

POSTGRADUATE INSTITUTE OF SCIENCE (PGIS)
UNIVERSITY OF PERADENIYA, SRI LANKA



M.Sc. in Disaster Management

*(Conducted jointly by the PGIS and the Faculty of Engineering,
University of Peradeniya)*

Collaborating Institutions:

1. International Institute for Geo-Information Science and Earth Observation (ITC), The Netherlands
2. Asian Disaster Preparedness Center (ADPC), Thailand
3. Pacific Disaster Center, Hawaii, USA

1. INTRODUCTION

During the last few decades, of the many natural hazards that are prevalent Sri Lanka, floods, landslides, droughts, cyclones and lightning have occurred more frequently causing severe damage to life and property. This situation has created an awareness among policymakers that disaster management should emphasize risk identification and mitigation rather than the commonly practiced relief-oriented approach. The subject of disaster management has now assumed prime importance particularly in view of the devastating December 26, 2004 tsunami that killed tens of thousands of people and destroyed several thousands of dwellings and other buildings.

Over the past five years, with the functioning of the Disaster Management Centre (DMC) under the Ministry of Disaster Management and Human Rights, disaster management infrastructure with an “All Hazards” approach has gradually got established. The capacity building process has been active at provincial, district and divisional administration levels, particularly in landslide- and flood-prone areas. More recently these efforts are being directed also in tsunami affected areas. Short-term training and awareness programs are being periodically conducted by the DMC covering natural, technological and human-induced disasters.

This M.Sc. Programme proposes a value adding philosophy that allows graduates with different backgrounds to gain a focused understanding of disaster management and mitigation. The strategy is to train a broad base of professionals from diverse sectors that can integrate risk reduction appropriately in their practices. It also actively models the interdisciplinary aspect across natural, physical and social sciences as well as between practitioners and researchers. The programme reflects the notion that effective disaster management is an inter-sectoral activity requiring knowledge from a wide range of disciplines. These include an understanding of hazard processes, an appreciation of

governance, poverty and household livelihoods as well as cognizance of health and illness on development potentials. The programme has, as its long term objective, the sustainable training of well accomplished professionals who would be available to carry out a range of activities related to hazard, vulnerability, risk analysis and mitigation. This applies irrespective of whether they work in the state sector, private sector, nongovernmental organizations or research institutions. A possible outcome with wide-reaching consequences would be the appreciation that skilled professionals who can contribute to the effectiveness of disaster risk and its management. Their skills achieved in participatory risk assessment techniques, forecasting methods, environmental management and GIS applications should indeed satisfy the aspirations of Sri Lanka's Disaster Management Act approved by the Parliament.

2. PROGRAMME ELIGIBILITY

Candidates should be proficient in English which will be the medium of instruction for the programme. The minimum requirements for enrolment

- (a) Bachelor's degree, preferably in science-based disciplines.

Those applicants possessing a bachelor's degree in Arts / Humanities should have at least 5 years of experience in disaster management activities, particularly in floods, landslides and tsunami affected and drought stricken areas **or** should have completed at the Bachelors degree level, a substantial component of the above activities.

OR

- (b) any other equivalent qualifications acceptable to the Postgraduate Institute of Science (PGIS).

3. PROGRAMME FEE

(N.B. The programme fees given below may be revised.)

	M.Sc. programme fee
local candidates	Rs. 160,000/-
foreign candidates	Rs. 320,000/-

Students registered for the M.Sc. degree shall pay the Programme fee in full or in two (*1/2 at the registration and the balance at the end of the first semester*) or three (*1/3rd at the registration, another 1/3rd after 4 months from the date of registration and the balance after 8 months from the date of registration*) installments. Other payments including registration fee, medical fee, library subscription, examination fee and deposits (science and library) should be paid according to the procedure stipulated by the PGIS. (N.B. The Programme fees given above may be revised as per recommendation of the Board of Management of the PGIS.)

4. THE PROGRAMME STRUCTURE AND DURATION

This is a full-time programme consisting of course work and a research project. Course work will be conducted over a period of two semesters of 15 - weeks each which will involve about 12 months. The entire programme duration will be about 15 - 18 months inclusive of further 3 - 6 months for the research project. Satisfactory completion of a minimum of 24 credits of course work (with a GPA of not less than 3.00) is required for the programme in addition to the 6 credits allocated for the full-time research project (*The student who does not satisfy the above criteria but obtains a GPA in the range 2.75 to 2.99 for course work is eligible for the Diploma in Disaster Management but not the M.Sc. Degree*). Continuous attendance is compulsory during the period of research work. After successful completion of the research project, the student is eligible for the award of the M.Sc. Degree.

