Ph.D. Programme
Coursework
Syllabus

of

Department of Planning & Geomatics
(Geomatics)

Islamic University of Science & Technology

Awantipora-192122, Kashmir

Overview of the Course Scheme for the Ph.D. programme

As per the university ordinance and new guidelines, the research scholars who are provisionally registered under the Ph.D. programme will have to undergo pre-Ph.D. coursework. The pre-Ph.D. coursework shall have three components. Every student admitted to the Ph.D. programme will have to pass coursework with a minimum of 14 credits. The candidate can submit his/her thesis only after passing the coursework.

1. Component one (Core Courses)

This component will comprise three courses of 10 credits which are general to a Ph.D. programme in the Department of Planning & Geomatics (DoPG), IUST, and every research scholar will have to opt for these courses mandatorily. It will have the following courses:

i. Research and Publication Ethics
ii. Research Methodology
iii. Recent Advances in the Subject

2. Component two (Research Centric)

The course is based on recent developments on the particular research topic assigned to the research student to envisage the recent developments in the available literature.

3. Component three (Discipline-Centric Elective Courses)

This component will comprise a basket of courses belonging to different research fields. Each course will be of 3 credits and out of the available basket of courses; students will have to opt for at least one course that will be mandatory for completion of the Ph.D. coursework.

Course	Course Code	Course Title	Course Type	Max. Marks			Credit Distribution			Credits
				Internal*	Final	Total	L	T	P	
Core	RPE	Research and Publication Ethics	Core	25	25	50	2	0	0	2
	DPG901C	Research Methodology	Core	50	50	100	3	0	1	4
	DPG902C	Recent Advances in the Subject	Core	50	50	100	3	0	1	4
Research Centric	DPG903C	Seminar on Recent Developments in the Area of Research	Core	Write-up = 50 Presentation = 30 Viva = 20		100				2
Discipline Centric Elective	DPG904E	Glaciers and Climate Change	Elective	25	25	50	2	0	1	3
	DPG905E	Glacier Hazards and Climate Change	Elective	25	25	50	2	0	1	3
	DPG906E	Climate Science Dynamics & Variability	Elective	25	25	50	2	0	1	3
	DPG907E	Climate Change: Understanding Impacts and Strategies for Action	Elective	25	25	50	2	0	1	3
Total Credits										**15**

*(Midterm 30 marks +Assignment/Attendance 20 marks)

Paper-I
(Core Course)
Common Course for all disciplines

Course Title: Research and Publication Ethics
Course Code: **RPE**
Credits: 2
Marks: 50

UNIT-I:

Part-A: Philosophy and Ethics (3 Hours)

1. Introduction to philosophy: definition, nature, scope, concept, branches.
2. Ethics: definition, moral philosophy, nature of moral judgments, and relations.

Part-B: Scientific Conduct (5 Hours)

1. Ethics with respect to science and research.
2. Intellectual honesty and research integrity.
3. Scientific misconduct: falsification, fabrication, and plagiarism.
4. Redundant publications: duplicate and overlapping publications, salami slicing.
5. Selective reporting and misrepresentation of data.

UNIT-II:

Publication Ethics (7 Hours)

1. Publication ethics: definition, introduction, and importance.
2. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest.
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types.
5. Violation of publication ethics, authorship, and contributor ship.
6. Identification of publication misconduct, complaints, and appeals.
7. Predatory publishers and journals.

UNIT-III:

Part-A: Open Access Publishing (4 Hours)

1. Open access publications and initiatives.
2. SHERPA/RoMEO online resources to check publisher copyright and self-archiving policies.
3. Software tool to identify predatory publications developed by Savitribai Phule Pune University (SPPU).
4. Journal finder/ journal suggestion tools viz., JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Part-B: Publication Misconduct (4 Hours)

A. Group Discussions (2hrs)

1. Subject-specific ethical issues, fabrication falsification or plagiarism (FFP), authorship.
2. Conflict of interest.
3. Complaints and appeals: examples and fraud from India and abroad.

B. Software Tools (2hrs)

1. Use of plagiarism software like Turnitin, Urkund and other open-source software tools.

Unit-IV:

Part-A: Databases (4 Hours)

Indexing databases, Citation databases: Web of Science, Scopus, etc.

Part-B: Research Metrics (3 Hours)

Impact Factor of journal as per journal citation report, Source Normalized Impact per Paper (SNIP), Scientific Journal Rankings (SJR), Impact Per Publication (IPP), Cite Score.

