Overview of the Course Scheme for the PhD Programme

As per the university ordinance and new guidelines, the research scholars who are provisionally registered under the PhD programme will have to undergo pre-PhD coursework. The pre-PhD coursework shall have three components. Every student admitted to the PhD 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 PhD programme in the Centre for Disaster Risk Reduction (CDRR), 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 2 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 PhD coursework.

Course	Course Code	Course Title	Course Type	Max. Marks			Credit Distribution				Credits
				Internal*	Final	Total	L	T	P	S	
Core	RPE	Research and Publication Ethics	Core	25	25	50	2	0	0	0	2
	DRR901C	Research Methodology	Core	50	50	100	3	1	0	0	4
	DRR902C	Advances in Disaster Sciences	Core	50	50	100	3	1	0	0	4
Research Centric	DRR903C	Research Communication	Core	25	25	50	0	2	0	0	2
Discipline Centric Elective	DRR904E	Seismology & Earthquake Engineering	Elective	25	25	50	2	0	0	0	2
	DRR905E	Flood Risk Management	Elective	25	25	50	2	0	0	0	2
	DRR906E	Landslide Hazard Assessment	Elective	25	25	50	2	0	0	0	2
	DRR907E	Risk Assessment of Potentially Toxic Elements	Elective	25	25	50	2	0	0	0	2
Total Credits											**14**

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

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

Research and Publication Ethics		Centre for Disaster Risk Reduction		
Course Code	**Credits**	**Course Type**	**L-T-P-S**	**Max. Marks**
RPE	**02 (30 Hours)**	**Common**	**2-0-0-0**	**50**

Course objective and outcome:

- To grasp the foundational principles of philosophy and ethics.
- To uphold intellectual honesty and research integrity throughout the scientific process.
- To adhere publication ethics guidelines and resolve issues like conflicts of interest and authorship.
- To utilize Open Access resources, plagiarism detection software, and journal finder tools.
- To apply research metrics for evaluating the impact and quality of scholarly work.

UNIT-I:

Part-A: Philosophy and Ethics **Hours: 03**

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

Part-B: Scientific Conduct **Hours: 05**

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 **Hours: 07**

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 **Hours: 04**

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 **Hours: 04**

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 **Hours: 04**

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

Part-B: Research Metrics **Hours: 03**

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.

Books Recommended/Readings:

1. 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
2. Chaddah, P. (2018). Ethics in competitive Research, do not get scooped; do not get plagiarized, ISBN: 978-9387480865.
3. Beall, J. (2012). Predatory publishers are corrupting open access, Nature, (489 (7415), 179-179, http://doi.org/10.1038/489179a.
4. 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.
5. 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.
6. Bird, A. (2006). Philosophy of Science.
7. MacIntyre, A. (2003). A short history of ethics: a history of moral philosophy from the Homeric age to the 20th Century. Routledge.

Paper-II
(Core Course)

Research Methodology		Centre for Disaster Risk Reduction		
Course Code	**Credits**	**Course Type**	**L-T-P-S**	**Max. Marks**
DRR901C	**04 (60 Hours)**	**Core**	**3-1-0-0**	**100**

Course objective and outcome:

- To understand the fundamentals of scientific research, including research design, hypothesis formulation, and scientific writing.
- To acquire skills for effective data collection through various qualitative and quantitative methods.
- To develop proficiency in data processing, statistical analysis, and interpretation using modern analytical tools and software.
- To apply interdisciplinary approaches for interpreting research findings and disseminating knowledge in the context of disaster risk reduction and management.

Unit-I: Fundamentals of Scientific Research **Hours: 15**

Scientific research: importance, and its needs. Types of research: descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs empirical. Literature review: primary and secondary sources, preparation of index card, identifying gaps, and science questions, and formulating hypothesis. Research problem: identification, motivation, formulation of research objectives, and execution of a research plan. Art of scientific writing: crafting research papers/ proposals, and thesis.

Unit-II: Data Collection **Hours: 15**

Types of data: categorical, nominal & ordinal. Primary, and secondary data sources. Methods of data collection: field investigation, experimental observations, reports, historical records, questionnaires, interviews, group discussions, and sensor networks. Fieldwork: selection and training of field investigator, field operation, and administration. Data network, sampling methods, and tools.

