

## GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

### Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021) Semester – IV

**Course Title: Structure**  
(Course Code: 41046305)

Diploma programme in which this course is offered	Semester in which offered
Architecture	Fourth

#### 1. RATIONALE

This course introduces the learners to various very basic fundamental concepts of Structures. Knowledge and understanding of various types of a designed and built building structure is very important for architecture students in order to draw detailing of various projects, before execution of the project. This course imparts basic concepts of structure along with its classification as well as concepts, principles, applications and practice covering introduction to force and its application, moment and its application, simple stress and strain, shear force and bending moment, center of gravity, reinforcement details of RCC components and steel sections. Understanding of structures is crucial for designing and constructing safe, durable, and sustainable buildings. The course is designed in such a manner so that the students get knowledge and understanding of basic fundamental of building structures. At diploma level students are expected to develop their understanding about these aspects of various structural design considerations in order to apply their knowledge and skills in their architectural design projects.

#### 2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Understand the basic concepts of structural analysis and structural detailing for preparing architectural designs**

#### 3. COURSE OUTCOMES(COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- a) Understand the concept of force and moment and its application
- b) Calculate simple stress and strain
- c) Understand the concept of centroid and center of gravity
- d) Draw reinforcement details of slab, beam, column and footing
- e) Understand various types of steel sections and its connections

#### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	0	3	30*	70	0	0	100

(\*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

**Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.

## 5. SUGGESTED PRACTICAL/STUDIOEXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. They are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. require
	Not Applicable		

## 6. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
	Not Applicable	

## 7. AFFECTIVE DOMAINOUTCOMES

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs. More could be added to fulfil the development of this course competency.

- Work as a leader/a team member
- Follow ethical practices
- Practice environmental friendly methods and processes. (Environment related)

The ADOs are best developed through the field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as explained below:

- 'Valuing Level' in 1<sup>st</sup> year
- 'Organization Level' in 2<sup>nd</sup> year.
- 'Characterization Level' in 3<sup>rd</sup> year.

## 8. UNDERPINNINGTHEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Major Learning Outcomes (In cognitive domain)	Topics and Sub-topics
<b>Unit –I Introduction</b>	1a. Explain the concept of mechanics 1b. Classify scalar and vector quantities 1c. Differentiate the systems of units	1.1 Classification of mechanics 1.2 Scalar and vector quantities 1.3 Fundamental units and derived units 1.4 International systems of units 1.5 S.I. Units of different quantities
<b>Unit-II Introduction to Force and moment and its application</b>	2a. Understand the force and moment 2b. Understand different types of beams, supports and loads 2c. Understand the concept of shear force and bending moment 2e. Draw shear force and bending moment diagram	2.1 Definition of force and moment 2.2 Condition of equilibrium 2.3 Components of structure: Beam, column, slab and footing and predominant actions subjected to them. 2.4 Types of beams 2.5 Types of loads: point load and uniformly distributed load (UDL) 2.6 Types of supports: Hinged, Fixed, Roller 2.7 Calculation of reaction at supports 2.8 Definition of shear force and bending moment 2.9 Examples on S.F. and B.M. on Cantilever and simply supported beam subjected to point load and UDL.
<b>Unit – III Centroid &amp; Centre of gravity</b>	3a. Differentiate between centroid and centre of gravity 3b. Compute centroid of line and area 3c. Compute centre of gravity of solids	3.1.1 Centroid 3.1.2 Centroid of simple geometric areas 3.1.3 Centroid of composite areas 3.1.4 Methods to find a centroid 3.1.5 Centre of gravity of solids 3.1.6 Examples of centroid of L, T, C and I sections
<b>Unit – IV Simple Stress and Strain</b>	4a. Understand the stress, strain, shear stress and shear strain 4b. Understand Hook's law 4c. Concept of elastic constants 4d. Compute stress and strain for bars of varying section	4.1 Definition of Stress and strain 4.2 Types of Stress and Strain 4.3 Definition of elastic limit, hook's law and Poisson's ratio 4.4 Elastic Constants – Modulus of elasticity, modulus of rigidity, bulk modulus 4.5 Modular ratio, volumetric strain Examples on simple bars and examples on varying cross section
<b>Unit– V Reinforcement details of Structural Component</b>	5a. Draw reinforcement detail of slab, beam, column and footing 5b. Enlist prestressed concrete elements.	5.1 Reinforcement detail of slab – one way, two way, continuous and cantilever 5.2. Reinforcement detail of beam – singly reinforced and doubly reinforced, T-beam, L-beam 5.3. Reinforcement detail of R.C.C. column and column footing – isolated, combined 5.4 Prestressing in concrete, types e.g. – Pretensioning and post-tensioning.
<b>Unit-VI Steel Sections</b>	6a. Know various types of rolled steel section 6b. Draw various connections	6.1 Types of rolled steel section used in beam and column 6.2 Various methods of connection of steel section – beam to beam and beam to column

