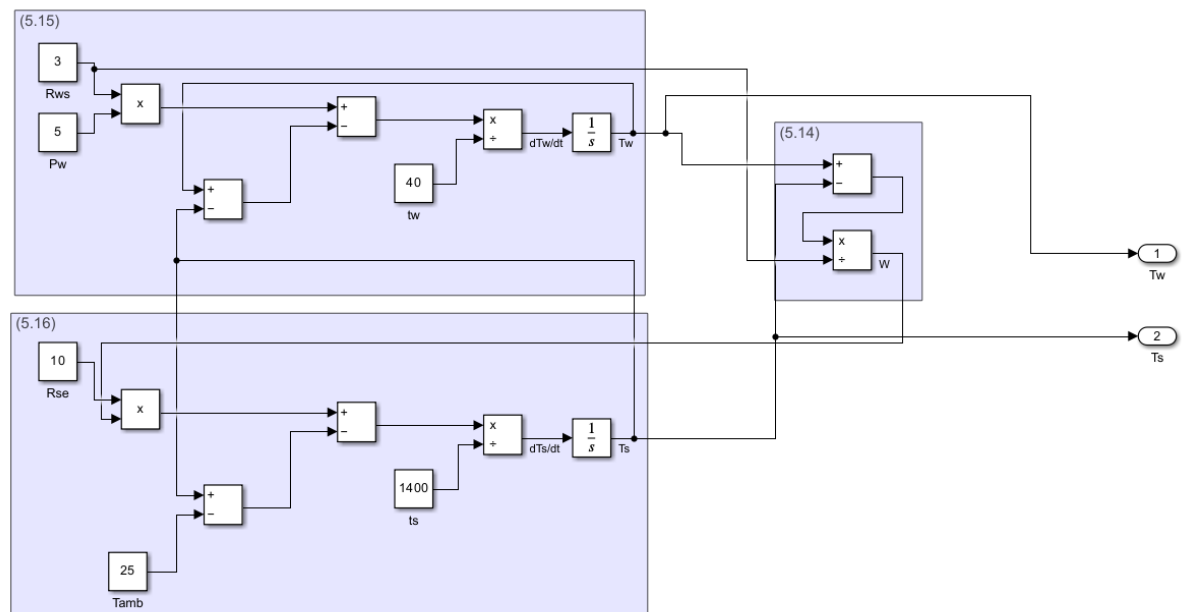## Simulation in Mechatronic Design – laboratory

Title of exercise	**Exercise 5** – Simulation investigation into thermal phenomena in an electric motor		
Name and surname	Harshit Verma	Date	14/06/24
Group	MTUSM-161	No of points	/10
Academic year	2023/2024		

