

Subject Description Form

Subject Code	ARCH383
Subject Title	Artificial Intelligence and Building Information Modelling in Architectural Design
Credit Value	3
Level	3
Pre-requisite / Co-requisite/ Exclusion	NIL
Objectives	This subject aims to equip students with an understanding of how Artificial Intelligence (AI) can be integrated into architectural design, the built environment, and construction management and the application of Building Information Modelling (BIM) in construction. Students will acquire a diverse set of skills, from basic AI concepts to advanced applications in architectural design, by exploring AI generative tools and methodologies that are transforming the architectural landscape, with a focus on automation, optimisation, and data-driven decision-making.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) Understand the significance of Generative Artificial Intelligence (Gen AI) in contemporary architectural practices, recognising its potential to enhance design efficiency, sustainability, and innovation. b) Understand the concept and role of BIM throughout the lifecycle of the construction project. c) Apply acquired knowledge to real-world architectural projects, demonstrating the ability to integrate AI with traditional practices for improved outcomes. d) Conduct thorough analyses using AI techniques to evaluate design choices, environmental impact, and structural integrity. e) Analyse and interpret large datasets related to architectural design and building operations, employing automated site analysis, energy efficiency modelling, and the use of AR/VR to derive actionable insights. f) Understand and address issues related to generative AI data privacy and protection, exploring key aspects of safeguarding data and ethical considerations to ensure integrity and regulatory compliance in a rapidly evolving technological landscape.
Subject Synopsis/ Indicative Syllabus	<u>Introduction to AI in Architecture</u> This section introduces fundamental AI concepts and their specific applications in architectural design and construction. It aims to bridge the gap between theoretical knowledge and practical applications, providing students with a solid foundation in how AI can be leveraged to enhance architectural practices. <u>Data-Driven Architecture</u> This section focuses on techniques for managing and analysing architectural data to improve design accuracy and efficiency. It includes an exploration of Large Language Models (LLMs), emphasizing the essentials of pre-training and scaling, and understanding how model size and data quality influence generalisation capabilities. Students will learn to harness data to drive informed and effective design decisions.

	<u>AI Technology in Architecture</u> This section highlights the critical role of AI and BIM in automated architectural design. The curriculum aligns with industry-leading tools such as Autodesk Revit, Generative AI, ChatGPT, and Midjourney, covering the entire process from conceptual design and analysis to project management. Students will be thoroughly equipped to meet industry demands and effectively leverage AI tools across various stages of architectural projects, including design, cost planning, procurement, project management, and facility management. <u>Case Studies and Ethical Considerations</u> This section presents real-world projects and the ethical considerations of using AI in architecture. It provides a balanced view of the academic debates and challenges associated with AI technologies, emphasizing the importance of ethical integrity and regulatory adherence. Students will explore the ethical implications of AI applications, ensuring they are prepared to navigate the complexities of implementing AI responsibly. <u>Future Trends and Practical Applications</u> This section examines emerging AI technologies with hands-on practice in applying AI tools to architectural assignments. AI-driven parametric design tools offer opportunities to dynamically manipulate design parameters, leading to highly customised and optimised solutions. By inputting design intent into parametric models, architects can automate the generation of design details that adjust according to changes in underlying parameters, enabling the creation of complex geometries and structures.
Teaching/Learning Methodology	• Conceptual models and analytical methods will be delivered in lectures. • Practice problems will be solved in tutorial classes. • Practical know-how and experiences will be shared in classes. • E-learning materials and e-discussion forums will be provided. • Basic software demonstration/use (Autodesk Revit/Rhino with Grasshopper) will be instrumental but not mandatory; guidance on spreadsheet applications will be provided to those in need of help. • Guest lecture will be arranged to share the most up-to-date AI technology in architecture and its practical applications to support automated data analysis and generate architectural outputs based on specific inputs.