Unit-III: Data Processing and Analysis **Hours: 15**

Software packages for data processing and analysis: Arc GIS and remote sensing for spatial data analysis. R or python for statistical analysis. Data error estimation: root mean square error (RMSE), Standard Deviation, instrument precision, and accuracy. Analysis of variance (ANOVA), covariance (ANOCOVA), correlation, and regression. Hypothesis testing through parametric and non-parametric tests. Pearson's r, Chi-Square, t-Test.

Unit-IV: Data Interpretation and Dissemination **Hours: 15**

Interdisciplinary approaches for disaster risk reduction. Risk-sensitive land use planning. Components of disaster risk matrix: likelihood, and impact. Tools and techniques for disaster audit. Community-Based Disaster Risk Management (CBDRM).

Books Recommended/Readings:

1. Kothari, C.R. & Garg, G. (2019). Research Methodology: Methods and Techniques. 4th Edition. New Age International Publishers, New Delhi.
2. Panneerselvam, R. (2019). Research Methodology, PHI Learning Pvt. Ltd., New Delhi.
3. Gupta, S.P. (2008). Statistical Methods. 37th ed. (Rev), Sultan Chand and Sons. New Delhi, 1470p.
4. Kumar, R. (2005). Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed.).
5. Garg, B.L., Karadia, R., Agarwal, F., & Agarwal, U.K. (2002). An introduction to Research Methodology.
6. Mishra R.P. (2001). Research Methodology, Concept Publishing Company, New Delhi.
7. Robert, A.S. (2001). Methods of Disaster Research, Xlibris Corporation.

Paper-III
(Core Course)

Advances in the Disaster Sciences		Centre for Disaster Risk Reduction		
Course Code	**Credits**	**Course Type**	**L-T-P-S**	**Max. Marks**
DRR902C	**04 (60 Hours)**	**Core**	**3-1-0-0**	**100**

Course objective and outcome:

- To develop a comprehensive understanding of current issues, policies, frameworks, and governance mechanisms related to Disaster Risk Reduction.
- To enhance knowledge of hazard classification, vulnerability assessment, and resilience strategies across different disaster types.
- To apply advanced technologies such as GIS, remote sensing, AI, and mobile applications in disaster management and risk reduction.
- To enable learners to assess disaster vulnerability and risk using established models and to design community-based mitigation and response plans.

Unit-I: Current Issues **Hours: 15**

Governance and policy. Local, national, and global legislation for DRR. National policy and Plan. Disaster Management Act. Disaster Management Authorities: NDMA, SDMA, NDRF, etc. Yokohama Declaration, Hyogo Framework for Action, Sendai framework for DRR and its mid-term review. Framework for integrating climate change adaptation into DRR. Community awareness, education, and training programs. Disaster research, and mitigation funding, resources, and risk transfer.

Unit-II: Advances in Disaster Risk Reduction (DRR) **Hours: 15**

Hazards and its classification – Geological (Earthquakes, and Landslides), Hydro-meteorological (Floods, Glacier Lake Outburst Floods, Droughts, and Snow Avalanches, Climatological (long-term climate variability), etc. Various strategies in DRR. Vulnerability- types and assessment. Role of Early Warning System (EWS) in DRR. Critical infrastructure and resilience.

Unit-III: Technological Innovations in DRR **Hours: 15**

Applications of Geographic Information System (GIS) and remote sensing in DRR. Mobile technology for real-time disaster information dissemination. Utilization of drones for disaster assessment and relief operations. Artificial Intelligence (AI), and Machine Learning (ML) in DRR. Global Positioning System (GPS) Navigation.

Unit-IV: Disaster Vulnerability and Risk Assessment **Hours: 15**

Vulnerability assessment models: Social Vulnerability Index (SoVI), Climate Vulnerability Index (CVI), and Community-Based Risk Assessment (CBRA). Disaster Risk Index (DRI), and Disaster Environmental Matrix (DEM). Multi-hazard disaster mitigation plans. Decision Support Systems (DSS). Development of disaster risk assessment, management & response plans at community levels.

Books Recommended/Readings:

1. Longley, P.A. (2010). Geographic Information Systems and Sciences, John Wiley & Sons Ltd.
2. Keller, E.A., & Blodgett, R.H. (2008). Natural hazards. Pearson Prentice Hall. 488p.
3. Schowengerdt, R.A. (2007). Remote Sensing: Models and Methods for Image Processing.
4. Edwards, B. (2005). Natural Hazard. Cambridge University Press, UK.
5. Stallings, R.A. (2001). Methods of Disaster Research, Xlibris Corporation, 528p.
6. Izumi, T., Shaw, R., Djalante, R., Ishiwatari, M., & Komino, T. (2019). Disaster risk reduction and innovations. Progress in Disaster Science, 2, 100033.

