Tribhuvan University

Institute of Engineering

Pulchowk, Lalitpur

Course Structure 2024

MSc in Disaster Risk Engineering and Management

Year : I **Part I**

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCEDR501	Principles of Disaster Risk Reduction and Management	4	40	3	60	100	
2	ENCEDR502	Landslide Risk Engineering and Management	4	40	3	60	100	
3	ENCEDR503	Flood Risk Engineering and Management	4	40	3	60	100	
4	ENCEDR504	Earthquake Risk Engineering and Management	4	40	3	60	100	
Total			**16**	**160**	**-**	**240**	**400**	

Year : I **Part II**

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCEDR551	Post Disaster Assessment and Response Planning	4	40	3	60	100	
2	ENCEDR552	Frontier Technologies in Disaster Risk Engineering and Management	4	40	3	60	100	
3	ENCEDR56X	Elective-I	4	40	3	60	100	
4	ENCEDR57X	Elective-II	4	40	3	60	100	
Total			**16**	**160**	**-**	**240**	**400**	

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Course Structure 2024

MSc in Disaster Risk Engineering and Management

Year : II **Part I**

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCEDR61X	Elective -III	4	40	3	60	100	
2	ENCEDR62X	Elective -IV	4	40	3	60	100	
3	ENCEDR601	Project	4	100	-		100	
Total			**12**	**180**	**-**	**120**	**300**	

Year: II **Part II**

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCEDR651	Thesis	16	100	-	-	100	

Note: Students will write a thesis in the fourth semester. However, the thesis work must start from the beginning of third semester, which may be associated to the project work. Students can carry out the research thesis with one or more supervisors.

Elective Courses

Elective courses will be offered as per the availability of resource persons. The lists of electives are as follows:

Elective I

1 Multi Hazard Risk Assessment and Early Warning System [Code: ENCEDR561]
2. Climate Change Adaptation and Disaster Risk Reduction [Code: ENCEDR562]
3. Mountain Risk Engineering [Code: ENCEDR563]
4. Natural Hazard Triggered Technological Accident [Code: ENCEDR564]

Elective II

1. Post Disaster Water Sanitation and Hygiene [Code: ENCEDR571]
2. Urban Disaster Risk Engineering and Management [Code: ENCEDR572]
3. Disaster Risk Financing [Code: ENCEDR573]
4. Vulnerability and Risk Analysis [Code: ENCEDR574]

Elective III

1. Fire Protection and Safety Engineering [Code: ENCEDR611]
2. Emergency Logistics and Telecommunication Engineering [Code: ENCEDR612]
3. Disaster Risk Management of Cultural Heritage [Code: ENCEDR613]
4. Structural Health Monitoring [Code: ENCEDR614]
5. Seismic Risk Assessment and Retrofitting [Code: ENCEDR615]

Elective IV

1. Socio-economic Aspect of Disaster Management [Code: ENCEDR621]
2. Ecosystem-based Disaster Risk Management [Code: ENCEDR622]
3. Integrated Disaster Risk Planning and Management [Code: ENCEDR623]
4. Anticipatory Action and Shock Responsive Social Protection [Code: ENCEDR624]

Further Explanation about Project and Thesis works

The project and thesis component theme could be one of the following:

- Industrial/organizational problem assessment (Mainly done at industry/organization)
- Community based problem assessment (Mainly done at community)
- Literature based problem assessment (Mainly done at institution)
- Analytical or experimental or prototype based problem assessment (Mainly done at institution)
- Case study based problem assessment (Mainly done at case specific site)

- Field work based problem assessment (Mainly done at specific site)
- Any other relevant and deemed suitable by department
- The project component will be of approximately 3 months (Full - time) duration

Eligibility and Degree Award

Eligibility: **BE in Civil Engineering**

Degree Award: **MSc in Disaster Risk Engineering and Management (Civil Engineering)**

PRINCIPLES OF DISASTER RISK REDUCTION AND MANAGEMENT

ENCEDR501

Credits: 4 **Year: I** **Part: I**

Course Objectives

The objective of this course is to deliver the fundamental principles and developments of disaster risk reduction and management, analyze the global and national frameworks for disaster risk reduction, integrate disaster risk reduction principles into various sectors and development planning, and evaluate effectiveness of disaster risk reduction strategies through case studies.

1 Introduction [12 hours]

1.1 Concept and terminologies
1.2 Disaster management cycle: Prevention, mitigation, preparedness, response, and recovery
1.3 Historical evolution of disaster risk reduction principles and practices

2 Disaster Governance [12 hours]

2.1 International framework, laws and treaties
2.2 Disaster management act, plans, policies and frameworks in Nepal
2.3 Institutional arrangement for disaster management in Nepal
2.4 Mainstreaming disaster risk reduction into sectoral policies and plans

3 Tools and Techniques of Disaster Risk Management [12 hours]

3.1 Hazard, vulnerability and risk assessment tools
3.2 Remote sensing and geographic information system
3.3 Early warning systems, simulation, and modelling tools
3.4 Innovative technologies for disaster risk reduction: Unmanned Aerial Vehicle (UAV), Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR)

4 Sectoral Approaches to Disaster Risk Reduction [12 hours]

4.1 Gender-sensitive and inclusive approaches to disaster risk reduction
4.2 Agriculture and food security; Forests, biodiversity, and watershed conservation; Disaster risk reduction and management; Health, drinking water and sanitation; Industry, transport, and physical infrastructure; Rural and urban settlements; Tourism, natural and cultural heritage; Water resources and energy
4.3 Community based early warning system in Nepal

5 Integration of Disaster Risk Management in Development Planning [12 hours]

5.1 Importance of integrating disaster risk management into development planning

5.2 Incorporating risk assessment in planning process
5.3 Resilience through integration of sustainable development and community-based disaster risk management
5.4 Principles of disaster risk financing in development planning

Assignments

1. A review of disaster risk management plan and policies
2. Analysis of disaster risk drivers in selected cases
3. Evaluation of disaster risk reduction strategies through case studies

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	12	12
2	12	12
3	12	12
4	12	12
5	12	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Wisner B., Blaikie P., Cannon T., Davis I. (2004). At Risk: Natural Hazards, People's Vulnerability and Disasters, (2nd Edition) Routledge
2. UNDRR (2015). Sendai Framework for Disaster Risk Reduction 2015-2030.
3. Venton, P., Hansford B., 2006. Reducing risk of disaster in our communities, TEARFUND
4. Bankoff, G., Frerks, G., Hilhorst, D., 2004. Mapping vulnerability: disasters, development, and people, Earthscan
5. Wisner, B., Gaillard, J.C., Kelman, I. (2012). Handbook of Hazards and Disaster Risk Reduction and Management.
6. Shaw, R. (2012). Community-based disaster risk reduction, Emerald Books, 400 p.
7. Alexander, D., "Principles of Emergency Planning and Management", Harpended:Terra Publishing

LANDSLIDE RISK ENGINEERING AND MANAGEMENT
ENCEDR502

Credits: 4 **Year: I** **Part: I**

Course Objectives

This course covers the phenomena of landslides and methods suitable for quantitative assessment of landslides hazards and risks. After completion of this course, students will be able to understand the landslide classification focused on failure mechanism; understand the principles of hazard and risk assessment; slope stability analysis; landslide early warning system.

1 Introduction [6 hours]

1.1 Features, classification, mechanism and morphology of landslides
1.2 Landslide occurrence and its impact
1.3 Geological and geomorphological sub-division of Nepal Himalaya and their relation with landslides

2 Investigation of Landslides [10 hours]

2.1 Causes of landslides: Geological, morphological, physical, anthropogenic
2.2 Triggering factors: Rainfall, earthquake, volcano, snowmelt
2.3 Surface and sub-surface investigations
2.4 Material, stress and strain behavior in landslides

3 Slope Stability Analysis [10 hours]

3.1 Rock and soil slope stability assessment
3.2 Rock and soil slope stability analysis

4 Landslide Risk Assessment [10 hours]

4.1 Landslide hazard assessment: Landslide inventory mapping, scope of landslide inventory mapping, landslide hazard zonation mapping, selection of scales, selection of geomorphic parameters for landslide susceptibility mapping, hazard zonation of rainfall and earthquake induced landslide
4.2 Landslide vulnerability analysis: Component of vulnerability mapping and analysis, mapping of element at risk, quantification of physical and social elements for analysis

5 Landslide Monitoring and Early Warning System [10 hours]

5.1 Monitoring of slope: Topographic survey, extensometer, piezometer, moving pegs, tilt meter
5.2 Components of landslide early warning system: Design, monitoring, forecasting, education

5.3 Community based landslide early warning system in Nepal

6 Design of Mitigation Measures [14 hours]

6.1 Bioengineering and its importance in Nepal for slope protection
6.2 Design of bioengineering techniques
6.3 Slope modification
6.4 Design of surface and sub-surface drainage structures
6.5 Design of retaining and revetment structures
6.6 Design of slope reinforcement: Rock bolts, anchors, soil nails

Assignments

1. A review of landslide studies in Nepal
2. Case study of typical landslide for its investigation and mitigation
3. Project work: Landslide risk mapping for a given scenario

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	6	5
2	10	10
3	10	10
4	10	10
5	10	10
6	14	15
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Glade, T., Anderson, M.G., and Crozier, M.J. (2005). Landslide Hazard and Risk, 824 p., ISBN: 978-0-471-48663.
2. Hungr, O., Fell., R., Couture, R., Eberhardt E., (2005). Landslide Risk Management: CRC press, 2005, 774 p. ISBN: 9780415380430#SW8043
3. Upreti, B.N., Dhital, M.R., (1996). Landslide studies and Management in Nepal, ICIMOD, 1996, 94p. ISBN: 92-9115-502-0
4. The Landslide Handbook-A guide to understanding landslides. USGS, 2008, 147 p.
5. Anderson M.G., Holcombe, E., (2013). Community Based Landslide Risk Reduction-Managing Disasters in small steps, The world Bank, 447 p. 2013.
6. Roadside Bio-engineering: John Howell, Department of Road, His Majesty's Government of Nepal, 1999, 160p., ISBN: 1-86192-170-5.
7. Anbalagan, R., Singh, B., Charkraborty, D., Kohli, A. (2007). A field manual for landslide investigations: India.

FLOOD RISK ENGINEERING AND MANAGEMENT

ENCEDR503

Credits: 4 **Year: I** **Part: I**

Course Objectives

This course aims to provide students with a comprehensive understanding and practical skills of flood risk engineering to execute the hydrologic and hydraulic analysis for flood hazard mapping and zoning. It focuses on understanding the principles and recent practices involved in flood risk assessment and knowledge on flood risk management before and after the occurrence of floods. It will also provide analyzing and solving capability to students for flood control measures to reduce the flood risk with exposers to flood preparedness, recovery planning and implementation. It aims to develop professionals who will be able to develop flood forecasting and warning systems to save the life, property, infrastructures and environment of the country and be able to explore the future possibilities in this field.