Programme Summary

<i>Course Code</i>	<i>Course Title</i>	<i>Lecture hrs.</i>	<i>Practical hrs.</i>	<i>No. of Credits</i>
Preliminary courses				
ESD 401	Preliminary Courses in Earth Sciences	15	-	-
ESD 402	Preliminary Courses in Climate Sciences	15	-	-
ESD 403	Preliminary Courses in Engineering	15	-	-
ESD 404	Computer Applications	15	-	-
ESD 405	Statistics Applications	15	-	-
General courses				
Semester I				
ESD 501	Introduction to Disaster Management	15	-	1
ESD 502	Risk Determination and Treatment	15	-	1
ESD 503	Disaster Preparedness and Emergency Management	30	-	2
ESD 504	Social, Cultural, and Administrative Aspects	30	-	2
ESD 505	Application of GIS and RS in Disaster Management	30	-	2
ESD 506	Landslides I: origin, occurrence and mitigation*	30	-	2
ESD 507	Seismic Hazards*	30	-	2
ESD 508	Coastal Hazards*	30	-	2
ESD 509	Hydrological Hazards*	30	-	2
Semester II				
ESD 510	Meteorological (Climatological) Hazards*	30	-	2
ESD 511	Industrial Hazards*	30	-	2
ESD 512	Fire Hazards*	30	-	2
ESD 513	Public Health and Biological Hazards*	45	-	3
ESD 514	Agriculture and Veterinary Hazards*	30	-	2
Specialized courses				
ESD 520	Executive Leadership and administrative skills*	30	-	2
CE 668	Hazard Forecasting and Mitigation*	30	-	2
CE 638	Urban/ Rural Planning and Hazard Mapping*	30	-	2
CE 669	Advanced Course on Landslides and Seismic Hazards*	30	-	2
CE 697	Advanced Course on Coastal and Hydrological Hazards*	30	-	2

CE 639	Design of Structures for Cyclones and High Winds*	15	-	1
CE 698	Mitigation of Industrial Hazards*	15	-	1
ESD599/C E699	Research Project			6

Preliminary courses are compulsory for those without sufficient background knowledge and they are not considered in the computation of the GPA.

CE 6XX courses will be offered by the Faculty of Engineering, University of Peradeniya.

** Optional courses*

Candidates are required to take 8 credits from compulsory General Courses and the balance 16 credits from optional General/Specialized courses.

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5. PROGRAMME CONTENTS

Preliminary courses

ESD 401: Preliminary Courses in Earth Sciences (1 credit)

Earth's structure and composition, development of continents and oceans, Theory of Plate Tectonics, Introduction to rocks and minerals, rock cycle, different types of rocks and their modes of formation; Methods of identification of rocks and minerals; Geology of Sri Lanka.

ESD 402: Preliminary Courses in Climate Sciences (1 credit)

Introduction to Climatology and Meteorology. Tropical cyclones, tornadoes, storms, hurricanes, droughts, thunderstorms and lightening

ESD 403: Preliminary courses in Engineering (1 credit)

Forces and Equilibrium, Stresses and Strains, Strength and Failure, Dynamics, Momentum, Hydrostatics, Water Flow, Materials and their Engineering Behaviour, Engineering Solutions, Engineering Design and use of Codes of Practice

ESD 404: Computer Applications (1 credit)

Introduction to computers, Windows and Disk operating system and commands. Microsoft applications; Computer software applications depending on the requirements of the programme.

ESD 405: Statistics Applications (1 credit)

(1 Credit: Lectures and Laboratory)

Population and sample; Measures of central tendency and dispersion; Sampling distribution of mean; Introduction to probability; The Z distribution and calculation of probabilities; Principles of hypothesis testing, Type I and II errors, power of test; Two sample paired and non-paired 't' test; Simple linear regression and correlation; Analysis of 2-dimensional categorical tables (chi-square test).

General courses

ESD 501: Introduction to Disaster Management (1 credit)

Mitigation, preparedness, response, relief, recovery and reconstruction. Perception and Identification of risk: Concept of risk and risk terminology. Applications to various situations. Sources of risk data, Risk Management tools. Hazard analysis, Vulnerability Mapping, Statistical techniques, Qualitative Methods.

ESD 502: Risk Determination and Treatment (1 credit)

Fundamental principle relating to loss presentation. Relevant legal structures on-site Emergency Planning and Procedures. Preparing for Emergencies, providing first aid and coping emotionally; Introduction of Risk Analysis techniques, Treatment Criteria including costing methods

ES 503: Disaster Preparedness and Emergency Management (2 credits)

History of Sri Lankan Disaster Management Systems, Disaster Management concepts and principles. Community Awareness and Education. Disaster Planning. Human response to disaster. Current issues and trends in emergency management; Personal effectiveness in relationship management at the workplace; Logistics and evacuation as a key component of emergency management. Legal implications. Logistical support such as medical needs, housing etc. Responsibilities of government/private sector in emergency management and disaster recovery. Community needs. Areas of vulnerability, cultural and social impacts. Tools in the evaluation and assessment of economic recovery. Environmental factors inhibiting recovery .