1   Tests of the motor model "suspended in air"

1.1   Two-element simulation model (*paste the graphics*)

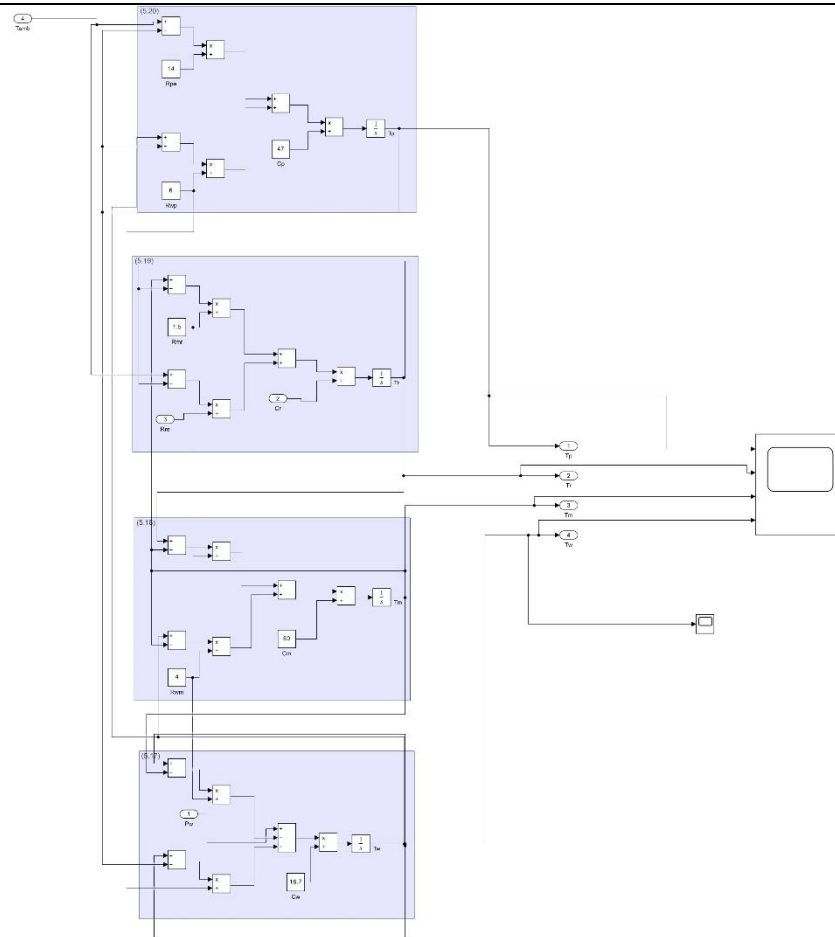| 1.2	Temperature responses of the two-element model
