INFORMATION BOOKLET FOR
MASTERS PROGRAM ON DISASTER AND ENVIRONMENTAL ENGINEERING

Department of Disaster and Environmental Engineering
Chittagong University of Engineering & Technology
Chittagong-4349, Bangladesh.

Curriculum Framework: Master in Disaster and Environmental Engineering

Schedule:

Core teaching time:	Winter:	January-April		13 weeks
	Summer	September- December		13 weeks
International School:	Middle of March- Middle of October		(Winter)	4 weeks
	Middle of September- Middle of October		(Summer)	4 weeks

The international school is rotating between the three institutions (CUET, SUST, UNIKA)

Basic Curriculum Structure:

One lecture should contain 50 minutes of contact time. During this time challenges and problems will be presented by the teacher. The students will have to work on various assignments on their own. The average workload per course should be 4 times the contact time.

An academic committee for postgraduate studies (ACPGS) will give advice on course content, check student work load and update the curriculum as needed. For each course, a Professor holding a doctorate will be responsible and be assisted by a lecturer holding at least a master degree.

Thesis:

The students will start their thesis in the second semester. The thesis should (deal with) aim towards a practical oriented regional focus. After 1/3 of the working hours, the students are required to submit a project report. The last 2/3 of the thesis should be research orientated. This subsequent research should also be preferably derived from the regional problem of the first third of the thesis.

Cooperation with UNIKA:

1st and 3rd semester	**International School**
3rd semester	**Courses and thesis work**
4th semester	**Thesis research**

Semester	Mandatory	Optional	International school (IS)*	Thesis	Total * without IS
1st	40		8+5 Language		40
2nd		24		18	42
3rd	3 Language	24	16	18	42
4th				40	40
				Total	183+3 language
				Int. School	24+5 language
				Total	212+5

*In weekly working hours (Whs)

	language

Academic Requirements for Master's Degree

Semester	Mandatory / Compulsory Courses	Optional Courses	International Schools (Optional)	Language Training	Thesis	Total Credits
Pre-semester	-	-	-	German-I	-	-
Semester 1	5 Courses@ 3 Cr = 15 Cr	-	8 hrs Summer/winter Schools	Intermediate German – I	-	15 Cr
Semester 2	-	3 Courses @2 Cr = 6 Cr	-	Intermediate German – II	4.5 Cr	10.5 Cr
Semester 3	-	3 Courses @2 Cr = 6 Cr	8 hrs Summer/winter Schools + 8 hrs Summer/winter Schools	-	4.5 Cr	10.5 Cr
Semester 4	-	-	-	-	12 Cr	12 Cr
Total	15 Cr	12 Cr	24 hrs International Summer/winter school	-	21 Cr	48Cr

Academic progress shall be measured in terms of credit hours earned by a student. 1.0 credit of a theory course usually require one hour of class attendance per week for one semester; while 1.5 credit hour for thesis should normally required three hours of work per week for one semester. The number of credit hours for each subject shall be as specified in the syllabus of the respective course.

SUMMARY OF COURSES FOR

M.Sc. in DISASTER AND ENVIRONMENTAL ENGINEERING

Course No.	Name of the Courses	Credits
MANDATORY COUSRES		
CE- 7101	Challenges in Disaster Engineering	**3.0**
CE- 7501	Challenges in Environmental Engineering	**3.0**
CE- 7103	Advanced Numerical Modeling	**3.0**
CE- 7401	Advanced Mechanics	**3.0**
CE- 7301	Project Management and Controlling	**3.0**
OPTIONAL COUSRES		
CE- 7503	Waste Reduction & Control	**2.0**
CE- 7505	Human Water Resources	**2.0**
CE- 7507	Natural Preservation and Human-Nature Interaction	**2.0**
CE- 7105	Earthquake Engineering	**2.0**
CE- 7403	Flood Control	**2.0**
CE- 7107	Wind Engineering	**2.0**
CE-7000	Thesis	**21.0**

Language courses

- German – I (Language Camp)
- Intermediate German – I
- Intermediate German – II

According to the agreement between CUET and UNIKA, Germany, students may be required to attend in the International Summer School at UNIKA, Germany. As most of the lectures as well as books are in German language, it will be difficult for the students to understand the lecture. Moreover, some students will go to Germany for completing their research works. Subsequently, they have to work with lab officials communicating through German language. Furthermore, they should adapt the German culture during their stay in Germany in order to conduct their research works.

Complete Description of Courses

A description of courses to e offered by the department of Disaster and Environmental Engineering is provided below. It should be noted that the course curricula are to be updated on a regular basis and new courses are to be added to the curricula from time to time

CE-7101 Challenges in Disaster Engineering
3 Credits

Natural Hazards & Disasters
Sciences of disaster, major types of disaster, impact of natural disasters in Bangladesh & future disasters.

Vulnerability of Built Environments
Structures (Engineered & non-engineered), Lifelines & their components, Regional land use policy and plan, Relationship between hazard and vulnerability i.e. Risk and Risk assessment & mitigation strategies, Development & disaster risk.

Earthquake
Historical records and geographical distribution, Seismicity of Bangladesh, Effects of Earthquake, Earthquake forecasting, Vulnerability of earthquakes on built & natural environments, Pre-disaster & post-disaster activities, Lesson learnt from past earthquakes, Challenges in seismic strengthening strategies & enforcement of seismic building code of practices.

Cyclone/Tidal Surge
Types of cyclones in Bangladesh, Historical examples & geographical distribution of cyclones, Cyclone forecasting & warning, Vulnerability on built & natural environments, Cyclone disaster preparedness & response, Good practices in Bangladesh, Challenges in reconstruction strategies of built environments.

Flood
Types of floods in Bangladesh, Historical records, examples and geographical distribution of floods, Forecasting, warning & monitoring systems, Impact/vulnerability on built & natural environments and also on river bank erosion, Flood risk assessment & mitigation strategies, Good practices in Bangladesh, Challenges in flood mitigation strategies.

Tsunami
Historical records and geographical distribution, Possibilities of tsunami occurrences in Bangladesh, Impacts (Vulnerability) of Tsunami on built & natural environments, Tsunami disaster mitigation & preparedness, Challenges Recovery/reconstruction strategies.

Landslides
Historical records and geographical distribution of landslides in Bangladesh, Various Landslide triggering mechanisms, Impacts (Vulnerability) of landslides on built & natural environments, landslide hazard assessment methods, seismic aspects of slope stability, Landslide warning & mitigation, Challenges in evacuation/settlement of landslide affected public and development issues.

Drought
Historical records and geographical distribution of droughts in Bangladesh, Natural preconditions for droughts, Impacts of droughts, Famine, Mitigation strategies, Post-disaster activities, Lesson learnt, Challenges in future.

Man-Made Disasters

Deforestation, Hill Cutting, Fire, Epidemic, Damage to heritage/lakes/water bodies.

