

## Detail Outline of Postgraduate Courses

*The Master of Science in Disaster Risk Reduction Engineering [M. Sc. Engg. (DRR)] program will consist of a total of 25 courses. Out of these, 18 courses will be provided by BUET-JIDPUS, while the remaining 7 courses will be offered by other departments or institutions within BUET.*

### **COURSES OFFERED BY BUET-JIDPUS**

#### **DP 6001 Multi Hazard Risk Assessment and Mitigation**

*3 Credits*

Natural Hazards & Man-made Hazards, Hazard Assessment, Risk Analysis for Different Hazards, Elements at Risk Assessment, Obtaining Spatial Data for Risk Assessment, Risk Based Zoning, Vulnerability Assessment, Risk Management, Forecasting and Warning.

#### **DP 6003 Remote sensing and GIS for Disaster Mitigation**

*3 Credits*

Stress-strain relationship; Plane-stress and plane-strain; Stress functions; Two dimensional problems in rectangular and polar coordinates; Torsion; Energy principles; Stress and strain in three dimensions; General theorems; Three dimensional problems; Theories of failure; Computer solutions of elasticity problem. Introduction to Spatial Information Engineering for Disaster management, Principle of Remote Sensing: Optical Sensors, SAR, LIDAR Images, Image Processing and Analysis, Principle of Geographic Information System: Geo-spatial and Thematic Data Analysis, GPS and Field Surveying, Data Integration and Database Generation, Spatial Analysis and Visualization; Advanced Mapping Technology: UAV, MMS, Field Sensor Network; Space-Based Technology for Disaster and International Collaborations; Location Based Service: Web GIS, Geo-Portal, Early Warning System.

#### **DP 6005 Wind Induced Disaster Mitigation**

*3 Credits*

Application of Meteorology in Wind Engineering, Turbulence Effects and Aero-Elasticity, Basics of Wind Resistant Design, Engineering Models for Wind Load & Wind Structure Interaction, Wind Induced Vibrations of Structures, Control and Mitigation of Wind Induced Vibrations of Structures Especially Tall Buildings and Bridges, Strengthening of Rural Houses, Design of Structures for Cyclone Prone Areas.

#### **DP 6007 Risk Analysis and Uncertainty Modeling**

*3 Credits*

Definition of risk, functional modeling and analysis techniques, probabilistic risk assessment procedure, risk methods, risk acceptance, assessment of failure likelihood, consequence assessment, risk benefit assessment, uncertainty sources and types, modeling uncertainty, risk analysis and decision making under uncertainty, collection of data, expert-opinion elicitation, human-machine interface, sources and types of knowledge and ignorance,

uncertainty sources and types for engineering systems, probability models, statistical models, fuzziness, fuzzy sets, fuzzy logic, fuzzy arithmetic, imprecise probabilities, uncertainty measures, uncertainty reduction.

### **DP 6009 Earthquake Disaster Mitigation**

*3 Credits*

Plate Tectonics, Active Faults, Seismic Waves, Seismographs, Earthquake Magnitude and Intensity, Seismic Hazard Assessment, Deterministic and Probabilistic Seismic Hazard Assessments, Ground Motion Attenuation Relationships, Seismic Hazard Maps and their uses for Earthquake Disaster Mitigation; Tsunami: Causes and Nature of Tsunami, Characteristics of Tsunami Waves, Tsunami Warning System, Tsunami Hazard Maps, Tsunami Risk Mitigation Measures, Earthquake-Induced Ground Failures: Soil Liquefaction & Mitigation Measures, Earthquake-Induced Landslides, Surface Rupture along Fault; Seismic Vulnerability of Buildings and Structures: Lessons Learned from Past Earthquakes, Seismic Vulnerability of Different Building Classes, Strengthening and Mitigating Seismic Risk, Seismic Loss Estimation, Strategies for Earthquake Protection.

### **DP 6013 Urban Fire Hazard Mitigation and Safety Planning**

*3 Credits*

Fire hazard in urban areas: Fuel/structure modification, Water supply, Emergency services, Emergency evacuations, Minimizing fire loss, Firefighter safety; Development of fire mitigation policies; Post event recovery and maintenance; Mandatory elements of the general plan: Land use, Housing, Circulation, Conservation, Open space, Safety, Related planning and regulatory tools.

### **DP 6015 Community Based Disaster Planning**

*3 Credits*

Major activities and concepts related to disaster mitigation; Community-based approaches to disaster mitigation; A communication model; Community preparedness programs; Community Disaster resilience programs and Community assessment tools; Developing partnerships and Connecting with the Public.

### **DP 6017 Land Use Planning Using Remote Sensing and GIS**

*3 Credits*

Introduction to Geographic Information Systems (GIS) and Remote Sensing (RS); Basic Land-use classifications with GIS software; Use of satellite technology for thermal remote sensing and temperature monitoring; Creation of 3D landscape models from drone surveys; Advanced classification of landscapes from street-level to district level; Introduction to declassified satellite imagery; Working with declassified data: registration and geometric corrections; Quantifying urban expansion and land-use change with mixed satellite data sources; Object -Oriented classification of urban landscapes with Corona data.