1 Flood Hydrology [8 hours]

- 1.1 Rainfall-runoff characteristics of Nepal; Monsoon floods; Cloud burst floods (CLOF); Glacier lake outburst floods (GLOF); Landslide dam outburst floods (LDOF)
- 1.2 Effects of floods on people, property, infrastructure and environment
- 1.3 River morphology and sediment transport in Nepalese rivers
- 1.4 Estimation of flood magnitudes:
  - 1.4.1 Flood frequency analysis using flood data of gauged basins
  - 1.4.2 Rational method for small ungauged basins
  - 1.4.3 Regional methods for ungauged basins used in Nepal
  - 1.4.4 Rainfall-runoff models suitable for Nepal
  - 1.4.5 Probable maximum precipitation and flood (PMP and PMF)

2 Flood Hydraulics and River Channel [8 hours]

- 2.1 Required cross-sections of river reach
- 2.2 Estimation of flood levels (hydraulic modeling)
- 2.3 Flood hazard mapping
- 2.4 Scouring of river bed and banks
- 2.5 Sedimentation of rivers and shifting of channel

3 Flood Hazard and Risk Assessment [8 hours]

- 3.1 Flooding risk and impacts
- 3.2 Preliminary flood risk assessment (PFRA)
- 3.3 Flood risk assessment considering climate change

3.4 Flood vulnerability and damage assessment
3.5 Capacity analysis and development
3.6 Scales used for flood risk assessment
3.7 Strategic flood risk assessment (SFRA) and justification test
3.8 Community based flood risk assessment

4 Flood Risk Management [8 hours]

4.1 Planning principles and components of flood risk management
4.2 Sequential approach in flood risk management
4.3 Flood risk management plans
4.4 Floodplain management for flood risk reduction
4.5 Urban flood management
4.6 Tools for flood risk management
4.7 Economics of flood risk management

5 Flood Control Measures for Risk Reduction [10 hours]

5.1 Construction of dikes and flood walls, bank revetment
5.2 Construction of storage tanks and reservoirs
5.3 Improvement of river capacity (channelization, sediment removal, cutoff)
5.4 Construction of diversion channels and floodways, inter basin transfer
5.5 Soil conservation and watershed management (bunds, terraces, grassed waterways, gully control structures, afforestation, rain water harvesting)

6 Flood Preparedness and Emergency Evacuation [10 hours]

6.1 Different aspects of flood problem
6.2 Pre and post flood preparedness, relief and recovery
6.3 Flood plain zoning
6.4 Flood recovery planning and implementation
6.5 Guidelines for sustainable recovery programs
6.6 Emergency evacuation
6.7 Flood damage and need assessment
6.8 Flood losses and economics of flood control
6.9 Flood control situation and provision of flood insurance in Nepal

7 Flood Forecasting and Warning Techniques [8 hours]

7.1 Need and functions of flood forecasting and warning
7.2 Flood forecasting by flood routing
7.3 Flood forecasting by inflow-outflow correlation curves
7.4 Forecasting the travel time and duration of the flood peak

7.5 Use of computers in flood forecasting
7.6 Flood alert and warning methods

Assignments

1. Estimation of floods by different approaches
2. Estimation of flood levels (Hydraulic Modeling)
3. Flood hazard mapping and zoning
4. Flood risk assessment
5. Design of flood control structures

Each student must prepare an individual project report on "Flood Risk Engineering and Management of a Selected River".

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	8	8
2	8	8
3	8	8
4	8	8
5	10	10
6	10	10
7	8	8
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Garg, S.K., (2005). Hydrology and Water Resources Engineering. Khanna Publishers. Delhi.
2. Fleming, G. (2002). How can we learn to live with rivers? The findings of the Institution of Civil Engineers Presidential Commission on flood-risk management. Philosophical

Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences, 360(1796), pp.1527-1530.

3. Pender, G. (2006). March. Briefing: Introducing the flood risk management research consortium. In Proceedings of the Institution of Civil Engineers-Water Management (Vol. 159, No. 1, pp. 3-8). Thomas Telford Ltd.
4. Blazejewski, R., Pilarczyk, K. W., Przedwojski, B. (1995). River training techniques: fundamentals, design and applications. CRC Press.
5. Sayers, P., Yuanyuan, L., Galloway, G., Penning-Rowsell, E., Fuxin, S., Kang, W., Le Quesne, T. (2013). Flood risk management: a strategic approach.
6. Chaturvedi, M. C. (1987). Water resources systems planning and management. Tata McGraw-Hill Publishing Company.
7. Jha, P.C., Devkota, N. (2024). A Textbook of Irrigation and Drainage Engineering. Heritage Publishers. Kathmandu
8. Hydrological Estimations in Nepal (2004). MOST, DHM, K P Sharma and N R Adhikari
9. Design Guidelines for Headworks of Hydropower Projects (2006). GoN, MoWR, DoED
10. Climate Change Scenarios for Nepal (National Adaptation Plan), (2019) GoN, MoFE

EARTHQUAKE RISK ENGINEERING AND MANAGEMENT
ENCEDR504

Credits: 4 **Year: I** **Part: I**

Course Objectives

The objective of this course is to provide students with an understanding of earthquake engineering, focusing on the principles of seismology, structural dynamics, and the behavior of structures under seismic excitation. By exploring the mechanisms of earthquakes and their induced hazards, the course aims to equip students with the skills to analyze vibrations and assess structural hazards. Upon completion, students will be proficient in evaluating seismic risks for structures and applying hazard mitigation techniques, fostering a comprehensive approach to earthquake resilience in engineering practice.

1 Seismology [10 hours]

1.1 Seismology and Earthquakes: Causes of Earthquakes; Classifications of Earthquakes; Earthquake Effects on Ground and Structures
1.2 Plate Tectonics and Seismicity: Internal Structure of the Earth; Plate Tectonics;
1.3 Elastic Rebound Theory; Faults ant their margins; Origin of Earthquakes; Seismicity of Earth; Major World's Earthquakes; Major Earthquakes in Nepal
1.4 Seismic Waves: Types and their characteristics; Attenuation and attenuation laws
1.5 Measurement of Earthquake: Earthquake Magnitude; Earthquake Intensity; Frequency recordings: Principles and theory of seismograph; Types of seismographs; Analog and digital recording, Real time warning system; International monitoring system (IMS); Local seismological networks, strong motion networks

2 Vibration Analysis [12 hours]

2.1 Single degree of freedom system: Free vibration analysis; Forced vibration analysis; Time domain and Frequency domain; Response spectrum
2.2 Multi-degree of freedom system: Equation of motion; Free vibration analysis; Natural frequencies and normal modes
2.3 Modal analysis
2.4 Pseudo-dynamic analysis
2.5 Response spectrum analysis
2.6 Time-history analysis

3 Seismic Hazard Analysis [8 hours]

3.1 Geological evidence and historical seismicity
3.2 Development of database

3.3 Seismic hazard source model
3.4 Attenuation relationships
3.5 Deterministic and probabilistic seismic hazard analysis
3.6 Uncertainties in probabilistic seismic hazard analysis
3.7 Hazard curve
3.8 Logic tree
3.9 Uniform hazard spectrum
3.10 Disaggregation
3.11 Hazard map

4 Geotechnical and Foundation Related Issues [10 hours]

4.1 Ground response analysis: Linear, equivalent and nonlinear approaches
4.2 Local site effects on ground motion: Topographic effect; Basin effects
4.3 Dynamic soil behavior
4.4 Liquefaction phenomena: Features of liquefaction-induced damages, onset mechanism
4.5 Liquefaction analysis: Cyclic undrained soil behavior; Liquefaction assessment methods; Post-liquefaction behavior of soils
4.6 Mitigation of liquefaction-induced and foundation related earthquake hazards

5 Seismic Soil-Structure Interaction [4 hours]

5.1 Effect of seismic soil-structure interaction (SSI)
5.2 Elements of soil-structure interaction
5.3 Kinematic soil-structure interaction and its validation

6 Earthquake Exposure, Vulnerability Assessment and Risk Estimation [10 hours]

6.1 Definition of hazard, exposure, vulnerability, and risk
6.2 Exposure mapping: Physical, social, economic, and cultural indicators; Mapping schemes
6.3 Vulnerability: Physical, social, cultural, and economic dimensions; Assessment approaches; Use of Capacity curves; Use of Fragility/Vulnerability curves
6.4 Loss estimation: Methods; Tools and techniques

7 Earthquake Resistant Design of Structures [6 hours]

7.1 Lateral Load Resisting Structural Systems
7.2 Structural Form and Materials
7.3 Code of Practice for Engineered Buildings and Infrastructures
7.4 Earthquake resistant design of masonry, RCC, timber and steel structures
7.5 Earthquake resistant design of retaining walls

Evaluation Scheme

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	10	10
2	12	10
3	8	8
4	10	10
5	4	6
6	6	6
7	10	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. A.K. Chopra (2014), “Dynamics of Structures, Theory and Application to Earthquake Engineering”, Pearson Education Limited.
2. J.W. Baker, B.A. Bradley, P.J. Stafford (2021), “Seismic Hazard and Risk Analysis”, Cambridge University Press
3. S.L. KRAMER, (1996),"Geotechnical Earthquake Engineering", Prentice Hall, Upper Saddle River, NJ
4. David Dowrick (2009). Earthquake Resistant Design and Risk Reduction, John Wiley and Sons, Ltd.
5. Amr Elnashai, Luigi Di Sarno (2008). Fundamentals of Earthquake Engineering. John Wiley and Sons, Ltd,
6. R Subramanian, Disaster Management (2018) Vikas Publishing House, First Edition,
7. W F Chen and C. Scawthorn (2003). Earthquake Engineering Handbook, CRC Press.
8. Hari Ram Parajuli and Bikram Bhusal (2018). Site Specific Probabilistic Seismic Hazard Assessment of Nepal, Heritage Publishers and Distributors Pvt. Ltd., Bhotahity, Kathmandu, Nepal.

POST DISASTER ASSESSMENT AND RESPONSE PLANNING

ENCEDR551

Credits: 4 **Year: I** **Part: II**

Course Objectives

The objective of this course is to equip students with comprehensive knowledge of disaster types, their impacts, and tools for analyzing and managing multi-hazard risks at local, national, and international levels. It aims to foster a thorough understanding of international laws, humanitarian principles, and coordination mechanisms essential for effective disaster response and recovery. The course will develop practical skills in disaster assessment, response planning, and long-term program management in post-disaster scenarios. Students will analyze lessons from the Gorkha Earthquake 2015, emphasizing strategies for post-disaster planning, response, and recovery coordination, to enhance their ability to address real-world challenges in disaster management.