CE-7501 Challenges in Environmental Engineering
3 Credits

Introduction to Challenges in Environmental Engineering
General Concept: Challenges for the Environment, Water resources, Energy, Population, Agriculture, Land degradation, Industrialization, Urbanization, Types of challenges: Acid rain, green house effects, Municipal waste water, problems of arsenic contamination, pesticides in agriculture. Fate and transport of environmental contaminations.
Design and Modeling of Environmental Systems
Chemical and biochemical reactions: rate of reactions, material balances, mass balance on flows and solids, mass balance on air flow and particulates, Flow regimes and reactors: Completely mixed batch-reactors, design plug flow reactor design.
Energy Balanced: Earth's energy balance and the greenhouse effect, Mass Transport Processes: Advection and dispersion, molecular diffusion, the movement of a particle in a fluid stock's law, flow of water through a porous medium, Darcy's law for ground water.
Theory of Water Treatment
Sedimentation: Theories of sedimentation (ideal settling of discrete and flocculent particles and deviation from ideality), Coagulation (Destabilization of colloidal particles), Flocculation: Peri-kinetic and Ortho-kinetic) theories, Granular Media Filtration Theory (Transportation, Attachment, and detachment mechanisms), Mechanisms of physical adsorption and chemi-sorption, Iron, manganese and Arsenic removal, Removal of nitrate and fluoride from water, Disinfection: Mechanisms , factors effectiveness and alternatives to disinfection. Chemical precipitation.
Membrane Filtration Technology
Mechanisms of revise osmosis, principle and theory, membrane configuration and type, process variables, Electro-dialysis,
Gas Transfer: Henry's law, Dalton's law, rate of solution, and dispersion, two film theory, gas transfer equation, and governing factors, type of aeration and applicability.
Causes and Sources of order and taste: Treatment, and removal and prevention and control of aquatic growth.
Domestic Waste Water treatment
Introduction, Wastewater treatment categorization, Secondary waste water treatment, Advanced wastewater treatment, Preliminary treatment, Primary treatment, Secondary treatment, Sludge treatment and disposal**.**
Air Pollution Principles and Control
Sources and effects of air pollution, Control of particulate matter from stationary sources, mechanical separation, electro statistic precipitators,
Gas and Vapor Control Technology: Incineration, absorption and gas de-sulfurization.
Sustainability and renewable energy
Challenges to sustainable development, concept of sustainability, Environment, development and sustainability, Factors governing sustainable development, the economics of sustainability, Renewable energy, Fossil fuels and climate changes, renewable energy sources, renewable energy in future, The world of hydrogen
Sustainability and renewable energy
Solar energy, Bio-energy: Energy crops, woody crops, agriculture crops, wood residues, animal waste, municipal solid waste, landfill gas, commercial and industrial waste etc.
Wind and water energy

CE-7103 Advanced Numerical Modeling
3 Credits

FUNDAMENTAL CONCEPTS
Mathematical models in engineering problems : Modeling in engineering problems, Types of problems in engineering, Ordinary and partial differential equations in engineering, Boundary and initial value problems, Classification of solution methods
Basic equations in Engineering Mechanics: Two dimensional elasticity equations, Beam under axial and transverse load, Lateral deflection of thin membrane, Plate under flexural load
Review of Linear Finite Element Methods (FEM): Basic concept of FEM, FEM for one-dimensional problems, FEM for two-dimensional problems, FEM for three-dimensional problems, Scalar field problems
STATIC NON- LINEAR ANALYSIS
Basics of non-linear structural mechanics: Non-linearities of structural mechanics, Material non-linearity, Geometrical non-linearity, Consistent linearization of internal virtual work
Finite element discretization of geometrically non-linear continua: Finite volume elements, Finite truss elements.
Solution of non-linear static structural equations: Strategies, Iteration methods, Control of iteration procedures
Stability analysis: Computation of stability points, Direct computation of singular points
Software tools and techniques for Static Non- linear FEM
DYNAMIC NON- LINEAR ANALYSIS
Newmark dynamics, Energy conserving schemes, FEM in Earthquake analysis, Software tools and techniques for Dynamic Non- linear FEM

CE-7401 Advanced Mechanics
3 Credits
A. Advanced Solid Mechanics
Analysis of state of stress and strain at a point.
Differential equation of equilibrium of a deformable body and Strain displacement relations in Cartesian and Cylindrical co-Ordinates; Generalized Hooke's law; Solution of Boundary Value Problems in a two-dimensional elastic continuum; St. Venant's principle; Specialization to problems of infinite domain, thick cylinders; Stress concentrations around holes; Specialization to problems of semi-infinite domains; Computation of contact stresses for two bodies in line contact.
Torsion of non-circular cross sections.
Membrane analogy; Hollow thin wall multiply connected torsion members.
Beam on elastic foundations: Short beams.
Fracture, Fatigue & smart materials
Linear elastic fracture mechanics, Stress intensity factor, Energy release rate, Relation between SIF and energy release rate, Conditions for onset of crack growth, Fracture toughness testing, Crack growth and fracture mechanisms, Modeling of plasticity effects, J-integral, Methods to evaluate SIF, Paris law, Crack closure, Retardation models, Repair methodologies, Elasto-plastic fracture mechanics, Mixed-mode fracture. Smart technology: types of smart materials, underlying mechanisms and applications of smart materials and structures.
Composite Materials and Structures

Introduction to Composite Materials - Generalized Hooke's Law - Transformation of Elastic Constants. Rule of mixtures - Structural Behavior of Lamina - Classical Lamination Theory - Constitutive Relations -Stress, Analysis of Laminated Plates and Shells.

B. Advanced Fluid Mechanics

Fluid Properties, Fluid Static and Fluid Flow

Fluid Properties; Fluid Pressure and Measurement; Hydrostatic Forces; Buoyancy Forces; Fluid Velocity and Measurement

Macroscopic Approach in Hydrodynamics

Theory of Fluid Flow: Reynolds Transport Theorem; Equation of Flow Continuity; Equation of Flow Momentum; Equation of Flow Energy; Equation of Moment of Flow Momentum.

Microscopic Approach in Hydrodynamics

Laminar and Turbulent Flows; Navier Stokes Equation; Boundary Layers of Flow in Pipes; Boundary Layers of Flow in Open Channels.

Wave Spectra, wave statistics & wave dynamics

Random wave approach shallow water area; waves & tides; theory of high wave runs; deep sea waves; near shore waves; interaction between shoreline and fluid motion in sea; wave-structure interaction; fluid-structure interaction

Dimensional Analysis and Hydrodynamic Similitude

Buckingham Theorem; Hydrodynamic Similitude; Physical Hydraulic Models.

Suggested Text for Solid Mechanics:

1. Chen, W. F. and Han, D. J., **Plasticity for Structural Engineering**, Springer-Verlag Berlin, 1992
2. Chakrabarty, **Theory of Plasticity**, McGraw-Hill Book Company, New York 1990
3. Suresh, S., **Fatigue of Materials**, 2nd Ed., Cambridge Univ. Press, 1998.
4. Gandhi, M.V. and Thomson, B.S., **Smart Materials and Structures**, Chapman & Hall, NY, 1992.
5. Jones, R. M., **Mechanics of Composite Materials**, 2nd Ed., Taylor and Francis, 1999
6. Reddy, J. N., **Mechanics of Laminated Composite Plates and Shells**, CRC Press, 2004.
7. Agarwal, B. D., and Broutman, L. J., **Ananlysis and Performance of Fiber Composite**s, J. Wiley.
8. Srinath L.S., **Advanced Mechanics of Solids**, Tata McGraw-Hill, 1980
9. Boresi, A.P. and Sidebottom, O.M., **Advanced Mechanics of Materials**, John Wiley, 1993.
10. Timoshenko, S.P. and Goodier, J.B., **Theory of Elasticity**, McGraw-Hill Kogakusha Ltd., 1970
11. Broek, D. **Elementary Engineering Fracture Mechanics**, 4th ed., Kluwer Academic,1986.
12. Anderson, T. L., **Fracture Mechanics: Fundamentals and Applications**, 3rd Ed., CRC Press, 2004.
13. Prashant Kumar, **Elements of Fracture Mechanics**, Wheeler Publishing,1999.