Metrics: h-index, g index, i10 index, altimetric.

Suggested Reading Material:

- Beall, J. (2012). Predatory publishers are corrupting open access, Nature, (489 (7415), 179-179, http://doi.org/10.1038/489179a.
- Bird, A. (2006). Philosophy of Science.
- Chaddah, P. (2018). Ethics in competitive Research, do not get scooped; do not get plagiarized, ISBN: 978-9387480865.
- Indian National Science Academy (INSA) (2019). Ethics in Science and Education, research and government. ISBN:978-81939482-1-7 http://www.insaindia.res.in/pdf/EthicsBooks.pdf
- MacIntyre, A. (2003). A short history of ethics: a history of moral philosophy from the Homeric age to the 20th Century. Routledge.
- National Academy of Sciences, National Academy of Engineering and Institute of Medicine (2009) on being a scientist: guide to Responsible conduct in research: Third Edition, National Academies Press.
- Resnik, D.B. (2011). What is ethics in research and why it is important, National Institute of Environmental Health Sciences, 1-10, retrieved from, http://niehs.nih.gov/research/resources/ bioethics/whatis/index.cfm.

Paper-II
(Core Course)

Course Title: Research Methodology
Course Code: **DPG901C**
Credits: 4
Marks: 100

UNIT-I: Research Methodology

Introduction to scientific Research, definition, and importance of scientific research, meaning and characteristics of scientific research, key features and principles of scientific research, different stages involved in the research process, factors driving research and setting research objectives, distinguishing between research methods and research methodology, types of research, descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical.

UNIT-II: Research Problem and Literature Review

Types of research problems, identification and formulation of research problems, literature survey and abstract surveys, techniques for preparation of index card, critical literature review, identifying gaps in existing research and developing a working hypothesis, techniques for data analysis and interpretation of results, formulation of research problem and methodology, art of scientific writing, crafting research papers, proposals, and thesis

UNIT-III: Statistical Research Methods and Error Analysis

Introduction to statistics, importance of statistics in research, types of data and their significance, basic concepts concerning testing of hypotheses, important parametric and non-parametric tests. Hypothesis testing of means, differences between means, comparing two related samples, proportions, differences between proportions, comparing a variance to some hypothesized population variance, variances of two normal populations, correlation coefficients. Limitations of tests of hypotheses. Measurement in research, measurement scales, goodness of fit tests and their significance in defining quality of data.

UNIT-IV: Python Programming for Data Analysis

Introduction to Python and R for research, basic elements of python, data types, arrays, functions, dictionaries, loops, and conditional statements (IF, ELSE, ELIF), learn to install anaconda and setting up Jupyter Notebook, statistical analysis of scientific data using Python, including hypothesis testing, data analysis and plotting by employing NumPy and Matplotlib, linear and nonlinear curve fitting of scientific data using Jupyter Notebook.

Recommended literature:

1. Research Methodology: Methods and Techniques (2019), C R Kothari, Gaurav Garg, 4th Edition, New Age International Publishers
2. Research design: Qualitative, quantitative, and mixed methods approaches (2014), J. W. Creswell, Sage publications.
3. Data reduction and error analysis for the physical sciences (2003), Philip R. Bevington and D.Keith Robinson, McGraw-Hill.

Paper-III
(Core Course)

Course Title: Recent Advances in the Geomatics and Geospatial Technology
Course Code: **DPG902C**
Credits: 4
Marks: 100

Unit-1: Advances in Remote Sensing Technologies

Hyperspectral imaging and its applications; LiDAR technology: Recent developments and applications; Unmanned Aerial Vehicles (UAVs) and drone-based remote sensing; SAR (Synthetic Aperture Radar) advances and interferometry; Integration of multi-source remote sensing data for advanced applications.

Unit-2: Geospatial Data Science and Big Data Analytics

Introduction to geospatial data science and its applications; Big data handling in Geoinformatics (cloud computing, Hadoop, etc.); Machine learning and deep learning for spatial data analysis; Data fusion and integration techniques in geospatial analytics; Case studies: Use of AI and big data in environmental monitoring, urban planning, etc.

Unit-3: Spatio-temporal Data Modelling and Analysis

Spatio-temporal GIS and dynamic modelling; Geostatistical methods for space-time data analysis; Agent-based modelling and cellular automata for simulating spatial processes; Real-time geospatial data processing and visualization; Emerging applications in, Environmental monitoring, disaster management and climate change.