1 Disasters and Emergencies [6 hours]

1.1 Types and levels of impact at household levels
1.2 Analyzing recent and multi-hazards
1.3 Emergency project planning

2 Humanitarian Assistance [8 hours]

2.1 Introduction of humanitarian principles
2.2 International guidelines and framework for humanitarian assistance
2.3 Humanitarian cluster and coordination mechanism

3 Emergency Response, Recovery and Reconstruction [16 hours]

3.1 Emergency Response: WASH in emergency, temporary shelter, communal facilities, critical infrastructure, international and national agencies in disaster response, disaster response skills
3.2 Recovery: Social, economic, and technical (human and technology) aspects of recovery, Phases of recovery
3.3 Reconstruction: Risk-informed reconstruction, concept of building back better, case study
3.4 3C principles: Check, call and care

4 Disaster Assessment and Planning [8 hours]

4.1 Principles, guidelines, and tools for assessment and response
4.2 Disaster assessment and response; Comprehensive risk assessment
4.3 Emergency planning and reconstruction frameworks
4.4 Disaster management frameworks

5 Emergency and Long-term Program Management [6 hours]

5.1 Emergency and program management
5.2 Assessment and operational planning
5.3 Community-based risk reduction
5.4 Coordination and local-level organization
5.5 Logistics planning and management

6 Implementation and Operation of Humanitarian Assistance [10 hours]

6.1 Rapid needs assessment, planning and advocacy
6.2 Donor and funding mechanisms
6.3 Private sector contribution and risks
6.4 Search and rescue operations and essentials
6.5 The cluster approach
6.6 Stakeholder roles and responsibilities
6.7 Monitoring, Evaluation, Accountability, and Learning (MEAL)
6.8 Gender inclusion, disability and social inclusion (GEDSI) in disaster response

7 Post Disaster Planning and Response: Lessons from Recent Earthquakes [6 hours]

7.1 Emergency Response, Recovery, and Reconstruction
7.2 Relief System (shelter and infrastructure)
7.3 Coordination
7.4 PDNA and PDRF
7.5 Implementation

Assignments

1. Case report on UNDAC systems, and cluster coordination mechanisms during disaster
2. Disaster case report on analysis of recovery and with a focus on community engagement and governance
3. Report on sector-specific assessment tool to analyze risk and propose disaster response measures
4. Design of an emergency response and operational plan, focusing on logistics, coordination, and community-based risk reduction
5. Report on the development of humanitarian assistance plan, including search and rescue, cluster approach, and stakeholder roles
6. Assessment Report on the post-Gorkha earthquake response, focusing on PDNA, PDRF, and lessons learned
7. Response, focusing on PDNA, PDRF, and lessons learned

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapters	Hours	Marks distribution*
1 and 2	14	12
3	16	14
4 and 5	14	12
6	10	12
7	6	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Blaikie, P., Cannon, T., Davis, I., Wisner, B., Wisner, B. (2004). At Risk: Natural Hazards, People's Vulnerability and Disasters. United Kingdom: Routledge.
2. Sphere Association. (2018). The Sphere handbook: Humanitarian charter and minimum standards in humanitarian response (4th ed.). Sphere Association. Retrieved from https://spherestandards.org/handbook.
3. Davis, I. (1978). Shelter after disaster. Oxford Polytechnic Press. Retrieved from https://www.humanitarianlibrary.org/resource/shelter-after-disaster-0.
4. Housing Recovery and Reconstruction Platform (HRRP). (2020). The path to housing recovery. Retrieved from https://www.hrrpnepal.org/uploads/media/HRRPtimelinebooklet-December2020_final_SM_min_20201218155954.pdf.
5. Age and Disability Consortium. (2018). Humanitarian inclusion standards for older people and people with disabilities. Sphere.
6. Shelter Cluster. (**2023**). Nepal: Environmental country profile for shelter and settlement. Retrieved from https://sheltercluster.org/environment-community-practice/documents/nepal-environmental-country-profile-shelter-and-settlement
7. CHS Alliance, Group URD, Sphere Association. (2014). Core humanitarian standard on quality and accountability. Retrieved from https://corehumanitarianstandard.org/the-standard
8. UNDP. (2015). Post-Disaster Needs Assessment (PDNA): A guide for practitioners. United Nations Development Programme (UNDP).

FRONTIER TECHNOLOGIES IN DISASTER RISK ENGINEERING AND MANAGEMENT
ENCEDR552

Credits: 4 **Year: I** **Part: II**

Course Objectives

This course aims to provide students with a solid foundation in the latest technological advancements in disaster risk engineering and management. Students will explore the role of cutting-edge tools like geographic information systems (GIS) and remote sensing in disaster risk assessment, mitigation, and response. By the end of the course, students will be prepared to apply geospatial technologies in real-world disaster scenarios and will gain insight into emerging trends like machine learning and drone-based data acquisition. This knowledge will enable them to effectively contribute to disaster risk management in various professional contexts.

1 Introduction [6 hours]

1.1 The Role of technology in disaster risk management
1.2 Geospatial analysis using GIS; Remote sensing techniques
1.3 Advanced technologies: Machine learning, artificial intelligence (AI), augmented reality (AR) and virtual reality (VR)
1.4 Web based technologies: Information sharing technologies

2 Concept of GIS, Tools and Techniques [10 hours]

2.1 Concept of datum, projection and coordinate reference system
2.2 Acquisition of data (GNSS, on Screen digitizing using Google Earth)
2.3 Introduction to software and tools (Commercial vs Open-source GIS)
2.4 GIS data models (Vector, Raster, Network, TIN)
2.5 Concept of database in GIS

3 Geospatial Analysis Principles [10 hours]

3.1 Concept of basic GIS operations with vector data (Geo-processing, overlay)
3.2 Basic GIS operations with raster data (clip, mosaic, resampling, reclassification)
3.3 Data interpolation methods (rainfall, temperature)
3.4 Advanced geospatial analysis techniques: Network analysis; Hotspot analysis; Multi-criteria decision analysis (MCDA); Zonal statistics

4 Analysis of Terrain [8 hours]

4.1 Terrain variables and its extraction
4.2 Principle of hydrological analysis (flow direction, accumulation, thresholds)
4.3 Terrain morphometric analysis and its application

5 Remote Sensing [20 hours]

5.1 Fundamentals of remote sensing
5.2 Introduction to remote sensing, sensor platform and sensors and related terminologies
5.3 Remote Sensing terminologies
5.4 Optical vs radar remote sensing
5.5 Advanced remote sensing analysis techniques: Radiometric indices; Filtering techniques; Data clustering; Time series analysis; Synthetic aperture radar (SAR) and its applications
5.6 Practical applications of remote sensing
  5.6.1 Supervised and unsupervised classification
  5.6.2 SAR interferometry and its applications (DEM generation, flood area identification)
  5.6.3 Burnt area analysis
  5.6.4 Landslide susceptibility mapping (with focus on GIS and RS)
  5.6.5 Disaster damage assessment using remote sensing

6 Advanced and Emerging Techniques [6 hours]

6.1 Introduction to python and task automation for geospatial analysis
6.2 Overview of machine learning, AI, VR and AR
6.3 Web based data sharing and visualization
6.4 Data acquisition with drone
6.5 Exploring the state of art technologies

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	6	6
2	10	10
3	10	10
4	8	8
5	20	20
6	6	6
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Bolstad, P. (2005). GIS Fundamentals: A First Text on Geographic Information Systems. United States: Eider Press.
2. Burrough, P. A., McDonnell, R. A., Lloyd, C. D. (2015). Principles of Geographical Information Systems. United Kingdom: OUP Oxford.
3. De Smith, M. J., Goodchild, M. F., Longley, P. (2007). Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools. United Kingdom: Troubador Publishing Limited.
4. Lillesand, T., Kiefer, R. W., Chipman, J. (2015). Remote Sensing and Image Interpretation. United Kingdom: Wiley.

MULTI-HAZARD RISK ASSESSMENT AND EARLY WARNING SYSTEM

ENCEDR561

Credits: 4 **Year: I** **Part: II**

Course Objectives

The objective of this course is to equip participants with comprehensive knowledge and practical skills in multi-hazard risk assessment and the design of Early Warning Systems (EWS) for natural and climate-related hazards. The course aims to enhance expertise in identifying hazard types, understanding their causes and impacts, and applying risk quantification methodologies. Participants will learn to design and manage effective EWS by leveraging advanced scientific and technical tools, including data analysis, modeling, and remote sensing, while mastering communication strategies to disseminate complex hazard information effectively. Furthermore, the course emphasizes evidence-based decision-making, enabling participants to translate risk assessments and EWS outputs into actionable disaster risk reduction strategies and policies at various governance levels.

1 Multi-Hazards and Disaster Risk Reduction in Nepal [10 hours]

1.1 Basics of disaster risk reduction; concepts of hazards, vulnerability, risk, and disaster risk reduction (DRR); ecosystem based DRR and nature-based solution; disaster risk reduction and management (DRRM) cycle, structural and non-structural measures for DRRM

1.2 Types of hazards and hazard risk: Natural hazards, hydro-climatic hazards,

1.3 Technological and biological hazards

2 Multi-Hazard Risk Assessment [10 hours]

2.1 Methods for physical science as well as social science approach to assess vulnerability, risk, exposure, and community capacity building resilience

2.2 Quantitative risk assessment: Probabilistic and deterministic methods for quantitative risk assessment, loss and damage approaches, and methodology to assess both economic as well as non-economic loss and damages under climate induced disaster

2.3 Hazards characteristics and cascading interrelationship, vulnerability and capacity analysis concepts, quantitative and qualitative risk assessment methodologies (e.g., GIS, remote sensing)

2.4 Practical exercise applying a chosen risk assessment methodology to a specific hazard scenario in Nepal using relevant data and tools

2.5 Group project: Formulating a risk assessment plan for a chosen hazard in a specific region of Nepal, considering vulnerability and capacity factors

3 Early Warning Systems (EWS): Concept and Applications [10 hours]

3.1 Technologies used in EWS, including sensor networks, communication systems, and decision support systems

3.2 Core principles and components of EWS, different types of EWS (community-based, technology-driven), case studies of successful EWS implementation globally

3.3 Analysis of strengths and weaknesses of different EWS models, comparison of different models and their outputs for daily, weekly, monthly, and seasonal forecast

3.4 Assignment, research and comparison of two contrasting EWS case studies from different countries based on model outputs, highlighting their successes and challenges

4 Data Acquisition, Monitoring, and Forecasting for EWS [10 hours]

4.1 Importance of data collection and analysis for EWS development, sources of data relevant to multi-hazard EWS in Nepal, monitoring and forecasting techniques for different hazards, data quality control and management practices

4.2 Assignment on impact of early warning in different sectors (e.g. transportation, farming, industries), a case study with report