## **DP 6201 Flood Control and Mitigation**

*3 Credits*

Background and causes of flood problem in Bangladesh; Flood damage: Flood induced riverbank erosion; Flood control policies: Post-disaster recovery, Indigenous flood-adjustment strategies, Sustainable floodplain development policy; Flood control measures: Mitigation of flood damage, Structural and Non-structural measures, Land use, zoning and risk assessment, Flood induced erosion control, Low cost measures; Flood forecasting and warning systems; Research, education and exchange of knowledge; Public awareness, preparedness and participation.

## **DP 6203 Coastal Water Disaster Mitigation**

*3 Credits*

Introduction to disaster; Coastal water disasters; Lessons from the previous Coastal water Disasters: Methodology and Description of Basic Tsunami Parameters, Storm Surge Due to 2008 Cyclone Nargis in Myanmar and Post-cyclone Preparedness Activities, Observations and Numerical Simulation of Storm Surge due to Cyclone Sidr 2007 in Bangladesh; Assessments of Vulnerability; Mitigation Measures (Structural Measures): Stability and Disaster Mitigation Effect of Wave-Dissipating Concrete Blocks of Detached Breakwaters Against Tsunami Waves, Breakwater Damage and the Effect of Breakwaters on Mitigation of Inundation Extent During Tsunamis: Case Study of The 2011 Great East Japan Earthquake and Tsunami, The New ASCE Tsunami Design Standard; Mitigation Measures (Soft Measures): Cost-Efficient Design of Multilayer Safety Systems Against Large-Scale Coastal Disasters, Wave Reduction in Mangrove Forests; Post-Disaster Reconstruction; Climate Change Influence on Coastal Disasters.

## **DP 6101 Structural Aspects of Earthquake Resistant Design**

*3 Credits*

Primary and Secondary Effects of Earthquake; Causes for Earthquake; Period of Vibration; Effects of Earthquake on Vertical Structures; Inertia due to earthquake; Earthquake effects on Buildings; Modes of Vibration due to Earthquake Forces; Effects of Earthquakes on Stress distribution; Earthquake Resistant Design Concept and Philosophy: Requirements of structural safety, Concepts of ductility, deformability and Damageability, Concept of isolation. (5<sup>th</sup>)

## **DP 6103 Non-destructive Methods for Structural Evaluation and Structural Health Monitoring**

*3 Credits*

Principal non-destructive (NDT) methods for structural evaluation: Ultrasonic Pulse Velocity, Seismic Tomography, Impact-Echo, Ground Penetrating Radar (GPR), Electrical Resistivity of Concrete; Relevant physical principles of continuum mechanics, electrical engineering, acoustics and elastic wave propagation underlying the experimental methods; Structural health monitoring (SHM): Level of SHM, Necessity, SHM components, Sensor data acquisition and interrogation and ultrasonic digital signal processing, Pattern recognition, Case studies: SHM in dams and bridges; Laboratory demonstrations on selected topics.

### **DP 6107 Emerging Technologies for Structural Rehabilitation**

*3 Credits*

Experimental investigation of design and retrofitting strategies using small scale structural models; Testing of elements and interpretation of failure mechanism, derivation of structural layout and simplified models of representative building types, damage prognosis and comparison with observed response; Fragility functions.

### **DP 6105 Experimental Methods for Structural Evaluation and Rehabilitation**

*3 Credits*

Experimental Structural evaluation: Testing facilities and technical equipment; Arrangement of sensors, Application of equivalent forces and ground motion in pseudo static and dynamic testing; Load and displacement relationship for full-scale testing of structural elements (RC columns, masonry wall); Damping devices, Prediction of capacity curves and material properties and parameters; Model testing for rehabilitation: Experimental investigation of design and retrofitting strategies using small scale structural models; Testing of elements and interpretation of failure mechanism.

### **DP 6011 Risk and Reliability in Geotechnical and Structural Engineering**

*3 Credits*

Introduction and Definition of Risk and Reliability; Constructing multivariate distributions for soil parameters; Evaluating reliability in geotechnical engineering; Maximum likelihood principle and its application in soil liquefaction assessment; Bayesian analysis for learning and updating geotechnical parameters and models with measurements; Practical reliability analysis and design by Monte Carlo Simulation; Evolution of geotechnical risk analysis; Verification of geotechnical reliability using load tests and integrity tests; Reliability and risk analysis in Structural Engineering: first order reliability method (FORM), Seismic reliability analysis of structures and infrastructures; Reliability based design: Practical procedures, geotechnical and structural examples, and insights.

### **DP 6401 Seismology and Geotechnical Aspects of Earthquake Engineering**

*3 Credits*

Introduction to engineering seismology; Causative mechanisms of earthquakes and ground motion attenuation relationships; Dynamic properties of soils; Geotechnical seismic hazards and their mitigation; Response of soils to seismic loading; Liquefaction of soil deposits; Analysis and design of slopes and embankments for seismic loading.