Assignments:

Unit-4: Geospatial Web Services and Interoperability

Geospatial Web Services (OGC standards, WMS, WFS, WCS); Geoportals, Spatial Data Infrastructures (SDI), and collaborative platforms; Advances in geospatial interoperability: GeoJSON, REST APIs, and data sharing frameworks; Open-source GIS (QGIS, GRASS) and cloud-based platforms (AWS, Azure, Google Cloud); Mobile GIS and real-time geospatial applications.

Practical:

- Hands-on project on UAV-based data collection and analysis.
- Practical implementation using cloud-based GIS platforms (e.g., Google Earth Engine).
- Hands-on training on various Open source and Web Based GIS applications

References:

i. Geospatial Data Science Quick Start Guide by Lei Zhang.
ii. Advances in Remote Sensing for Natural Resource Monitoring by Qihao Weng.
iii. Spatial Analysis with R by Robin Lovelace.

Paper-IV
(Research Centric Course)

Course Title: Seminar on Recent Developments in the Area of Research

Course Code: DPG903C

Credits: 2

Marks: 100

Review of published literature:

Preparation of a comprehensive and critical review of the already published literature in his/her proposed field of study and the same may be submitted to a refereed/reputed journal as notified by UGC. The candidate will be evaluated on the basis of a comprehensive report to be submitted and a seminar to be delivered at the end of the semester.

100 Marks

- Write-up-50;
- Presentation-30;
- Viva-20

Paper-V
Discipline Centric Elective (E) Course

Course Title: Glaciers and Climate Change

Course Code: DPG904E

Credits: 3

Marks: 50

Unit 1: **Glaciology and the Cryosphere in a Changing Climate**

Introduction to glaciology and the components of the cryosphere; Glacier dynamics and processes (accumulation, ablation, glacier flow, and mass balance); Impact of climate change on glaciers, permafrost, and sea ice; Glacial hazards: Glacial Lake Outburst Floods (GLOFs) and avalanches; Climate change feedback mechanisms and cryosphere sensitivity; Case studies: Key regions impacted by climate change (e.g., the Himalayas, the Alps and the Arctic).

Unit-2: Modelling Glacier and Cryosphere Dynamics

Numerical modelling of glacier dynamics (e.g., mass balance, ice flow); Climate-cryosphere interaction models and future projections; Glacier lake outburst floods (GLOF) modelling and risk assessment; Integrated assessment of glaciers using Earth system models; Application of Geoinformatics in glacier mass balance and hydrological modelling; Emerging technologies: UAVs for glacier mapping and cryospheric research; Tools and techniques for simulating glacier response to climate scenarios.

Practical:

- Mapping & Monitoring Glacier from Optical & MW data.
- Hands-on training on open-source distributed glacier models and empirical methods for simulating glacier responses to climate change using real-world data.
- Evaluation of modelling tools and techniques for glacier volume assessment.

References:

- Glaciers and Climate Change by J. Oerlemans.
- Remote Sensing of the Cryosphere by Marco Tedesco.
- Glacier Science and Environmental Change by Peter Knight.

Paper-VI
Discipline Centric Elective (E) Course

Course Title: Glacier Hazards and Climate Change

Course Code: DPG905E

Credits: 3

Marks: 50

Unit-1: Cryospheric Hazards and Climate Change

Glacier Hazards: Types (GLOFs, ice avalanches, glacier surges), their triggers, and consequences; Permafrost Hazards: Thawing permafrost, land subsidence, and infrastructure risks; Introduction to Climate Change Science: Key indicators, such as temperature and precipitation patterns, and how they relate to glacier and permafrost changes; Impact of Climate Change on Glacier and Permafrost Systems: Glacier retreat, permafrost degradation, and increased hazard frequency; Human Adaptation and Resilience: Engineering solutions and community-based adaptation strategies to manage glacier and permafrost hazards; Case Studies: Global and regional perspectives on permafrost and glacier hazards, including the Himalayas, the Arctic, and the Andes.

