

Program Name : Civil Engineering Program Group
Program Code : CE/CR/CS
Semester : Sixth
Course Title : Emerging Trends in Civil Engineering
Course Code : 22603

1. RATIONALE

Civil Engineering sector has completed number of projects with conventional techniques to meet the needs of the society. But, in recent two decades, various new innovative techniques are being used worldwide, which our practicing engineers, are also partially using to achieve their goals. The emerging trends in Civil Engineering help to complete the undertaken projects within prescribed schedule, saves the natural resources and to make the projects eco-friendly. This subject helps to make awareness about soft computing techniques, new materials, advanced machineries, sustainable resource management and advancement in Civil Engineering.

2. COMPETENCY

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

- Recommend emerging techniques in civil engineering.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented COs* associated with the above mentioned competency:

- Reveal different applications of software's for planning, designing and execution of projects.
- Suggest the advanced materials as per site condition.
- Recommend the suitable tools and equipments for the given situation.
- Suggest the advanced resource management techniques for the given project.
- Use the feasible advance techniques for various civil engineering projects.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	-	3	90 Min	70*#	28	30*	00	100	40	-	-	-	-	-	-

(*#): Under the theory ESE; Total 70 marks of **online exam** will be conducted.

(*): Under the theory PA; Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 mark is the average of 2 tests (**MCQ type**) to be taken during the semester for the assessment of the UOs required for the attainment of the COs.



