research scholar at the Indian Institute of Technology, Kharagpur. Earlier, I have a postgraduate degree (Master of Technology (M.Tech)) in Remote sensing from Banasthali Vidyapith, Rajasthan in the year of 2020 with my bachelor's degree in Electronics & Communication in the year of 2018 from the same institution. I am pursuing my doctoral degree in the domain of Landscape modelling under the supervision of Dr. Bharath H. Aithal, Ranbir and Chitra Gupta School of Infrastructure Design and Management, IIT Kharagpur, West Bengal. University of Melbourne and Infrastructure Engineering departments have expertise in my area of research, especially the computing part of my research. This is essential to present the research suitably with a focus on current state of art computing and technological perspective. This collaboration would help to improve my research project and provides me with an opportunity to work and interact with experts in my research area with varied perspective through this Dual Degree program. This would significantly help me to develop my expertise and boost the quality of my research for contributing to sustainable development policies.

As a holder of a master's degree in Remote Sensing and GIS, I have experience in satellite data processing and applications of geospatial tools for solving real-world problems. I am proficient in programming and worked on geoinformatics and remote sensing projects. The coursework in my doctoral training program gave me experience in handling earth observatory data, statistical analysis in the multivariate domain, knowledge-based algorithms to reach out the global solutions as well as deep neural network concepts and paradigms. Also, I am confident enough to handle doctoral research and meet all the deadlines related to my research work within a given period with my utmost efforts and knowledge. My research theme and its requirements have driven me to look at the JDP program and I believe is in perfect harmony with my long-term aims and objectives.

Anita Gautam

Anita Gautam.

12/11/2022.

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

STATEMENTS OF GRADE OBTAINED (INTERIM)
IN THE RECOMMENDED COURSEWORK FOR THE RESEARCH PROGRAMME
LEADING TO THE DEGREE OF DOCTOR OF PHILOSOPHY

Date: 13-10-2022

Roll no: 21ID91R02
Name: Anita Gautam
Department: RANBIR & CHITRA GUPTA SCHOOL OF INFRASTRUCTURE DESIGN & MANAGEMENT
Date of Joining: 02-08-2021

Session	Semester	Subject No.	Subject Title	LTP	Credit	Grade
2021-2022	SPRING	AI61002	DEEP LEARNING FOUNDATIONS AND APPLICATIONS	3-1-0	4	A
2021-2022	SPRING	HS63002	ENGLISH FOR TECHNICAL WRITING	2-2-0	4	A
2021-2022	AUTUMN	ID61002	REMOTE SENSING, GIS AND IMAGE PROCESSING IN URBAN INFRASTRUCTURE MANAGEMENT	3-1-0	4	A
2021-2022	AUTUMN	IM60061	APPLIED MULTIVARIATE STATISTICAL MODELLING - I	4-0-0	4	B
2021-2022	AUTUMN	ME60353	KNOWLEDGE BASED SYSTEMS IN ENGINEERING	4-0-0	4	A

N.B.: Not yet completed all requirements for the award of the Ph.D. degree

Date of Issue: 13/10/2022 Checked by Superintendent (PGS & R) Deputy Registrar (Academic)/ Assistant Registrar (PGS&R)

Deputy Registrar (Academic)
IIT Kharagpur

1. The abbreviation L-T-P stands for weekly contact hours for a subject in respect of Lecture, Tutorial and Practical

2. English is the medium of instruction at all levels

3. No rank or class or division is awarded. No system exists for conversion of letter grades into percentage or marks.

4. The following 7 point letter grade system is used by the Institute to assess a student's performance in a subject

Description	Letter Grade	Grade point per credit
Excellent	EX	10
Very Good	A	9
Good	B	8
Fair	C	7
Average	D	6
Pass	P	5
Fail	F	0

5. Candidates assigned course work must obtain a grade not lower than 'C' in each of the subjects.

Anita Gautam.
12/11/2022.

DI No.-19MTR401002

BANASTHALI VIDYAPITH

Master of Technology (Remote Sensing)

Fourth Semester Examination, May 2020

Statement of Grades

Student's Name : ANITA GAUTAM **Roll Number : 1856132**

Father's Name : PRAMOD GAUTAM **Enrollment No. : 2014/2831**

Mother's Name : MANJU GAUTAM

Course Code	Particulars of Subjects / Courses	Credit Points	Grade Obtained	Remarks
Reading Elective(s)				
RS 608R	Spatial Modeling and Resource Model	2	A+	
Project				
RS 604P	Project (Part - II)	24	O	
	------ End of Courses ------			
	Total	**26**		**SGPA: 9.92**

Details of SGPA/CGPA(Credits) Scored in Semester's:

Semester	I	II	III	IV	CGPA up to IV Sem.	Secure Result
SGPA (Credit Points)	8.38(26)	7.81(26)	8.00(26)	9.92(26)	8.53(104)	**8.53/10 Distinction**

SGPA: Semester Grade Point Average, CGPA: Cumulative Grade Point Average, IMP: Improvement, **Due: Short Attendance,
GA : Grade Awaited, I: Incomplete Course, W: Course Withdrawn, SGPA and CGPA are on scale of 10,
NC: Not Cleared. Due: Required to Repeat

Anita Gautam, 12/11/2020

Result Declared on : 25-06-2020

Banasthali Vidyapith

Prepared by: Checked by:

OFFICIATING SECRETARY
BANASTHALI VIDYAPITH

DI No.-17BTE801012

BANASTHALI VIDYAPITH

Copy of Marks obtained
at the
Bachelor of Technology (Electronics and Communication)
Eighth Semester Examination May-2018

Student Name : ANITA GAUTAM
Roll Number : 10102
Father's Name : PRAMOD GAUTAM
Enrollment No. : 2014/2831
Mother's Name : MANJU GAUTAM

