

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

Semester - I

Course Title: **Building Materials**

(Course Code: C4315003)

| Diploma programme in which this course is offered | Semester in which offered |
|---|---------------------------|
| Architectural Assistantship | First |

1. RATIONALE

This course introduces the learners to the basic building materials used in the construction industry. Building material is an integral part of the architectural field. The site condition, as well as the nature of its surroundings, determines the building type, and choice of building materials to be used. The type and form of structure is determined by the type of material used. The proper choice of building material is very important as it glorifies the endurance and visual aspects of design. It also helps in enhancing the aesthetic quality of a building—*venustas* (beauty) and *firmitas* (structure). This course gives a brief description about different types of materials used in building construction projects. Properties of various construction materials and their uses are discussed in this subject. This course will not only help diploma students in identifying suitable building material as per the type of building but also maintain its aesthetic aspects.

2. COMPETENCY

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

- **Use the relevant building materials for a given architectural applications**

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:

- Classify the various building materials
- Select the relevant man-made materials like bricks, cement, concrete, artificial stone, etc. as per architectural project requirements
- Select the relevant natural materials like stone/rock, timber, lime, etc. as per architectural project requirements
- Differentiate between various types of binding materials in a given situation

4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P/2) | Examination Scheme | | | | |
|-------------------------------|---|---|----------------------------|--------------------|-----|-----------------|-----|-------------|
| L | T | P | | Theory Marks | | Practical Marks | | Total Marks |
| | | | 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/STUDIO EXERCISES

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. required |
|--------|---------------------------|----------|-----------------------|
| | Not Applicable | | |

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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 DOMAIN OUTCOMES

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.

- a) Work as a leader/a team member.
- b) Follow ethical practices.
- c) 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:

- i. 'Valuing Level' in 1st year
- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

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 | Unit Outcomes (UOs) (4 to 6 UOs at different levels) | Topics and Sub-topics |
|--|---|---|
| Unit – I Introduction | 1a. Classify the building materials. 1b. Explain the Characteristics of the given building material. 1c. Explain properties of the given building materials. 1d. Identify factors affecting the selection of material. | 1.1 Definition and Classifications of building materials. 1.2 Characteristics of Building Materials and their application in architecture 1.3 Properties of the given building materials 1.4 Factors affecting the selection of material |
| Unit – II Bricks | 2a. Describe composition of bricks 2b. Describe the manufacturing process of bricks 2c. Classify bricks Select the bricks of good quality (To be written properly) 2d. Explain special types of bricks 2e. Conduct given field tests for bricks 2f. Compare the bricks of different grades 2g. Explain size and weight of different types of bricks | 2.1. Composition of Bricks: Constituents of good brick earth 2.2. Manufacture of Bricks: Preparation of Clay, Moulding, Drying, Burning. 2.3. Classification of Bricks 2.4. Qualities of Good Brick 2.5. Special Types of Bricks 2.6. Tests for Bricks 2.7. Grading of Bricks 2.8. Size and weight of bricks |
| Unit– III Stones | 3a. Classify different types of rocks 3b. Describe qualities of a good building stone 3c. Explain characteristics of different stones 3d. Explain the term, “artificial stones”. 3e. Enlist advantages of artificial stones 3f. Differentiate between fine and coarse aggregates 3g. Segregate the given aggregates as per relevant grades | 3.1 Classification of Rocks: Geological, Physical, Chemical 3.2 Qualities of a good building stone 3.3 Characteristics of different stones: e.g., Granite, Ballast, Sand Stone, Lime Stone, Marble, Slate, etc. 3.4 Artificial Stones: Cement Concrete, Mosaic tiles, Terrazzo, etc. 3.5 Advantages of artificial stones 3.6 Aggregates: Fine Aggregates, Coarse Aggregates 3.7 Grading of Aggregates |
| Unit– IV Timber | 4a. Explain the uses of timber 4b. Classify the trees with relevant examples | 4.1 Uses of Timber 4.2 Classification of trees: Endogenous trees, Exogenous trees |

| Unit | Unit Outcomes (UOs) (4 to 6 UOs at different levels) | Topics and Sub-topics |
|--|--|---|
| | 4c. Compare soft wood with hard wood 4d. Draw the structure of a given tree 4e. Identify the defects in timbers 4f. Identify various wood-based products 4g. Enlist characteristics of good timber 4h. Explain the term, "Seasoning of timber" along with its importance | 4.3 Comparison of Soft wood and Hard wood 4.4 Structure of tree: Macro structure, Micro structure 4.5 Defects in Timber: Defects due to conversion, Defects due to fungi, Defects due to insects, Defects due to natural forces, etc. 4.6 Wood based products: Veneers, Plywood, Fibre boards, Impregnated timbers, Compregnated (Please check) timbers 4.7 Characteristics of good timbers 4.8 Seasoning of Timber and its Importance |
| Unit– V Lime, Cement and Sand | 5a. Classify lime according to their uses and properties 5b. Compare different types of lime with respect to its properties (Same as 5a) 5c. Describe proportions and properties of lime mortar 5d. Explain process of storing lime 5e. Discuss ingredients of cement and their functions 5f. Explain proportion and use of cement mortar 5g. Enlist the uses of admixtures 5h. Describe the sources, characteristics, grading and bulking of sand. | 5.1 Lime: Types, Properties & Uses 5.2 Comparison among properties of different types of lime 5.3 Lime mortar, different proportions, Properties of good mortar 5.4 Storing & slaking of lime 5.5 Cement: Ingredients and Functions 5.6 Types of cement 5.7 Uses of cement 5.8 Cement Mortar: Proportion and Use 5.9 Admixtures – Uses 5.10 Sand: Sources, Characteristics, Grading of sand, Bulking of sand |
| Unit– VI Concrete | 6a. Explain the constituents and requirements of concrete 6b. Justify the necessity of water in concrete 6c. Explain the process of various types of concrete mix 6d. Explain the methods of compaction of concrete 6e. Enumerate the importance of Curing of concrete" | 8.1 Concrete – Constituents, Requirements 8.2 Function of water 8.3 Uses of Concrete 8.4 Types of Concrete 8.5 Preparation of concrete mix: Hand mixing, Machine mixing 8.6 Compaction – Methods: Hand compaction, Mechanical compaction 8.7 Curing of concrete |