ESD 504: Social, Cultural and Administrative Aspects (2 credits)

Investigation of basic socio-cultural causes and reasons. Different aspects of human casualties in disasters. Demographic considerations. Inventorying of socio-cultural properties of the impact areas lands, boundaries, trees, animal resources etc. Impact of disaster on anthropological aspects. Sociological studies on the family unit, extended family, single parent family etc.

ESD 505: Applications of GIS & Remote Sensing in Disaster Management (2 credits)

Overview of concepts of Remote Sensing (RS) technology. Visual interpretation of aerial photographs and satellite imagery for landuse, land pattern analysis, geological and structural analysis etc.) Basics of photogrammetry. Overview, history and concepts of GIS; Scope and application areas. Mapping Concept and Map/Projection Data Structure, Input of geospatial data. Concept of Spatial data base. Data acquisition, manipulation and analysis. Introduction to GPS and basic concepts. Integration of RS, GIS techniques and thematic map data and interpretation.

ESD 506: Landslides (2 credits)

Understanding of geological causes, types and processes of slope movement, engineering methods for slope stabilization and mitigation. Landslide risk analysis using Remote Sensing, GIS and other techniques. Preparation of landslide hazard zonation maps. Identification of safe sites for new construction with community participation. Awareness programmes for the community.

ESD 507: Seismic Hazards (2 credits)

Geology of Earthquakes. Seismological studies and surveys. What causes earthquakes and ground-shaking. Economic impact of ground-shaking. How to reduce losses from ground-shaking. Surface faulting and effects. Landslides and liquefaction triggered by earthquakes. Can earthquakes be predicted? Earthquake resistant constructions.

Geology of volcanism. Seismological studies and surveys. Different kinds of volcanic eruptions. Hazards from Volcanic eruptions. Frequency of occurrence. Forecasting of volcanism. Reduction of losses from volcanic activity.

ESD 508: Coastal Hazards (2 credits)

Causes, locations, modes of occurrence of different coastal hazards such as Tsunamis, Storm Surges, Erosion. Their origins, occurrence, and mitigation. Social and economic impacts of tsunamis. Historical records of tsunamis. Construction of tsunami walls, levees etc. Mitigation of their effects. Tsunami Early Warning Systems, Awareness programmes and Drilling exercises: Identification of safe evacuation routes. Modelling studies for Tsunami predictions.

ESD 509: Hydrological Hazards (2 credits)

Hazards from floods, causes of flooding. Dam failures, flash flooding, riverine floods and tidal floods. Their causes, physical characteristics and locations of occurrence. Mitigation procedures.

Droughts: Climatological and human-induced causes. Identification of water supplies in drought-stricken areas. Methods of rain-water harvesting. Awareness programmes.

ESD 510: Meteorological Hazards (2 credits)

Cyclones, genesis, dynamics, products and forecasting;

Atmospheric instability, thunderstorms, products of thunderstorms, cloud electrification, ground and cloud discharge (lightening), types of lightening, energy and hazards, precautions against lightning, Lightning Protection Systems (including lightning conductor).

Tornado, waterspout, downdraughts, updraughts, microburst, gust fronts, hazards,

Meteorites, characteristics, movements. Planetary activities, Solar system, Radiation intensity, global circulation and energy transfer, diurnal and monthly variation of atmospheric pressure leading to weather change. Climate Change/Global Warming: Origin, occurrence, forecasting and mitigation.

ESD 511: Industrial Hazards (2 credits)

Accidents in factories and nuclear power stations. Protection against contamination of the environment from radioactive fallout and leaking of toxic chemicals. Industrial pollution, effluent contamination and acid rain. Monitoring and protective measures. Safe toxic waste disposal technologies.

ESD 512: Fire Hazards (2 credits)

Fires due to natural, technological and human-induced causes. Bush fires: control and safety measures, evacuation, fire fighting procedures and relevant training programmes and drills.

ES 513: Public Health and Biological Hazards (3 credits)

Outbreak of Dengue and Malaria epidemics, contagious diseases e.g. AIDS. Protection and awareness. Ground water contamination; Water-borne diseases affecting bowels/kidney. Human disasters due to air accidents and bomb explosions - development of field disaster victim identification capability and enhancement of forensic and pathology capabilities.

ES 514: Agricultural and Veterinary Hazards (2 credits)

Locust outbreaks and their management. Brown plant hopper attacks in paddy, Foreign animal and plant species invasion, monitoring/forecasting. Coconut mite and beetle attacks. Salt water intrusion into crop fields. Remedial measures. Birds' Flu epidemics and protection and awareness measures. Foot and Mouth/Mad Cow disease. Educating Farmers.