4.3 Field visit to a relevant monitoring station or a Met Authority to understand data collection, processing and dissemination approaches

5 Design Multi-hazards EWS, Risk Communication [10 hours]

5.1 Design and implementation of multi-hazard EWS, focusing on stakeholder engagement, communication strategies, and institutional frameworks, effective risk communication messages and engaging communities in EWS preparedness, customized approach in risk communication, mobile technology for risk communication, common alerting protocol for risk communication

5.2 Case study analysis: Detailed case study of EWS design and implementation in a specific region of Nepal, identifying key success factors and challenges

5.3 Group Project: Design of basic EWS model for a chosen hazard in a specific Nepalese community, considering stakeholder engagement and communication strategies

6 Policy, Capacity Building, Future of EWS in Nepal [10 hours]

6.1 Role of EWS in national and local DRR policies and legislation; Cost-benefit analysis of EWS implementation; Capacity building for EWS operation and maintenance

6.2 Seminar: Debate on importance of policy frameworks for supporting EWS development; Discussion on challenges and opportunities for capacity building in EWS operation and maintenance

6.3 Course wrap-up and future directions: Review of key learnings from the course; Discussion with guest speakers on emerging technologies and trends in EWS development; Presentation of student's final projects on EWS design for Nepal

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	10	10
2	10	10
3	10	10
4	10	10
5	10	10
6	10	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Anna S, et al 2022: Connecting Warning with Decision and Action: A Partnership of Communicators and Users
2. ADB. (2016). Reducing Disaster Risk by Managing Urban Land Use: Guidance Notes for Planners. Asian Development Bank.
3. Amaratunga, D., Haigh, R., Dias, N. (Eds.). (2021). Multi-Hazard early warning and disaster risks. Springer.
4. Bani-Mustafa, T. (2019). Multi-Hazards Risk Aggregation Considering the Trustworthiness of the Risk Assessment (Doctoral dissertation, Université Paris Saclay (COmUE)).
5. Chowdhury, M. R. (2022). Seasonal Flood Forecasts and Warning Response Opportunities. SpringerLink.
6. Chiozzi, A., Benvenuti, E., Nikolić, Ž. (2023). Natural-Hazards Risk Assessment for Disaster Mitigation. MDPI-Multidisciplinary Digital Publishing Institute.
7. Kwag, S. (2016). Probabilistic Approaches for Multi-Hazard Risk Assessment of Structures and Systems. NC State.
8. Pal, I., Shaw, R. (2023). Multi-Hazard Vulnerability and Resilience Building. ScienceDirect.
9. Gardoni, P., LaFave, J. M. (2016). Multi-hazard approaches to civil infrastructure engineering: Mitigating risks and promoting resilience (pp. 3-12). Springer International Publishing.
10. Stalhandske, Z., Steinmann, C. B., Meiler, S., Sauer, I. J., Vogt, T., Bresch, D. N., & Kropf, C. M. (2024). Global multi-hazard risk assessment in a changing climate. Scientific Reports, 14(1), 5875.

CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

ENCEDR562

Credits: 4 **Year: I** **Part: II**

Course Objectives

This course aims to provide students with a comprehensive understanding of climate change science, its impacts, and its role in driving disasters. It develops expertise in climate adaptation strategies, including local-led and sectoral approaches, while equipping students with the skills to address challenges posed by climate change and disasters. Students will learn disaster risk reduction techniques such as risk assessment, evacuation planning, and policy development to mitigate damage. Emphasizing interdisciplinary collaboration, the course prepares students to design resilient infrastructures, create sustainable solutions, and engage in risk-informed planning and decision-making.

1 Principles of Climate Science and Adaptation [12 hours]

1.1 Weather pattern, climate change
1.2 Adaptation and mitigation in climate change
1.3 Weather system and extreme climate events
1.4 Fundamental of climate science, green houses gases, factors affecting climate change,
1.5 Historical and future climate projections
1.6 Sectoral impacts of climate change e.g. on watershed, biodiversity, forest ecosystem, agriculture

2 Disaster Risk Reduction and Climate Change Adaptation [10 hours]

2.1 Critical issues in disaster risk reduction and management
2.2 Engineering principles in disaster risk reduction management
2.3 Structural and non-structural measures for disaster risk reduction
2.4 Policy landscape on CCA and DRR-SFDRR, Paris agreement and other international treaties
2.5 Case studies in local disaster risk reduction and resilience

3 Climate Change Impact Assessment [10 hours]

3.1 Methods for assessing climate change impacts on engineering projects
3.2 Vulnerability and exposure assessments
3.3 Strategies for integrating climate impact assessments in design
3.4 Design of hazard trigger mechanism and impact of hazards in different scenarios
3.5 Early warning, early action and resilience

4 Resilient Infrastructure Development [10 hours]

4.1 Concepts of resilience in engineering design
4.2 Principles of resilient recovery with examples from post disaster recovery
4.3 Sustainable materials and technologies
4.4 Design considerations for climate resilience and disaster scenarios

5 Risk Analysis and Decision-Making [8 hours]

5.1 Research methodologies and tools risk assessment
5.2 Decision Support System and hazard risk analysis
5.3 Quantitative and qualitative methods for risk analysis
5.4 Decision theory in uncertain environments
5.5 Frameworks for integrating risk considerations into engineering assessments

6 Project Management for Disaster Resilience [10 hours]

6.1 Principles of project management in disaster recovery and adaptation projects
6.2 Project development and management in development cooperation
6.3 Stakeholder engagement and community participation
6.4 Community based approaches in resilience
6.5 Tools and techniques for effective project implementation and evaluation

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	12	10
2	10	10
3	10	10
4	10	10
5	8	10
6	10	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Dash, Jan W., (2021). World Scientific Encyclopedia of Climate Change: Case Studies of Climate Risk, Action, And Opportunity (In 3 Volumes). World Scientific.
2. Jana, N. C., Singh, R. B. (Eds.). (2022). Climate, environment and disaster in developing countries (p. 536). Springer.
3. Nautiyal, Sunil, et al., (2023). eds. The Palgrave Handbook of Socio-ecological Resilience in the Face of Climate Change: Contexts from a Developing Country. Springer Nature.
4. Madhanagopal, Devendraraj, and Salim Momtaz, (2022). eds. Climate Change and Risk in South and Southeast Asia: Sociopolitical Perspectives. Taylor and Francis,
5. Shaw, R., Pulhin, J.M. and Jacqueline Pereira, J. (2010), "Chapter 1 Climate change adaptation and disaster risk reduction: An Asian perspective",
6. Shaw, R., Pulhin, J.M. and Jacqueline Pereira, J. (Ed.) Climate Change Adaptation and Disaster Risk Reduction: An Asian Perspective (Community, Environment and Disaster Risk Management, Vol. 5), Emerald Group Publishing Limited, Leeds, pp. 1-18
7. Morgan, J, Tirpak, D, Levin, K and Dagnet, Y 2013, A Pathway to a Climate Change Agreement in 2015: Options for Setting and Reviewing GHG Emission Reduction Offers, World Resources Institute, Washington D.C.

MOUNTAIN RISK ENGINEERING

ENCEDR563

Credits: 4 **Year: I** **Part: II**

Course Objectives

This course covers the geophysical process that contribute to hazards in mountain regions. After completion of this course, students will be able to identify and assess risks associated with various natural hazards, design engineering solution to mitigate the risk posed by the natural hazards, implement GIS, remote sensing, and other tools in risk mapping, monitoring and early warning systems.

1 Geological Setting of the Himalaya [12 hours]

1.1 Tectonic evolution of the Himalaya
1.2 Himalaya seismo-tectonics
1.3 Tectonic sub-division of the Nepal Himalaya
1.4 Major discontinuity systems of the Nepal Himalaya and associated problems
1.5 Major geological structures and associated problems

2 Geomorphological Processes [12 hours]

2.1 Geomorphological processes in mountain environments
2.2 Weathering and erosion processes in mountainous terrain
2.3 Landslide and mass wasting process
2.4 River dynamics and flood hazard in mountain areas
2.5 Glacier, permafrost, and climate change impacts

3 Risk Assessment and Mapping [12 hours]

3.1 Hazard mapping techniques using GIS and remote sensing
3.2 Quantitative and qualitative risk assessment methodologies
3.3 Vulnerability and exposure analysis in mountain regions
3.4 Multi-hazard mapping and its application in risk mitigation
3.5 Use of decision-support tools in mountain risk engineering

4 Development of Risk Management Plans [12 hours]

4.1 Framework for creating risk management plans
4.2 Incorporating climate change adaptation into mountain risk engineering
4.3 Policy and governance issues related to mountain risk management
4.4 Risk reduction strategies and engineering interventions
4.5 Community-based risk management and capacity building

5 Monitoring and Early Warning Systems in the Himalayas [12 hours]

5.1 Implementation of remote sensing and GIS in hazard monitoring in the Himalayas
5.2 Development of early warning systems for landslide, GLOFs, and earthquakes
5.3 Community-Base monitoring approaches in the Himalayan regions
5.4 Integration of traditional knowledge with modern engineering practices in the Himalayas
5.5 Future trends and challenges in Himalayan early warning systems

Assignments

1. Prepare a report on geological and geomorphological processes and their impact on mountain risk engineering
2. Design and prepare a report on integrated early waring and risk management plan for mountain communities
3. Prepare a presentation by reviewing and analyzing major hazards in the Nepal Himalaya and their mitigation measures

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapters	Hours	Marks distribution*
1	12	12
2	12	12
3	12	12
4	12	12
5	12	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Deoja, B., Dhital, M., Thapa, B. and Wagner, A. (Eds.) (1991). Mountain risk engineering handbook. ICIMOD, 875p.

2. Hearn, G.J., (2011). Slope engineering for mountain roads, The Geological Society, London, 301p.
3. Sassa, K., Canuti, P., & Yin, Y. (Eds.). (2013). Mountain risks: From prediction to management and governance. Springer. 340p.
4. Keller, E. A., & Blodgett, R. H. (2006). Natural hazards: Earth's processes as hazards, disasters, and catastrophes. Pearson Prentice Hall. 576p.

NATURAL HAZARD TRIGGERED TECHNOLOGICAL ACCIDENT

ENCEDR564

Credits: 4 **Year: I** **Part: II**

Course Objectives

This course covers the complex interactions between natural and technological systems, leading to Natech (Natural Hazard Triggering Technological Disasters). After completion of this course, students will be able to understand Natech phenomena, identify vulnerability, risk assessment, mitigation strategies, disaster response and recovery.

