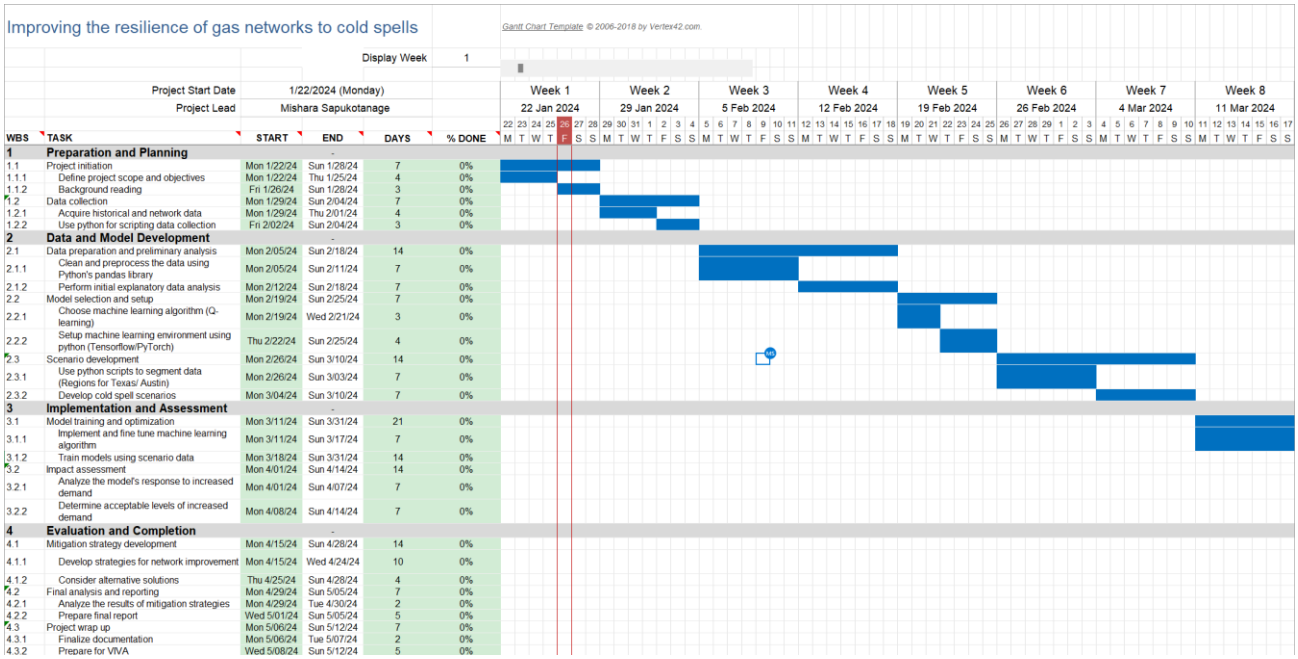
Department of Mechanical Engineering

Individual Research Project (MENG35000)