Particulars of Subject & Papers	Maximum Marks	Minimum Marks	Obtained Marks	Remarks
Electronics & Communication				
EC-8.1 Fiber Optics & Communication	60	22	50	
EC-8.1 Lab:Fiber Optics & Communication	15	5	11	
EC-8.2 VLSI Design	60	22	41	
EC-8.2 Lab:VLSI Design	15	5	14	
EC-8.3 Antenna & Radar	60	22	50	
Departmental Electives				
DE-8 Mobile Communication	60	22	51	
DE-9 Geoinformatics	60	22	42	
Total Marks	**330**	**119**	**259**	**Pass/ 78.48%**

Activities offered under Five Fold Education (Point Scale - **A** : Excellent **B** : Good **C** : Satisfactory)

Activities - Grade	1. Not Applicable	2. Not Applicable	3. Not Applicable

Details of Semester wise Total Marks Obtained (Obtained Marks/Maximum Marks)

Sem - I	Sem - II	Sem - III	Sem - IV	Sem - V	Sem - VI	Sem - VII	Sem - VIII	Grand Total	Result / %age
272 / 405	275 / 405	290 / 435	279 / 435	362 / 480	407 / 510	256 / 330	259 / 330	**2400 / 3330**	I Div. / 72.07

DUE - Eligible to Reappear **DUE - Short attendance AB - Absent
I - Improvement of performance. The candidate reappearing in the paper(s) in the year given in bracket and marks shown are those obtained on reappearance.

Anita Gautam.
12/11/2022.

Result Declared on : 25-06-2018
Banasthali Vidyapith

Prepared by: SAli Checked by: Pandeep

OFFG. SECRETARY
BANASTHALI VIDYAPITH

01/01021382

क्रमांक (Sr. No.)
0377382

माध्यमिक शिक्षा परिषद, उत्तर प्रदेश

Board of High School and Intermediate Education U.P.

इण्टरमीडिएट परीक्षा - २०१४
Intermediate Examination - 2014
प्रमाणपत्र-सह-अंकपत्र (CERTIFICATE-CUM-MARKS SHEET)

अनुक्रमांक Roll No.	जनपद/केन्द्र/विद्यालय कोड Distt./Centre/School Code	संस्थागत/व्यक्तिगत Regular / Private	परीक्षा प्रवर्ग Exam. Type	विषय-वर्ग Subject-Group	प्रमाणपत्र क्रमांक Certificate No.
0023213	01/00112/1185	REGULAR	FULL EXAM	SCIENCE	I1021525

प्रमाणित किया जाता है कि (This is to certify that)

परिषद के अभिलेखानुसार (according to the Board's record)- KM. ANITA GAUTAM

आत्मज/आत्मजा श्रीमती (son/daughter of Mrs)- MANJU GAUTAM

एवं श्री (and Mr.)- PRAMOD GAUTAM

ने मार्च अप्रैल 2014 की इण्टरमीडिएट परीक्षा विद्यालय/केन्द्र (has passed Intermediate Examination held in March/April 2014 from School/Centre)- RAJKAMAL KANYA INT COLL KEDAR NAGAR AGRA

में श्रेणी (with division) FIRST HONOURS

उत्तीर्ण विषयों द्वारा उत्तीर्ण विषयों के प्राप्तांक निम्नवत हैं (Marks obtained by the candidate in passed subjects are as under)-

विषय Subject	अधिकतम अंक Max. Marks	प्रश्नपत्रवार प्राप्तांक Paper-wise Obtained Marks			योग Total	सम्पूर्ण योग एवं परीक्षाफल Grand Total & Result
GENERAL HINDI	100	1/38	2/37		075D	420/500
ENGLISH	100	1/43	2/36		079D	PASSED
PHYSICS	100	1/33	2/32	T/65 P/30	095D	
CHEMISTRY	100	1/29	2/27	T/56 P/30	086D	
MATHEMATICS	100	1/45	2/40		085D	
SPORT & PHY EDU	100			T/40 P/45	085	

Note - Marks of Sports and Physical Education will have no effect on overall Result.

'D' indicates Distinction in that particular subject,
'HONOURS' indicates candidate "passed with honour"
Note : For Important Instructions see overleaf

Anita Gautam.
12/11/2021.

तिथि (Date)- 25/05/2014
स्थान (Place)- Allahabad, Uttar Pradesh

(शकुन्तला देवी यादव)
(Shakuntala Devi Yadav)
सचिव (Secretary)

क्रमांक (Sr. No.)

0742865
01/1185/021131

माध्यमिक शिक्षा परिषद्, उत्तर प्रदेश

Board of High School and Intermediate Education U.P.

हाईस्कूल परीक्षा-२०१२

High School Examination-2012

प्रमाणपत्र-सह-अंकपत्र (CERTIFICATE-CUM-MARKS SHEET)

अनुक्रमांक Roll No.	जनपद/केन्द्र/विद्यालय कोड Distt./Centre/School Code	संस्थागत/व्यक्तिगत Regular / Private	परीक्षा प्रकार Exam. Type	प्रमाणपत्र क्रमांक Certificate No.
0023880	01/12118/1185	REGULAR	FULL EXAM	0121088

प्रमाणित किया जाता है कि (This is to certify that)

परिषद् के अभिलेखानुसार (according to the Board's record)- KM ANITA GAUTAM

आत्मज/आत्मजा श्रीमती (son/daughter of Mrs.)- MANJU GAUTAM

एवं श्री (and Mr.)- PRAMOD GAUTAM

जिनकी जन्मतिथि (whose date of birth is)-

16TH OCTOBER NINETEEN HUNDRED NINETY SEVEN (16/10/1997)

ने मार्च/अप्रैल 2012 की हाईस्कूल परीक्षा विद्यालय/केन्द्र (has passed High School Examination held in March/April 2012 from School/Centre)- RAJ KAMAL KANYA INT COLL K NAGAR AGRA

से निम्न विवरणानुसार उत्तीर्ण की है (with the following details):-

विषय Subject	अधिकतम अंक Max. Marks	प्राप्तांक Obtained Marks सैद्धान्तिक (Theory)	प्रयोगात्मक (Practical)	योग Total	ग्रेड Grade	परीक्षाफल Result
HINDI	100	61	29	090	A2	
ENGLISH	100	55	29	084	A2	
MATHEMATICS	100	55	28	083	A2	PASSED
SCIENCE	100	55	28	083	A2	
SOCIAL SCIENCE	100	55	28	083	A2	
DRAWING	100	62	28	090	A2	

No divisions are awarded

Category of Moral, Sports and Physical Education- A

तिथि (Date)- 8TH JUNE,2012

स्थान (Place)- Allahabad, Uttar Pradesh

Anita Gautam.
12/1/2022.