Suggested Text for Fluid Mechanics:

1. Chow, V.T. (1992):**Open Channel Hydraulics**, Mc Graw Hill, New York, U.S.A.
2. Daugherty, R.L., Franzine, J.B. and Finnemore, E.J. (1985):**Fluid Mechanics with Engineering Applications**, 8th Edition, McGraw Hill, New York, U.S.A
3. French, R.H. (1986):**Open Channel Hydraulics**, McGraw Hill, New York, U.S.A
4. Roberson, J.A. and Crowe, C. (1990):**Engineering Fluid Mechanics**, 4th Edition, Haughton Mifflin Co., Boston, U.S.A
5. Shames, I.H. (1982):**Mechanics of Fluids**, McGraw Hill, New York, U.S.A
6. Streeter, V.L. and Wylie, E.B. (1985):**Fluid Mechanics**, 8th Edition, McGraw

Hill, New York, U.S.A

Journals:

Journal of Fluid Mechanics, Cambridge University Press
Journal of Hydraulic Engineering, ASCE

CE-7301 Project Management and Controlling
3 Credits

Characteristics of Project Management:
Introduction, Elements of constitutes a successful project, PMI definition, Project management vs. general management, Selecting projects, Confronting uncertainty – the management of risk, Role of project manager, Discussion of project management basics, Discussion of the systems approach and its relevance to project management

The Manager, the Organization and The team:
Facilitator, Communicator, Selection of a project manager, Fitting projects in the parent organization

The Planning the Project:
Discussion of the system and project definition and planning and the determination of the appropriate project management approach, Project Planning Fundamentals, Regional Land Use Policy & Plan, The work breakdown structure

Budgeting the Project:
Introduction, Methods of budgeting, Cost estimating, Basic cost accounting information, Improving cost estimates, Budget uncertainty and risk management, Discussion of basics of project cost management, Life cycle costs.

Scheduling the Project:
PERT AND CPM Networks, Precedence diagramming, Network analysis, Resource loading
Project uncertainty and risk management, Resource Constraints for Mega Projects, Organization of Project Participants, Leadership and Motivation for the Project Team, Risk Assessment Methodologies in construction, Acceptable Risk, Risk Mitigation, Simulation

Allocating resources to the Project
Introduction, Resource loading, Resource leveling, Allocating scarce resources to several projects, Goldratt's critical chain, Monitoring and controlling the project

Project Quality Management
Definition of quality, Quality processes, Quality assurance, Challenges to Recovery/reconstruction strategies

Project Human Resources and Communication
Discussion of human resources, Stakeholder management and project communication, Organization structures, roles, Organizational responsible and organizational maturity

CE-7513 Waste Reduction and Control
2 Credits

Waste Management
Introduction to waste management, Impact of man on the environment, Waste legislation, Waste Management planning, Waste Management Cycle

Characteristics of different types of waste
Solid Waste Management: Sources and characteristics of Solid waste; Solid waste generation; Collection and transportation (Community and Municipality); Volume reduction; sorting; Stabilization.

Industrial waste: Requirements of the water for various industries, Characteristics and volume of industrial waste, Problems associated with industrial waste water, Quality and treatment of industrial water

Waste Minimization

Conventional and low cost treatment method: Duckweed treatment for waste; Septic tank, Bio-gas plant; Different sanitation options; Sanitation practices in Bangladesh

Solid waste Control: Incineration; Resource recovery and recycling; Land filling; and Composting; and Mechanical Treatment before landfill Planning and socio-economic aspects of solid waste management; Community mobilization in solid waste management.

Industrial Waste Control: Waste water treatment objectives; Physical, chemical and biological methods of industrial waste water treatment including neutralization, equalization, oil separation, flotation, sour water strippers, heavy metal removal,Air stripping, chemical oxidation; Overview of waste reduction techniques in industries, Waste problems in different industries Treatment and disposal of industrial waste sludge; Laws and regulations for industrial wastewater and waste treatment.

Advanced and complex waste water treatment methods:

Different types of settling, Advanced theory of coagulation, Advanced theory of filtration, Membrane filtration, Water softening, Air stripping, aeration and gas transfer, Reverse osmosis, desalination, water treatment by UV-radiation , Ozonization, adsorption, ion-exchange, modification of activated sludge

Waste Reduction and Preservation:

Introduction, Zero waste, Hazardous waste management, Strategies, Regulation and implementation, Recycling legislation, Strategies and policy and Bangladesh Conservation Law

Example- 1 - Solvent Waste Reduction

Example- 2 - Selection of Sustainable Waste Management

Example- 3 - Waste Management and Health

Example- 4 - Application of Linear Program in Waste Management

Case study-1: Field Trip on types of Waste generation in Bangladesh

Case study-2 Field trip on Waste or Waste water control practices in Bangladesh

CE-7505 Human Water Resources
2 Credits

Sources of Water

Ground Water Sources, Surface Water Sources, Rain Water, Water Sources of Bangladesh

Water and Waste Water Quality

Drinking Water Quality, Waste Water Quality, Water and Waster Water Quality Monitoring Bio-monitoring

Water Treatment

Sedimentation Theory, Coagulation and Flocculation, Filtration Adsorption, Ion Exchange, Hardness and Softening, Aeration and Gas Transfer, Advanced Water Treatment

Waste Water Treatment

Preparatory or Preliminary Treatment, Primary Treatment: Imhoff tank, Septic Tank, Small Bore Sewer System (SBS), Secondary Treatment: Suspended Growth System and Attached Growth System, Waste Stabilization Pond and Lagoons, Nutrient Removal, Natural Waste Treatment and Reuse of Waste Water, Sludge Treatment, Advanced Wastewater Treatment

CE-7555 Natural Preservation and Human-Nature Interaction
2 Credits

Urban Hazard and Brown Agenda
Natural hazards, Man-made hazards, Green Belt, Brown Block, Issues of Brown Agenda
Human Interaction on Nature
Industrial Hazards: Green House Gas Emissions, Carbon Issues: Carbon Emission, Carbon Trade, Carbon Tax, Hill-cutting, Deforestation and Afforestration, Blocking Water Flow with Dam and Other Man-made Structure versus Free Flow River
Evaluation Images of Urbanized Cities
Characteristics of Urban towns and Cities, Different types of Evaluation, Social Interactions on Urban Life
Pattern of Urbanization
Classification of Cities, Linear Cities, Non-Linear Cities: Square City, Rectangular City, Circular City.
Ecological Planning
Ecological Components, Human Interactions on Ecosystem, Abiotic and Biotic Components of Ecosystems, Ecological Model for urbanization, Cake model
Environmental Planning For Natural Conservation and Preservation
Natural Conservation, Green Marketing, Theory of Environmental Panning, Sustainable Environmental Planning
Sustainable Development:
Definition of sustainability, Human interactions on Sustainability, Sustainable Development Models