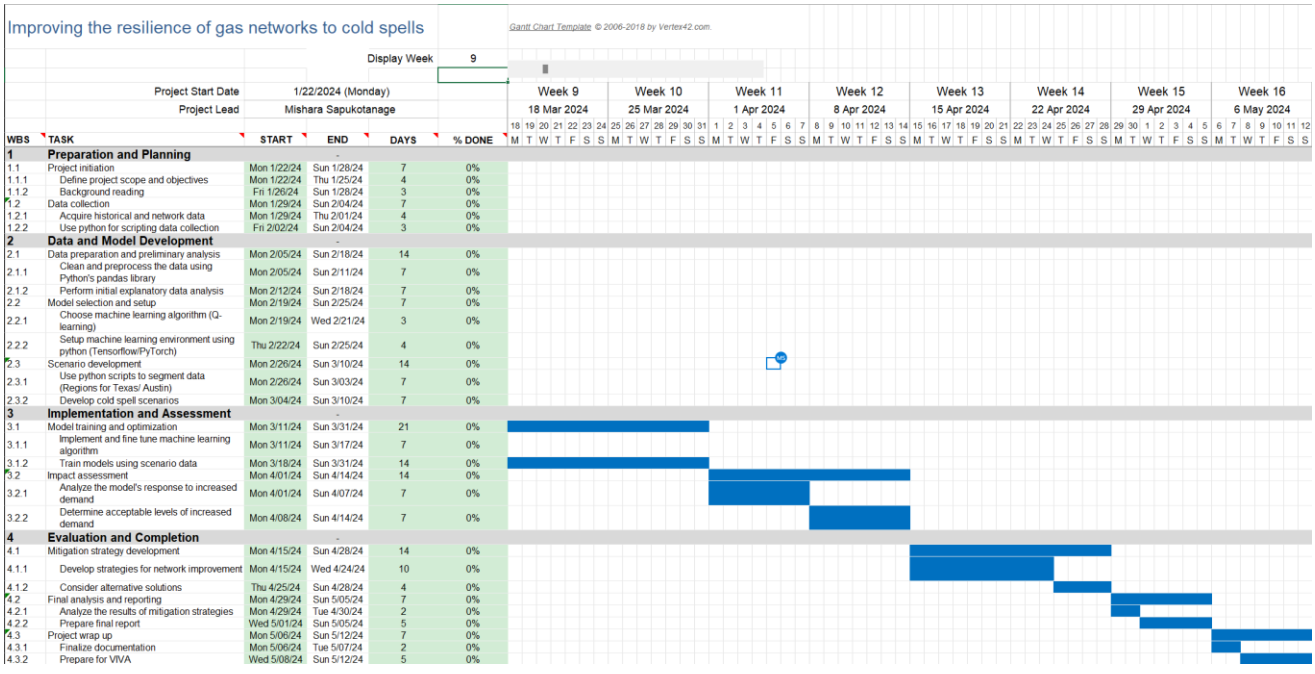
Project Plan

Name	Mishara Sapukotanage
Project title	Improving the resilience of gas networks to cold spells using machine learning
Aims	• Map and simulate the gas pipeline network • Integrate machine learning algorithms with the gas network model to predict normal and abnormal behaviour based on pressure data during cold spells • Create a scenario analysis tool to assess the impact of cold spells on the pipe network • Optimize the network's performance during high demand scenarios, ensuring effective gas delivery and minimization of disruptions • Develop a scalable and efficient codebase that can be expanded for future research • Establish criteria for network upgrades based on the simulation and machine learning analysis • Assess the resilience of the gas network
Methodology	• Review literature on machine learning applications for pipeline network analysis • Define project objectives, focusing on simulation and pressure-based behaviour prediction • Gather historical and network data in JSON/CSV formats • Clean and preprocess data using Python's pandas library • Simulate the gas network using Pandapipes in python • Select and implement machine learning algorithm (Q-learning) • Develop cold spell scenarios for various intensities • Integrate machine learning with Pandapipes to predict network behaviour • Train and optimize the machine learning model with scenario data • Assess the model's predictions and optimize network performance • Validate the machine learning model against real world data • Document the process and findings (Maintainable codebase for future work) • Finalize the project with a comprehensive report and presentation outlining results and network resilience
Planning	Shown below

- Week 13 – Project initiation
- Week 14 – Data collection
- Week 15/16 – Data preparation and preliminary analysis
- Week 17 – Model selection and setup
- Week 18/19 – Develop scenarios for cold spells
- Week 20/21/22 – Model training and optimization
- Week 23/24 – Impact assessment
- Week 25/26 – Mitigation strategy development
- Week 27 – Final analysis and reporting
- Week 28 – Presentation/VIVA



WBS	TASK	START	END	DAYS	% DONE
1	**Preparation and Planning**		-		
1.1	Project initiation	Mon 1/22/24	Sun 1/28/24	7	0%
1.1.1	Define project scope and objectives	Mon 1/22/24	Thu 1/25/24	4	0%
1.1.2	Background reading	Fri 1/26/24	Sun 1/28/24	3	0%
1.2	Data collection	Mon 1/29/24	Sun 2/04/24	7	0%
1.2.1	Acquire historical and network data	Mon 1/29/24	Thu 2/01/24	4	0%
1.2.2	Use python for scripting data collection	Fri 2/02/24	Sun 2/04/24	3	0%
2	**Data and Model Development**		-		
2.1	Data preparation and preliminary analysis	Mon 2/05/24	Sun 2/18/24	14	0%
2.1.1	Clean and preprocess the data using Python's pandas library	Mon 2/05/24	Sun 2/11/24	7	0%
2.1.2	Perform initial explanatory data analysis	Mon 2/12/24	Sun 2/18/24	7	0%
2.2	Model selection and setup	Mon 2/19/24	Sun 2/25/24	7	0%
2.2.1	Choose machine learning algorithm (Q-learning)	Mon 2/19/24	Wed 2/21/24	3	0%
2.2.2	Setup machine learning environment using python (Tensorflow/PyTorch)	Thu 2/22/24	Sun 2/25/24	4	0%
2.3	Scenario development	Mon 2/26/24	Sun 3/10/24	14	0%
2.3.1	Use python scripts to segment data (Regions for Texas/ Austin)	Mon 2/26/24	Sun 3/03/24	7	0%
2.3.2	Develop cold spell scenarios	Mon 3/04/24	Sun 3/10/24	7	0%
3	**Implementation and Assessment**		-		
3.1	Model training and optimization	Mon 3/11/24	Sun 3/31/24	21	0%
3.1.1	Implement and fine tune machine learning algorithm	Mon 3/11/24	Sun 3/17/24	7	0%
3.1.2	Train models using scenario data	Mon 3/18/24	Sun 3/31/24	14	0%
3.2	Impact assessment	Mon 4/01/24	Sun 4/14/24	14	0%
3.2.1	Analyze the model's response to increased demand	Mon 4/01/24	Sun 4/07/24	7	0%
3.2.2	Determine acceptable levels of increased demand	Mon 4/08/24	Sun 4/14/24	7	0%
4	**Evaluation and Completion**		-		
4.1	Mitigation strategy development	Mon 4/15/24	Sun 4/28/24	14	0%
4.1.1	Develop strategies for network improvement	Mon 4/15/24	Wed 4/24/24	10	0%
4.1.2	Consider alternative solutions	Thu 4/25/24	Sun 4/28/24	4	0%
4.2	Final analysis and reporting	Mon 4/29/24	Sun 5/05/24	7	0%
4.2.1	Analyze the results of mitigation strategies	Mon 4/29/24	Tue 4/30/24	2	0%
4.2.2	Prepare final report	Wed 5/01/24	Sun 5/05/24	5	0%
4.3	Project wrap up	Mon 5/06/24	Sun 5/12/24	7	0%
4.3.1	Finalize documentation	Mon 5/06/24	Tue 5/07/24	2	0%
4.3.2	Prepare for VIVA	Wed 5/08/24	Sun 5/12/24	5	0%



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4.3.2	Prepare for VIVA	Wed 5/08/24	Sun 5/12/24	5	0%