

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**NAME OF CENTRE:** Centre of Excellence in Disaster Mitigation and Management**Subject Code:** DMC-501 **Course Title:** Introduction to Disaster Mitigation and Management**L-T-P:** 3-0-0**Credits:** 3**Subject Area:** PCC

Course Outlines: Theories and concepts of disaster studies, key terms - hazard, vulnerability, response, risk; disaster management cycle; disaster mitigation and management; preparedness, recovery; National and International policies and conventions on disasters; Transition from relief-centric to holistic disaster risk reduction; Case-studies: In-depth analysis of recent disaster events and responses; Examining best practices and lessons learned.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DMC-503

Course Title: Geodata Processing Techniques and Models

L-T-P: 3-0-2

Credits: 4

Subject Area: PCC

Course Outlines: Importance of Geodata processing techniques; Geographic coordinate and projection systems, Modern surveying, GPS technologies, Aerial data collection techniques, Remote sensing: Active and Passive, Digital Image Processing, Geodatabase Management, and GIS Components. Applications of remote sensing and GIS software.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DMC-505

Course Title: Natural Hazards: Processes, Monitoring and Prediction

L-T-P: 3-0-2

Credits: 4

Subject Area: PCC

Course Outlines: Introduction to various natural hazards: earthquakes, landslides, cyclones, floods, and tsunami. Geological Processes leading to natural hazards, short term and long term prediction. Earthquakes: causes, classification, estimation of size, magnitude and intensity. Seismic hazard assessment. Monitoring and alert systems for earthquake prediction. Landslides: causes, hazard zonation, monitoring and prediction. Cyclones: causes, characteristics, monitoring. Floods: causes, damages, analysis, mapping, monitoring, forecasting. Tsunami: Tsunamigenic earthquakes, modelling and hazard zonation. Other natural hazards: volcanic eruptions and forest fires. Case studies of above natural hazards.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DMC-507 **Course Title:** Climate Change: Impact, Adaptation and Mitigation

L-T-P: 2-1-2

Credits: 4

Subject Area: PCC

Course Outlines: Components of the climate system; Reconstruction of past climate; Climate variability and climate change, teleconnections; Radiative forcing, climate feedback and climate sensitivity; Climate modelling; Future climate projections, Carbon emission pathways, Climate change scenario development; Changes in extreme weather-related events; Concept of climate change adaptation and Mitigation; Resources and technologies to reduce greenhouse gas emission and level.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DMS-501

Course Title: Climate Change and Sustainable Development

L-T-P: 2-0-0

Credits: 2

Subject Area: SSC

Course Outlines: Climate Change and its impacts; Concepts of adaptation and mitigation; Sustainability and its various dimensions (economic, social and environmental); Principles of sustainable development; Sustainable development goals; Sustainable development sectors: Food-Energy-Water (FEW) nexus, material, city; Sustainable development policies.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-501

Course Title: Analysis of Hydrological Extremes

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outlines: Hydro-metrological data: importance and observation, Understanding floods, Different methods of flood estimation, flood frequency analysis, flood routing, Flood plain and inundation mapping, Flood plain modelling, Design flood estimation, Concept of flood risk, risk assessment in technological, social and environment context, urban drainage and runoff computations, urban flooding. Flood mitigation and management using structural and non-structural methods. Drought and its classification, Causes of drought, Assessment of drought, drought indices, Drought management plan; Drought Monitoring and prediction, Drought response and mitigation strategies.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-502

Course Title: Landslide Hazard Assessment and Mitigation

L-T-P: 2-1-2

Credits: 4

Subject Area: PEC

Course Outlines: Introduction, classification of landslides and mass movements. Background of landslides with special reference to the Himalayas and the Western Ghats, India. Scale dependent Landslide Hazard Assessment and Zonation, Mechanics of landslides, Landslide Hazard Mitigation, Case studies.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-505

Course Title: Weather and Climate Modelling

L-T-P: 2-1-2

Credits: 4

Subject Area: PEC

Course Outlines: Introduction to weather and climate models; Model Hierarchy; Governing equations; discretization and integration, stability and Courant–Friedrichs–Lewy criterion, model components, dynamical core, physical parameterization, Numerical models for weather forecasting and climate projection with case studies.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-506