(वासुदेव यादव)
(Basudeo Yadav)
सचिव (Secretary)

Note : For Important Instructions see overleaf

Enrolment No.
2014/2831

वनस्थली विद्यापीठ

अनीता गौतम

को इस विद्यापीठ की 2020 मे आयोजित परीक्षा

डिस्टिंक्शन श्रेणी मे उत्तीर्ण करने पर

मास्टर ऑफ़ टेक्नोलॉजी

(रिमोट सेंसिंग)

की उपाधि प्रदान की गई ।
प्रमाण स्वरूप विद्यापीठ की मुद्रा एवं कुलपति के हस्ताक्षर
अंकित किये जाते है ।

BANASTHALI VIDYAPITH

Anita Gautam

has been awarded the degree of

MASTER OF TECHNOLOGY

(REMOTE SENSING)

of the Vidyapith having passed the Examination of 2020
in the *Distinction* Division.
In token whereof are inscribed the seal of the Vidyapith
and the signature of the Vice-Chancellor.

वनस्थली विद्यापीठ 19 35 सा विद्या या विमुक्तये

तारीख
Date 18 April, 2021

कुलपति
Vice-Chancellor

Enrolment No. 2014/2831 Roll No. 1856132

वनस्थली विद्यापीठ

वरीयता एवं स्वर्ण पदक प्रमाण-पत्र

प्रमाणित किया जाता है कि अनीता गौतम

आत्मजा श्री प्रमोद गौतम

एवं श्रीमती मन्जू गौतम

वनस्थली विद्यापीठ द्वारा आयोजित मास्टर ऑफ् टेक्नोलॉजी (रिमोट सेंसिंग)

परीक्षा, 2020 में सम्मिलित हुई और वरीयता सूची में प्रथम स्थान प्राप्त करने पर स्वर्ण पदक प्राप्त किया।

BANASTHALI VIDYAPITH

MERIT - CUM - GOLD MEDAL CERTIFICATE

Certified that *Anita Gautam*

Daughter of Shri *Pramod Gautam*

and Smt. *Manju Gautam*

who appeared at the *Master of Technology (Remote Sensing)*

Examination conducted by the Vidyapith in **2020** ***stood First in order of merit at the said examination and secured GOLD MEDAL.***

वनस्थली विद्यापीठ 19 35 सा विद्या या विमुक्तये

दिनांक
Dated 18 April, 2021

मंत्री
Secretary

Enrolment No.
2014/2831

वनस्थली विद्यापीठ

अनीता गौतम

को इस विद्यापीठ की **2018** में आयोजित परीक्षा

प्रथम श्रेणी में उत्तीर्ण करने पर

बैचलर ऑफ् टेक्नोलॉजी

(इलेक्ट्रोनिक्स एण्ड कॅम्यूनिकेशॅन)

की उपाधि प्रदान की गई ।
प्रमाण स्वरूप विद्यापीठ की मुद्रा एवं कुलपति के हस्ताक्षर
अंकित किये जाते हैं ।

BANASTHALI VIDYAPITH

Anita Gautam

has been awarded the degree of

BACHELOR OF TECHNOLOGY

(ELECTRONICS AND COMMUNICATION)

of the Vidyapith having passed the Examination of **2018**
in the *First* Division.
In token whereof are inscribed the seal of the Vidyapith
and the signature of the Vice-Chancellor.

वनस्थली विद्यापीठ 19 35 सा विद्या या विमुक्तये

तारीख
Date 5 October, 2018

कुलपति
Vice-Chancellor

To,

Associate Dean International Relations & Ranking

Indian Institute of Technology, Kharagpur

Subject: No objection Certificate to apply for MIPA, DDP IIT Kharagpur and University of Melbourne (Australia).

Dear Sir,

Ms. **Anita Gautam, 21ID91R02** is looking forward to applying for the Joint Doctoral Program at with University of **Melbourne (Australia).** She is presently enrolled in the Ph.D. program at the Ranbir and Chitra Gupta School of Infrastructure Design and Management at IIT Kharagpur.

Through this letter, I have already received consent from Dr. Bharath H. Aithal (my supervisor at IIT Kharagpur) and Dr. Jagannath Aryal from the University of Melbourne for supporting my MIPA application.

Further, it may be noted that the Ranbir and Chitra Gupta School of Infrastructure Design and Management has No objection regarding the application form.