CE-7150 Earthquake Engineering
2 Credits

Introduction:
Earthquake, General causes of Earthquake, Effete of recent Earthquakes
Seismology:
Plate tectonics, Earthquake mechanism, Epicenter, Focus, Magnitude, Intensity, Seismic waves, Hypocenter, Wave propagation in layered bodies, Earthquake motion on ground surface, Earthquake scales, Seismic zoning map of Bangladesh
Earthquake Recording Instruments:
Seismograph, Accelerograph
Behavior of Structure under Earthquake:
Seismic response analysis of SDOF structure and MDOF structure, Linear and Non-Linear analysis of Structures, Behavior of - Reinforced concrete structure, Masonry structure, Timber structure
Seismic Strengthening:
REHAB technology: Beam, Column, Column-Beam joint, Non structural components, Slab In filled walls, FRP strips technology
Seismic Design of Structures:
Basic design requirements, Basic representation of seismic action, Methods of analysis (Linear and Non-Linear), Lateral Force method, Response Spectrum analysis, Static Push over analysis, Time History analysis
Examples on Design: Earthquake dimensioning and construction of conventional masonry in filled and RC structure, **Software** demonstration
Modern Seismic Robust Concept:
Confined masonry, Reinforced masonry, Seismic controls- Passive, Base isolation, Pagoda system, HYDE system, Tendom system- Semi-Active, Active
Life Lines:

Types of life lines, Critical impact on lifelines, Life line failures, Common features of life line

Urban Seismic Renewal:

Challenges for Urban seismic design, Seismic assessment, Street survey-Preliminary investigation, Final investigation, Risk analysis.

CE-7403 Flood Control
2 Credits

Flood Hydrology and Flood Characteristics

Cause of Floods and Flood Inundation, Flood Hydrology and Hydraulics, Classification of Floods: flash flood, river flood, coastal flood, Flood Control and Mitigation

Flood Modeling and Model Classification

Physically-based Models, Lumped Conceptual Models, Black Box Models.

Flood Routing Methods

Hydrodynamic Routing, Diffusion Routing, Muskingum Routing, Kinematics Routing

Flood Routing in River Basins, River Channels and Over Bank Flow Areas

River Basin Runoff Routing, River Channel Routing, Channel Network Routing, Flood Plain Routing

Flood Forecasting Models

Deterministic Models, Stochastic Models, Combined Deterministic - Stochastic Models, Model Output Updating Process

Flood Routing and Forecasting Using Artificial
Neural Network (ANN)

Types of Neural Network, Neural Network Architectures, Back Propagation Technique Training and Testing ANN

Flood Control and Management

Comprehensive Flood Disaster Prevention and Management, Structural and Non-structural, Flood Control Measures, Flood Risk Analysis and Mapping in GIS environment, Flood Plain Development and Management, Flood Damage Categories & Damage Assessment, Feasibility of Flood Control Projects

Structures during Floods

Vulnerability & Evaluation of Flood Damages to built environments, Flood Resistant Inland and Coastal Structures, Flood Resistant Rural Housing

CE-7107 Wind Engineering
2 Credits

Nature of Wind Induced Vibrations and Damages

Nature and types of wind from meteorological and engineering points of view, Statistical analysis of extreme wind speeds and stochastic model of wind turbulence, Wind Effects on Structures, Damages of Structures due to Wind Effects, Economic as impacted by catastrophe such as wind storm

Introduction to Dynamics of Structures

Fundamentals of Structural Dynamics, Dynamic Properties of Structures, Modal Analysis of Structures, Frequency Domain Analysis of Structures, Time Domain Analysis of Structures

Structural Response and Wind Resistant Design of Structures

Interaction of wind with buildings and structures, Aerodynamic drag, lift, moment & pressure Periodic vortex-induced forces, Random wind forces caused by random wind velocity luctuations, Aero-elastic phenomena: Torsional divergence, vortex induced oscillation,

galloping and torsional flutter, Wind Loading Codes and Standards and design considerations beyond code: Low Rise Buildings, Tall Buildings, Bridges, Tower, Chimneys, and Masts, Transmission Line

Control of Wind Induced Vibrations

Active Control of Vibrations, Passive Control of Vibrations, Hybrid Control of Vibrations, Semi-active Control of Vibrations

Typical Wind Induced Disasters Experienced in Bangladesh

Cyclones: Origin of Cyclones, Tropical Cyclone Structure, Tropical Cyclone Size, Cyclones Intensity and Frequency, Predicting Cyclone Frequency and Intensity, Monitoring and Tracking Cyclones, Cyclone Damage, Reducing Cyclone Damage

Tornadoes: Tornado Development, Tornado Intensity, Tornado Frequency, Tornado Damage, Tornado Prediction and Warning, Mitigation of Tornado Disasters

Strengthening of Structures Against Wind-Vibrations

Low Rise Buildings, Tall Buildings, Life Line Structures

Experimental Investigation for Wind Responses of Structures

Modeling of Wind Effects, Analysis of Wind Induced Vibrations, Wind Tunnel Testing

Introduction to instrument, Design of various experiments, Data analysis and interpretation of full and modal scale wind engineering, Applications.

Wind Induced Damage & Loss Assessment

Documentation, analysis and identification of windstorm induced damage failure modes, platforms for damage documentation include on-ground, aerial and satellite images, application of GIS tools and HAZUS software.

Detailed Lecture Plan

CE-7101 Challenges in Disaster Engineering

Lecture : 1
Historical records and geographical distribution, Seismicity of Bangladesh, Effects of Earthquake, Earthquake forecasting. Vulnerability of earthquakes on built & natural environments ,Pre-disaster & post-disaster activities. Lesson learnt from past earthquakes. Challenges in seismic strengthening strategies & enforcement of seismic building code of practices.

Lecture : 2
Types of cyclones in Bangladesh, Historical examples & geographical distribution of cyclones, Cyclone forecasting & warning, Vulnerability on built & natural environments, Cyclone disaster preparedness & response, Good practices in Bangladesh, Challenges in reconstruction strategies of built environments.

Lecture : 3
Types of floods in Bangladesh,Historical records, examples and geographical distribution of floods, Forecasting, warning & monitoring systems Impact/vulnerability on built & natural environments and also on river bank erosion. Flood risk assessment & mitigation strategies. Good practices in Bangladesh. Challenges in flood mitigation strategies.

Lecture : 4
Historical records and geographical distribution, Possibilities of tsunami occurrences in Bangladesh. Impacts (Vulnerability) of Tsunami on built & natural environments , Tsunami disaster mitigation & preparedness. Challenges Recovery/reconstruction strategies.

Lecture : 5
Historical records and geographical distribution of landslides in Bangladesh. Various Landslide triggering mechanisms. Impacts (Vulnerability) of landslides on built & natural environments ,landslide hazard assessment methods, seismic aspects of slope stability. Landslide warning & mitigation Challenges in evacuation/settlement of landslide affected public and development issues.

Lecture : 6
Historical records and geographical distribution of droughts in Bangladesh. Natural preconditions for droughts. Impacts of droughts, Famine Mitigation strategies Post-disaster activities, Lesson learnt Challenges in future

Lecture : 7
Deforestation, Hill Cutting, Fire, Epidemic, Damage to heritage/lakes/water bodies.