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 | 03 | 01 | 00 | 04 |
| II | Bricks | 08 | 06 | 08 | 00 | 14 |
| III | Stones | 08 | 06 | 08 | 00 | 14 |
| IV | Timber | 08 | 07 | 07 | 00 | 14 |
| V | Lime, Cement and Sand | 08 | 07 | 07 | 00 | 14 |
| VI | Concrete | 06 | 04 | 06 | 00 | 10 |
| Total | | 42 | 33 | 37 | 00 | 70 |

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:

- a) Conduct Market survey for building materials.
- b) Visit of construction sites to study the uses of building materials and prepare a report.
- c) Visit to historical structures to study uses of stone

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:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) Guide student(s) in undertaking micro-projects.
- c) '**L**' in **section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- d) 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.
- e) With respect to **section No.10**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- f) Guide students on how to address issues on freehand sketching, model making etc. (not related to this course).
- g) Guide students for using relevant ordering principle.

- h) Arrange visit to nearby site for understanding various concepts related to Architectural Design.
- i) 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 microproject 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) Conduct Market survey for the building materials.
- b) Prepare a report on the market survey supported with the photographs

13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication with place, year and ISBN |
|--------|--|---|---|
| 1 | Engineering Materials (Material Science) | Rangwala | Charotar Publishing House Pvt. Ltd., Anand, ISBN: 9789385039171 |
| 2 | Building Construction | Sushil Kumar | Standard Publishers Distributors, ISBN 13: 9788180141683 |
| 3 | The text book of Building Construction | S. P. Arora, S. P. Bindra | Dhanpat Rai Publications, ISBN 13: 9788189928803 |
| 4 | A text book of Building Construction | Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain | Laxmi Publications (P) Ltd., ISBN: 81-7008-053-3 |
| 5 | Building Materials | S. K. Duggal | New Age International (P) Limited, Publishers ISBN (13):978-81-224-2975-6 |
| 6 | Building Construction | Dr. Janardan Jha, Prof. S. K. Sinha | Kanna Publisher, ISBN-10: 978817409263 2 |
| 7 | Building Materials in Civil Engineering | H. Zhang | (Woodhead Publishing, 2011) ISBN: 978-1-84569-955-0 (print) |

| S. No. | Title of Book | Author | Publication with place, year and ISBN |
|--------|---|-----------------|--|
| | | | ISBN: 978-1-84569-956-7 (online) |
| 8 | Building Construction and Material (SI Units) | Gurcharan Singh | Standard Book House ISBN: 978-81-89401-21-4 |

14. SOFTWARE/LEARNING WEBSITES

- <http://www.nptelvideos.in/2012/11/building-materials-and-construction.html>
- https://www.vssut.ac.in/lecture_notes/lecture1424085991.pdf
- <https://nptel.ac.in/courses/105/106/105106206/>
- <https://nptel.ac.in/courses/124/105/124105013/>
- <https://nptel.ac.in/courses/105/102/105102088/>

15. PO-COMPETENCY-CO MAPPING

| Semester I | Building Materials (Course Code: C4315003) | | | | | | | | | |
|--|--|--------------------------|---|--|---|----------------------------|----------------------------|-----------|-----------|--|
| | POs and PSOs | | | | | | | | | |
| Competency & Course Outcomes | PO 1 Basic & Discipline specific knowledge | PO 2 Problem Analysis | PO 3 Design/development of solutions | PO 4 Engineering Tools, Experimentation & Testing | PO 5 Engineering practices for society, sustainability & environment | PO 6 Project Management | PO 7 Life-long learning | PSO1 * | PSO2 # | |
| Competency | Use the relevant building materials for the given architectural applications | | | | | | | | | |
| Course Outcomes | | | | | | | | | | |
| CO a) Classify the various building materials | 3 | - | - | - | - | - | 1 | 1 | 1 | |
| CO b) Select the relevant man-made materials like bricks, cement, concrete, artificial stone, etc. as per architectural project requirements | 3 | - | - | - | 2 | - | 1 | 1 | 1 | |
| CO c) Select the relevant natural materials like stone/rock, timber, lime, etc. as per architectural project requirements | 3 | - | - | - | 2 | - | 1 | 1 | 1 | |
| CO d) Differentiate between various types of building materials in a given situation | 3 | - | - | - | 2 | - | 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: Suggest appropriate building materials as per the requirement.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE**GTU Resource Persons**

| Sr. No. | Name and Designation | Institute | Contact No. | Email |
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NITTTR Resource Persons

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