Subject Description Form

Subject Code	COMP5583
Subject Title	Agentic Computing, Systems, and Applications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	**Prerequisite**: Nil (but Basic programming experience and introductory knowledge of artificial intelligence are preferable)
Objectives	The objectives of this subject are: 1. Provide students with a solid understanding of the conceptual, computational, and system-level principles underpinning agentic computing, including autonomy, reasoning, planning, memory, perception, and interaction. 2. Equip students with hands-on experience in both software and hardware integration for agentic and autonomous systems, such as sensor processing, embodiment, and edge deployment. 3. Enable students to critically evaluate real-world agentic and cyber-physical systems, including safety, alignment, human-AI collaboration, evaluation metrics, and future directions in agentic engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Demonstrate a clear understanding of the fundamental concepts of agentic intelligence, including autonomy, reasoning, planning, memory, perception, and interaction. b. Design and implement agentic computing systems that integrate perception, planning, control, and actuation across software–hardware boundaries. c. Develop prototypes using hardware platforms such as embedded boards, sensors, or robotic kits to demonstrate embodied agent behavior. d. Collaborate effectively in teams to develop, test, and present a complete agentic system, demonstrating skills in system integration and iterative development. e. Critically evaluate agentic intelligence systems in terms of safety, ethical alignment, human-AI interaction, and societal impact, using both qualitative and quantitative methods.

Subject Synopsis/ Indicative Syllabus	This subject introduces the foundational concepts, architectures, and design practices of agentic artificial intelligence. Students will explore key components such as reasoning, planning, memory, perception, and autonomy, and how these elements are integrated in the development of interactive, autonomous agents. The course bridges theoretical foundations with hands-on implementation of agentic systems through large language models (LLMs), multimodal integration, and multi-agent or embodied environments. Students will also critically examine system evaluation, safety, ethical alignment, and future directions in agentic engineering.

Topic
1. Foundations of Agentic Intelligence Overview of agentic intelligence principles including autonomy, reasoning, planning, memory, perception, and interaction.
2. Large Language Models and Tool-Augmented Agents Transformer architectures, prompt engineering, Chain-of-Thought reasoning, ReAct agents, and retrieval-augmented generation (RAG).
3. Multimodal and Embodied Agent Systems Integration of vision, language, and action; embodied AI; sim-to-real transfer; case studies such as Voyager and digital humans.
4. Multi-Agent Collaboration and Human-AI Interaction Multi-agent systems, generative agents, collaborative and mixed-initiative teams.
5. Hardware-Software Co-Design and Systems Integration Middleware for agentic systems (ROS, embedded Linux, microcontrollers), interface protocols, and system optimization.
6. System Evaluation, Safety, and Ethics Benchmarks, evaluation metrics, tuning strategies, hallucination risks, value alignment, and societal implications of agent deployment.

Teaching/Learning Methodology	**Lectures:** Lectures will introduce the fundamental concepts and computational models of agentic intelligence, including autonomy, reasoning, planning, memory, and multi-agent collaboration. Key frameworks such as Transformers, Chain-of-Thought, RAG, and ReAct will be covered to build students' theoretical foundation. **Tutorials:** Students will engage in discussions and exercises based on recent research papers and agent system case studies. These sessions aim to strengthen students' analytical thinking and understanding of agent design principles. **Assignments:** Students will complete hands-on tasks such as implementing reasoning strategies, integrating memory modules, or

using open-source frameworks. These assignments reinforce technical skills through experimentation and analysis.

Project: Working in teams, students will design and implement a small-scale embodied or sensor-based agentic system, integrating LLM reasoning with hardware interaction for a real-world-inspired task. The project will culminate in a demo and written report, demonstrating their ability to integrate concepts, tools, and evaluation methods.

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	e	
Continuous Assessment	30%						
1. Assignments	20%	✓	✓	✓			
2. Group Project	10%	✓	✓	✓	✓	✓	
Examination	70%	✓	✓	✓		✓	
Total	100 %						

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

Assignment: The assignments evaluate practical implementation of reasoning, retrieval, and multimodal agent skills

Project: The group project examines system design, integration, and teamwork in real-world scenarios

Examination: The final exam tests comprehensive knowledge of theories, methodologies, and safety considerations

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial/Lab	13 Hrs.
Other student study effort:	
▪ Regular Reading and Assignment Effort	88 Hrs.
Total student study effort	127 Hrs.

Reading List and References

1. Russell, S. J., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach (3rd ed.)*. Pearson.
2. Wei, Jason, et al. *Chain-of-thought prompting elicits reasoning in large language models.* NeurIPS
3. Vaswani, A., et al. (2017). *Attention Is All You Need*. NeurIPS.

	4. Lewis, P., et al. (2020). *Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks*. NeurIPS. 5. Yao, S., et al. (2022). *ReAct: Synergizing Reasoning and Acting in Language Models*. ACL. 6. Yang, Hui, Sifu Yue, and Yunzhong He. *Auto-gpt for online decision making: Benchmarks and additional opinions*. arXiv preprint arXiv:2306.02224 (2023). 7. Siciliano, B., & Khatib, O. (2016). *Springer Handbook of Robotics*. Springer. 8. Bai, Y., et al. (2022). *Constitutional AI: Harmlessness from AI Feedback*. arXiv preprint. 9. Henderson, P., et al. (2020). *Deep RL Has a Poor Understanding of MPC*. ICML. 10. Robeyns, Maxime, Martin Szummer, and Laurence Aitchison. *A self-improving coding agent*. arXiv preprint arXiv:2504.15228 (2025).