Lecture : 8
Discussion with Poster/Seminar on assignments related to earthquake

Lecture : 9
Discussion with Poster/Seminar on assignments related to cyclone

Lecture : 10
Discussion with Poster/Seminar on assignments related to flood

Lecture : 11
Discussion with Poster/Seminar on assignments related to tsunami

Lecture : 12
Discussion with Poster/Seminar on assignments related to landslides

Lecture : 13

Discussion with Poster/Seminar on assignments related to drought

CE-7501 Challenges in Environmental Engineering

Lecture-1
General Concept: Challenges for the Environment, Water resources, Energy, Population, Agriculture, Land degradation, Industrialization, Urbanization.
Types of challenges: Acid rain, green house effects, Municipal waste water, problems of arsenic contamination, pesticides in agriculture. Fate and transport of environmental contaminations.
Lecture-2
Chemical and biochemical reactions: rate of reactions, material balances, mass balance on flows and solids, mass balance on air flow and particulates.
Flow regimes and reactors: Completely mixed batch-reactors, design plug flow reactor design.
Lecture-3
Discussion on
Energy Balanced: Earth's energy balance and the greenhouse effect.
Mass Transport Processes: Advection and dispersion, molecular diffusion, the movement of a particle in a fluid stock's law, flow of water through a porous medium, Darcy's law for ground water.
Lecture-4
Sedimentation: Theories of sedimentation (ideal settling of discrete and flocculent particles and deviation from ideality), Coagulation (Destabilization of colloidal particles), Flocculation: Peri-kinetic and Ortho-kinetic) theories, Granular Media Filtration Theory (Transportation, Attachment, and detachment mechanisms), Mechanisms of physical adsorption and chemi-sorption.
Lecture-5
Field Trip, Removal of Arsenic, Manganese, Nitrate, Iron, Fluoride from Water Environment
Lecture-6
Mechanisms of revise osmosis, principle and theory, membrane configuration and type, process variables, Electro-dialysis, Elements of electro-dialysis, pretreatment and its advantages
Lecture-7
Discussion
Removal of Arsenic by **Membrane Filtration Technology and Reverse Osmosis**
Lecture-8
Gas Transfer: Henry's law, Dalton's law, rate of solution, and dispersion, two film theory, gas transfer equation, and governing factors, type of aeration and applicability, Causes and Sources of order and taste: Treatment, and removal and prevention and control of aquatic growth.
Lecture-9
Introduction, Wastewater treatment categorization, Secondary waste water treatment Advanced wastewater treatment, Preliminary treatment, Primary treatment, Secondary treatment, Sludge treatment and disposal.
Lecture-10
Sources and effects of air pollution, Control of particulate matter from stationary sources, mechanical separation, electro statistic precipitators.
Gas and Vapor Control Technology: Incineration, absorption and gas de-sulfurization.
Lecture-11

Challenges to sustainable development, concept of sustainability, Environment, development and sustainability, Factors governing sustainable development, the economics of sustainability, Renewable energy, Fossil fuels and climate changes, renewable energy sources, renewable energy in future, The world of hydrogen

Lecture-12

Discussion with Poster, Activated Sludge, Aerator System and Trickling Filters

Lecture-13

Solar energy**,** Bio-energy: Energy crops, woody crops, agriculture crops, wood residues, animal waste, municipal solid waste, landfill gas, commercial and industrial waste etc, Wind and water energy

CE-7103 Advanced Numerical Methods

Lecture-1

FUNDAMENTAL CONCEPTS

Mathematical models in engineering problems

Modeling in engineering problems, Types of problems in engineering, Ordinary and partial differential equations in engineering, Boundary and initial value problems, Classification of solution methods

Basic equations in Engineering Mechanics

Two dimensional elasticity equations, Beam under axial and transverse load, Lateral deflection of thin membrane, Plate under flexural load

Lecture-2

Review of Linear Finite Element Methods (FEM)

Basic concept of FEM, FEM for one dimensional problems, FEM for two-dimensional problems

Lecture-3

FEM for three-dimensional problems, Scalar field problems (Steady heat transfer, torsion, potential flow, seepage, electric and magnetic fields, flow in ducts, acoustics)

Lecture-4

Exercise on linear problems, Problem solving by programming for linear FEM, Problem solving by using readymade software, Assignment for home

Lecture-5

STATIC NON- LINEAR ANALYSIS

Basics of non-linear structural mechanics

Non-linearities of structural mechanics, Material non-linearity, Geometrical non-linearity (Kinematics, Kinetics, Constitutive law, Principle of virtual displacements, Internal virtual work, Elastic internal potential), Consistent linearization of internal virtual work (Gateaux derivative, Gateaux derivative of internal virtual work, Linearization of Green Lagrange strains, Linearization of variation of Green Lagrange strains)

Lecture-6

Finite element discretization of geometrically non-linear continua

Finite volume elements (Discretization of internal virtual work, Non-linear semi-discrete initial value problem, Non-linear discrete static equilibrium, Discretization of linearized internal virtual work, Linearization of internal forces vector), Finite truss elements (Truss elements of arbitrary polynomial degree)

Lecture-7

Continued...

Finite truss elements (Linear truss element),Examples, exercises on finite volume elements and finite truss elements

Lecture-8

Solution of non-linear static structural equations

Iteration methods (Pure Newton-Raphson method, Modified Newton-Raphson method), Control of Iteration Procedures (Load incrementing and control)

Lecture-9

Continued...

Control of Iteration Procedures (Arc-length controlling method)

Stability analysis

Computation of stability points (Classical and linear buckling analysis, general investigation of stability), Direct computation of singular points (Extended systems)

Lecture-10

Examples, exercises, programming on iteration methods of Solution of non-linear static structural equations, Examples, exercises, programming on stability problems

Lecture-11

DYNAMIC NON- LINEAR ANALYSIS

Newmark dynamics, Energy conserving schemes

Lecture-12

Examples, Software tools and techniques for Dynamic Non- linear FEM, Exercises, programming

Lecture-13

FEM in Earthquake analysis, Problem solving on earthquake analysis

1. Wriggers, P. (2008):
Nonlinear Finite element Methods, Springer Publication

2. Belytschko, T. et al. (2000):
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3. Chandrupatla, T.R. and Belegundu, A.D. (2005):
Introduction to Finite Elements in Engineering, Prentice Hall

4. Klaus Jürgen Bathe, K.J. (1996)
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Finite Element Methods in Linear Structural Mechanics, Ruhr University Bochum

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Advanced Finite Element Methods, Ruhr University Bochum

3. Kuhl, D. (2009):
Computational Structural Dynamics, University of Kassel

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Linear Finite Element Analysis (CE4257), National University of Singapore