Course Title: Advanced Landslide Analysis

L-T-P: 2-1-2

Credits: 4

Subject Area: PEC

Course Outlines: Methods for field (in-situ) identification and classification of landslides, Constitutive and numerical modelling of landslides for landslide analysis, Analysis of cold region landslides i.e., rock/rock-ice avalanche. Reduced-scale experiments for prototype testing of landslides, Laboratory experiments for landslide material characterisation for strength and permeability.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-510

Course Title: Vulnerability and Risk Analysis

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outlines: Concepts and types of vulnerability; Components of vulnerability – Adaptive capacity and Sensitivity; Vulnerability Assessment: Damage statistics, analytical and hybrid methods, community-based and participatory methods; Concept of exposure, Exposure assessment: preparation of exposure database, sample surveys; Risk assessment: deterministic and probabilistic approach; Uncertainty and sensitivity analysis, Application of earth-observation data in vulnerability and risk analysis.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-516

Course Title: Cryosphere hazards

L-T-P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outlines: Cryosphere and its components, Snow/glacier melt runoff modelling, Glacier formation, classification and characteristics, monitoring glacial retreat, down wasting, mass movement (Surging), Glacier geomorphic processes: erosion, transport and deposition, glacial sedimentation. Glacier mass balance, Glacier velocity and motion, Glacier surface elevation changes, Glacier ice thickness and volume estimation, Calving and glacier instabilities, Glacial lake, types and characteristics, lake bathymetry mapping studies, Vulnerability of lakes, Glacial lake outburst flood modeling, Mitigation measures, Early warning system.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-519

Course Title: Fire Science & Engineering

L-T-P: 3-0-2

Credits: 4

Subject Area: PEC

Course Outlines: Fire, combustion and explosion, flammability characteristics of chemicals and materials: liquids, vapors, gaseous/vaporous mixtures, gas-liquid two-phase mixtures, flame propagation, Flammability diagram, ignition energy, auto ignition, and auto-oxidation, fire initiation and propagation-severity and duration, adiabatic ignition temperature, effect of enclosure and heat transfer in fire development, stack and pool fires. Critical aspects of fire dynamics, diffusion flame and fire plumes, flame spread, production and movement of smoke, computer simulations of fire dynamics. Fire detection systems. Fire prevention and control: inerting procedures, static electricity - charge accumulation, electrostatic discharging, charge balancing in flow systems, design of sprinkler systems, flare design.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-509 **Course Title:** Application of Geospatial Data for Disaster Mitigation

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PEC

Course Outlines: Role of Remote Sensing, GIS and GPS in each stage of disaster mitigation. Preparation of seismic hazard zonation maps, regional risk assessment. Preparation of landslide hazard zonation maps, regional and site-specific risk assessments. Flood prone area demarcation, analysis and risk assessment. Drought prone area demarcation. Differential SAR Interferometry for ground displacement estimations due to earthquakes, landslides and subsidence. Case studies of the above disasters.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DML-514

Course Title: Industrial/Manmade Disasters and Safety

L-T -P: 3-1-0

Credits: 4

Subject Area: PEC

Course Outlines: Introduction and background of significant disasters; Fundamental terminology and definitions-safety philosophy, need for safety; World-class safety culture and core attributes; Introduction to industrial Acts/Laws, Regulations and codes; Reasons for accident prevention; Reactive vs Proactive approaches for safety; Measurements of safety performance/indices, budgeting for safety; Risk assessment identification and its mitigation process-HIRA; Safety measures to avoid accidents; Onsite and offsite emergency plan- legal requirements; Case-studies: In-depth analysis of manmade/industrial disasters, mitigation practices and lessons learned.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF CENTRE: Centre of Excellence in Disaster Mitigation and Management

Subject Code: DMT-501

Course Title: AI/ML for Disaster Management

L-T-P: 2-1-0

Credits: 3

Subject Area: STAR

Course Outlines: Introduction to AI/MLs, Classification and Clustering, Supervised and Unsupervised Learning, Decision Trees, Random Forest, Principal Component Analysis (PCA), Support Vector Machines, K-Nearest Neighbors, Logistic Regression, Gradient Boosting, Bayesian Networks, Ensemble Methods, Neural Networks, Deep Learning (CNN, RNN), Reinforcement Learning. Natural Language Processing (NLP), NLP application in Disaster Studies. Exploratory Data Analysis: Python for Data Analytics, Libraries like PyTorch, Keras. R Programming language: Dplyr, Tidyr, Lubricate packages.