Specialized courses

ESD 520: Executive Leadership and administrative skills (2 credits)

Leadership qualities, capacity and decision making skills, problem solving skills, executive management to meet the needs of police, law enforcement and public safety organisations; Analysis of policing and public safety from a strategic leadership perspective, and the impact of economic, social and technological issues; understanding of the strengths and weaknesses of leadership styles.

CE 668: Hazard Forecasting and Mitigation (2 credits)

Hazard Forecasting and Early Warning Systems: Introduction and historical background, Forecasting techniques, Stochastic modelling of natural and man-made hazards, Reliability analysis involving random loads (exposure) and resistances (vulnerability), Extreme-value probability models, Early warning systems: requirements, reliability, level of penetration, human response, communication.

Engineering Interventions for Hazard Mitigation: Prevention, Vulnerability assessment, Evaluation of failure modes, Vulnerability reduction, Disaster-resistant construction techniques, Structural mitigation measures for tsunamis and storm surges, Flood damage mitigation techniques, Earthquake-resistant structures, Slope stability, Rehabilitation and Re-construction, Technologies for post-disaster repair of lifeline damage.

CE 638: Urban/ Rural Planning and Hazard Mapping (2 credits)

Integration of hazard loss considerations in urban infrastructure planning, Facilities location and planning, Hazard mapping and zoning, Building regulations, Building codes, Performance standards, Shelters, Evacuation route planning.

Practice of Disaster Management: How disaster mitigation is practised in different institutions within the country and outside will be discussed; this will also include presentation of case studies covering all hazards.

CE 669: Advanced Course on Landslides and Seismic Hazards (2 credits)

Pre-requisites: ESD 506 Landslides and ESD 507 Seismic Hazards

Basic characteristics of local soils/rocks, Permeability and seepage, Effective stress and shear strength, Mechanism and classification of landslides, Stability analyses, Preventive, control, and remedial measures.

Seismic zonation, Seismic risk analysis, Soil liquefaction, Performance of infrastructure, Lifeline earthquake engineering.

CE 697: Advanced Course on Coastal and Hydrological Hazards (2 credits)

Pre-requisites: ESD 508 Coastal Hazards and ESD 509 Hydrological Hazards

Wave theories, Coastal environment and Coastal processes, Mechanics of nearshore sediment transport, Hydrodynamics of tsunamis and storm surges, Numerical modelling of tsunamis and storm surges, Marine Pollution, Salinity intrusion, Oil slicks, Impact of sea level rise.

Hydrological data analysis: extreme rainfall and runoff prediction, flood frequency analysis, flood flow regulation, real-time flood forecasting.

General one-dimensional equations for unsteady flows: one-dimensional river flood routing, surge waves in canals, dam-break flood waves.

Flood hazard and inundation modelling, urban flooding, flood control, Two-dimensional kinematic and diffusion wave models, contaminant transport modelling in surface and subsurface flow.

CE 639: Design of Structures for Cyclones and High Winds (1 credit)

Pre-requisite: ESD 510 Meteorological Hazards

Effect of wind forces on buildings and other structures, Assessment of wind pressure, Requirements for structural adequacy, Use of design codes for wind resistant design of masonry, steel and timber structures, Improve resistance to cyclones and high winds; foundations, walls, frames and roofs.

CE 698: Mitigation of Industrial Hazards (1 credit)

Pre-requisite: ESD 511 Industrial Hazards

Hazard analysis at the design stage, Planning and Preparation of Response, Contingency plans for hazardous waste generators, Pollution incident prevention plan, Spill prevention, Control and countermeasure plan, Containment of hazardous spills, Sources of information.

ESD 599/CE 699: Research Project

Each candidate is required to conduct and complete a research project falling within the discipline of disaster management under the guidance of a supervisor. They are expected to submit a project report and conduct a seminar which will both be evaluated.

6. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Handbook.

7. PANEL OF TEACHERS

- Prof. S. B. S. Abayakoon, Dept. of Civil Engineering, University of Peradeniya
B.Sc.Eng. (Perad.), M.A.Sc., Ph.D. (British Columbia), CEng, MIE SL
- Mr. K. R. Abeyasinghe, Director, Dept. of Meteorology, Baudhaloka Mw., Colombo 07
B.Sc. (Perad.), M.Sc. (Reading), M.Phil. (Colombo)
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- Dr. K. Arulananthan, NARA, Crow Island, Mattakuliya, Colombo 15
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- Dr. S. D. Dewasurendra, Dept. of Computer Engineering, University of Peradeniya
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- Prof. M. A. K. L. Dissanayake, Chairman/Board of Study - Sc.Ed., Dept. of Physics,
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8. PROGRAMME COORDINATOR

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