Unit-II: 2. Geomatics for Hazard Mapping and Monitoring

Geospatial Data Acquisition for Glacier Hazard and Permafrost Studies: Remote sensing (optical, radar), LiDAR, UAVs, and in-situ measurements; Glacier Hazard Modelling using Geoinformatics: Early warning systems, hazard zonation mapping, and GLOF risk assessment; Permafrost Monitoring Techniques: Remote sensing and GIS applications for tracking permafrost changes over time; Predictive Modeling of Glacier and Permafrost Dynamics: Using climate change scenarios to forecast future hazards; Introduction to Machine Learning for Hazard Prediction: Overview of machine learning techniques and their applications in glacier and permafrost studies; Data Integration Techniques: Combining various geospatial datasets (e.g., remote sensing with in-situ data) for more accurate hazard assessments; Decision-Making with Geospatial Data: Risk assessment, vulnerability mapping, and disaster management strategies.

Practical:

- Analyse Temperature and Precipitation Trends and Correlating with Glacier Retreat or Permafrost Degradation
- Monitoring Permafrost and Glacier hazards using Remote Sensing data and techniques.
- Compare two major glacier or permafrost hazard events, focusing on climate change factors and mitigation efforts.

Suggested Reading Material:

i. Climate Change and Glacier Hazards by Garry Clarke
ii. Permafrost Engineering by Orlando B. Andersland and Branko Ladanyi
iii. Glacier and Permafrost Hazards in High Mountains by Wilfried Haeberli

Paper-VII
Discipline Centric Elective (E) Course

Course Title: Climate Science Dynamics & Variability
Course Code: DPG906E
Credits: 3
Marks: 50

Module I: Introduction to the Climate System

Introduction to Climate and Climate Change; Climate and Weather; Key climate variables (Temperature, Precipitation, wind, evaporation, ET, LST); Earth's Energy Budget**:** Solar radiation, reflection, and absorption; Components of the Climate System: Atmosphere, Hydrosphere, Lithosphere, Cryosphere and Biosphere; Climate System Feedbacks Positive (ice-albedo feedback) and Negative (cloud feedback); Climate Extremes

Module II: Causes of Climate Variability and Change

Natural Causes of Climate: Solar radiation changes, Volcanic activity, Ocean-atmosphere interactions (e.g., El Niño and La Niña); Anthropogenic Climate Forcing: Greenhouse Gas Emissions (CO2, Methane), deforestation, industrial activities; Radiative Forcing and the Greenhouse Effect

Practical:

- Basic analysis of observed climate, plotting, analysis and basic interpretation of climate data.
- Analysis and interpretation of historical climate data to identify trends and anomalies.
- Analysis of a time series GHG data from reanalysis and satellite derived-data to determine trends.
- Spatiotemporal analysis of extreme climatic events

Suggested Reading Material:

i. Climate Change: A Very Short Introduction" by Mark Maslin
ii. "Climate Change: The Science of Global Warming and Our Energy Future" by Edmond A. Mathez
iii. "Introduction to Climate Change" by David S. Lee
iv. "Paleoclimate: Understanding the Earth's Climate History" by Robert E. Kopp
v. "Climate Change Adaptation and Mitigation Strategies: Global and Regional Perspectives" by A. A. A. Elhassan

Paper-VII
Discipline Centric Elective (E) Course

Course Title: Climate Change: Understanding Impacts and Strategies for Action
Course Code: DPG907E
Credits: 3
Marks: 50

Module I: Climate Models and Scientific Tools

Introduction to Climate Models; Types of climate Models: Global Climate Models (GCMs) & Regional Climate Models (RCMs); Various Climate Model Experiments (CMIP3, CMIP5, CMIP6); Uncertainties in Climate Models; Emission Scenarios**:** Special Report on Emission Scenarios (SRES), Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs); Climate change impacts on water, food and energy security.

Module II: Adaptation and Mitigation of Climate Change

Concept of Adaptation and Mitigation; Vulnerability Assessment; Resilience Building; Mitigation Strategies: Greenhouse Gas Reduction strategy, Energy Efficiency, Carbon Sequestration; COP meetings and other Global Frameworks and networks

Practical:

- Comparison and analysis of modelled and observed climate data using statistical tests.
- Climate model uncertainty analysis using empirical approach.
- Bias correction of climate model data for improved accuracy in climate projections

Suggested Reading Material:

1. Climate Change: A Very Short Introduction by Mark Maslin
2. Climate Change: The Science of Global Warming and Our Energy Future by Edmond A. Mathez
3. Introduction to Climate Change by David S. Lee
4. Paleoclimate: Understanding the Earth's Climate History by Robert E. Kopp
5. Climate Change Adaptation and Mitigation Strategies: Global and Regional Perspectives by A. A. A. Elhassan