5. Swaddiwudhipong, S. (2008):
Advanced Finite Element Analysis (CE6006), National University of Singapore

6. Tong, Q.S. (2004): **Numerical Methods in Engineering Mechanics (CE 6003)**, National University of Singapore

CE-7301 Project Management and Controlling

Lecture-1
Introduction, Definition of project management, Why the emphasis on project management? Characteristics of Projects, Other Common Characteristics of Projects, Elements of constitutes a successful project, What is PMI?, Characteristics of PMI, Skill Requirements for Effective Project Management, What are life cycles of projects?, Different stages of life, cycles of project management, Discussion of project management basics, Discussion of the systems approach and its relevance to project management, What uncertainties are encountered in project management? Can uncertainty surrounding projects ever be eliminated?
Lecture-2
Discussion of the system and project definition and planning and the determination of the Manager-as-supervisor versus manager-as-facilitator Systems approach versus analytical approach Sub-optimization, Must ensure project team members have appropriate knowledge and resources Micromanagement, Roles of manager ---Three Overriding Responsibilities Negotiation, Conflict Resolution, and Persuasion, Organization and its roles, The Pure Project Organization, Functional Project Organization, Matrix Project Organization, Characteristics of Effective Project Team Members
Lecture-3
Project Planning Fundamentals, Regional Land Use Policy & Plan, Elements of Project Master Plan , Simple Approach for Creating the WBS, Concurrent Engineering, Interface Coordination -- Interface Management, Design Structure Matrix (DSM), Comments on Empowerment and Work Teams, Advantages of Empowerment
Lecture-4
Introduction, Top-Down Budgeting , Bottom-Up Budgeting, Work Element Costing, Risk Management Planning, Risk Identification, Qualitative Risk Analysis, Risk Response Planning, Risk Monitoring and Control, Resource Constraints for Mega Projects
Effects of Project Risks on Organization**,** Organization of Project Participants**,** Matrix Organization of an Engineering Division**,** Traditional Designer-Constructor Sequence
Managing of the Pipeline Project**,** Leadership and Motivation for the Project Team
Risk Assessment Methodologies in construction, Acceptable Risk, Risk Mitigation
Lecture-5
Building the Network, AOA Network, AON Network, Calculating Probabilistic Activity Times, Discussion of activity sequencing**,** Precedence diagramming**,** Network analysis
Resource loading, Basic cost accounting information
Lecture-6
Expediting a project, The Critical Path Method, Probabilistic Activity Durations, Using Excel's Solver to Crash a Project, Fast-Tracking a Project, Resource Loading, The Charismatic VP, Pseudo activities, Resource Allocation and the Project Life Cycle, Variance Analysis Questions

Lecture-7
Definition of quality**,** Quality processes**,** Quality assurance**,** Challenges to Recovery/reconstruction strategies
Lecture-8
Discussion of human resources, Stakeholder management and project communication Organization structures, roles, Organizational responsible and organizational maturity
Lecture-9
Examples on Project Networking with software
Lecture-10
Field Trip, Field trip to Mega Project
Lecture-11
Discussion with Poster, Discussion with Design and Construction as an Integrated System
Lecture-12
Discussion with Poster, Discussion with Poster on Construction Risk and Vulnerability
Lecture-13
Discussion on , Good Examples of Innovation and Economic Feasibility and Innovative use of structural frames for buildings

Reference Books:

Barrie, Donald S. and Boyd C. Paulson, Jr., *Professional Construction Management,* McGraw-Hill Book Company, 2nd Ed., 1984.

Halpin, Daniel W. and Ronald W. Woodhead, *Construction Management*, John Wiley and Sons, 1980.

Hodgetts, R.M., *Management: Theory, Process and Practice*, W.B. Saunders Co., Philadelphia, PA, 1979.

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Building Research Advisory Board, *Exploratory Study on Responsibility, Liability and Accountability for Risks in Construction,* National Academy of Sciences, Washington, D.C., 1978.

Drucker, P.F., *Innovation and Entrepreneurship: Practice and Principles,* Harper and Row, New York, 1985.

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Journals/Magazines:

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2. Moolin, F.P., Jr., and F.A. McCoy: "Managing the Alaska Pipeline Project," *Civil Engineering*, November 1981, pp. 51-54.
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4. Tatum, C.B., "Innovation on the Construction Project: A Process View," *Project Management Journal,* Vol. 18, No. 5, 1987, pp. 57-67.

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CE-7503 Waste Reduction and Control

Lecture-1
Introduction to waste management
Impact of man on the environment, Introduction, Biosphere , Pollution of Air, Water and Soil
Waste legislation, Waste Management planning, Waste Management Cycle
Lecture-2
Principles of excreta disposal and characteristics and risk, Sources and characteristics of Solid waste; Solid waste generation**,** Collection and transportation (Community and Municipality), Frequency of collection, Setout locations, Container type, Collection vehicles
Volume reduction; sorting; Stabilization, Processing and storage approaches, How much processing is needed?, Balers and shredders.
Lecture-3
Requirements of the water for various industries, Different parameters of water quality
Characteristics and volume of industrial waste, Problems associated with industrial waste water, Quality and treatment of industrial water;
Lecture-4
Duckweed treatment for waste, Septic tank, Bio-gas plant, Incineration, Advantages and disadvantages, Design of incinerator, Resource recovery and recycling,
Recycling system
Collecting and processing reclaimed materials
Vermicomposting
Peoples' Awareness Regarding Solid Waste Recycling, Reuse and energy recovery study in dcc area

Land filling; and Composting, Advantages and disadvantages of landfills, Methods of composting and its positive impacts, Mechanical of treatment of solid wate , Planning and

socio-economic aspects of solid waste management, Community mobilization in solid waste management

Lecture-5

Waste water treatment objectives, Physical, chemical and biological methods of industrial waste water treatment, Neutralization---Why it is needed, advantages, effect of pH, Equalization—Effect of pH, Oil separation, flotation, sour water strippers, Air stripping, chemical oxidation---Advantages, disadvantages, processes

Lecture-6

Waste problems of major industries and their methods of treatment and disposal- such as petroleum industries (gasoline kerosene treatment), textile industries, tannery; cement, fertilizer, paper and pulp, jute processing, dairy, drug and pharmaceutical, food and allied industry, Treatment and disposal of industrial waste sludge, Laws and regulations for industrial wastewater and waste treatment.

Lecture-7

Different types of settling, Advanced theory of coagulation---advantages, disadvantages, methodologies, Advanced theory of filtration—advantages, disadvantages, methodologies

Membrane filtration-- advantages, disadvantages, methodologies, Water softening, Air stripping, aeration and gas transfer, Reverse osmosis, desalination, water treatment by UV-radiation --- advantages, disadvantages, methodologies, Ozonization, adsorption, ion-exchange, modification of activated sludge-- advantages, disadvantages, methodologies

Lecture-8

Introduction, Zero waste—definition, zero waste movement, case study

Hazardous waste management—What is a Hazardous Waste?

Characteristic of Ignitability, Characteristic of Reactivity, Characteristic of Corrosivity

Disposal, Exposure Routes, Treatment methods----adsorption, absorption, chemical treatment, biological treatment Strategies, Regulation and implementation, Strategies and policy and Bangladesh Conservation Law

Lecture-9

Examples on - Solvent Waste Reduction

Lecture-10

Field Trip

Field trip to Selection of Sustainable Waste Management

Lecture-11

Discussion with Poster , Discussion with Poster on Waste Management and Health

Lecture-12

Discussion with Poster, Discussion with Poster on Pagllah for understanding of sewage treatment plant

Lecture-13

Discussion on Good Examples of case studies on Waste or Waste water control practices in Bangladesh

Reference Books:

Saleh, M. M. A. and Mahmmod, U. F. "Anaerobic digestion Technology for industrial waste water treatment" 8th international water technology Conference, IWTC8, 2004, Egypt.