Sincerely

Name of Mentor

Dr. Bharath H. Aithal

Through:

HoD/HoS/HoC

प्रो. दिलीप कुमार बैद्य / Prof Dilip Kumar Baidya
अध्यक्ष / Chair Person
Ranbir and Chitra Gupta School of Infrastructure Design and Management
भा.प्रौ.सं. खड़गपुर / IIT Kharagpur

15/11/2

Through:

Dean of FoEA

Indian Institute of Technology Kharagpur

Request to Joint Doctoral Program with Partner University (University of Melbourne)

From:

Anita Gautam
Research Scholar
Ranbir and Chitra Gupta School of Infrastructure Design & Management
Indian Institute of Technology, Kharagpur

To: Approved BA Aithal

Dr. Bharath H. Aithal
Assistant Professor
Ranbir and Chitra Gupta School of Infrastructure Design and Management
Indian Institute of Technology (IIT), Kharagpur

Subject: Request to join the Joint Doctoral Program at the University of Melbourne

Dear Sir,

I, **Anita Gautam, Roll #21ID91R02**, Research Scholar at the Ranbir and Chitra Gupta School of Infrastructure Design and Management, IIT Kharagpur, am presently working under the supervision of **Dr. Bharath H. Aithal** in the area of **Landscape Modelling.** I am interested in applying for the Joint Doctoral Program between IITKGP and the University of Melbourne. If selected, I hope to work in the area of **Urban land use land cover change modelling using multisource remote sensing data fusion.**

My Mentor at the host University will be **Dr. Jagannath Aryal,** who has agreed to guide me. The duration of the studies will be 04 years, out of which 1.5 year(s) would be spent at the Host Institute. I expect to complete data fusion and land use modelling areas of my research during my stay at the University of Melbourne

Please find enclosed the supporting documents required for the application to the Joint Doctoral Program. I request your kind approval for joining the program.

Best Wishes

ANITA GAUTAM
Anita Gautam.
12/11/2022.

Ranbir and Chitra Gupta School of Infrastructure
Design and Management (RCG SIDM)
Indian Institute of Technology Kharagpur
Kharagpur, West Bengal 721302
E-Mail: bharath@infra.iitkgp.ac.in

Bharath H Aithal **November 15, 2022**

Letter of Recommendation

To Whom It May Concern:

I am pleased to recommend Ms. Anita Gautam for the MIPA joint PhD program. I have observed that she is extremely talented, knowledgeable, and demonstrates great potential. I have been associated with Ms. Gautham for a duration of fourteen months. She joined me as a doctoral candidate in August 2021 at the Indian Institute of Technology Kharagpur.

She has been very prompt with her subjects and classes. She has been associated with certain mini projects with postgraduate students and has responded to them with ideas and insights from her side. She has worked hard and diligently on the projects and tasks that were allotted to him. Throughout her Doctoral training process in the first year of her joining, she worked extremely hard and dedicated a significant amount of time to learning new things. I found her a hardworking and enthusiastic learner with a zest for learning and performing at par throughout the time. She displays great interpersonal and communication skills as demonstrated by her time to time. She puts a great effort into reading relevant literature and discussing innovative methods with all members, thereby demonstrating research understanding, and teamwork skills. She showed problem-solving aptitude and worked on coding skills by diligently performing experiments. He has also excelled in academic requirements that were exhibited during the first year of his Doctoral Training Program, she went well beyond the institute course requirements of 10 credits with excellent grades.
Overall, I believe that Ms. Anita Gautam can successfully handle the rigors of the MIPA joint PhD program.

I therefore confidently and strongly endorse her candidature for the same. Please feel free to contact me if you need any further information.

Sincerely,

15/11/22

Prof. Bharath H. Aithal
Ranbir and Chitra Gupta School of Infrastructure Design and Management
Indian Institute of Technology Kharagpur, West Bengal, India

Dr. Bharath Haridas Aithal
Ranbir and Chitra Gupta School
of Infrastructure Design and Management
Indian Institute of Technology Kharagpur
West Bengal India-721302

Dear IITKgP and The University of Melbourne application processing team,

I am providing this support letter to Ms. Anita Gautam for her application / admission to the joint PhD program under Melbourne India Postgraduate Academy (MIPA).

I have been discussing the collaboration through research with Ms. Gautam (PhD candidate) and Dr. Aithal (IITKgP supervisor). There has been discussion and interview during which we could assess her ability to do quality research. We both (IITKgp and Melbourne supervisors) are happy so far with her excellent performance during the interview process.

After a discussion with Dr. Aithal and Ms Gautam, I came to know that she stood as first class first and earned a gold medal in her post-graduate coursework. Therefore, I believe she is an outstanding student in her coursework. In discussion with the candidate, I could understand that she has a natural curiosity in tackling the questions intelligently.
Ms. Anita Gautam would be an excellent addition to the MIPA program, and I believe she has great potential to excel in the research within the MIPA environment. I believe we can have a wonderful research team and collaboration with Dr Aithal and MS. Gautam.

With all above attributes, I have a strong support to her application.

Please feel free to contact me if you need further information.

Thanks and kind regards,

Dr Jagannath Aryal
Senior Lecturer, Digital Infrastructure Engineering
Department of Infrastructure Engineering | Faculty of Engineering and Information Technology
Melbourne Connect 6310
The University of Melbourne, Victoria 3010 Australia
E:Jagannath.aryal@unimelb.edu.au, M: 0406773870
https://findanexpert.unimelb.edu.au/profile/865150-jagannath-aryal

Course coordinator: Master of Digital Infrastructure Engineering

National Commission Chair: Remote Sensing and Photogrammetry, SSSI, Australia

I acknowledge the Traditional Owners of the land on which I work, and pay my respects to the Elders, past and present.

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

STATEMENTS OF GRADE OBTAINED (INTERIM)
IN THE RECOMMENDED COURSEWORK FOR THE RESEARCH PROGRAMME
LEADING TO THE DEGREE OF DOCTOR OF PHILOSOPHY

Roll no: 21ID91R02 **Date: 13-10-2022**
Name: Anita Gautam
Department: RANBIR & CHITRA GUPTA SCHOOL OF INFRASTRUCTURE DESIGN & MANAGEMENT
Date of Joining: 02-08-2021