	(*paste rotor and stator temperatures in a common coordinate system*)
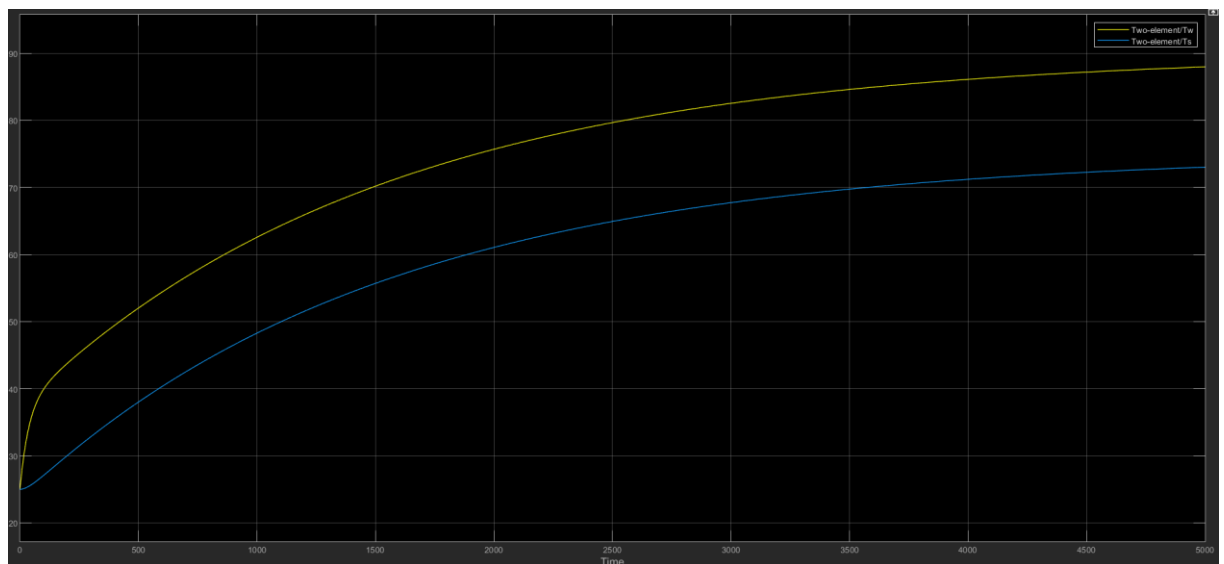
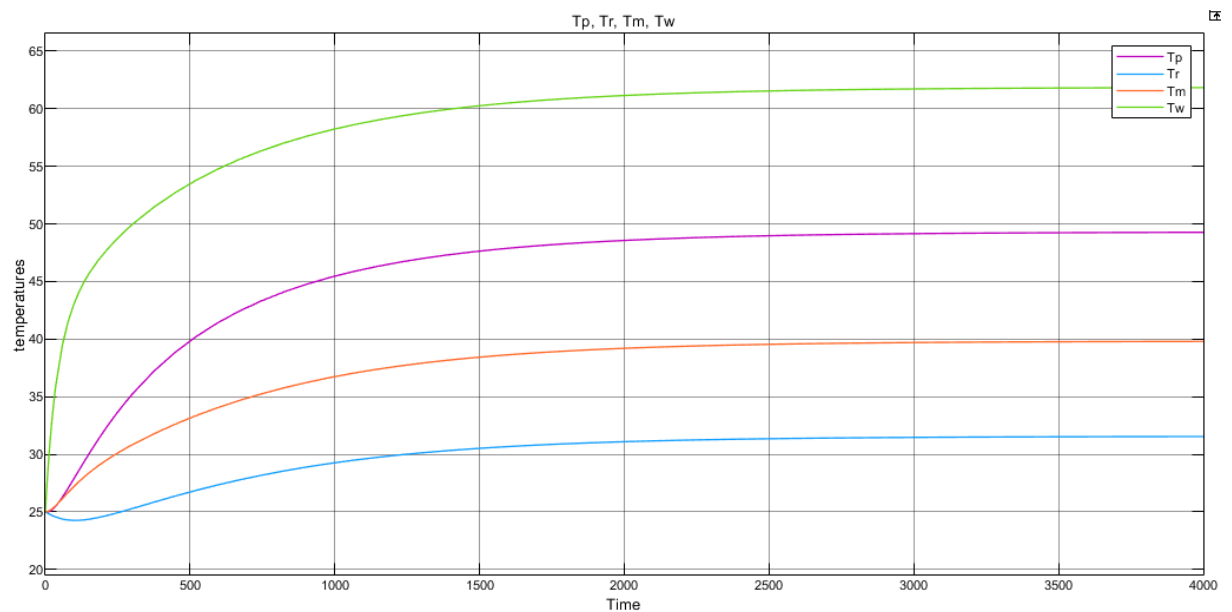| 1.3	Comment on the compatibility of the two-element model with the real object

