Subject Description Form

Subject Code	CSE586
Subject Title	Low-Carbon Construction Materials
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To introduce the advanced low-carbon materials and technologies used in civil engineering construction.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Develop a comprehensive understanding of the significance, challenges, methodologies, and prospects of developing low-carbon construction materials. b. Critically analyze and evaluate the current and emerging low-carbon construction materials or technologies in civil engineering. c. Design or propose appropriate low-carbon construction materials or technologies with well-grounded judgement. d. Communicate effectively in verbally and in writing formats
Subject Synopsis/ Indicative Syllabus	1. Cement Chemistry and greenhouse gas emissions 2. Common low-carbon supplementary cementitious materials 3. New supplementary cementitious materials 4. Alkali-activated cementitious materials 5. Recycled aggregate and recycled aggregate concrete 6. Waste incineration residues 7. Advanced CO2 mineralization materials and technologies 8. 3D printed concrete 9. Life cycle assessment I 10. Life cycle assessment II 11. Waste-based low-carbon pavement materials 12. Pavement materials with low construction energy consumption
Teaching/Learning Methodology	Fundamental theories about low-carbon construction materials and technologies will be explained in lectures. The applications case studies in civil engineering construction will be discussed in interactive tutorial sessions. Project-based learning approach is adopted in this subject, through engaging in a realistic case study project, students will be able to develop a critical understanding of the subject knowledge, the ability to evaluate, design or propose appropriate low-carbon construction materials and technologies, and sharpen their written and verbal communication skills.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Literature review	30	√	√		√
2. Project Report	40	√	√	√	√
3. Project Presentation	30	√	√	√	√
Total	100 %				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Students are expected to complete an individual **literature review** assignment to gain in-depth understanding of different low-carbon construction materials and technologies, and be able to compare their strengths and weaknesses in different applications (ILO a, b, d). Upon gaining a comprehensive understanding of the various low-carbon construction and technologies, students are going to work on a **case study project** (group) where students are expected to evaluate, design or propose appropriate low-carbon construction materials and technologies based on a realistic situation. Students are required to submit a **written report** (40%) and deliver an **oral presentation** (30%). Students are required to demonstrate individual contribution and are assessed individually in both the written report and the oral presentation.

In order to obtain a passing grade in this subject, **students MUST pass both the written report and the oral presentation components**. Students who are found to commit acts of academic dishonesty, including but not limited to plagiarism, violating university's guideline on using GenAI, will result in direct disqualification in this subject and subjected to further disciplinary actions.

Student Study Effort Expected

Class contact:	Total hours
▪ Lectures/tutorials	39 Hrs
Other student study effort:	
▪ Reading and Studying	39 Hrs
▪ Completion of assignments	39 Hrs
Total student study effort	117 Hrs

Reading List and References	**Essential References** **Books** 1. Jamal M. Khatib, *Sustainability of Construction Materials* 2nd Edition, 2016. https://doi.org/10.1016/C2014-0-02849-3. 2. Ali Nazari, Jay G. Sanjayan, *Handbook of Low Carbon Concrete* 1st Edition, 2016. https://doi.org/10.1016/C2015-0-01844-5. 3. Michael Z. Hauschild, Ralph K. Rosenbaum, Stig Irving Olsen, *Life Cycle Assessment: Theory and Practice* 1st Edition, 2018. https://doi.org/10.1007/978-3-319-56475-3. **Journal papers** 1. C.S. Poon, P. Shen, Y. Jiang, Z. Ma, D. Xuan, Total recycling of concrete waste using accelerated carbonation: A review, Cement and Concrete Research, 173 (2023) 107284. 2. M. Zajac, I. Maruyama, A. Iizuka, J. Skibsted, Enforced carbonation of cementitious materials, Cement and Concrete Research, 174 (2023) 107285. 3. Z. Liu, C. Lv, F. Wang, S. Hu, Recent advances in carbonatable binders, Cement and Concrete Research, 173 (2023) 107286. 4. Barbara Lothenbach, Karen Scrivener, R.D. Hooton, Supplementary cementitious materials, Cement and Concrete Research, 41 (2011) 1244. 5. M.C.G. Juenger, R. Siddique, Recent advances in understanding the role of supplementary cementitious materials in concrete, Cement and Concrete Research, 78 (2015) 71-80. 6. Maria C.G. Juenger, Ruben Snellings, Susan A. Bernal, Supplementary cementitious materials: New sources, characterization, and performance insights, Cement and Concrete Research, 122 (2019) 257-273. 7. Chen Li, Jiaqi Li, Qiang Ren, Qiaomu Zheng, Zhengwu Jiang, Durability of concrete coupled with life cycle assessment: Review and perspective, Cement and Concrete Composites, 139 (2023) 105041. 8. Pai-Haung Shih, Juu-En Chang, Li-Choung Chiang, Replacement of raw mix in cement production by municipal solid waste incineration ash, Cement and Concrete Research, 33, 11 (2003) 1831-1836. 9. V. Masson-Delmotte, P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, Global Warming of 1.5 C: IPCC special report on impacts of global warming of 1.5 C above pre-industrial levels in context of strengthening response to climate change, sustainable development, and efforts to eradicate poverty, Cambridge University Press2022. 10. K.-y. Chen, J. Xia, R.-j. Wu, X.-y. Shen, J.-j. Chen, Y.-x. Zhao, W.-l. Jin, An overview on the influence of various parameters on the fabrication and engineering properties of CO2-cured cement-based composites, Journal of Cleaner Production, 366 (2022).