Assessment Methods in Alignment with Intended Learning Outcomes	The coursework, in the form of continuous assessment, will account for 50% of the final grade, while the written examination will account for the remaining 50%. The marking will emphasise both the process and the submitted product. Students are encouraged to explore options for property development within the constraints of development control law through project work and tutorial assignments. Questions will be asked during presentations to ensure that students have achieved the intended learning outcomes.																																																		
	<table><tr><th rowspan="2">Specific assessment methods/tasks</th><th rowspan="2">% weighting</th><th colspan="6">Intended subject learning outcomes to be assessed</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th><th>e</th><th>f</th></tr><tr><td>1. Project</td><td>40</td><td>√</td><td></td><td>√</td><td>√</td><td>√</td><td></td></tr><tr><td>2. Tutorial participation and discussion</td><td>10</td><td>√</td><td>√</td><td></td><td>√</td><td></td><td>√</td></tr><tr><td>3. Examination</td><td>50</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr><tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr></table>		Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed						a	b	c	d	e	f	1. Project	40	√		√	√	√		2. Tutorial participation and discussion	10	√	√		√		√	3. Examination	50	√	√	√	√	√	√	Total	100 %									
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	▪ Lecture			26 Hrs.																																															
	▪ Tutorial			13 Hrs.																																															
	Other student study effort:																																																		
	▪ Project work			60 Hrs.																																															
	▪ Self-study			21 Hrs.																																															
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Reading List and References	Beyan, E. V. P., & Rossy, A. G. C. (2023). A review of AI image generator: influences, challenges, and future prospects for architectural field. <i>Journal of Artificial Intelligence in Architecture</i> , 2(1), 53-65.																																																		
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	Fareed, M. W., Bou Nassif, A., & Nofal, E. (2024). Exploring the potentials of artificial intelligence image generators for educating the history of architecture. <i>Heritage</i> , 7(3), 1727-1753.																																																		
	Hegazy, M., & Saleh, A. (2023). Evolution of AI role in architectural design: between parametric exploration and machine hallucination. <i>MSA Engineering Journal</i> , 2(2), 262-288.																																																		
	Kee, T., Kuys, B., & King, R. (2024). Generative artificial intelligence to enhance architecture education to develop digital literacy and holistic competency. <i>Journal of Artificial Intelligence in Architecture</i> , 3(1), 24-41.																																																		

	Kwon, C. (2023). AI and the future of architecture: A Smart secretary, revolutionary tool, or a cause for concern? <i>International Journal of Sustainable Building Technology and Urban Development</i>, 14(1), 128-131. Liang, C. J., Le, T. H., Ham, Y., Mantha, B. R., Cheng, M. H., & Lin, J. J. (2024). Ethics of artificial intelligence and robotics in the architecture, engineering, and construction industry. <i>Automation in Construction</i>, 162, 105369. Pan, Y., & Zhang, L. (2023). Integrating BIM and AI for smart construction management: Current status and future directions. <i>Archives of Computational Methods in Engineering</i>, 30(2), 1081-1110. Rane, N. (2023). Integrating leading-edge artificial intelligence (AI), internet of things (IOT), and big data technologies for smart and sustainable architecture, engineering and construction (AEC) industry: Challenges and future directions. <i>Engineering and Construction (AEC) Industry: Challenges and Future Directions</i> (September 24, 2023). Rožanec, J. M., Novalija, I., Zajec, P., Kenda, K., Tavakoli Ghinani, H., Suh, S., ... & Soldatos, J. (2023). Human-centric artificial intelligence architecture for industry 5.0 applications. <i>International journal of production research</i>, 61(20), 6847-6872. Urbiet, M., Urbiet, M., Laborde, T., Villarreal, G., & Rossi, G. (2023). Generating BIM model from structural and architectural plans using Artificial Intelligence. <i>Journal of Building Engineering</i>, 78, 107672. Zhang, Z., Fort, J. M., & Mateu, L. G. (2023). Exploring the potential of artificial intelligence as a tool for architectural design: A perception study using gaudí's works. <i>Buildings</i>, 13(7), 1863.
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