GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Advanced Construction Technology
(Course Code: 4350605)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	5th Semester

1. RATIONALE

Before taking this course on "Advanced Construction Technology," it is expected that students have already learned some basic concepts, principles, and important aspects of construction materials and technology in the third-semester course (Code: 4330603). This course builds on that knowledge and explores advanced aspects of construction technology to address the demands of the internal and globalized market for quality and faster completion of projects using modern techniques, waste materials, and mechanized construction.

The construction industry is constantly evolving, and today, high-capacity machines with better output and greater efficiency are needed to make the construction process less stressful. This course has been designed to equip diploma engineers with the necessary skills to use advanced construction technology effectively. With the knowledge gained in this course, students will be able to apply modern techniques and use modern and waste materials to improve construction quality and speed up project completion. They will also be able to leverage mechanized construction to reduce manual labour and increase efficiency. Overall, this course will provide students with the tools they need to succeed in today's construction industry.

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 advanced construction technologies.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) To develop the conceptual knowledge of advanced construction material and concur knowledge of Waste products and Industrial byproducts.
b) Students are able to appreciate various types of advanced and latest construction machineries, equipment, formworks and safety measures involved in construction works.
c) Contribute either as an executioner or Supervisor in the special types of civil engineering construction aided with state of the art technology.

d) Describe important aspects, operations and safety points pertaining to:
   a. Drilling and Blasting
   b. Coffer Dams
   c. Caissons

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30*	70	25	25	150

(*):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 EXERCISES

The following practical outcomes (PrOs) are thesub-components of the COs.*Some of the **PrOs** marked **'*'** are compulsory, as 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
1	Draw Sketches With Nomenclature and Short Details in Sketch book. • **Plants and Equipment Used In Construction.** a. Earthmoving machineries b. Equipment for excavation c. Handling equipment d. Hoisting equipment e. Conveying equipment f. Pumping equipment g. Compacting equipment h. Concrete vibrating equipment i. Pile driving equipment j. Plants for Grouting, Guniting. k. Drilling equipment l. Concrete and mixing plant • Different types of coffer dams. • Different types of caisson. • Crib and Trestle • Blast hole	I, II, III, IV and V	Home Assignment

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	• Tunnel Formwork System		
2	Prepare a report on use of Waste products and Industrial byproducts in bricks, blocks, concrete and mortar.	I	4*
3	Prepare a site visit report regarding your visit in which construction work of Multi storied buildings is going on with advanced Equipments and machineries stating list of it including its selection criteria and its advantages.	II	4*
4	Prepare a report on various admixtures used in Concrete.	III	2*
5	Prepare a report on Under water concreting in Bridge pier and bored pile.	III	2*
6	Prepare a report on 3D Volumetric Construction.	IV	4*
7	Prepare a site visit report regarding your visit in which Equipment and machineries required for Foundation and Super structures of Bridges.	IV	4*
8	Prepare a site visit report regarding your visit in which deep foundation work is going on including type of deep foundation adopted and its selection criteria.	V	2*
9	Prepare a site visit report regarding your visit in which caisson/ cofferdam construction work is going on.	V	2
10	Prepare a site visit report regarding your visit in which drilling/ blasting work is going on.	V	4
11	Prepare a report on blasting process using various types of explosives.	V	2*
12	Topic of Seminar shall be given to a group of students. The students are required to submit and present/ defend the Seminar in presence of students and teachers and report including PowerPoint presentation to be attached with submission.	I, II, III, IV and V	4*
	Total		**28**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills(more may be added/deleted depending on the course)that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 1	
1	Neatness, Cleanness in Sketch book	10
2	Uniformity in Drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer the question	10
6	Submission of drawing in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 3, 7, 8, 9, & 11	
1	Discipline	10
2	Involvement during site visit	20
3	Data collection at site	20
4	Organization of report	20
5	Answer the question	10
6	Timely submission of report	20
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 2, 4, 5, 6, 10	
1	Data collection	20
2	Write up, Grammar etc.	20
3	Organization of report	20
4	Answer the question	20
5	Timely submission of report	20
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 12	
1	Initiative	20
2	Data Collection	20
3	Content of Presentation (Use of multi media)	20
4	Presentation (Body Language- Gesture, Posture etc.)	20
5	Answer the question	20
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	PrO.No.
1	Computer system (An computer system with basic configuration)	20

7. AFFECTIVE DOMAIN OUTCOMES

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

a) Work as a leader/a team member.
b) Follow safe practice on site/ lab.
c) Maintain tools and equipment.
d) Follow ethical practices.
e) Practice environmental friendly methods and processes. (Environment related)