Session	Semester	Subject No.	Subject Title	LTP	Credit	Grade
2021-2022	SPRING	AI61002	DEEP LEARNING FOUNDATIONS AND APPLICATIONS	3-1-0	4	A
2021-2022	SPRING	HS63002	ENGLISH FOR TECHNICAL WRITING	2-2-0	4	A
2021-2022	AUTUMN	ID61002	REMOTE SENSING, GIS AND IMAGE PROCESSING IN URBAN INFRASTRUCTURE MANAGEMENT	3-1-0	4	A
2021-2022	AUTUMN	IM60061	APPLIED MULTIVARIATE STATISTICAL MODELLING - I	4-0-0	4	B
2021-2022	AUTUMN	ME60353	KNOWLEDGE BASED SYSTEMS IN ENGINEERING	4-0-0	4	A

N.B.: Not yet completed all requirements for the award of the Ph.D. degree

Date of Issue: 13/10/2022 Checked by Superintendent (PGS & R) Deputy Registrar (Academic)/ Assistant Registrar (PGS&R)

Deputy Registrar (Academic)
IIT Kharagpur

1. The abbreviation L-T-P stands for weekly contact hours for a subject in respect of Lecture, Tutorial and Practical

2. English is the medium of instruction at all levels

3. No rank or class or division is awarded. No system exists for conversion of letter grades into percentage or marks.

4. The following 7 point letter grade system is used by the Institute to assess a student's performance in a subject

Description	Letter Grade	Grade point per credit
Excellent	EX	10
Very Good	A	9
Good	B	8
Fair	C	7
Average	D	6
Pass	P	5
Fail	F	0

5. Candidates assigned course work must obtain a grade not lower than 'C' in each of the subjects.

Anita Gautam.
12/11/2022.

Details of Student

Roll No : 21ID91R02 **Name** : Anita Gautam

Contact Details : Email : gautama076@gmail.com **Phone : Joining Date :** : 02 AUGUST 2021 **Joining Confirmed by Department** : Y

Broad Area of Research : Landscape modelling

Registration Seminar date:

Thesis Submission Date:

Education

Qualification	University/Board	Year of Passing	Percentage	Subjects/Specialization
CLASS 10	Raj Kamal Kanya Inter college, U.P Board, Agra	2012	85.5	All
CLASS 12	Raj Kamal kanya Inter college, U.P Board, Agra	2014	84	PCM
BTECH	Banasthali Vidyapith	2018	72.07	Electronics and communication
MTECH	Banasthali Vidyapith	2020	8.53	Remote Sensing

Experience

Organization	Place	From Date	To Date	Responsibility
JAWAHAHLAL NEHRU UNIVERSITY	NEW DELHI	01 JULY 2019	30 APRIL 2020	RESEARCH

Semester Registration Status

** Semester registration is not applicable for joining session semester

Session	Semester	Semester Registration	Supervisor Recommendation	HOD/Chairman,DSC Acceptance
2021-2022	SPRING	02 JANUARY 2022	**Supervisor:** Satisfactory. Good, Satisfactory	**Reg. Card**
2022-2023	AUTUMN	26 JULY 2022	**Supervisor:** Satisfactory.	**Reg. Card**

DSC Formation Status

Emp No	Faculty Name	Department	Type
Chairman DSC : Head of the Dept./Centre/School			
18104	Bharath Haridas Aithal	Ranbir and Chitra Gupta School of Infrastructure Design and Mngt.	Supervisor
06056	Achanta Naga Venkata Satyanarayana	Centre for Oceans, Rivers, Atmosphere and Land Sciences (CORAL)	Member
18106	Ankhi Banerjee	Ranbir and Chitra Gupta School of Infrastructure Design and Mngt.	Member
11017	Shankha Pratim Bhattacharya	Architecture and Regional Planning	Member

Comprehensive Exam

Exam Date	Status
17-AUG-2022	PASS

Approval Status

Department Recommendation	Verification Status	
Enrolment		
07 AUGUST 2021	**Verified**	**Approved (27 JUNE 2022)**
Annual Progress Report		
12 MAY 2022	**Verified**	**Approved (05 JULY 2022)**

Enrolment, Subject Registration, Grade [(Lower Limit: 10, Upper Limit: 20) excluding HS63002]

Sub No	Sub Name	Type	L-T-P	Credit	Registration Semester & Session	Grade
HS63002	ENGLISH FOR TECHNICAL WRITING	COMPULSORY	2-2-0	4	2021-2022-SPRING	A
IM60061	APPLIED MULTIVARIATE STATISTICAL MODELLING - I	RECOMMENDED	4-0-0	4	2021-2022-AUTUMN	B
ME60353	KNOWLEDGE BASED SYSTEMS IN ENGINEERING	RECOMMENDED	4-0-0	4	2021-2022-AUTUMN	A
AI61002	DEEP LEARNING FOUNDATIONS AND APPLICATIONS	RECOMMENDED	3-1-0	4	2021-2022-SPRING	A
ID61002	REMOTE SENSING, GIS AND IMAGE PROCESSING IN URBAN INFRASTRUCTURE MANAGEMENT	INTERDISCIPLINARY	3-1-0	4	2021-2022-AUTUMN	A

Synopsis & Thesis Status

No Details Available

Reminder to Examiner(s)

Examiner Type Event Type Sl No. Date

No Details Available

Anita Gautam.
12/11/2022.

To:

The Director,
Melbourne India Postgraduate Program
University of Melbourne

Subject: Request for English Language Requirement to be waived for the Joint Doctoral Program Application of **Anita Gautam, 21ID91R02** for Joint Doctoral Program with the University of **Melbourne, Australia**

Dear Sir / Ma'am,

Ms. **Anita Gautam, 21ID91R02** is looking forward to applying for the Joint Doctoral Program at with the University of Melbourne, Australia**).** She is presently enrolled in the Ph.D. program at the Ranbir and Chitra Gupta School of Infrastructure Design and Management at IIT Kharagpur. I am **her** Ph.D. Supervisor.

I confirm that the medium of instruction and evaluation at IIT Kharagpur is in the English language. Therefore, it is requested that **Anita Gautam** English language requirement as part of this JDP application may be waived.