Paper-IV
(Research Centric Course)

Research Communication		Centre for Disaster Risk Reduction		
Course Code	**Credits**	**Course Type**	**L-T-P-S**	**Max. Marks**
DRR903C	**02 (30 Hours)**	**Research Centric**	**0-2-0-0**	**50**

Course objective and outcome:

- To critically review and synthesise published literature in the chosen field of study.
- To identify research gaps and formulate clear research questions and objectives.
- To develop a detailed and methodologically sound research proposal.
- To enhance academic communication skills through presentations, discussions, and seminar delivery.

Unit-I: Review of published literature **Hours: 15**

Preparation of a comprehensive and critical review of the published literature in the proposed field of study, and the same may be submitted to a refereed/reputed journal as notified by UGC. Also, developing a detailed research proposal related to the chosen research topic.

Unit-II: Presentation/Group discussion **Hours: 15**

Weekly presentation/group discussion on the chosen topic, providing formative feedback on the aims and objectives of the proposed research problem.

Final Evaluation

The candidate will be evaluated based on a comprehensive report submission, weekly presentation/group discussion, and a final seminar to be delivered at the end of the PhD. Coursework semester.

Marks Distribution:

- Assignment/Attendance = 10 Marks
- Write-up = 15 Marks
- Presentation = 25 Marks

Paper-V
(Discipline Centric Elective (E) Course)

Seismology & Earthquake Engineering		**Centre for Disaster Risk Reduction**					
Course Code	Credits	**Course Type**	L	T	P	S	**Max. Marks**
DRR904E	**02 (30 Hours)**	**Elective**	**2**	**0**	**0**	**0**	**50**

Course objective and outcome:

- To understand the fundamental mechanisms of earthquakes, including faulting, plate tectonics, and rupture dynamics, with a focus on historical and recent case studies.
- To explore seismic hazard assessment, earthquake engineering principles, and mitigation strategies, including earthquake-resistant designs and retrofitting techniques.
- Students will gain an understanding of earthquake mechanisms, historical seismicity, and the impacts of significant earthquakes, enabling informed hazard analysis.
- Students will develop skills to assess seismic risks, propose mitigation strategies, and apply engineering solutions for building resilience against earthquakes.

Unit-I: Earthquake Mechanism **Hours: 15**

Earthquake Basic Terminology. Earthquake types and mechanisms, faults, and plate tectonics. Stress and strain in the Earth's crust. Active tectonics, faulting, and slip rates. Paleo-seismology and prehistoric earthquake dating. Earthquake cycle and rupture dynamics. Case studies of some devastating earthquakes in the recent past: 2004 Japan Earthquake, 2005 Kashmir Earthquake, 2015 Nepal Earthquake, & 2024 Turkey Earthquakes. Historical Background of Earthquakes in Jammu and Kashmir.

Unit-II: Earthquake Engineering **Hours: 15**

Seismicity of the northwest Himalaya, and seismic hazard assessment. Seismic shaking, liquefaction-induced features, and liquefaction susceptibility. Seismically induced landslides, Glacial Lake Outburst Floods (GLOFs), and snow avalanches. Earthquake prediction, micro-seismic zonation, and early warning systems. Earthquake engineering: earthquake-resistant structures and retrofitting of existing structures. Traditional Construction Practices.

Books Recommended/Readings:

1. Shearer, P.M. (2019). Introduction to Seismology. Cambridge University Press.
2. Burbank, D.W., & Anderson, R.S. (2013). Tectonic geomorphology. John Wiley & Sons.
3. Dowrick, D.J. (2009). Earthquake Resistant Design and Risk Reduction. Wiley.
4. Stein, S., & Wysession, M. (2003). An Introduction to Seismology, Earthquakes, and Earth Structure. Blackwell Publishing.
5. Lee, W.H.K., Kanamori, H., Jennings, P.C., & Kisslinger, C. (2003). International Handbook of Earthquake and Engineering Seismology. Academic Press.
6. Scholz, C.H. (2002). The Mechanics of Earthquakes and Faulting. Cambridge University Press.
7. Keller, E.A., & Pinter, N. (1996). Active tectonics (Vol. 338). Upper Saddle River, NJ: Prentice Hall.
8. Reiter, L. (1990). Earthquake Hazard Analysis: Issues and Insights. Columbia University Press.
9. McCalpin, J.P., & Nelson, A.R. (2009). Introduction to paleoseismology. International Geophysics, 95, 1-27.