1 Introduction [10 hours]

1.1 Definitions and scope of Natech
1.2 Historical overview of major Natech events
1.3 The interplay between natural hazards and technological systems
1.4 The role of climate change in increasing Natech risks
1.5 International agreements on industrial disaster prevention

2 Natural Hazards and Technological Systems [10 hours]

2.1 Earthquake and structural vulnerabilities
2.2 Floods and water-related technological risks
2.3 Landslides, volcanoes, and industrial accidents
2.4 Wildfires and industrial explosions
2.5 Cyclones, hurricanes, and industrial hazards

3 Risk Assessment and Vulnerability Analysis [10 hours]

3.1 Hazard identification and characterization
3.2 Vulnerability of industrial facilities and critical infrastructure
3.3 Tools and techniques for Natech risk assessment
3.4 Natech risk mapping and GIS applications
3.5 Risk communication and public awareness

4 Mitigation of Natech Risks [10 hours]

4.1 Engineering solutions and technological advancements
4.2 Land-use planning and zoning regulations
4.3 Policy frameworks and regulatory measures
4.4 Insurance and financial instruments for Natech risk reduction
4.5 Industry best practices and Corporate Social Responsibility (CSR)

5 Response and Recovery [10 hours]

5.1 Emergency response planning for Natech events
5.2 Coordination between governmental, industrial and community stakeholders
5.3 Long-term recovery and rebuilding strategies
5.4 Environmental remediation and contaminant cleanup
5.5 Psychological and societal impact of Natech disasters

6 Emerging Trends and Future Directions [10 hours]

6.1 Climate change and its impact on Natech risks
6.2 Advances in technology and their implications for Natech
6.3 Integrating Natech considerations into broader disaster risk management
6.4 International collaboration and policy development for Natech prevention
6.5 Future research directions and innovations in Natech risk mitigation

Assignments

1. A review of different Natech events
2. Project Work: Fukushima Daiichi nuclear disaster, Japan, 2011; Toulouse Chemical factory explosion, France, 2011; Hurricane Harvey and chemical plant explosion, USA, 2017, Los Angeles fire, 2024 and other Natech disasters.

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	10	10
2	10	10
3	10	10
4	10	10
5	10	10
6	10	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Krausmann, E., Baranzini, D., Delavos, A. (2017). Natech Risk Assessment and Management: Reducing the Risk of Natural-Hazard Impact on Hazardous Installations. Elsevier.
2. Cruz, A. M., Krausmann, E. (2013). Vulnerability of the oil and gas sector to climate change and extreme weather events. Springer.
3. Steinberg, L. J., Cruz, A. M. (2004). When Natural and Technological Disasters Collide: Lessons from the Turkey Earthquake of August 17, 1999. Natural Hazards Review.
4. Izumi, T., Abe, M., Fujita, K. and Shaw, R. (2024). All-hazards approach, Springer Nature, 284 p.

POST DISASTER WATER SANITATION AND HYGIENE
ENCEDR571

Credits: 4 **Year: I** **Part: II**

Course Objectives

The objective of this course is to provide students with a comprehensive understanding of Water, Sanitation and Hygiene (WASH) activities across all phases of a disaster, pre-disaster preparedness, response during emergencies and post-disaster recovery. It emphasizes national and international guidelines, the prevention of disease outbreaks and the technical aspects of emergency WASH management.

1 Introduction [12 hours]

1.1 Understanding disaster and emergencies in WASH context
1.2 Key stakeholders and institutions in WASH disaster risk management
1.3 Humanitarian principles and WASH standards
1.4 Protection of vulnerable groups in WASH emergencies
1.5 Coordination mechanisms in WASH disaster response

2 Health and Diseases Transmission in Emergency Setting [12 hours]

2.1 Environmental Health and WASH in disasters
2.2 Impact of disaster on public health and WASH
2.3 Establishing Hygiene promotion programs
2.4 Sanitation and excreta disposal challenges
2.5 Safe water supply and contamination risks

3 Technical Aspects of WASH in Emergencies [12 hours]

3.1 Emergency water supply systems
3.2 Solid waste and medical waste management
3.3 WASH in temporary settlements
3.4 Water quality and disease prevention
3.5 Quality monitoring and maintenance of emergency water

4 Construction of WASH Facilities in Emergency Planning: Practical Experience [12 hours]

4.1 Sphere standards and estimation techniques
4.2 Water storage, treatment, and distribution
4.3 Emergency latrines and solid waste management
4.4 Challenges in constructing WASH infrastructure in emergencies
4.5 Case studies on emergency WASH interventions

5 Post-emergency and Rehabilitation WASH Strategies, and Future Trends [12 hours]

5.1 Components of post-emergency WASH rehabilitation
5.2 Gender and environmental consideration on WASH
5.3 Monitoring and evaluation of WASH programs
5.4 Role of technology in enhancing emergency WASH
5.5 Future research directions innovations in WASH management

Assignments

1. Review of past practices (Best and worst practices)
2. Review and proposed of emergency wash plan (GON and NGO Practices)
3. Cross sectoral collaboration during emergency

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	12	12
2	12	12
3	12	12
4	12	12
5	12	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Townes, D., Gerber, M., & Anderson, M. (Eds.). (2018). Health in humanitarian emergencies: Principles and practice for public health and healthcare practitioners. Cambridge University Press, 485p.
2. Allen, K. M. (2006). Community-based disaster preparedness and climate adaptation: Local capacity-building in the Philippines. *Disasters*, 30(1), 81–101.
3. Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (2004). At risk: Natural hazards, people's vulnerability and disasters (2nd ed.). Routledge.

4. Kreimer, A., & Arnold, M. (Eds.). (2000). Managing Disaster Risk in Emerging Economies. World Bank, 200p.
5. Shaw, R. (Ed.). (2012). Community-based disaster risk reduction. Emerald Group Publishing Limited, 424p.
6. Reed, B., Shaw, R., & Chatterton, K. (Eds.). (2013). Technical notes on drinking-water, sanitation and hygiene in emergencies (2nd ed.). Loughborough, UK: Water, Engineering and Development Centre (WEDC), Loughborough University.

URBAN DISASTER RISK ENGINEERING AND MANAGEMENT
ENCEDR572

Credits: 4 **Year: I** **Part: II**

Course Objectives

This course aims to equip students with the knowledge and skills to apply engineering principles and techniques for assessing and mitigating disaster risks in urban environments. It emphasizes the integration of disaster risk management strategies with urban planning, policy frameworks, and sustainable infrastructure design. Students will develop the ability to evaluate and categorize urban disaster risks using advanced engineering tools, decision-making frameworks, and technological innovations. By addressing the unique challenges of urban disaster management, the course prepares students to contribute to safer, more resilient cities.

6 Introduction [6 hours]

6.1 Concept and definition of disaster risk and vulnerability
6.2 Access model and pressure and release (PAR) model
6.3 Types of disasters in urban areas
6.4 Urbanization and disaster vulnerability
6.5 Urban risk and its dimensions

7 Urban Disaster Risk Assessment [12 hours]

7.1 Hazard identification and mapping
7.2 Exposure and sensitivity
7.3 Vulnerability and capacity assessments
7.4 Seismic vulnerability assessment
7.5 Risk mapping and categorization
7.6 Loss assessment

8 Urban Disaster Risk Reduction Strategies [16 hours]

8.1 Risk sensitive land use plans
8.2 Risk informed bylaws and building codes
8.3 Sectoral integration of risks
8.4 Resilient public infrastructure design
8.5 Building retrofits
8.6 Community-based disaster risk reduction

9 Urban Disaster Management and Response [8 hours]

9.1 Preparedness, response, and recovery strategies

9.2 Emergency management systems
9.3 Post-disaster damage and needs assessment
9.4 Case studies in urban disaster management
9.5 Early warning systems and risk communication

10 Policy, Legislation, and Institutional Framework [8 hours]

10.1 Urban and DRRM policies
10.2 Nexus between urban planning and DRRM policies
10.3 Role of local governments in urban DRR
10.4 Institutional coordination
10.5 Capacity building

11 Technological Innovations in Urban DRRM [4 hours]

11.1 Emerging technologies
11.2 Smart infrastructure

12 Climate Change and Urban Disaster Risk [6 hours]

12.1 Impact of climate change on urban disaster risks
12.2 Adaptation strategies for climate-resilient cities
12.3 Climate-sensitive urban planning and infrastructure design

Assignments

1. Reporting/Seminar/Minor Tests
2. Tutorials-group discussion/brainstorming
    a. Urban vulnerability assessment report
    b. Urban hazard identification and risk mapping
    c. Seismic vulnerability assessment of an urban area
    d. Evaluation of early warning systems and risk communication
    e. Evaluation of urban resilience through policy and frameworks
    f. Research paper on technological innovations in disaster risk
    g. Case study analysis on climate-induced disaster risks

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapters	Hours	Marks distribution*
1 and 6	10	12
2	12	12
3	16	12
4 and 7	14	12
5	8	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Blaikie, P., Cannon, T., Davis, I., Wisner, B. (2004*).* At risk: Natural hazards, people's vulnerability and disasters (2nd ed.). Routledge.
2. Jha, A.K., Miner, T. W., Stanton-Geddes, Z. (2013). Building Urban Resilience: Principles, Tools, and Practice. The World Bank.
3. Birkmann, J. (Ed.). (2015). Measuring vulnerability to natural hazards: Towards disaster resilient societies (2nd ed.). United Nations University Press.
4. Lindell, M. (Ed.). (2020). The Routledge handbook of urban disaster resilience: Integrating mitigation, preparedness, and recovery planning (1st ed.). Routledge.
5. Gencer, E. A. (2013). The interplay between urban development, vulnerability, and risk: A case study of Istanbul. Springer.
6. UNISDR (2009). Disaster Risk Reduction Terminology

DISASTER RISK FINANCING
ENCEDR573

Credits: 4 **Year: I** **Part: II**

Course Objectives

This course delves into the financial aspects of disaster management, focusing on how resources are accessed, allocated, and utilized at various levels within the country. It provides students with a comprehensive understanding of disaster risk management through the lenses of planning, budgeting, and financing from the national to the local scale. The curriculum covers the fundamentals of fiscal budgeting, climate finance, and institutional frameworks to address disaster risks effectively. By the end of the course, students will gain insights into disaster risk financing, understand climate finance mechanisms, evaluate various financial instruments, and appreciate the role of stakeholders in financing disaster risk management, develop equitable disaster management plans and budgets that empower communities and promote resilience.