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

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

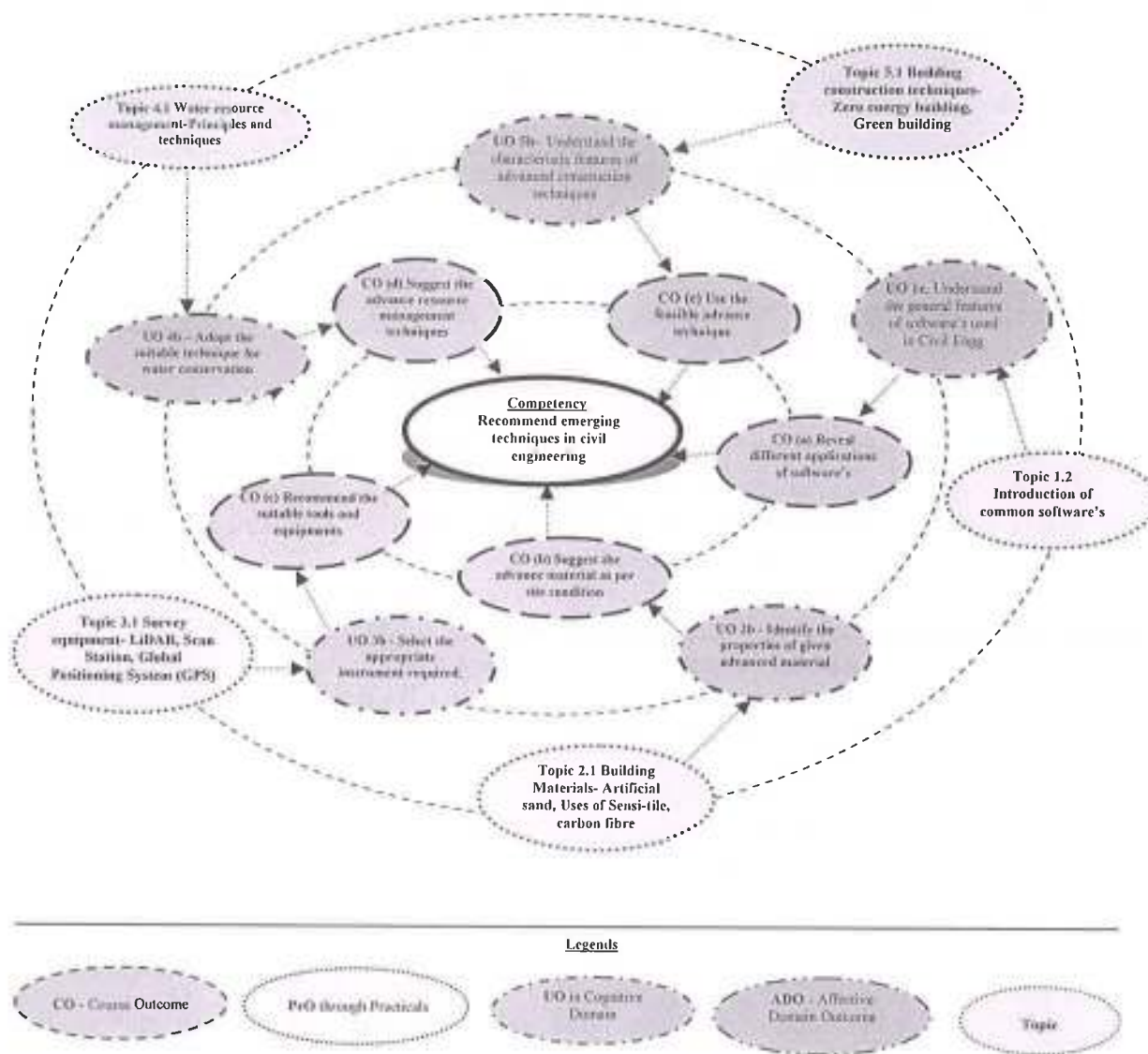


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.



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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of theory.

S. No.	Equipment Name with Broad Specifications	UOs. S. No.
1.1	Computer system (Any computer system with basic configuration)	All
1.2	LCD Projector with accessories	All

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Soft Computing Techniques	1a. Enlist the characteristic uses of soft computing techniques in civil engineering. 1b. Identify merits and demerits of soft computing techniques. 1c. Understand the general features of software's used in Civil Engg 1d. Suggest the suitable software/s for the given construction activity.	1.1 Introduction of soft computing techniques and its types, Merits and demerits of soft computing technique, Graphical User Interface Software (GUI) . 1.2 Introduction, salient features and applications of software's - REVIT, ETAB, 3D Architect Home, Build-Master, HEC-RAS, STRAP, WaterGEMS, Tekla, ArcGIS, QuikGrid, STAAD.Pro, SAFE, RISA-Connection, Civil 3D, Site 3D, SkyCiv Structural 3D, SAP 2000, MIDAS, LUSAS, BricsCAD, Estimate Master, ProEst, WinEst, Clear Estimate, Procore, Buildertrend, Building Management System (BMS), Plant Design and Management System (PDMS), Building Information Modeling (BIM), Primavera Pro, Microsoft Project (MSP)
Unit– II Recent Construction Materials	2a. List the advanced construction materials for given construction project. 2b. Identify the properties of given advanced material. 2c. Enumerate the applications of given form of material/s in civil engineering.	2.1 Building Materials- Artificial sand, Sensi tile, carbon fibre, Bricks made up of cigarette butts, 3D printed bricks, Translucent wood, laminated timber, 3D Tiles 2.2 Road Materials- Geo-synthetics, Noise-reducing asphalt, Porous Pavement, Plastic Roads, solar roads,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2d. Identify the situations to use the given material. 2e. Justify the use of given material for given site condition.	Anti Icing Roads, Piezoelectric roads 2.3 Concrete Materials- Portland Pozzolana Cement, Portland Slag Cement, New admixtures – Masterglanium, Polycarboxylic Ether, Self Healing Concrete, Fibre-Reinforced Concrete, High Strength concrete, High Performance Concrete, Nano concrete, Light transmitting concrete. 2.4 Sustainable Materials- Ground Granulated Glass Blast-furnace Slag (GGBS) concrete, Aero-gel insulation, Cooling bricks, Green concrete, Timbercrete, Ferrock
Unit III- Latest Tools and Equipments	3a. Identify the correct use/s of given advanced tool/equipment. 3b. Select the appropriate instrument required for the given construction activity. 3c. Identify the situation for the use of given advance equipment/instrument.	3.1 Survey equipment- LiDAR, Scan Station, Global Positioning System (GPS), Geographical Information System (GIS), Photogrammetry, Drones, Direct Reading Grade Rods, 3D Laser scanning, laser level 3.2 Construction Equipment- Earth moving equipment-Skid and crawler loaders, trenchers, scrappers, wheeled loading shovels, advanced plastering machine, Bridge launcher. 3.3 Material handling equipment- Cranes, conveyors, hoists, forklifts, mobile concrete mixer, paver, road header, tunnel boring machine.
Unit-IV Sustainable Resource Management	4a. Elaborate the principle of water resource management. 4b. Adopt the suitable technique for water conservation. 4c. Justify the need of 4R principle in waste management. 4d. Recommend the use of waste for the given civil construction work. 4e. Suggest the appropriate safety technique for given site condition.	4.1 Water resource management- Principles and techniques 4.2 4R's in waste management-Reduce, Reuse, Recycle and Recover, Concept of Zero Waste 4.3 Reuse of waste in construction-Fly Ash, Slag and Plastic 4.4 Renewable energy sources-solar energy, biomass, wind energy, ocean wave energy, Geo thermal energy and hybrid power system. 4.5 Energy Audit-Necessity and methods. 4.6 Natural disaster management- Flood , Earthquake, Tsunami, Volcanic Eruption, Hurricanes, Landslides. 4.7 Site Safety-necessity, principles, tools, techniques, laws, rules and regulations.
Unit –V	5a. Select the appropriate	5.1 Building construction techniques-