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

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

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level 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 Application and above level)	Topics and Sub-topics
Unit – I Advanced Construction Materials	1a. Describe the features of special types of civil engineering materials. 1b.Explain different types of advanced building materials and their uses in construction 1c. Discuss properties of advance materials and by products. 1d. Miscellaneous materials Properties and uses of acoustics materials, wall claddings, plaster boards, Micro-silica, artificial sand, bonding agents, adhesives etc.	1.1 Innovation in building materials is an unceasing reality of our construction industry. 1.2 advanced building materials 1.2.1 Plastics and PVC 1.2.2 Ceramic products 1.2.3 Paints and Varnish 1.2.4 Materials for damp proofing, water proofing 1.2.5 Materials for anti-termite treatment 1.2.6 Glass and fiber 1.2.7.Steel and iron materials 1.2.8 Materials used for false ceiling 1.2.9 Asbestoses 1.2.10 Concrete blocks 1.3 Admixtures and its Classification. 1.3.1.Admixtures and its benefits, Types of Admixtures - Accelerator and Retarder Plasticizer and Super Plasticizer Water roofing and Air entraining admixture 1.4 Use of Waste products and Industrial byproducts in bricks, blocks, concrete and mortar.
Unit – II Miscellaneous machineries and Hoisting, Conveying Equipments	2a. Able to introduce different types of construction machinery, its features and Working.	2.1 Purpose, advantages and disadvantages of Construction machinery. 2.2 Machineries used for earthwork and for other construction works. Mortar – Types & specific uses 2.2.1 Their details, special features, suitable uses, specifications.
Unit– III Advanced Concreting methods and Equipments	3a. Explain about latest Developments in the field of concrete works. 3b. Under water Concreting for bridge piers and bored pile construction.	3.1 Grouting, Guniting, Shotcrete: Terminology, applications, Materials, Proportioning and Properties, Dry-Mix Process, Wet- Mix Process, Auxiliary Equipment, Special Equipment, methods.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	3c.Ready Mix concrete: Necessity and use of Ready Mix Concrete. Production and equipment's for RMC. 3d.Ready Mix Concrete plant. Conveying of RMC. Transit mixers-working and time of transportation. 3e.Workability and water cement ratio for RMC. Strength of RMC	3.2 Special Concrete: Properties, uses and procedure of Roller compacted concrete. 3.2.1 Properties and uses of High Impact Resisting concrete. 3.2.2 Properties, uses and constituents of Steel fiber reinforced concrete. 3.2.3 Percentage of steel fibers in SFRC. 3.2.4 Effect of size, aspect, ratio and percentage of steel fibers on strength of concrete. 3.3 Flat slab technology. 3.4 Tunnel Formwork System. 3.5 3D Volumetric Construction. 3.6 Hybrid Concrete Construction. 3.7 Tremie method of underwater concreting: Procedure and equipment's required for tremie method. Properties, workability and water cement ratio of the concrete required.
Unit– IV Advanced Technology in Construction	4a. Describe Construction of Bridges and flyover work. 4c. Describe Construction of Multi storeyed buildings work. 4d. Select suitable type of Equipments and machineries for Multi storeyed buildings and Bridges. 4e. Explain 3D Printing in Construction. 4f. Select Geo synthetics for Strengthening of Embankments	4.1 Construction of Bridges and flyover. 4.2 Equipment and machineries required for Foundation and Super structures of Bridges. 4.3 Construction of Multi storeyed buildings. 4.4 Equipments and machineries required for Construction of Multi storeyed buildings such as use of lifts, belt conveyors, pumping of concrete. 4.5 Equipments and machineries used for placing and jointing of pre fabricated elements. 4.6 Use of 3D Printing in Construction. 4.7 Strengthening of Embankments by soil reinforcing technique using geo synthetics
Unit– V Drilling, Blasting	5a. Explain the need of Drilling and blasting. 5b. Select the appropriate	5.1 Drilling: Types, Drilling requirements, Selecting the drilling pattern for blasting

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
and Special Construction	Explosive materials and precautions required in storage and in handling of explosives. 5c. Describe drilling and blasting operations 5d. Explain purpose, use, principles of working and features of types of coffer dams. 5e. Describe the selection criteria of types of coffer dams 5f. State the leakage points and suggest leakage prevention in coffer dams. 5g. Describe the uses of caissons and Classify the types of caisson. 5h. Explain method of sinking of caissons. 5i. Differentiate between Cofferdams and caissons	5.2 Effect of air pressure on drilling operation 5.3 Bentonite/ mud slurry in drilling 5.4 Factors affecting the selection of drilling method and equipment 5.5 Blasting: Explosives for blasting (Dynamite, Blasting caps Primeline, Safety fuse, Stemming, Blast hole, Prime detonators etc.) 5.6 Types of blasting: Process of using explosive, Precautions 5.7 Storage of explosives 5.8 Features of magazine building 5.9 Special Construction — Coffer dams: Types, requirements, Selection criteria, Design features, Leakage points and leakage prevention in coffer dams. — Caissons: Materials used, Sinking loading of caissons.