- Real mechanism simulation offers high fidelity and accuracy, closely mimicking actual motor operations.
- The two-model method is less computationally intensive.
- Real mechanism simulation requires more computational resources and detailed motor knowledge.

2 Tests of the motor with a heat sink
2.1   Four element model (*paste the graphics*)

2.2 Temperature responses of the four-element model
(*paste rotor, stator and heat sink temperatures in a common coordinate system*)


2.3 Comment on the compatibility of the four-element model with the real object

- The four-model method involves multiple layers of abstraction, each representing different aspects of motor behavior, balancing between detail and computational efficiency.
- It provides a more comprehensive simulation than simpler methods, capturing a wider range of motor dynamics.
- Real mechanism simulation offers the highest fidelity by accurately replicating physical phenomena, including electromagnetic and mechanical interactions.
- While the four-model method improves on simplicity and efficiency, it still does not match the precision and detail of real mechanism simulations, which require extensive computational resources and detailed motor parameters.

3 Operation of the drive system under load

3.1 Modified electromechanical model of the DC motor – with R_t output and T_w input (*paste the graphics*)
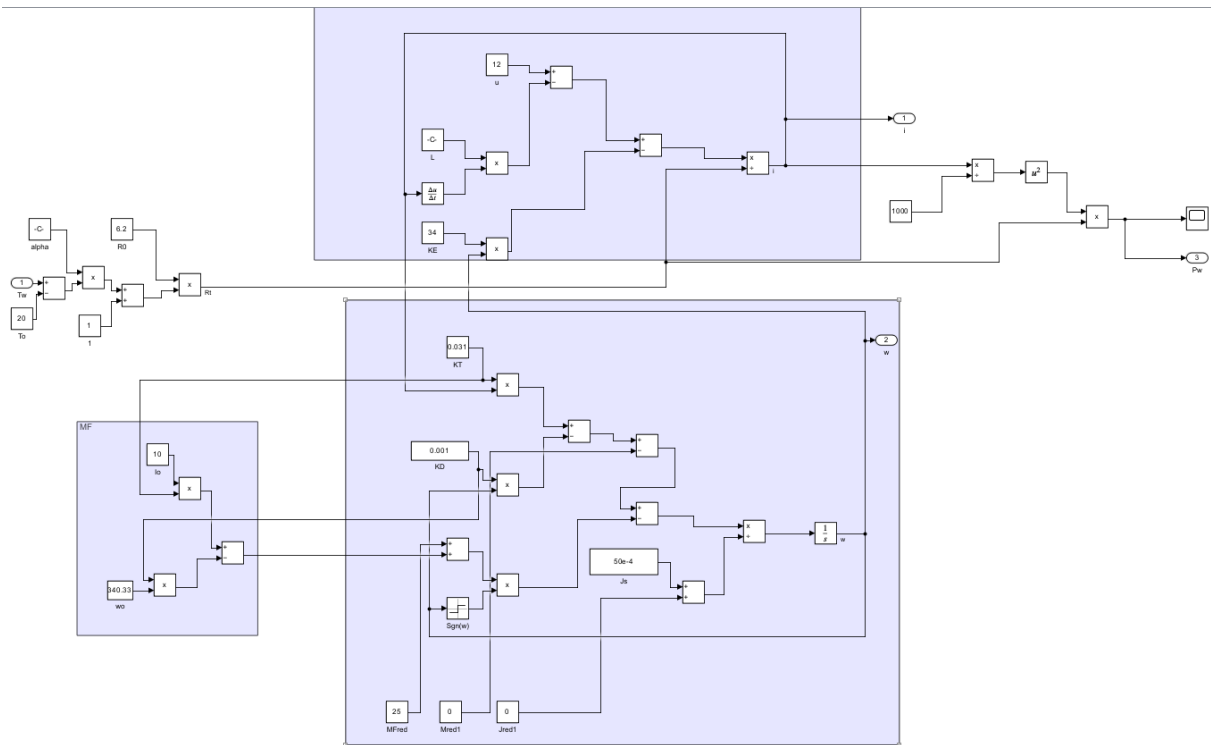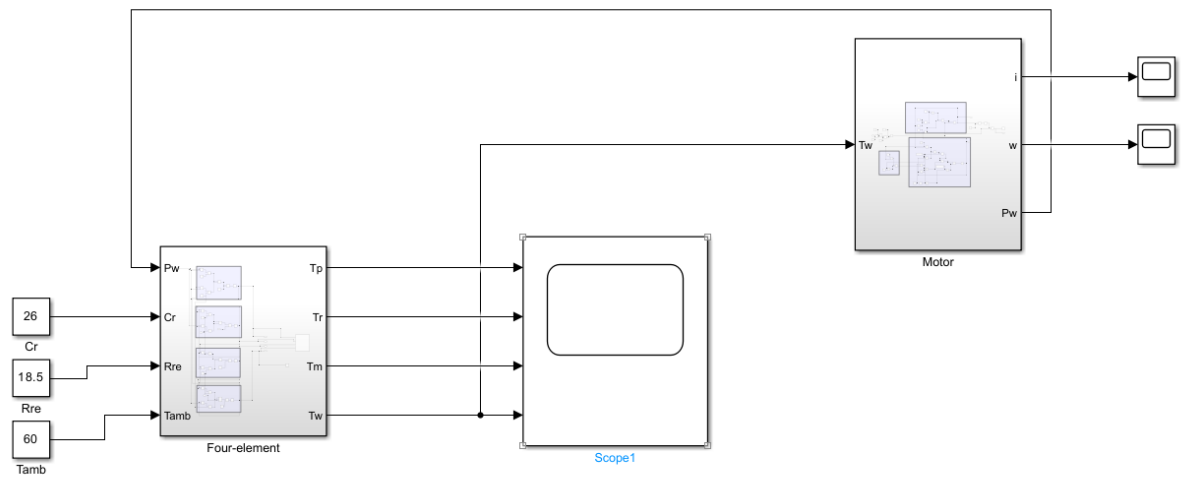
3.2	Individual parameters of experiments		Number of data set	
Constant loading torque	M_{Fred}	25		N·mm
Ambient temperature	T_{amb}	60		°C
Admissible rotor temperature	T_{adm}	100		°C

3.3 Steady rotor temperatures for individual heat sinks

Heat sink	No	1	2	3	4	5
Rotor temperature	℃	90.25	92.53	99.08	105.7	116.7
Selected heat sink №	No. 3					

4 Summary and conclusions

4.1 Summary
(*how the work was going*)

In comparing the four-model method to the real mechanism of motor simulation, the four-model method uses multiple layers of abstraction to balance detail and computational efficiency. This approach captures a broader range of motor dynamics than simpler methods. However, real mechanism simulations provide the highest fidelity by accurately replicating all physical phenomena, including electromagnetic and mechanical interactions. Despite its improved comprehensiveness, the four-model method still falls short of the precision and detail offered by real mechanism simulations, which demand more computational resources and extensive motor-specific knowledge.

4.2 Conclusions

The four-model method offers a practical balance between detail and efficiency, making it suitable for many applications where computational resources are limited or where some level of abstraction is acceptable. However, for scenarios requiring the utmost accuracy and detailed insights into motor behavior, real mechanism simulations are superior, despite their higher computational demands and complexity.