With Best Regards,

Dr. Bharath H. Aithal

भारतीय प्रौद्योगिकी संस्थान, खड़गपुर
खड़गपुर - 721 302
Indian Institute of Technology Kharagpur
Kharagpur - 721302

डॉ. गोपाल सिन्हा
उप कुलसचिव (शैक्षणिक)
Dr. Gopal Sinha
Deputy Registrar (Academic)

No: IIT/Acad(PGS&R)/Medium/2023/02
Date: April 3, 2023

TO WHOM IT MAY CONCERN

This is to certify that **Ms. Anita Gautam (21ID91R02)** is a bonafide PhD student in the Ranbir and Chitra Gupta School of Infrastructure Development and Management (RCGSIDM) of IIT Kharagpur. She has completed her coursework.

The medium of instruction and assessment of the above course is entirely in **English**.

Deputy Registrar (Academic)

Deputy Registrar (Academic)
IIT Kharagpur

Indian Institute of Technology Kharagpur

DSC Approval/Recommendation for joining Joint Doctoral Program (JDP)

Name: Anita Gautam

Roll no: 21ID91R02

Hall of Residence: Sister Nivedita Hall of Residence

Date of enrolment IITKGP: 2 August 2021

Name of Host Institute: University of Melbourne

Proposed duration of stay at Host Institute: 12 Months

Total months completed as Ph.D Student: 19 Months

Reason for visiting Host Institute: For Joint Doctoral Program (University of Melbourne & IIT Kharagpur) that provides an opportunity for active collocations. It will provide me with an exclusive opportunity for my research work in host institutions (University of Melbourne).

Full address of correspondence during Absence: Dr. Jagannath Aryal, 06, 6310, Melbourne Connect – 700 Swanston St, Parkville.

Supervisor(s)

Name, Dept/School/Center	Email/Phone
Dr. Bharath H. Aithal Ranbir and Chitra Gupta School of Infrastructure Design and Management	bharath@infra.iitkgp.ac.in +918861551265

Recommendation of the DSC (Please tick as applicable)

The research student has

1. Completed the prescribed course work.
2. Fulfilled the minimum residential requirement of first year
3. Completed the comprehensive examination.
4. Completed registration seminar

} All completed

Signature of the Home Supervisor	*Signature of the Head of the Department/Centre/School*	*Signature of the DSC Member, IITKGP*
Signature of the DSC Member, IITKGP	*Signature of the DSC Member, IITKGP*	*Signature of the DSC Member, IITKGP*

Indian Institute of Technology Kharagpur

APPLICATION FOR Ph.D. REGISTRATION

PART A: To be filled in by the Ph.D. Student

1. Roll no: 21ID91R02

2. Name: Anita Gautam

3. Date of Joining: 02-08-2021

4. Date of Enrolment: 02-08-2021

5. Broad Area of Research: Landscape modelling

6. Coursework assigned and completed:

Subject No	Subject Name	LTP	Credit	Grade Obtained	Subject Type
HS63002	ENGLISH FOR TECHNICAL WRITING	2-2-0	4	A	COMPULSORY
ID61002	REMOTE SENSING, GIS AND IMAGE PROCESSING IN URBAN INFRASTRUCTURE MANAGEMENT	3-1-0	4	A	INTERDISCIPLINARY
AI61002	DEEP LEARNING FOUNDATIONS AND APPLICATIONS	3-1-0	4	A	RECOMMENDED
IM60061	APPLIED MULTIVARIATE STATISTICAL MODELLING - I	4-0-0	4	B	RECOMMENDED
ME60353	KNOWLEDGE BASED SYSTEMS IN ENGINEERING	4-0-0	4	A	RECOMMENDED

7. Result in the Comprehensive Examination: PASS

8. Number of times Ph.D. Registration Seminar was given: 1

9. Topic of Research Work, as appearing in the Registration Seminar Report:

Urban land use land cover change modelling using multisource remote sensing data fusion

Please upload soft copy of Registration Seminar Report. No hard copy of the report to be sent along with this application

Date: 10/04/2023

Signature: Anita Gautam

PART B: For use by the Department/Centre/School

1. Date of Registration Seminar: 28-03-2023

2. Attendance: 30 persons

3. Performance

Feature	Grade	Comment
Problem Definition	A	Satisfactory
Literature Survey	A	Satisfactory
Report	A	Satisfactory
Seminar Presentation	EX	Satisfactory

4. Recommendation of the DSC :

The Student Be Registered with effect from a date 02-08-2021.

10/04/23

Signature of the Chairman, DSC

Signature of the Supervisor

Signature of the Joint Supervisor

Signature of the DSC Member

Signature of the DSC Member

Signature of the DSC Member

SCHEDULE: GRADUATE RESEARCHER AGREEMENT

RECITALS

The University of Melbourne and IIT Kharagpur wish to establish a Joint PhD framework (Program) for [Name of Graduate Researcher] under this Graduate Researcher Agreement in accordance with the Agreement for Jointly Awarded Doctor of Philosophy (PhD) signed by the parties dated __13 November 2022 ('Head Agreement').

The purpose of this Graduate Researcher Agreement is to confirm the agreed arrangements for this Graduate Researcher's jointly awarded Doctor of Philosophy (PhD).

Graduate Researchers should refer to the detailed guidelines in **Attachment 1** for further information.

Policy regulations:
The University of Melbourne:

- Graduate Research Training Policy (MPF1321): *https://policy.unimelb.edu.au/MPF1321*;
- Health and Safety Policy (MPF1205): *https://policy.unimelb.edu.au/MPF1205*;
- Enrolment and Timetabling Policy (MPF1294): *https://policy.unimelb.edu.au/MPF1294*

IIT Kharagpur:

- *https://erp.iitkgp.ac.in/IITKGPApplications/admfile/2019201Information.pdf*

1. GRADUATE RESEARCHER DETAILS

Graduate Researcher identification numbers	University of Melbourne (Student ID)	21ID91R02	
Family name	Gautam	Given name(s)	Anita
Date of birth	16 October 1997		
Email address	gautama076@kgpian.iitkgp.ac.in		
Mobile /cell telephone	+919599802129		

2. UNIVERSITY DETAILS

Unless otherwise indicated below the Home Institution is the Party at which the Graduate Researcher first enrols.