Paper-VI

(Discipline Centric Elective (E) Course)

Flood Risk Management		Centre for Disaster Risk Reduction		
Course Code	**Credits**	**Course Type**	**L-T-P-S**	**Max. Marks**
DRR905E	**02 (30 Hours)**	**Elective**	**2-0-0-0**	**50**

Course objective and outcome:

- To provide a comprehensive understanding of flood types, causes, hydrodynamics, and their impacts, with a focus on flood vulnerability and water management.
- To train students in flood risk mapping, mitigation strategies, and the application of structural and non-structural measures for flood hazard reduction.
- Students will develop the ability to analyse flood causes and impacts, apply hydrological concepts, and assess vulnerability using historical and contemporary case studies.
- Students will gain expertise in geospatial applications, engineering solutions, and policy-driven approaches to flood risk management, contributing to sustainable urban planning and infrastructure resilience.

Unit-I: Introduction to Floods **Hours: 15**

Floods, types, and their causes: rainfall-runoff processes, topography, gradient, lithology, and climate. River hydrodynamics. Urban hydrology and flooding. Flash floods – climate change, precipitation extremes, dam or levee failure. Flood frequency analysis. Urban planning. Vulnerability of Kashmir to Floods- causes and consequences. Water management. Historical perspective of significant flood events. Case study of Kashmir 2014 flood.

Unit-II: Flood Hazard Impacts & Risk Reduction **Hours: 15**

Physical, socio-economic, and environmental impacts of floods. Application of geospatial technology in flood risk mapping. Engineering solutions of flooding: **s**tructural measures (dams, levees, floodwalls), and non-structural measures (land-use planning, flood forecasting). Interdisciplinary approaches for flood risk reduction. Smart cities and management of river channels. International frameworks and policies. Implications of flooding on infrastructure e.g., hospitals, schools, airports, hotels, shopping malls.

Books Recommended/Readings:

1. Hegger, D.L.T., Driessen, P.P.J., & Bakker, M.H.N. (2016). Flood Risk Management in Europe: Innovation in Policy and Practice. Springer.
2. Wisner, B., Gaillard, J.C., & Kelman, I. (2012). Handbook of Hazards and Disaster Risk Reduction and Management. Routledge.
3. Beven, K. (2012). Rainfall-Runoff Modelling: The Primer. Wiley.
4. Plate, E.J. (2002). Flood Risk and Flood Management. Journal of Hydrology.
5. Smith, K., & Ward, R. (1998). Floods: Physical Processes and Human Impacts. Wiley.
6. Penning-Rowsell, E., & Fordham, M. (1994). Floods Across Europe: Flood Hazard Assessment, Modelling, and Management. Middlesex University Press.
7. Romshoo, S. A., et. Al., (2018). Climatic, geomorphic and anthropogenic drivers of the 2014 extreme flooding in the Jhelum basin of Kashmir, India. Geomatics, Natural Hazards and Risk, 9(1), 224-248.

Paper-VII
(Discipline Centric Elective (E) Course)

Landslide Hazard Assessment		Centre for Disaster Risk Reduction		
Course Code	**Credits**	**Course Type**	**L-T-P-S**	**Max. Marks**
DRR906E	**02 (30 Hours)**	**Elective**	**2-0-0-0**	**50**

Course Objective and Outcome:

- To provide an in-depth understanding of landslide processes, classification, dynamics, and impacts, while introducing slope stability concepts and analysis.
- To train students in advanced techniques for landslide hazard and risk assessment, including remote sensing, GIS, and monitoring methods.
- Students will be able to identify, analyse, and classify landslides, assess their socio-economic and environmental impacts, and apply slope stability principles.
- Students will acquire the skills to develop hazard maps, implement monitoring techniques, and propose effective mitigation measures for landslide-prone areas.

Unit-I: Introduction to Landslides **Hours: 15**

Landslides: Classification, causes and triggering factors (geological, hydrological, etc). Mass movement dynamics and types of failures (rotational, translational, and flow). Slope stability concepts and analysis (shear strength, and pore water pressure). Socio-economic and environmental impacts of landslides.