Alexander, P.E. (1993). Assessment of Sources of Air, Water, and Land Pollution: A guide to rapid Source inventory techniques and their use in formulating environmental control strategies. WHO, Geneva, 1993

Peavy, H.S., Rowe, D.R., and Tchobaboglous, G., 1985. Environmental Engineering, McGraw-Hill, New York.

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Anastas, P., Kirchhoff, M., Williamson, T. (2001). Catalysis as a foundational pillar of green chemistry. Journal of Applied Catalysis A: General 221 (2001) 3–13.

CE-7505 Human Water Recourses

Lecture-1
Ground Water Sources, Surface Water Sources , Rain Water , Water Sources of Bangladesh
Lecture-2
Drinking Water Quality, Waste Water Quality
Lecture-3
Water and Waster Water Quality Monitoring, Bio-monitoring
Lecture-4
Sedimentation Theory
Lecture-5
Coagulation and Flocculation
Lecture-6
Filtration, Adsorption
Lecture-7
Ion Exchange, Hardness and Softening, Aeration and Gas Transfer
Lecture-8
Advanced Waste Treatment
Lecture-9
Preparatory or Preliminary Treatment, Primary Treatment: Imhoff tank, Septic Tank, Small Bore Sewer System (SBS)
Lecture-10
Suspended Growth System
Lecture-11
Attached Growth System
Lecture-12
Waste Stabilization Pond and Lagoons, Nutrient Removal, Natural Waste Treatment and Reuse of Waste Water
Lecture-13
Sludge Treatment, Advanced Wastewater Treatment

Reference Books:

Peavy, H.S., Rowe, D.R., and Tchobaboglous, G., 1985. Environmental Engineering, McGraw-Hill, New York.

Pichtel, J., 2005. Waste Management Practices: municipal, hazardous, and industrial. Boca Raton, FL: Taylor & Francis/CRC Press. UTS 628.4/PICH

1. Masters, G et al "Introduction to environmental engineering and Science", Pretice Hall (2009).

CE-7507 Natural Preservation and Human-Nature Interaction

Lecture-1
Natural hazards, Man-made hazards,
Lecture-2
Green Belt, Brown Block, Issues of Brown Agenda
Lecture-3

Industrial Hazards: Green House Gas Emissions, Carbon Issues: Carbon Emission, Carbon Trade, Carbon Tax

Lecture-4

Hill-cutting, Deforestation and Afforestration, Blocking Water Flow with Dam and Other Man-made Structure versus Free Flow River

Lecture-5

Characteristics of Urban towns and Cities, Different types of Evaluation, Social Interactions on Urban Life

Lecture-6

Classification of Cities, Linear Cities , Non-Linear Cities: Square City, Rectangular City, Circular City.

Lecture-7

Ecological Components , Human Interactions on Ecosystem

Lecture-8

Abiotic and Biotic Components of Ecosystems,

Lecture-9

Ecological Model for urbanization, Cake model

Lecture-10

Natural Conservation, Green Marketing

Lecture-11

Theory of Environmental Panning, Sustainable Environmental Planning

Lecture-12

Definition of sustainability, Human interactions on Sustainability

Lecture-13

Sustainable Development Models

Reference Books:

2. Richard O. Mines , Laura W. Lackey "Introduction to Environmental Engineering", Pretice Hall (2009).
3. Masters, G et al "Introduction to environmental engineering and Science", Pretice Hall (2009).
4. Kaltsmith, M. ; Streitcher, W. et al " Renewable energy—technology, economics and environment", Springer V. Berlin-Heidelberg (2007).
5. Mackenzie, L. D. and Davis, A. C. "Introduction to Environmental Engineering" McGraw-Hill Int.Edt. (1991).
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7. Rose, A. V." Fundamentals of Renewable Energy Process", Elsevier Acad. Press (2005).

CE-7105 Earthquake Engineering

Lecture-1

Introduction:

Earthquake, General causes of Earthquake, Effete of recent Earthquakes

Lecture-2

Seismology:
Plate tectonics, Earthquake mechanism, Epicenter, Focus, Magnitude, Intensity, Seismic waves, Hypocenter, Wave propagation in layered bodies, Earthquake motion on ground surface, Earthquake scales, Seismic zoning map of Bangladesh

Lecture-3

Earthquake Recording Instruments:
Seismograph, Accelerograph

Lecture-4

Behavior of Structure under Earthquake:
Seismic response analysis ofm SDOF structure, MDOF structure, Linear and Non-Linear analysis of Structures**,** Behavior of Reinforced concrete structure Masonry structure Timber structure

Lecture-5

Seismic Strengthening:
REHAB technology Beam, Column, Column-Beam joint, Non structural components**,** Slab**,** In filled walls**,** FRP strips technology

Lecture-6

Seismic Design of Structures:
Basic design requirements, Basic representation of seismic action, Methods of analysis (Linear and Non-Linear), Lateral Force method, Response Spectrum analysis, Static Push over analysis, Time History analysis

Examples on Design:
Earthquake dimensioning and construction of conventional masonry in filled and RC structure, Software demonstration

Lecture-7

Modern Seismic Robust Concepts:
Confined masonry, Reinforced masonry, Seismic controls, Base isolation, Pagoda system, HYDE system, Tendom system, Semi-Activ, Exercise on Structural Control Concepts

Lecture-8

Life Lines:
Types of life lines, Critical impact on lifelines, Life line failures, Common features of life line

Lecture-9

Urban Seismic Renewal:
Challenges for Urban seismic design, Seismic assessment, Street survey, Preliminary investigation, Final investigation, Risk analysis

Lecture-10

Field trip to City for the Seismic Assessment of Existing Structures

Lecture-11

Discussion with Poster on assignments related to Seismology, Behavior of Structure and Seismic Strengthening

Lecture-12

Discussion with Poster on assignments related to Seismic Control Concept, Life lines and Urban Seismic Renewal

Lecture-13

Discussion on Seismic Assessment Project and Possible Urban Renewal Concepts

BOOK List and References

DYNAMICS:

1. Clough and Penzien, Dynamics of Structures, 2nd Ed., McGraw-Hill, 1993.
2. L. Meirovitch, Analytical Methods in Vibrations, MacMillan, 1967.
3. L. Meirovitch Elements of Vibration Analysis, 2nd. Ed., McGraw-Hill, 1986.
4. J.M. Biggs, Introduction to Structural Dynamics, McGraw-Hill, 1964.
5. M. Paz, Structural Dynamics, 2nd Ed., Van Nostrand Reinhold, 1985.
6. J. L. Humar, Dynamics of Structures, Prentice-Hill, 1990.
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EARTHQUAKE ENGINEERING

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3. D. J. Dowrick, Earthquake Resistant Design, John Wiley & Sons, 1977.
4. The Seismic Design Handbook, Edited by F. Naeim, Van Nostrand Reinhold, 1989.
5. Design of Earthquake Resistant Structures, Edited by E. Rosenblueth, John Wiley & Sonsk, 1980.
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SOIL-DYNAMICS AND SOIL-STRUCTURE INTERACTION:

1. J. Wolf, Dynamic Soil-Structure Interaction, Prentice-Hall, 1985.
2. J. Wolf, Soil-Structure-Interaction Analysis in Time Domain, Prentice-Hall, 1988.
3. Earthquake Ground Motion and Its Effects on Structures, Edited by S. K. Datta, AMD-Vol. 53, ASME, 1982.