The Home Institution will be:	Indian Institute of Technology, Kharagpur
The Host Institution will be:	University of Melbourne

The following persons have been designated as the **principal supervisors**, and will be responsible for providing primary supervision of the Graduate Researcher from their respective institution

	Home institution	Host institution
Principal supervisors (name and title)	Dr. Bharath H. Aithal	Dr. Jagannath Aryal
Faculty and School/ Department	Assistant Professor Ranbir and Chitra Gupta School of Infrastructure Design and Managment	[redacted] Associate Professor Infrastructure Engineering
Email address	bharath@infra.iitkgp.ac.in	jagannath.aryal@unimelb.edu.au
Telephone numbers	+91-3222-214944	

3. INTERNATIONAL RESEARCH TRAINING GROUPS

Is the Graduate Researcher part of an established International Research Training Group (IRTG) between Melbourne and IIT Kharagpur?

	Yes ☑	No ☐
If yes, name of IRTG:	Melbourne India Postgraduate Academy	

4. PROPOSED PROJECT AND SUPERVISION ARRANGEMENTS

Describe the thesis topic that will be undertaken:

Urban land use land cover change modelling using multisource remote sensing data fusion

The following regulatory approvals will be required in order for the Graduate Researcher to conduct their research at the Home and Host institutions *(eg: ethics approvals, materials handling certifications, health or police checks)*:

The Graduate Researcher must complete Melbourne's *Research Integrity Online Training* course prior to Confirmation.

The following arrangements will be put in place for the appropriate management and retention of research data generated during the research:

Melbourne and IIT Kharagpur agree to provide a safe environment for the Graduate Researcher for the duration of the Program in accordance with Melbourne's Health and Safety Policy: *https://policy.unimelb.edu.au/MPF1205*

The proposed/recorded date of commencement of joint candidature arrangements is:

Commencement date is the first day that the Graduate Researcher starts work towards the Program. For Graduate Researchers whose Home Institution is IIT Kharagpur, this will be the date when the graduate researcher enrols at Melbourne.

Allocation of time

For Graduate Researchers whose Home Institution is IIT Kharagpur, the maximum duration of the PhD is 8 years (including the coursework year(s) at IIT Kharagpur).

For Graduate Researchers whose Home Institution is Melbourne, the maximum duration of the PhD is 4 years.

All Graduate Researchers must submit for examination at Melbourne within 4 years of enrolling at Melbourne.

The Graduate Researcher will divide their time between the Home and Host institution and will spend a minimum of 12 months, and a maximum of 24 months, at the Host institution. The expected periods to be spent at each institution are as follows:

Period *(Provide proposed dates in dd/mm/yy format)*		Location (Home or Host Institution)
From date	to	
From date	to	
From date	to	
From date	to	
From date	to	

Leave policies affecting candidature

Leave will be granted in accordance with *sections 5.61-5.67* of the Melbourne Enrolment and Timetabling Policy (MPF1294).

Leave of absence is a period of non-enrolment that may be granted for reasons such as sickness, family or carer responsibilities, which temporarily hinder the Postgraduate Researcher's studies.

When leave is approved, the expected thesis submission date and progress review due dates will be adjusted at both institutions.

***Note*:** recreational leave (up to 4 weeks at Melbourne) will not affect the thesis submission date.

The following arrangements will be put in place to ensure effective supervision of the candidate and effective communication between the supervisors at Home and Host institutions *(please include details of the proposed frequency and mode of supervision meetings, and how the outcomes of those meetings will be recorded):*

Supervisory meetings will be held at least monthly with the Graduate Researcher over video-conference

The following arrangements will be put in place to ensure the Graduate Researcher's progress is reviewed formally on at least an annual basis:

On enrolment at the Home Institution, an Advisory Panel will be formed as per rules of the Home Institution.

- At IIT Kharagpur, the Advisory Panel must be comprised of the supervisor(s), the Department/School/Centre Head, and at least three more faculty members, at least one of whom must not be from the parent Department/School/Centre.
- At Melbourne, the Advisory Panel must be comprised of at least three people including the advisory committee chair and the candidate's supervisors as per the *Graduate Research Training Policy*.

Upon successful enrolment in the Joint PhD, the Host Institution's supervisor(s) and two more Academics from the Host Institution will be added to the Advisory Panel to make up a **Joint Advisory Panel**.

- The Joint Advisory Panel will include all IIT Kharagpur and Melbourne supervisors.
- The Joint Advisory Panel will meet at least once a year (online mode) to assess the graduate researcher's progress.
- Graduate researchers will be required to submit annual progress reports to both Institutions via the Joint Advisory Panel. Progress reviews will be recorded through online forms linked to the student system at Melbourne.

***Note*:** The Joint Advisory Panel will be involved in the examination of the Oral Defence, as set out in section 7.

5. THESIS REQUIREMENTS

The expected format and approximate word length of the thesis is:

The expected format of the thesis is per the *Preparation of Graduate Research Theses Rules*.

The word length of the thesis will not exceed 100,000 words exclusive of tables, maps, bibliographies and appendices.

The thesis will be written in the following language: English

6. THESIS EXAMINATION

The Examination Board will consist of:

- At least two examiners external to, and independent of, all Partners. One of these two external examiners must be resident outside Australia and India.

The following arrangements will govern the selection of examiners and examination of the thesis.

6.1 The primary supervisors from both institutions will jointly search for and nominate the potential external and independent examiners as per *section 4.103-4.110* of the Melbourne Graduate Research Training Policy. These must be external to all Partners and remain anonymous to the candidate. At least one of these external and independent examiners will be required to participate in the Oral Defence, as set out in section 7, and will cede anonymity at that point.

