GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Civil Engineering
SUBJECT NAME: _ Glass Façade Engineering
SUBJECT CODE: 2180613
B.E. 8th SEMESTER

Type of course: Under Graduate

Prerequisite *(if any)*: NO

Rationale: The course aims to provide fundamental knowledge Glass Facades in the building envelope with design, structural and how to improve the building performance using glass.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	1	4	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Learning Objectives:

An Industry based elective course to provide them with concepts on modern concepts on role of Glass Facades in the building envelope with design, structural and concepts on considerations for improving the building performance using glass

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**INTRODUCTION: GLASS – THE BUILDING MATERIAL** Glass as a building material & its Applications, Float glass manufacturing technology, Key Functional Requirements - Building Physics: Theory of electromagnetic radiation, Factors defining performance & Selection of Glass: (VLT, SF, UV, SHGC) - Value Addition: Optical Properties- Coating Technology - Need for Green Buildings: Energy efficient buildings, Energy codes, Green ratings & its Approaches: ECBC, IGBC, GRIHA - Human safety Compliances - Fire Resistant Glazing: Types & Applications - Understanding Acoustic Glazing: Principle & Applications - Interior Glazing: Types & Applications - Glass for segments- Hospitals, Green Homes, Airports, Offices, Educational institutions - Types of Glass - Glass Processing: Tempering, Heat Strengthening, Insulation, Lamination & Ceramic Frit	10	20
2	**GLASS APPLICATIONS ON FACADES** Glass Façade - Understanding Glass façade - Types of Glazing & Applications: Forms of Construction, Windows- punch & strip, Doors /external partitions- hinged, sliding & rotating, Building perimeter glazing- Framed & Frameless systems	5	10

3	**STRUCTURAL DESIGNING OF GLASS & GLASS FAÇADE** Key Design Basis – Strength, Deflection, Earthquake & Natural disasters, Thermal Breakage resistance - Design for safety - Design for serviceability	10	15
4	**DESIGN APPROACH & METHOD** Linear analysis: Wind load calculations, deflection and stress checking - Non-linear analysis-Introduction and methodology – Framing - What is structural framing, How structural framing is done - Framing of – Steel, Aluminium - Design of Glass and Glazing: Structural Design of Glass - Wind load analysis - Thickness analysis - Stress analysis - Size & Aspect ratio analysis - Innovative designs (skylights, balustrades & canopies) - Design of Glazing and Fixtures - Design of Glass Supporting systems - Design of interfacing with Buildings (fixing and anchorages) - Component, framing sizing & Optimizing the frame	10	35
5	**GLASS FAÇADE TESTING & CERTIFICATION** Codes & Regulations - Allowable limits - Need for Façade Testing - FAÇADE TESTING & CERTIFICATION - Weather performance, Structural load, Seismic floor displacement, Acoustic performance, Fire test, Thermal & U-Value test - ON-SITE TESTS	10	20

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	35	20	15	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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.

Reference Books:

1. Structural Glass: Hugh Dutton, Peter Rice: 9780419199403
2. Structural Glass Facades and Enclosures, Mic Patterson; ISBN: 978-0-470-93185-1
3. Joseph S. Amstock's Glass in Construction (McGraw-Hill, 1997)
4. Envelope Design for Buildings ISBN 0750628545 by William Allen
5. Thomas Herzog, "Facade Construction Manual." Birkhauser, 2004

References:

1. Glass in Architecture ISBN 0714829226 by Michael Wigginton
2. FOSG Architectural Guide
3. Glass Academy Foundation Manual Volume – I
4. Glass Academy Foundation Manual Volume – II
5. Glass Academy Foundation Manual Volume - III

Course Outcome:

After learning the course the students should be able to:

- Understand Glass as a building material, its various applications and benefits
- Design and analyze the suitable façade based on drawings

Major Equipment:

Students may be exposed to following software/tools used for the design of various components.

1. Auto-Cad
2. Ecotect
3. Glass Wizard
4. Staad Pro

List of Open Source Software/learning websites required for better understanding of the subject

1. www.glass-academy.com
2. www.glassisgreen.com

Term Work/Practical

1. Project management mapping for a facade design and execution
2. Glass as a green material- Savings with usage of glass in time, cost, space, site material wastage and overall reduction in the weight of the building and its savings on foundation

Design based problems/open ended problems

1. Glass wastage optimization
2. Envelope specification for a project

Active learning assignment

1. Thickness calculation for a given case study
2. Studying the Impact of climate/ environment over the building performance

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.