1 Introduction [12 hours]

1.1 Understanding disaster risk and the role of disaster risk finance
1.2 Emerging future risks and evolving financial needs
1.3 International convention, treaties and agreement: Paris Agreement, Sendai Framework for DRR
1.4 Key stakeholders in climate and disaster risk finance (governments, international organizations, private sector, NGOs, academia, development partners)
1.5 Sources of finance for climate and disaster management
1.6 Public and private finance

2 Climate and Disaster Financing [12 hours]

2.1 Understanding on building climate resilience
2.2 Climate finance and its linkage to climate induced disasters
2.3 Role of international finance: Humanitarian, development and climate change
2.4 Role of development partners in providing finance
2.5 Actors involved in providing, accessing, managing and utilizing finance

3 Financial Instruments for Disaster Management [12 hours]

3.1 Financial instruments and tools
3.2 Risk transfer and retention in disaster risk finance
3.3 Insurance mechanism (micro insurance, risk pooling)
3.4 Innovative sources of finance for disaster and climate

4 National Planning and Budgeting Process [12 hours]

4.1 National climate and disaster policies, plans and strategies
4.2 Institutional structure and mechanism of finance
4.3 Integration of disaster risk finance into national development plans
4.4 Fiscal planning and budgeting process

5 Preparedness for Climate and Disaster Risk Finance [6 hours]

5.1 Strengthening capacity of national, subnational institutions and community preparedness
5.2 Role of government, academia, development partners, NGOs and humanitarian organizations
5.3 Sustainability of climate and disaster finance
5.4 Future challenges and opportunities for the sector

6 Planning, Designing and Budgeting Disaster Risk Management Interventions [6 hours]

6.1 Equity and fairness in climate and disaster risk finance
6.2 Cost-benefit analysis
6.3 Developing a project: Background, objective, rationale, outputs, activities and budget

Assignments

1. Review an article on financing disaster events and make a short presentation
2. Review the fiscal budget of the Ministry of Home Affairs and NDRRMA for the last five years, which is focused on disaster management, and prepare a personal conclusion
3. Choose a municipality hit by a climate-induced extreme event and assess the challenges faced by the municipality in managing finances to support its community

Evaluation Schemes

b. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapters	Hours	Marks distribution*
1	12	12
2	12	12
3	12	12
4	12	12
5 and 6	12	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Asian Disaster Preparedness Center (2021). Strengthening Financial Resilience to Disaster Risks in Nepal. ADPC, Bangkok, Thailand.
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VULNERABILITY AND RISK ANALYSIS
ENCEDR574

Credits: 4 **Year: I** **Part: II**

Course Objectives

This course aims to provide students with a comprehensive understanding of the concepts, methodologies, and tools used in vulnerability and risk assessment, focusing on both climatic and non-climatic hazards. Through a blend of theoretical knowledge and practical applications, students will learn to identify, analyze, and manage risks, equipping them to address real-world challenges effectively. By the end of the course, students will grasp the fundamental concepts of hazard, exposure, vulnerability, and risk, explore various approaches to assessment, apply methodologies and tools to identify associated risks and vulnerabilities, and design effective risk management strategies to enhance resilience.

1 Introduction [12 hours]

1.1 Definitions and fundamental concepts of hazard, exposure, vulnerability, risk
1.2 Identification of climatic, non-climatic and multi-hazards
1.3 Perspectives and theories on climate/disaster risks and its assessment
1.4 Concept of environment risk, critical infrastructure risk and loss and damage

2 Qualitative and Quantitative Risk Assessment Techniques [12 hours]

2.1 Qualitative risk assessment methodologies
2.2 Community based risk assessment approaches
2.3 Modelling/probabilistic risk assessment methods and impact-based forecasting
2.4 Multicriteria evaluation techniques

3 Risk Assessment Frameworks and Models [12 hours]

3.1 Introduction to qualitative versus quantitative risk assessment
3.2 Global and national status of vulnerability and risk assessment
3.3 Introduction to the vulnerability and risk assessment framework of Nepal

4 Ethical and Legal Considerations in Risk Assessment [12 hours]

4.1 Ethical issues in the context of risk assessment
4.2 Introduction to national policies and plans including DRR Act, DRR Policy, NAP
4.3 Global frameworks and agreements on risk reduction; Sendai framework for disaster risk reduction, Paris agreement, IPCC assessment reports

5 Approaches to Climate/Disaster Resilient Planning and Risk Reduction [12 hours]

5.1 Introduction to the concept of resilience, disaster risk reduction and climate adaptation
5.2 Sectoral approach and examples to resilience planning and development
5.3 Locally led, nature-based and indigenous approaches to risk reduction and management
5.4 Anticipatory actions and concept of the build back better
5.5 Risk communication through forecasting and monitoring and early warning
5.6 Institutional frameworks and governance

Assignments

1. Students will work in a group to prepare comprehensive vulnerability and risk assessment project, applying the tools and concepts learned in the course to a real-world scenario
2. Presentation and peer review of the group projects

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Mark distribution*
1	12	12
2	12	12
3	12	12
4	12	12
5	12	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

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5. Sendai Framework for Disaster Risk Reduction 2015 – 2030

FIRE PROTECTION AND SAFETY ENGINEERING

ENCEDR611

Credits: 4 **Year: II** **Part: I**

Course Objectives

This course provides a comprehensive understanding of fire phenomena and the methodologies used for the quantitative assessment of fire hazards and risks. By the end of the course, students will have gained the ability to understand fire behavior, fire dynamics, and fire protection systems; apply principles of fire safety engineering; conduct fire risk assessments; and design fire prevention and mitigation strategies.

1 Introduction [15 hours]

1.1 Definitions and terminologies in fire science
1.2 Types of fires: Structural fires, wildfires, industrial fires
1.3 Fire occurrence and its significance in urban and industrial settings
1.4 Fundamentals of fire behavior: Fire triangle, ignition, combustion, heat transfer
1.5 Fire dynamics: Flame spread, smoke movement, and fire growth
1.6 Historical overview of major fire incidents globally and in Nepal

2 Fire Investigation [10 hours]

2.1 Causes of fire: Electrical faults, chemical reactions, human error, arson
2.2 Fire investigation techniques: Forensic analysis, fire scene examination
2.3 Identification of ignition sources and fire patterns
2.4 Fire modeling: Computational fluid dynamics (CFD), zone models
2.5 Post-fire analysis: Damage assessment, fire debris analysis

3 Fire Risk Assessment [15 hours]

3.1 Principles of fire risk assessment: Hazard identification, risk quantification
3.2 Fire hazard analysis: Fault tree analysis (FTA), event tree analysis (ETA)
3.3 Fire safety codes and standards
3.4 Fire risk mapping, identifying high-risk zones, vulnerability assessment
3.5 Fire risk management, risk mitigation strategies, safety protocols

4 Detection, Monitoring, and Early Warning Systems [10 hours]

4.1 Fire detection systems: Smoke detectors, heat detectors, flame detectors
4.2 Fire monitoring systems: CCTV, fire alarm systems, emergency communication systems
4.3 Early warning systems: Design, operation, and effectiveness
4.4 Community-based fire early warning systems in Nepal

4.5 Integration of fire monitoring with emergency response systems

5 Fire Mitigation and Management [10 hours]

5.1 Structural fire protection: Fire-resistant materials, compartmentation, passive fire protection
5.2 Active fire protection: Sprinkler systems, fire extinguishers, fire suppression systems
5.3 Emergency planning: Evacuation planning, emergency response drills
5.4 Post-fire management: Disaster recovery, structural repairs, community rehabilitation
5.5 Wildfire management: Firebreaks, controlled burns, community fire brigades

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	15	12
2	10	12
3	15	12
4	10	12
5	10	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

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EMERGENCY LOGISTICS AND TELECOMMUNICATION ENGINEERING

ENCEDR612

Credits: 4 **Year: II** **Part: I**

Course Objectives

The objective of this course is to make the students capable of understanding the basics of emergency logistics and supply chain management. It emphasizes on the logistics management and supply chain process; planning, management, operation, procurement, transportation, warehousing, inventory, supply/distribution, fleet management among others. The course aims to produce logistics managers for emergency response by making them capable of planning, programming and implementation: effectively fulfilling needs in highly complex and challenging environments.

1 Principle of Logistics [6 hours]

1.1 Basic concepts and terminologies
1.2 Definition of logistics in general and logistics in post disaster
1.3 Importance of logistics in disaster risk management (DRM)
1.4 Disasters and need of logistics
1.5 Emergency response logistic network
1.6 Logistic strategy
1.7 Performance measurement of humanitarian logistics

2 Humanitarian Supply Chain and Supply Chain Management Principle [8 hours]

2.1 Tools
2.2 Operational module: Transportation; Procurement
2.3 Logistic hubs

3 Cluster Approach: Principle of Cluster Approach [8 hours]

3.1 Logistic cluster and framework
3.2 Cluster approach and practices in Nepal
3.3 Disaster management framework in Nepal
3.4 Incident command system

4 Assessment, Planning and Operation of Logistic [8 hours]

4.1 Warehouse standard, capacity and practices
4.2 Warehouse assessment and planning
4.3 Site planning for emergency hub warehouse
4.4 Service triads in humanitarian logistics

5 Logistic Preparedness [8 hours]

5.1 Return on investment of preparedness activities
5.2 Logistics hubs
5.3 Logistics capacity assessments
5.4 Contingency planning (ERP's/ConOps)

6 Information Systems and Emergency Telecommunications [10 hours]

6.1 Computer systems
6.2 Information and communications technology
6.3 Emergency telecommunication systems: Radio systems and Ham radio; Satellite communications; Wireless communications; Artificial intelligence (AI) in disasters
6.4 Role of social media
6.5 Preparedness and coordination frameworks in emergency telecommunications

7 Technology in Emergency Logistic Information Management [12 hours]

7.1 Early warning systems
7.2 Remote sensing and geographic information systems (GIS)
7.3 Digital image processing
7.4 Disaster information management systems and sources
7.5 Common alerting protocol

Assignments

Case study on emergency logistics and telecommunication on recent disasters

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapters	Hours	Marks distribution*
1 and 2	14	12
3	8	12
4 and 5	16	12
6	10	12
7	12	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

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2. Coppacino, William C., (1997), Supply chain management: The basic and beyond
3. Hugos, Michael, (2003), Essential of supply chain management
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9. Anisya S. Thomas; Laura, S. Kopczak, Fritz Institute (2013), From logistics to supply chain management: The path forward in the humanitarian sector
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12. Manual, guidelines of WFP, Academics, Training institutes
13. P. K. Sinha, BPB Publications Computer Fundamentals
14. V. Rajaraman, PHI Publication, 4th Edition. Fundamentals of Computers
15. Raj K. Jain, S. Chand Publication Fundamentals of Programming
16. M. Anji Reddy JNTU Hyderabad (2001), B. S. Publications. Remote Sensing and Geographical Information Systems
17. George Haddow, Kim Haddow, Disaster Communications in a Changing Media World 2nd Edition
18. Websites: www.moha.gov.np, www.etcluster.org, www.logisticscluster.org

DISASTER RISK MANAGEMENT OF CULTURAL HERITAGE
ENCEDR613

Credits: 4 **Year: II** **Part: I**

Course Objectives

This course equips students with techniques for assessing and mitigating disaster risks to cultural heritage, focusing on integrating disaster risk management into the preparedness, recovery, and reconstruction of heritage sites. It also provides insights into the recent disasters reconstruction efforts, enabling students to analyze and apply lessons learned for preserving cultural heritage in disaster-prone areas.