6.2 The Graduate Researcher will submit identical copies of the thesis to each institution in line with each institution's policies and procedures.

6.3 The thesis examination will be initiated by the Home Institution and the initial contact and invitations to examiners will be sent by the Home Institution. Once initial contact has been made, each institution will send their relevant forms to the examiners.

6.4 The examiners will submit the relevant examiners' assessment form and written report to each institution in line with each institution's requirements.

6.5 The Melbourne Chair of Examiners will assess the two external examiners' reports against a scale of recommendations as per *section 5.119-5.129* of the Melbourne Graduate Research Training Policy.

6.6 The Oral Defence must take place after thesis submission, and before the revised version of the thesis has been resubmitted to each institution. The Oral Defence will run as set out in section 7.

6.7 If the candidate is required to make some form of change to the thesis as an outcome of the thesis examination and Oral Defence, identical copies of the revised version of the thesis will be resubmitted to each institution as the final version of the thesis.

The jointly awarded degree from Melbourne and IIT Kharagpur is a PhD.

7. ORAL DEFENCE

The Oral Defence Examination Board will be assembled by IIT Kharagpur and will consist of:

- At least one of the two examiners external to, and independent of, all Partners, as described in section 6.; AND
- The Joint Advisory Panel, as described in section 4.

The following arrangements will govern the Oral Defence examination process:

The Oral Defence will be conducted in the following language: English

It is expected that the Oral Defence will be conducted at the Home Institution and be attended by the Graduate Researcher and the Oral Defence Examination Board as described below:

	Physically present	Option to join via video-conference
Graduate Researcher	☒	
Joint Advisory Panel members at Home Institution	☒	
Joint Advisory Panel members at Host Institution		☒
At least one of the two external examiners, as described in 6.		☒*

* If the examiner is located within India, for candidates enrolled with IIT Kharagpur as the Home Institution, then they should be physically present. The external examiner may attend via video conference if they are outside India or unable to travel.

8. FINANCIAL ARRANGEMENTS

The following financial arrangements will apply to this Graduate Researcher's Program:

Institution:	Home	Host
Tuition fee remission waiver:	Full fee remission	Full fee remission

Living stipend (scholarship):	Base scholarship rate when candidate is located at Home Institution	Base scholarship rate when candidate is located at Host Institution
Note: The maximum duration of the scholarship paid by the Host Institution will be 2 years.		
Travel costs of the Graduate Researcher:	As required (minimum one return airfare)	None
Insurance costs of the Graduate Researcher (health, travel):	As required	As required, when candidate is located at Host Institution
Travel costs of the supervisors, as they apply to the supervision of the Graduate Researcher:	As required, for Home-based supervisor	As required, for Host-based supervisor
Honoraria for external examiners:	As per usual standard	As per usual standard
Technology costs associated with the Oral defence (e.g. video/ teleconference):	As required	As required
Travel costs associated with the Oral Defence for the:	*IIT Kharagpur will pay the travel cost for one external examiner to attend the Oral Defence, if the examiner is located within India, for candidates enrolled with IITKgp as the Home Institution. The external examiner may attend via video conference if they are outside India or unable to travel.	
a. Graduate Researcher	None	None
b. Supervisors	None	None
c. External examiners	*	*

9. INTELLECTUAL PROPERTY ARRANGEMENTS

(IF RELEVANT) This research is conducted under a funding / third-party agreement that places the following conditions upon ownership and /or communication of the research:

Confidentiality requirements:
Disemination of the research findings, including access to the thesis *(note whether these restrictions are worldwide or apply to specific jurisdictions only)*:
Intellectual Property generated in the project (excluding the Graduate Researcher's thesis):
Background Intellectual Property made available by the third party:

Intellectual Property rights in the research project will vest in accordance with the position set out at clause 6.3 of the Head Agreement unless otherwise indicated below or as separately agreed in writing by the parties.

10. AUTHORSHIP AND THESIS ACCESS ARRANGEMENTS

Copyright and access arrangements to the Graduate Researcher's thesis will be governed by the position set out clause 6.1 of the Head Agreement unless otherwise indicated below:

The following arrangements will apply to any publications arising from the Graduate Researcher's work *(indicate copyright arrangements, anticipated author roles and attributions where co-authored publications are expected and publication access requirements)*

11. UNIVERSITY APPROVALS

INSTITUTION NAME	University of Melbourne	IIT Kharagpur
PRINCIPAL SUPERVISORS		
Name	Dr. Jagannath Aryal	Dr. Bharath H. Aithal
Signature		
Date	28/04/2023	13/4/23
(IF RELEVANT) To confirm whether the Graduate Researcher has been granted a place in an International Researh Training Group (IRTG), the Head of Department/Head of School will consult with the IRTG coordinator or academic lead. Has the Head of Department/Head of School received confirmation from the IRTG coordinator or academic lead that the named Graduate Researcher is being supported as part of the IRTG?	Yes ☐ No ☐	Yes ☐ No ☐
HEAD OF DEPARTMENT / SCHOOL (as appropriate)		
Name	Prof. Dilip Kumar Baidya	
Signature		
Date	18/04/23	
RESPONSIBLE OFFICER AT ENROLLING FACULTY		
Name	Goutam Chakraborty	
Position	Associate Dean, ~~Research Training~~ International Relations & Rankings	
Signature		
Date		

12. GRADUATE RESEARCHER ACKNOWLEDGEMENT

The content of this Agreement has been discussed with me, and I acknowledge these conditions will apply in respect to my Program, unless varied by agreement between the Home and Host institutions, and with my knowledge.
I acknowledge that progress outcomes will be shared with the relevant administrators at both institutions to ensure all program requirements are met.

Name	Anita Gautam		
Signature	Anita Gautam	Date	13 April 2023