Unit-II: Landslide Risk Assessment **Hours:15**

Techniques for hazard mapping: Experimental, statistical, and deterministic approaches. Use of remote sensing and GIS in landslide susceptibility mapping. Quantitative and qualitative methods of risk assessment. Structural and non-structural mitigation measures. Landslide early warning systems and monitoring networks. Monitoring techniques for landslide-prone areas (Ground-based monitoring and remote sensing techniques; LiDAR, SAR Interferometry).

Books Recommended/Readings:

1. Hungr, O. (2018). A review of landslide hazard and risk assessment methodology. Landslides and engineered slopes. Experience, theory and practice, 3-27.
2. Glade, T., Anderson, M.G., & Crozier, M.J. (Eds.). (2005). Landslide hazard and risk (Vol. 807). Chichester: Wiley.
3. Abramson, L.W., Lee, T.S., Sharma, S., & Boyce, G.M. (2001). Slope stability and stabilization methods. John Wiley & Sons.
4. Martinsen, O. (1994). Mass movements. In The geological deformation of sediments (pp. 127-165). Dordrecht: Springer Netherlands.
5. Dai, F. C., Lee, C. F., & Ngai, Y. Y. (2002). Landslide risk assessment and management: an overview. Engineering geology, 64(1), 65-87.

Paper-VIII
(Discipline Centric Elective Course)

Risk Assessment of Potentially Toxic Elements		Centre for Disaster Risk Reduction		
Course Code	**Credits**	**Course Type**	**L-T-P-S**	**Max. Marks**
DRR907E	**02 (30 Hours)**	**Elective**	**2-0-0-0**	**50**

Course objective:

- To develop advanced knowledge of the geochemistry, mobility, bioavailability, and sources of Potentially Toxic Elements (PTEs) and emerging contaminants in environmental systems.
- To provide theoretical and practical understanding of ecological and human health risk assessment, source apportionment, and remediation strategies.

Course Outcomes:

- Analyze the geochemical behavior and spatial distribution of PTEs and apply statistical and modelling tools for source identification and risk evaluation.
- Conduct deterministic and probabilistic health risk assessments and recommend appropriate mitigation and remediation strategies based on scientific evidence.

Unit-I: Introduction to Potentially Toxic Elements **Hours: 15**

Concept and classification of trace elements. Potentially Toxic Elements (PTEs). Identifying contamination sources; geogenic and anthropogenic. Spatial distribution maps for visualizing pollutant hotspots. Soil and water quality limits. Bioavailability, bioaccumulation, and biomagnification. Occurrence, industrial production, uses, and potential for human exposure. Techniques for remediation of contaminated soils/sediment, and water, including bioremediation and ecosystem-sustainable approaches. Analytical techniques such as XRF, ICP-MS, AAS, and DMA for quantitative measurements of PTEs.

Unit-II: Risk Assessment of PTEs **Hours: 15**

Conceptual framework of PTEs risk assessment. Assessment of soil/sediment and water contamination. Trends in temporal and spatial distribution of PTEs. Pollution indices; Contamination Factor (CF), Enrichment Factor (EF), Ecological Risk Index (ERI), Toxic Risk Index (TRI), Geo-accumulation Index (Igeo), Pollution Load Index (PLI), Potential Ecological Risk Index (PERI), and toxicity response factors. Human exposure pathways. Non-carcinogenic and carcinogenic risk assessment; Hazard Quotient (HQ), Hazard Index (HI), Carcinogenic Risk (CR) using USEPA models. Geochemical modelling; Receptor model such as Positive Matrix Factorization (PMF); Probabilistic or uncertainty-based health risk assessment model. Risk mitigation strategies, policy implications, and regulatory frameworks.

Books Recommended/Readings:

- Verma, D., Verma, C., & Mahish, P.K. (Eds.) (2023). Heavy Metals in the Environment: Management Strategies for Global Pollution (Vol. 1456). American Chemical Society.
- Kumar, V., Sharma, A., & Cerda, A. (2020). Heavy Metals in the Environment: Impact, Assessment, and Remediation (1st ed.). Elsevier.
- Siegel, F.R. (2014). Environmental Geochemistry of Potentially Toxic Metals. Springer.
- Gupta, R., & Gupta, R.K. (2012). Trace Elements: Environmental Sources, Geochemistry and Human Health (Chemical Engineering Methods and Technology). Springer.
- Mir, I.A. (2025). Micronutrients and contaminants in the grazing and agricultural soils of Kashmir Valley, India. Nature Scientific Reports 15, 10949.