1 Cultural Heritage in the Urban Environment [6 hours]

1.1 Cultural heritage: Concept, evolution and terminology
1.2 Disasters impact on cultural heritage
1.3 Basic principles of disaster risk management

2 Principles of Safeguarding Heritage [8 hours]

2.1 Conservation, preservation, renovation, and reconstruction
2.2 Disaster risk assessment of cultural heritage
2.3 Qualitative and quantitative value of risk
2.4 Government regulation and institutional framework
2.5 UNESCO heritage policies

3 Risk Assessment for Cultural Heritage [10 hours]

3.1 Hazard mapping
3.2 Risk identification
3.3 Vulnerability analysis
3.4 Constructing disaster scenarios
3.5 Evaluating risk levels
3.6 Seismic and climate risks
3.7 Local knowledge in risk assessment

4 Prevention and Mitigation Strategies [8 hours]

4.1 Approaches for risk prevention and mitigation
4.2 Reducing disaster risks from various hazards
4.3 Integrating traditional knowledge
4.4 Mitigation through urban planning
4.5 Community-Based risk mitigation

5 Emergency Preparedness for Cultural Heritage [6 hours]

5.1 Planning and procedures for emergency preparedness
5.2 Early warning systems and risk communication
5.3 Coordination with local communities
5.4 Crisis management during disasters

6 Recovery and Rehabilitation of Cultural Heritage [8 hours]

6.1 Damage assessment for cultural heritage
6.2 Post-disaster recovery planning
6.3 Repair and restoration of cultural heritage
6.4 Linking recovery to mitigation
6.5 Community-led recovery initiatives

7 Integrating DRM Plans for Cultural Heritage [6 hours]

7.1 DRM plan for cultural heritage
7.2 Community engagement in DRM
7.3 Communication tools and media for heritage protection
7.4 Implementation of DRM plans

8 Post-Earthquake Reconstruction of Heritage Sites in Nepal [6 hours]

8.1 Heritage activism
8.2 Reconstruction methods
8.3 Community engagement
8.4 Institutional coordination
8.5 Financial management
8.6 Lessons learnt

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapters	Hours	Marks distribution*
1 and 6	14	12
2	8	10
3	10	12
4 and 7	14	12
5	6	8
8	8	6
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Jigyasu, R., Chmutina, K. (Eds.). (2024). Routledge handbook on cultural heritage and disaster risk management (1st ed.). Routledge.
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STRUCTURAL HEALTH MONITORING
ENCEDR614

Credits: 4 **Year: II** **Part: I**

Course Objectives

This course aims to provide a comprehensive understanding of structural health monitoring (SHM) by exploring various sensor technologies, their applications in civil engineering structures and their critical role in disaster risk management. Students will learn about data acquisition, transmission, processing, and management systems within SHM, along with utilizing SHM for identifying dynamic modal properties in structures. The course also explores how SHM can be used to mitigate risks and enhance the safety of infrastructures during natural disasters.

1 Introduction [10 hours]

1.1 Historical background
1.2 Structural assessment, structural monitoring, and structural control
1.3 SHM system and its components
1.4 SHM strategy and method
1.5 SHM and predictive analytics in DRM

2 Sensors and Sensing Technology for SHM [8 hours]

2.1 Sensor types: Fiber optic sensors; Magneto strictive sensors; Shape memory alloys; Wireless sensors
2.2 Sensor measurements in structural monitoring
2.3 Optimum sensor selection and placement

3 SHM Strategies and Methods [6 hours]

3.1 Short term and long-term monitoring
3.2 Local and global monitoring
3.3 Static and vibration-based health monitoring
3.4 Planning SHM in civil infrastructures

4 Structural Damage Identification Techniques [6 hours]

4.1 Non-destructive testing techniques
4.2 Ultrasound
4.3 Guided (Lamb) waves
4.4 Thermography
4.5 Electromagnetic and capacitive methods

5 Data Acquisition, Transmission and Management [8 hours]

5.1 Data acquisition systems
5.2 Data transmission systems
5.3 Data processing systems
5.4 Data management systems

6 Damage Identification Methods [10 hours]

6.1 Vibration-based monitoring and its components
6.2 Damage identification: Frequency and mode shapes, lumped mass, element modal stiffness, modal strain energy
6.3 Example problem for damage identification
6.4 Comparison of vibration-based methods of damage detection
6.5 Visual inspection methods for damage identification.

7 SHM in Disaster Risk Management [12 hours]

7.1 Early warning systems and SHM
7.2 SHM in post-disaster assessment
7.3 SHM applications in earthquake-prone areas
7.4 SHM case studies in disaster risk reduction

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	10	10
2	8	10
3	6	5
4	6	5
5	8	10
6	10	10
7	12	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

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2. Gandhi, M.V. and Thompson, B.D. (1992). Smart materials and structures, Springer Netherlands.
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SEISMIC RISK ASSESSMENT AND RETROFITTING
ENCEDR615

Credits: 4 **Year: II** **Part: I**

Course Objectives

The objective of this course is to establish a strong foundation in earthquake engineering by focusing on seismic hazard, vulnerability, and risk assessment while providing essential knowledge of analytical tools for seismic risk reduction. Students will gain the expertise to evaluate seismic hazards and vulnerabilities effectively, estimate the overall risk to the built environment, and apply fundamental techniques for retrofitting structures to enhance their resilience. This course aims to equip students with the skills necessary to contribute to safer and more sustainable infrastructure in earthquake-prone regions.

1 Introduction [2 hours]

1.1 History of Nepalese and global significant earthquakes, their damages, death and loss
1.2 Definition of hazard, exposure, vulnerability and risk

2 Exposure Mapping [8 hours]

2.1 Identification of physical, social, economic, and cultural indicators
2.2 Spatial distribution: count, population, replacement cost
2.3 Mapping schemes
2.4 Uncertainties in exposure modeling

3 Vulnerability Assessment [8 hours]

3.1 Physical, social, cultural, and economic dimension of vulnerability
3.2 Rapid Visual Screening (RVS) assessment
3.3 Vulnerability index approach: GNDT, RISK-UE and Combined methods
3.4 Use of capacity and fragility/vulnerability curves

4 Loss Estimation [8 hours)

4.1 Quantitative risk assessment (QRA)
4.2 Event-tree analysis (ETA)
4.3 Risk matrix approach (RMA)
4.4 Seismic risk indices, process-related risk indices (PRI)
4.5 Indicator-based approach (IBA)
4.6 Integrating seismic hazard to seismic risk
4.7 Consequence analysis

5 Tools and Techniques [10 hours]

5.1 Use of Remote Sensing and GIS
5.2 Risk assessment tools for diagnosis of urban areas against seismic disasters (RADIUS)
5.3 CAPRA-EQ (Probability risk assessment) Platform
5.4 Open quake engine
  5.4.1 Scenario, PSHA, risk and damage calculators
  5.4.2 Ground motion field and GMPEs
  5.4.3 Source model and logic tree
  5.4.4 Exposure model, vulnerability functions, and hazard curves
  5.4.5 Loss and damage maps
5.5 HAZUS Model and Analysis levels: Basic and advanced

6 Seismic Risk Assessment of Lifelines and Infrastructures [10 hours]

6.1 Damage functions, definition of damage state, component restoration curves
6.2 Residential buildings
6.3 Essential and high potential loss facilities (Hospitals)
6.4 Transportation systems (Highways, roads, bridges, tunnels)
6.5 Water supply system (Pipelines)
6.6 Electric power supply system
6.7 Communications system
6.8 Liquefaction susceptibility and ground water depth estimation

7 Strengthening/Retrofitting Techniques [14 hours]

7.1 Basic concept of retrofitting: global and local retrofitting
7.2 Various retrofitting techniques: Jacketing; Grout and epoxy injection; Steel bracing; Steel moment frame; Adding new shear walls; Fiber-reinforced polymer; Post-tensioning; Dampers; Base isolation
7.3 Retrofitting materials
7.4 Available codes and guidelines for retrofitting design
7.5 Existing retrofitting practices in Nepal

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	2	5
2	8	5
3	8	10
4	8	10
5	10	10
6	10	10
7	14	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Baker et al. (2021). Seismic Hazard and Risk Analysis, Cambridge University Press, Cambridge, England.
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SOCIO-ECONOMIC ASPECT OF DISASTER MANAGEMENT

ENCEDR621

Credits: 4 **Year: II** **Part: I**

Course Objectives

This course aims to provide students with a deep understanding of the intersection between socioeconomic dimensions and engineering practices in disaster management. It focuses on equipping students with the knowledge and analytical skills to evaluate how socioeconomic factors influence disaster vulnerability and the resilience of communities, economies, and infrastructure.

1 Introduction [10 hours]

1.1 Overview of disaster management
1.2 Socioeconomic factors in disaster vulnerability and resilience
1.3 Role of engineers in disaster management considering socioeconomic dimensions
1.4 Definitions and concepts of vulnerability and resilience
1.5 The relationship between disasters and sustainable development
1.6 Disasters influenced by development processes

2 Socioeconomic Determinants and Vulnerability [10 hours]

2.1 Socioeconomic determinants of vulnerability: Poverty, inequality, gender and age
2.2 Impact of poverty and inequality in disaster risks
2.3 GEDSI consideration in disasters
2.4 Resilience building through community-based approaches
2.5 Strategies for addressing the needs of vulnerable populations

3 Economic and Social Impacts of Disasters [10 hours]

3.1 Direct and indirect economic losses from disasters
3.2 Macroeconomic and microeconomic impacts
3.3 Cost-benefit analysis of disaster risk reduction measures
3.4 Economic evaluation of disaster risk reduction strategies
3.5 Social dimensions of disasters

4 Infrastructure and Resilience Building [10 hours]

4.1 The role of infrastructure in disaster resilience
4.2 Socioeconomic impacts of infrastructure damage
4.3 Engineering solutions to enhance infrastructure resilience
4.4 Integration of disaster risk reduction into development planning
4.5 Engineering responses to climate-related disaster risks

5 Policy, Governance, and Risk Communication [10 hours]

5.1 National and international policies on disaster risk management
5.2 Governance structures and their role in disaster management
5.3 Integration of socioeconomic aspects into policymaking
5.4 Importance of effective risk communication
5.5 Strategies for public awareness and education
5.6 Role of engineers in community engagement and risk communication

6 Ethics, Gender and Climate Considerations [10 hours]

6.1 Ethical dilemmas in disaster management
6.2 The role of engineers in ethical decision-making
6.3 Balancing socioeconomic and technical considerations
6.4 Gender-sensitive approaches to disaster management
6.5 Policies and practices for promoting gender equity in disaster contexts
6.6 The impact of climate change on disaster frequency and intensity
6.7 Socioeconomic implications of climate-induced disasters

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	10	10
2	10	10
3	10	10
4	10	10
5	10	10
6	10	10
Total	60	**60**

*There may be minor deviation in marks distribution.