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Advancement in Construction	advanced techniques for the given construction project. 5b. Understand the characteristic features of advanced construction techniques 5c. Recommend the use of appropriate construction techniques as per site condition. 5d. Identify the application of given construction technique	Zero energy building, Green building, Mass housing-precast housing, prefabricated homes, pre-engineering building, Solar Paints, Building Integrated Photovoltaic (BIPV), Earthquake Resisting Controls-Isolation and Dissipation. 5.2 Road construction techniques- 3D Printing, Road Printer, smart roads 5.3 Coastal construction techniques- Sound Proofing walls, water resistant roofs, high performance doors and windows, air and moisture barriers. 5.4 Ground improvement techniques- Advanced piling techniques - Stone Column, Vibro Floatation, Micro Piles, Soil Nailing, Vertical drains-Sand Drains, Pre-Fabricated Vertical Drains, Thermal Methods- soil heating and soil freezing.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

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	Soft Computing Techniques	08	06	04	02	12
II	Recent Construction Materials	10	04	06	04	14
III	Latest Tools and Equipments	10	06	04	04	14
IV	Sustainable Resource Management	08	04	06	02	12
V	Advancement in Construction	12	06	08	04	18
Total		48	26	28	16	70

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

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may 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 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. Visit the appropriate website and observe the relevant videos and other related learning material.
- b. Group discussion on sustainable resource management.
- c. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

- a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b. '*L*' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate the particular situation before undertaking the task in practice.
- g. Show video clips of emerging trends in civil engineering and undertake the discussion.
- h. Show picture clips/photographs of advance construction techniques available online.
- i. Arrange expert lectures of various practicing engineers from various construction sites.
- j. Arrange the brain storming sessions on recent modifications in construction methodology, projects undertaken, innovative materials etc.

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. Similar micro-projects could be added by the concerned faculty:

- a. Prepare the chart showing software and their applications.
- b. Prepare a model of any one construction material or machinery used in recent days.



- c. Prepare a report on advanced machinery and materials.
- d. Elaborate the process of mass housing, pre-engineered buildings etc.
- e. Make posters showing site safety and its awareness.
- f. Prepare the charts showing different types of safety rules and regulations of site.

13. SUGGESTED LEARNING RESOURCES :

S. No.	Title of Book	Author	Publication
1	Emerging Materials for Civil Infrastructure: State of the Art	Roberto Lopez-Anido, Tarun Naik	American Society of Civil Engineers (31 July 2000), ISBN-13: 978-0784405383
2	Sustainable Construction Materials	Ravindra K. Dhir OBE Jorge de Brito Rui Silva Chao Qun Lye	Woodhead Publishing, 9th January 2019, eBook ISBN: 9780081009918 Hardcover ISBN: 9780081009857
3	Learning Manual on "Emerging Trends in Civil Engineering"	MSBTE, Mumbai	---

14. SOFTWARE/LEARNING WEBSITES

- a. <https://www.engineeringcivil.com/software>.
- b. <https://www.nbmcw.com/tech-articles/concrete/3725-new-construction-materials-for-modern-projects.html>
- c. <https://geniebelt.com/blog/10-innovative-construction-materials>
- d. <https://www.viatechnik.com/blog/modern-construction-machines-theyre-used/>
- e. https://www.academia.edu/28172313/ADVANCED_BUILDING_CONSTRUCTION_EQUIPMENT
- f. <https://theconstructor.org/construction/sustainability-construction-civil-engineering/9492/>
- g. https://www.designingbuildings.co.uk/wiki/Advanced_construction_technology
- h. <https://www.constructionjunkie.com/blog/2018/1/7/the-16-most-interesting-advances-in-construction-technology-of-2017>
- i. https://mysubs.in/buy/recent-trends-in-civil-engineering-and-technology-journal-subscription?gclid=Cj0KCQjw6lfoBRCiARIsAF6q06scZ5teDlexIYz_j85yy2ZH_v1kiQcytNvYf3AelfE3LcZndTbhrOwaAqv2EALw_wcB
- j. <https://www.flatworldsolutions.com/engineering/articles/6-latest-trends-in-civil-engineering.php>.