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	04	02	02	00	04
II	Introduction to Force and moment and its application	10	04	04	12	20
III	Centroid & Center of gravity	07	04	02	04	10
IV	Simple stress and strain	10	04	04	12	20
V	Reinforcement details of structural component	07	00	02	08	10
VI	Steel sections	04	01	02	03	06
<b>Total</b>		<b>42</b>	<b>15</b>	<b>16</b>	<b>39</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

**Note:** This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student- related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

- Study of on-going constructions works and documentation of the same in the form of a report with photographs and sketches.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- Guide student(s) in undertaking micro-projects.
- 'L' in section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.
- With respect to **section No.10**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide students on how to address issues on freehand sketching, model making etc. (not related to this course).
- Guide students for using relevant ordering principle.
- Arrange visit to nearby site for understanding various concepts related to Architectural Design.
- Use video/animation films to explain various concepts/processes related to Architectural Design themes.

- j) Use different instructional strategies in classroom teaching.
- k) Display various technical brochures of recent Architectural Design processes

## 12. SUGGESTED MICRO-PROJECTS

**Only one micro-project** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro-project should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This must match with the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- a) Prepare a portfolio (in A4 or A3 size drawing sheet) of all the required sketches of reinforcement details of the different components as per the syllabus.
- b) Prepare a portfolio (in A4 or A3 size drawing sheet) of various structural elements with predominant actions subjected to them.

## 13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	A textbook of Engineering Mechanics (In SI Units)	R. S. Khurmi	S. Chand Publication, New Delhi, ISBN-10, 9352833961
2	Applied Mechanics	S. B. Junarkar and Dr. H. J. Shah	Charotar Publishing House Pvt. Ltd., Anand, ISBN: 9789385039065
3	Smts - I Strength of Materials	Dr B. C. Punmia, Er Ashok Kumar Jain, Dr Arun Kumar Jain	Laxmi Publications, ISBN-10, 8131809250
4	Strength of Materials	S. Ramamurtham	Dhanpat Rai Publishing Company (P) Limited ISBN: 818743354X

## 14. SOFTWARE/LEARNING WEBSITES

- <https://nptel.ac.in/courses/112106286>
- <https://nptel.ac.in/courses/105105108>
- <https://nptel.ac.in/courses/105106117>
- <https://cosmolearning.org/courses/prestressed-concrete-structures/>
- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/IARE\\_PSC\\_LECTURE\\_NOTES.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_PSC_LECTURE_NOTES.pdf)

## 15. PO-COMPETENCY-CO-MAPPING

Semester IV	Structure (Course Code: 4345005)								
	POs and PSOs								
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/development of solutions	PO4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO6 Project Management	PO 7 Life-long learning	PSO1*	PSO2#
Competency	<ul style="list-style-type: none"> <li>Understand the basic concepts of structural analysis and structural detailing for preparing architectural designs</li> </ul>								
CO a) Understand the concept of force and moment and its application	3	-	-	-	2	-	2	1	1
CO b) Calculate simple stress and strain	2	3	1	2	2	-	1	1	1
CO c) Understand the concept of centroid and center of gravity	2	2	-	-	2	-	1	1	1
CO d) Draw reinforcement details of slab, beam, column and footing	2	-	-	-	2	-	2	1	1
CO e) Understand various types of steel sections and its connections	1	1	1	-	1	-	1	1	1

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO/PSO.

**\*PSO1: Planning & Design:** Prepare architectural designs and all types of drawings with appropriate material specifications and application techniques as per specific project requirements.

**#PSO2: Execution:** Work competently as assistants in architectural firms so as to contribute and coordinate both office work and execution on site.

## 16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### GTU Resource Persons

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