References

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ECOSYSTEM BASED DISASTER RISK MANAGEMENT

ENCEDR622

Credits: 4 **Year: II** **Part: I**

Course Objectives

The objective of this course is to provide advanced knowledge of integrating ecosystem-based approaches to manage and reduce disaster risks. It equips students with skills to analyze, evaluate, and apply strategies that enhance ecological resilience and mitigate disaster impacts. The course emphasizes understanding interactions between ecosystems, natural hazards, and human activities while exploring theoretical frameworks and practical approaches.

1 Integrated Disaster Risk Planning [6 hours]

1.1 Understanding the concept of ecosystem-based approaches
1.2 Linkages between ecosystems, natural hazards, and disaster vulnerability
1.3 Critical review of current disaster risk management strategies
1.4 Sustainable development, resilient development and disaster
1.5 Major Eco Zones

2 Ecological Resilience and Adaptation [6 hours]

2.1 Principles of ecological resilience
2.2 Ecosystem services and their role in reducing disaster risks
2.3 Assessing ecosystems' capacity to adapt to disturbances

3 Ecosystem-Based Interventions for Disaster Risk Reduction [20 hours]

3.1 Nature Based Solutions: Bioengineering; Soil conservation; Flood management; Land slide prevention and management; Integrated water resource management
3.2 Ecosystem-based interventions: National and international practices
3.3 Community based ecosystem adaptive DRR
3.4 Integrating traditional knowledge with modern approaches
3.5 Evaluating the effectiveness of nature-based solutions

4 Policy Frameworks and Governance for Ecosystem-Based DRRM [15 hours]

4.1 International conventions related to ecosystem-based disaster risk management
4.2 Institutional arrangements for implementing ecosystem-based approaches
4.3 Federal, provincial and local act policies; Strategies for DRRM; Ecosystem approaches
4.4 Institutional framework at federal, provincial and local level for DRRM and Ecosystem Approaches
4.5 Developing policy recommendations for mainstreaming ecosystem considerations

5 Innovative Tools and Techniques in Disaster Risk Management [7 hours]

5.1 Understanding social dimensions in ecosystem-based DRRM
5.2 Community engagement and participation in implementing nature-based solutions
5.3 Addressing equity, justice, and ethics within socioecological frameworks
5.4 Economics of ecological approaches in DRRM

6 Advanced Technologies for Spatial Planning [6 hours]

6.1 Advanced technologies for monitoring ecosystems
6.2 Integration of Ecosystem Based DRR in spatial Planning
6.3 GIS applications for spatial planning in disaster risk reduction

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	6	5
2	6	5
3	20	20
4	15	20
5	7	5
6	6	5
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., Rockström, J. (2005). Social-ecological resilience to coastal disasters. Science, 309 (5737), 1036-1039.
2. Lacambra, C., Spencer, T., Moeller, I. (2008). The Role of Environmental Management and Eco-Engineering in Disaster Risk Reduction and Climate. Change Adaptation Cambridge Coastal Research Unit, Department of Geography, University of Cambridge. UK.
3. Devkota, S., Lal, A. C. (2017). Local Knowledge for Addressing Climate Change Risks at Local Level: A Case Study from Nepal. Identifying Emerging Issues in Disaster Risk Reduction, Migration, Climate Change and Sustainable Development. SDP, 211-230.

INTEGRATED DISASTER RISK PLANNING AND MANAGEMENT

ENCEDR623

Credits: 4 **Year: II** **Part: I**

Course Objectives

This course provides an in-depth understanding of the integrated approach to disaster risk planning and management. After completion of this course, students will be able to: understand the principles and frameworks of integrated disaster risk planning and management, analyze the roles of different sectors and stakeholders in disaster risk management, develop comprehensive disaster risk management plans that integrate multiple disaster risk reduction strategies, evaluate the effectiveness of integrated risk management approaches through case studies, apply innovative tools and techniques for disaster risk assessment, planning and management and promote cross-sectoral collaboration and stakeholder engagement in disaster risk planning.

1 Introduction [12 hours]

1.1 Overview of disaster risk management concept
1.2 Importance of an integrated approach
1.3 International frameworks and policies

2 Strategic Planning in Disaster Risk Management [12 hours]

2.1 Component of a disaster risk management plan
2.2 Setting goals, objectives, and priorities
2.3 Resource allocation and management

3 Cross-sectoral Collaboration and Stakeholder Engagement [12 hours]

3.1 Roles of government, private sector, NGOs and community
3.2 Public-private partnership in disaster risk management
3.3 Communication and coordination among stakeholders

4 Mitigation and Resilience Building [12 hours]

4.1 Structural and non-structural mitigation measures
4.2 Resilience framework and indicators
4.3 Case studies of successful resilience-building initiatives

5 Innovative tools and techniques in disaster risk management [12 hours]

5.1 Use of GIS, remote sensing, and early warning systems
5.2 Integration of climate change adaptation into disaster risk planning
5.3 Emerging technologies in disaster risk management

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	12	12
2	12	12
3	12	12
4	12	12
5	12	12
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Jha, A. K., Todd, W. M., and Zuzana, S. G. (eds). (2013). Building Urban Resilience: Principles, Tools, and Practice. Directions in Development. Washington, DC: World Bank. doi:10.1596/978-0-8213-8865-5. License: Creative Commons Attribution CC BY 3.0
2. Baas, S., Ramasamy, S., DePryck, J.D., Battista, F. (2008). Disaster Risk Management Systems analysis. Food and Agriculture Organization of the United Nations. 74p.
3. Mahamood, A., Ha, H., Fernando, L.S. (2015). Strategic Disaster Risk Management in Asia. Springer, 226p.
4. Jyoce, P., (2022). Strategic Management and Governance: Strategy Execution Around the World. Taylor and Francis, 264p.
5. Singh, P., Rai, P.K., Mishra, V.N., (2021). Recent Technologies for Disaster Management and Risk Reduction: Sustainable Community Resilience and Response. Springer International Publishing, 479p.

ANTICIPATORY ACTION AND SHOCK RESPONSIVE SOCIAL PROTECTION
ENCEDR624

Credits: 4 **Year: II** **Part: I**

Course Objectives

This course covers the evolving concepts and practices of anticipatory action and shock responsive social protection in disaster risk management. The course units aim to give students all the technical and practical knowledge and skills in relation to the development and implementation of anticipatory action systems and mechanisms including their linkages and integration with social protection systems and instruments to reduce and respond to humanitarian impacts of disasters.

1 Introduction [7 hours]

1.1 Anticipatory Action (AA): Concepts, key components of AA; Basic terms and terminologies; Use of AA in different hazards

1.2 Anticipatory action in disaster risk management continuum: Anticipatory action preparedness, response, disaster risk reduction

1.3 Global, regional and country overview: Anticipatory action in the world, learning, experiences and evidence base

2 Forecast Triggers, Thresholds and Early Action [15 hours]

2.1 Forecasting science and approaches: Forecasting approaches to various hazards, deterministic and probabilistic forecasts, impact-based forecasting for early action, verification of forecasts accuracy

2.2 Risk assessment and early action: Risk indicators, impacts analysis, hazard-impact curves, problem tree analysis, selection of early actions and theory of change

2.3 Trigger points/mechanism for AA: Hazard and impact thresholds, geographic targeting and intervention mapping, AA trigger models for various hazard and data context

3 Financing and Operationalization of Anticipatory Action [8 hours]

3.1 Financing for anticipatory action: Types and potential sources of finances, AA financing instruments and models

3.2 AA protocol and framework: AA operationalization process, operational decision context and considerations for slow and fast onset events, readiness and early actions, AA activation

3.3 Monitoring and evaluation of AA: M&E approaches, considerations for rapid and slow onset events, theory of change for AA, research ethics in humanitarian context

4 Social Protection in Disaster Risk Management [8 hours]

4.1 Definitions, Social protection instruments and examples

4.2 Approaches to social protection: Adaptive social protection (ASP), shock responsive social protection (SRSP), differences between ASP and SRSP

5 Integrating Anticipatory Action and Social Protection [15 hours]

5.1 Role of social protection for anticipatory action: social protection and humanitarian linkages, advantages of linking social protection and anticipatory action (with examples and case studies)

5.2 Options and steps for integrating anticipatory action (AA) and social protection (SP): SP systems for AA interventions, integrating AA into SP systems, vertical expansions, horizontal expansions, design tweaks, piggybacking, alignment

5.3 Operational infrastructure and financing options for AA and SP integration: Coordination, policy and institutional entry points, capacity building, financing requirements and options

6 Institutionalization of AA and Shock Responsive Social Protection [7 hours]

6.1 Enabling environment and pathways for institutionalization: Global, regional and national perspectives, proof of concept and evidence base, harmonization of AA protocols and frameworks, policies and legal frameworks

6.2 Advocacy, coordination and partnerships

Assignments

1. A review paper on state of play of anticipatory action in Nepal including challenges and future opportunities
2. Exercise on developing an impact database and menu of forecasts for the given hazards and area of interest in Nepal
3. Scoping Paper on the potentials of social protection schemes of Nepal to deliver AA and respond to shocks and stresses
4. Critical commentary on published studies, articles or reports around impact evaluation and evidence base of anticipatory action and/or shock responsive social protection

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Marks distribution*
1	7	10
2	15	10
3	8	10
4	8	10
5	15	10
6	7	10
Total	**60**	**60**

*There may be minor deviation in marks distribution.

References

1. Asia-Pacific Technical Working Group on Anticipatory Action. (2023). Technical Standards on Anticipatory Action in Asia and the Pacific, Bangkok. Available at https://www.anticipation-hub.org/download/file-3299
2. Harrowsmith, M., Nielsen, M., Sanchez, M. J., de Perez, E. C., Uprety, M., Johnson, C., Van den Homberg, M., Tijssen, A., Page, E.M., Lux, S. and Comment, T. (2020). The Future of Forecast: Impact based Forecasting for Early Action. Available at https://www.anticipation-hub.org/download/file-58
3. Lopez, A., de Perez, E. C., Bazo, J., Suarez, P., van den Hurk, B., & van Aalst, M. (2020). Bridging forecast verification and humanitarian decisions: A valuation approach for setting up action-oriented early warnings. Weather and Climate Extremes, 27, 100167. https://doi.org/10.1016/j.wace.2018.03.006
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5. O'Brien et al. (2018). Shock-Responsive Social Protection Systems Research: Synthesis Report. Oxford Policy Management. https://www.opml.co.uk/files/Publications/a0408-shock-responsive-social-protection-systems/srsp-synthesis-report.pdf?noredirect=1
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