***Note**:TheUOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Advanced Construction Materials	10	04	06	04	14
II	Miscellaneous machineries and Hoisting, Conveying Equipments	08	04	04	04	12
III	Advanced Concreting methods and Equipments	10	04	06	06	16
IV	Advanced Technology in Construction	08	04	06	06	16
V	Drilling, Blasting and Special Construction	06	02	04	06	12
Total		**42**	**18**	**26**	**26**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of theUOs. The actual distribution of marks at*

different taxonomy levels (of R, U and A) in the question paper may varyslightly 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 conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Collect the information on Advanced Materials used in construction and prepare a report.
b) Visit a nearby site, where advanced machineries are used and prepare a report.
c) Prepare a report on advanced concreting methods.
d) Explore latest technology adopted globally for Construction and prepare a report on it.
e) Prepare seminar on relevant topic
f) Prepare a report on Explosives used for Blasting in civil engineering projects.
g) Undertake micro project.

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.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environ and sustainability.

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. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, 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 total duration of the micro-project

should not be less than ***16 (sixteen) student engagement hours*** during the course. The student 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 has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Green Solutions:** Prepare a report suggesting replacement of atleast 10 nos. of conventional advanced construction materials with Sustainable and Green Building Materials and justify it in terms of environmental impact.
b) **Safety**: Prepare posters/ charts/ SOPs for the awareness of safety while operating miscellaneous machineries used in various activates of advanced construction.
c) **Foundation**: Prepare a report on pile foundation being executed in any nearby structures.
d) **Advanced Construction Technology**: Collect the information of recent technologies practiced in advanced construction and prepare a report on it.
e) **Drilling and blasting:** Prepare a report on controlled blasting in civil engineering projects, and also describe the procedures to get the permissions of competent authorities along with Performa if any.
f) **Drilling and blasting:** Prepare a report on drilling activity being executed for the work of blasting and also describe any alternative arrangement for the same.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Construction Technology	Atev. S.S.	Mir Publisher.
2	Building construction	S.C. Rangwala	Charotar Publishing House Pvt. Ltd. Anand
3	Building Construction	Arun Kumar Jain, Ashok Kumar Jain, B.C. Punmia	Laxmi Publication, ISBN 10: 8131804283 ISBN 13: 9788131804285
4	Building Repair and Maintenance Management	Gahlot. P.S., Sharma Sanjay	Edition 2005, CVS publication, ISBN 10: 8123912439, ISBN 13: 9788123912431
5	Building Maintenance Management	Paul Wordsworth, Lee	4th Edition, 2000, Wiley-Blackwell, ISBN: 978-0-632-05362-9
6	Construction Dewatering and Groundwater Control: New Methods and Applications	J. Patrick Powers, Arthur B. Corwin, Paul C. Schmall, Walter E. Kaeck	ISBN: 978-0-471-47943-7, Wiley & Sons, Inc., 3rd Edition.
7	Ground Improvement Techniques	Raj Purushothama	Laxmi Publications, and ISBN: 9788131808573, Edition: First, 1999.
8	Ground Improvement	Moseley, M. P	Blackie Academic & Professional, Boca Raton, Florida, USA, ISBN 0751400734, 084937717X, 1993
9	Construction Materials	D.N. Ghose	TATA Mc Graw Hill
10	Pile Foundations	Tomlinson	Longman Group, U. K.

14. SOFTWARE/LEARNING WEBSITES

a) ww.nptel.iitm.ac.in
b) http://www.asce.org/
c) https://www.astm.org/
d) https://www.concrete.org/

15. PO-COMPETENCY-CO MAPPING

Semester V	Advanced Construction Technology (Course Code: 4350603)									
	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	PSO 1	PSO 2	PSO 3 (If needed)
Competency	• **Use advanced construction technologies.**									
Course Outcomes CO a) To develop the conceptual knowledge of advanced construction material and concur knowledge of Waste products and Industrial byproducts.	3	3	3	2	3	-	3	-	-	-
CO b) Students are able to appreciate various types of advanced and latest construction machineries, equipment, formworks and safety measures involved in construction works.	2	-	-	3	2	-	2	-	-	-
CO c) Contribute either as an executioner or Supervisor in the special types of civil engineering construction aided with state of the art technology.	2	2	2	-	3	2	3	-	-	-
CO d) Describe important aspects, operations and safety points pertaining to: a. Drilling and Blasting b. Coffer Dams c. Caissons	3	-	-	3	3	-	3	-	-	-

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Shri C. B. Patel	G.P. Ahmedabad	079-26301285	cbpatel@gpahmedabad.ac.in
2	Shri D. V. Patel	G.P. Ahmedabad	079-26301285	dvpatel@gpahmedabad.ac.in
3	Smt. D. B. Joshi	G.P. Gandhinagar	079-2328 7433	dbjgpg@gmail.com