### **DP 6403 Geotechnical Application of Slope Protection, Settlement Control & Erosion Control**

*3 Credits*

Slope stability analyses: Macro stability of a slope, Stability analysis for infinite slopes (with and without seepage), Stability analysis for finite slopes (with plane and circular failure surfaces, Method of slices, Bishop & Morgenstern's solution with seepage, Morgenstern's

method for rapid drawdown, Spencer's solution with seepage); Shallow slope movement: Types of movement, Factors in slope movement, Slope movement assessment; Erosion: Types of erosion, Factors in erosion, Erosion assessment, Sensitivity of factors, Erosion control management; Control measures: Bank protection, Slope reinforcement, Vegetation covers, Temporary slope drainage and other measures; Slope erosion design: Universal Soil Loss Equation and other conventional methods; Settlement control: By deep and mass soil mixing in clayey soil, Use of geotechnical instruments.

### **DP 6405 Field Evaluation of Site Condition**

*3 Credits*

Determination of effects of earth deformations and strong ground shaking had on structures; Measurement of cracks, fault widths, uplift, subsidence, tilting, or warping; Examination and documentation of surface expressions of the causative fault; Drawing of relevant geologic cross-sections; Inspection and assessment of the performance of engineered structures with respect to strong ground motion and earth deformations such as settlement, liquefaction, ground cracking, landslides, and ground offset; Documentation of undamaged sites, sites near the threshold of failure, and good performance of structures, noting types of soils.

## **COURSES OFFERED BY EXTERNAL INSTITUTIONS/DEPARTMENTS**

### **CE 6117 Structural Dynamics and Seismic Design of Structures**

*3 Credits*

Fundamentals of structural dynamics. SDOF, Free vibration response, response to harmonic, periodic, impulsive and general dynamic loading. MDOF, undamped free vibrations. Analysis of dynamic response. Beam: vibrations, random vibrations. Probability theory. Deterministic and nondeterministic analysis of earthquake response. Earthquake resistant design of buildings, bridges and dams.

### **CE 6411 Earthquake Engineering**

*3 Credits*

Historical Background, Plate tectonics; Various types of earthquakes and faulting; Wave types; Seismometers and micro tremor instruments; Magnitude and intensity scales; Earthquake time histories; Fourier and response spectra; Historical seismicity and earthquake catalogues: data acquisition, sources, magnitude rescaling, application to hazard analysis; Site characterization: amplification and responses; Experimental simulation and shaking tables; Introduction to lifeline engineering: electricity, water, natural gas, telecommunication and transportation systems, Post earthquake damage survey; Mitigation strategies; Case studies of major earthquakes.

### **CE 6407 Soil Dynamics**

*3 Credits*

Sources and types of dynamic loading. Vibration of elementary systems, Wave propagation in soils. Dynamic soil properties and their determination, liquefaction, shear modulus and

damping effects. Vibrations of foundations on elastic media, machine foundations, earthquake response, blast effects including nuclear weapon effects.

### **WFM 6201 Hazards and Risk Analysis**

*3 Credits*

Natural hazards: climate, riverine and coastal; Man made hazards; Presentation of hazards data; Hazards assessment; Expected damage; Risk analysis; Risk reduction measure: structural and non-structural; Operation and maintenance of mitigation facilities; Reliability analysis; Risk-based zoning; Forecasting and warning; Hazard management planning; Case studies.

### **WFM 6311 Climate Change Risk Management**

*3 Credits*

The global climate system: global heat and water balance, atmospheric circulation, ocean circulation, coupled ocean and atmospheric processes; Climate variability and climate change; Assessment of climate change risks; Forecasts and scenarios development; Impact of climate change on water related hazards; Economic, social and environmental implications; Mitigation measures and adaptation techniques, Mainstreaming climate change risk management.

### **WFM 6305 Coastal Zone Management**

*3 Credits*

Definition and delineation of the coastal zone; Coastal zone management: concepts, issues, prospects; Coastal, estuarine and delta processes; Coastal hazards: storm surge, sea level rise, tsunami; Linkages among coastal systems; Coastal ecosystem and environment; Socio-economic, political and institutional considerations; Coastal infrastructure: erosion protection, embankment, polder, cyclone shelter, cross-dam, port and waterway; Coastal population and livelihood; Marine and coastal resources; Coastal zone policy and strategy; Case studies on Integrated Coastal Zone Management.

### **PLAN 6153 Disaster Management in Planning**

*3 Credits*

Type and nature of natural and man-made disasters; techniques and issues related to hazard assessments vulnerability analysis and risk assessment; socio-economic impacts of disasters; disasters in urban areas; disaster preparedness and pre-disasters in urban areas; disaster preparedness and pre-disaster management; disaster response and post-disaster management; institutional framework and the experience of disaster management in Bangladesh.