



Gyanmanjari
Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-6 (B. Tech.)

Subject: Earthquake Engineering–BETCV16329
Type of Course: Professional Core
Prerequisite: Knowledge of Design & Analysis of Structure

Rationale: This subject is conceptual applications of principles of dynamics and earthquake resistant design & detailing of RC structures. Some special topics like earthquake resistant masonry structures, liquefaction, structural controls and seismic strengthening are included aiming students know that these are challenges in this subject. This subject is useful to understand the behavior of the structure subjected to earthquake forces and earthquake resistant design of the structure and also about disaster management.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
3	0	0	3	60	30	10	00	50	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Note: Subject related Indian Standard Codes: (1) Criteria for earthquake resistant design General provision & Building - IS: 1893 (Part I)- 2016, (2) Code of Practice for Ductile Detailing of RC Structures - IS: 13920 (2016), (3) Improving Earthquake Resistance of Earthen Buildings - IS 13827(1993) (R 2006)



CourseContent:

Sr.No.	CourseContent	Hrs.	% Weightage
1	Basics of Earthquake Engineering Interior of Earth, plate tectonics, faults, consequences of earthquake, Basic parameters of earthquake, seismic waves, magnitude & intensity, scales, Seismic zones of India, damages caused during past earthquakes (worldwide).	5	15
2	Fundamentals of Earthquake Vibrations of buildings Static load v/s Dynamic load, simplified single degree of freedom system, mathematical modelling of buildings, natural frequency, resonance v/s increased response, responses of buildings to different types of vibrations like free and forced, damped and un-damped vibration, response of building to earthquake ground motion, Response to multi degree (maximum three) of freedom systems up to mode shapes.	13	25
3	Design Philosophy of Earthquake Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural configuration, Introduction to IS: 1893 (Part I) 2016, IS: 875 (Part V). Seismic load: Seismic Coefficient Method– base shear and its distribution along height. Introduction to Response spectrum, IS code provisions.	12	25
4	Lateral Loads on structural Buildings Lateral Load Distribution (SDOF): Rigid diaphragm effect, centers of mass and stiffness, torsional coupled and uncoupled system. Lateral Load Analysis: Analysis of frames using approximate methods like portal & cantilever methods	7	15
5	Ductile Detailing of structural components Concepts of Ductile Design & Detailing of various structural components as per IS:13920 - 2016 provisions. Special topics: Introduction to Earthquake Resistant Features of un-reinforced & reinforced masonry Structure, Confined Masonry, Soil liquefaction, Structural controls, Seismic strengthening.	3	10

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1	Observation of Building Features Students in group will go around their college campus or nearby market area and observe different buildings. They will identify features like regular shape, soft storey, open ground floor, or presence of shear walls. Each student will write a short note with poster presentation of buildings and upload it on the GMIU web Portal.	10



2	Earthquake News Case Study Individual Student will collect one recent online article about an earthquake. They will note down the magnitude, location, damages caused, and one key learning point. Each student will prepare a summary report and upload it on the GMIU web portal.	10
3	Soil Type & Liquefaction Awareness Individual Student will visit a nearby open ground, farm, or construction site and observe the type of soil. They will write about whether that soil is safe or vulnerable to liquefaction during earthquakes. Each student will submit a short report with soil description and their conclusion, and upload it on the GMIU web portal.	10
4	Earthquake Safety Audit of Classroom Students in group will inspect their own classroom or laboratory for earthquake safety features. They will look for things like heavy objects on shelves, exit routes, cracks in walls, or quality of connections between walls and roof. Each student will prepare a short checklist-based report and upload it to the GMIU web portal.	10
5	Mapping Seismic Zone of Home District Each student will find the seismic zone of their home district/state using NDMA website. They will also note the expected intensity of shaking in that zone. Each student will prepare a small map or note indicating their district's seismic zone, risks, and precautions. Report to be uploaded to the GMIU web portal.	10
TOTAL		50

Suggested Specification table with Marks(Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	20%	30%	20%	20%	5%	5%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:

CO1	Identify the causes of damages in structures during earthquake events.
CO2	Determine the response of SDOF & MDOF structural system subjected to vibration including earthquake.
CO3	Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings in design of RC structures.
CO4	Determine the lateral forces generated in the structure due to earthquake.
CO5	Apply the concept of ductile detailing in RC structures & the concepts ERD



Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by blackboard, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

- [1] Earthquake resistant design of structures, Manish Shrikhande & Pankaj Agrawal, PHI Publication, New Delhi
- [2] Earthquake resistance design of structures, S.K. Duggal, Oxford University Press, New Delhi.
- [3] Dynamics of structures, A.K. Chopra, Pearson, New Delhi
- [4] Example of a Six Storey Building, IITK-GSDMA EQ26 – V -3.0 Design
- [5] Mechanical Vibration, S S Rao, Pearson, New Delhi.