EARTHQUAKE GROUND MOTIONS:

1. B. Bolt, Earthquakes, W. H. Freeman & Company, San Francisco, 1988.
2. K. E. Bollen and B. Bolt, Introduction to the Theory of Seismology, 4th Ed., Cambridge University Press, 1985.
3. B. Gutenberg and C.F. Richter, Seismicity of the Earth, Princeton University Press, 1954.
4. C.F. Richter, Elementary Seismology, W. H. Freeman and Company, San Francisco, 1958.

EARTHQUAKE ENGINEERING RESEARCH INSTITUTE (EERI) MONOGRAPHS:

1. S. T. Algermissen, An Introduction to the Seismicity of the United States, MN0-7, 1983.
2. G. V. Berg, Seismic Design Codes and Procedures, MN0-6, 1983.
3. H. B. Seed and I. M. Idriss, Ground Motions and Soil Liquefaction During Earthquakes, MN0-5, 1983.
4. G. W. Housner and P. C. Jennings, Earthquake Design Criteria, MN0-4, 1982.
5. N. M. Newmark and W. J. Hall, Earthquake Spectra and Design, MN0-3, 1982.
6. A. K. Chopra, Dynamics of Structures, A Primer, MN0-2, 1981.
7. D.E. Hudson, Reading and Interpreting Strong Motion Accelerograms, MN0-1, 1979.

BUILDING CODES:

1. Uniform Building Code, 1997.
2 Bangladesh National Building Code-1993
3 EURO, DIN, BS, IS, ACI Building codes

4. Tentative Provisions for the Development of Seismic Regulations for Buildings, ATC 3-06, Applied Technology Council, 1978.
5. Performance Based Seismic Design of Buildings," FEMA Publication 283, FEMA, Washington. D.C., 1996.
6. NEHRP Guidelines for the Seismic Rehabilitation of Buildings." FEMA Publication 273, Building Seismic Safety Council, Washington. D.C., 1997.
7. NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, FEMA Publications 302 and 303, Building Seismic Safety Council, Washington, D.C., 1997.
8. Performance Based Seismic Engineering of Buildings, Vision 2000 Committee, Structural Engineers Association of California, Sacramento, CA, 1995.

CE-7403 Flood Control

Lecture-1
Flood Hydrology and Flood Characteristics, Cause of Floods and Flood Inundation, Flood Hydrology and Hydraulics, Classification of Floods: flash flood, river flood, coastal flood. Flood Control and Mitigation

Lecture-2
Flood Modeling and Model Classification, Physically-based Models, Lumped Conceptual Models, Black Box Models.

Lecture-3
Flood Routing Methods, Hydrodynamic Routing, Diffusion Routing, Muskingum Routing Kinematics Routing

Lecture-4
Flood Routing in River Basins, River Channels and Over Bank Flow Areas, River Basin Runoff Routing, River Channel Routing, Channel Network Routing, Flood Plain Routing

Lecture-5
Flood Forecasting Models, Deterministic Models, Stochastic Models, Combined Deterministic - Stochastic Models, Model Output Updating Process

Lecture-6
Flood Routing and Forecasting Using Artificial Neural Network (ANN), Types of Neural Network, Neural Network Architectures, Back Propagation Technique, Training and Testing ANN

Lecture-7
Flood Control and Management, Comprehensive Flood Disaster Prevention and Management Structural and Non-structural Flood Control Measures, Flood Risk Analysis and Mapping in GIS environment, Flood Plain Development and Management, Flood Damage Categories & Damage Assessment, Feasibility of Flood Control Projects

Lecture-8
Structures during Floods, Vulnerability & Evaluation of Flood Damages to built environments, Flood Resistant Inland and Coastal Structures, Flood Resistant Rural Housing

Lecture-9
Examples on Flood Modeling using Software

Lecture-10
Field Trip, Field trip to Flood Control Projects

Lecture-11
Discussion with Poster, Discussion with Poster on Flood Routing & Models

Lecture-12
Discussion with Poster, Discussion with Poster on Flood Warning & Management
Lecture-13
Discussion on Good Examples of Flood Control

Reference Books:

Box, G.E.P. and Jenkins, G. (1991):
Time Series Analysis, Forecasting and Control, Holden Day, San Francisco, U.S.A.
DHI (1993, 1994):
MIKE - 11, and MIKE – 21 (Student version), Reference Manuals, Danish Hydraulic Institute,
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Dresden Flood Research center, Germany	www.dresden-frc.de
Flood Hazard Research Center, Middlesex University, UK.	www.fhrc.mdx.ac.uk
USGS Flood Hazards, US Geology Survey ,USA	www.colorado.edu
Water Hazard and Risk Management (ICHARM), Japan.	www.icharm.pwri.go.jp

CE-7107 Wind Engineering

Lecture-1
Nature of Wind Induced Vibrations and Damages
Nature and types of wind from meteorological and engineering points of view, Statistical analysis of extreme wind speeds and stochastic model of wind turbulence, Wind Effects on Structures, Damages of Structures due to Wind Effects, Economic as impacted by catastrophe such as wind storm
Lecture-2
Introduction to Dynamics of Structures
Fundamentals of Structural Dynamics, Dynamic Properties of Structures, Modal Analysis of Structures

Lecture-3
Introduction to Dynamics of Structures (contd.)
Frequency Domain Analysis of Structures, Time Domain Analysis of Structures
Lecture-4
Examples on Dynamic Analysis of Structures-1
Introduction to Structural Engineering Application Software
Lecture-5
Structural Response and Wind resistant design of structures
Interaction of wind with buildings and structures. Aerodynamic drag, lift, moment & pressure. Periodic vortex-induced forces, Random wind forces caused by random wind velocity fluctuations, Aero-elastic phenomena: Torsional divergence, vortex induced oscillation, galloping and torsional flutter, Wind Loading Codes and Standards and design considerations beyond code, Low Rise Buildings, Tall Buildings
Lecture-6
Structural Response and Wind resistant design of structures (contd.)
Bridges, Tower, Chimneys, and Masts, Transmission Line
Lecture-7
Examples on Dynamic Analysis of Structures-2
Introduction to Structural Engineering Application Software
Lecture-8
Control of Wind Induced Vibrations
Active Control of Vibrations, Semi-active Control of Vibrations
Lecture-9
Control of Wind Induced Vibrations (contd.)
Passive Control of Vibrations, Hybrid Control of Vibrations
Lecture-10
Wind Induced Damage Assessment in Bangladesh
Cyclones & Tornadoes:
Documentation, analysis and identification of windstorm induced damage failure modes, platforms for damage documentation include on-ground, aerial and satellite images, application of GIS tools and HAZUS software.
Lecture-11
Experimental Investigation for Wind Responses of Structures
Modeling of Wind Effects, Analysis of Wind Induced Vibrations, Wind Tunnel Testing
Introduction to instrument, Design of various experiments, Data analysis and interpretation of full and modal scale wind engineering applications.
Lecture-12
Strengthening of Structures Against Wind-Vibrations
Low Rise Buildings, Tall Buildings, Life Line Structures
Lecture-13
Examples on Damage & Loss Estimation due to Wind
Introduction to Application Software: HAZUS

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2. Chopra, A.K., 1995. **Dynamics of structures: theory and application to earthquake engineering**, Prentice Hall.
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